

Hampshire Water Transfer and Water Recycling Project

Environmental Statement – Appendix 19.7 Nutrient Assessment

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1 Introduction

1.1 Purpose of this report

- 1.1.1 The Hampshire Water Transfer and Water Recycling Project (hereafter referred to as the 'Proposed Development') comprises a combination of both water transfer and water recycling technology that would play a major role in making up the shortfall in water supply across the Hampshire supply area.
- 1.1.2 This report, which forms an appendix to the Environmental Statement (ES) Chapter 19 Water environment, Volume I, (Document reference 6.1, DCO Volume 6), presents an assessment of the implications of the construction and operation of the Proposed Development on nutrient loads within the Solent and River Itchen catchments.
- 1.1.3 The report is structured as follows:
1. Section 1: Introduction
 2. Section 2: Assessment methodology
 3. Section 3: Nutrient assessment
 4. Section 3.5: Summary

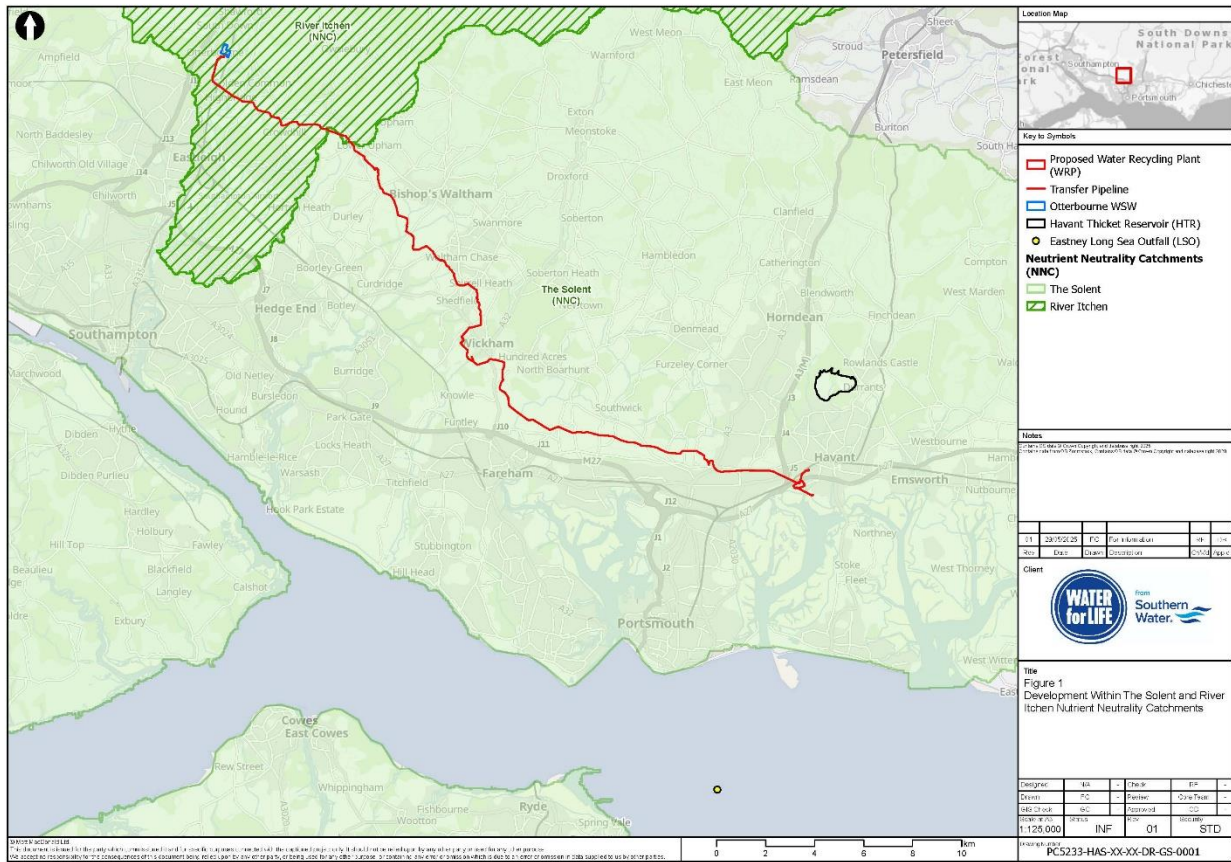
1.2 Nutrient neutrality

- 1.2.1 The Dutch Nitrogen Joint Cases¹ in the Court of Justice of the European Union (CJEU) ruled that where a European protected site (i.e. a Special Area of Conservation (SAC) and/or Special Protection Area (SPA)) or sites protected under the Ramsar Convention (together referred to as 'National Site Network (NSN) sites' in the United Kingdom) has an unfavourable conservation status, the possibility of authorising activities which may subsequently affect the ecological condition of such sites is "necessarily limited". The cases have informed the interpretation of Regulation 63 of the Conservation of Habitats and Species Regulations 2017 [1].
- 1.2.2 The Dutch Nitrogen ruling has resulted in greater scrutiny of proposed developments that are likely to increase nutrient loads to NSN sites in cases where a reason for unfavourable condition is an excess of a specific nutrient. In response to the ruling, Natural England (NE) has produced nutrient guidance [2] that applies to NSN sites that are already in an unfavourable condition due to high nutrient loads.
- 1.2.3 The Proposed Development would be located within the catchments of both the Solent and River Itchen, which are subject to the nutrient neutrality guidance by NE². These catchments are shown in Graphic 1-1.

¹ Joined Cases C-293/17 and C-294/17, Coöperatie Mobilisation for the Environment UA, Vereniging Leefmilieu V College van gedeputeerde staten van Limburg and Stichting Werkgroep Behoud de Peel v College van gedeputeerde staten van Noord-Brabant.

² [Natural England Water Quality and Nutrient Neutrality Advice \(16 March 2022\) - NE785](#)

Graphic 1-1 Location of the Proposed Development within the Solent and River Itchen Nutrient Neutrality Catchments



1.2.4 NE guidance states that nutrient neutrality is a means of ensuring that new development does not add to existing nutrient burdens and that nutrient neutrality measures to mitigate excess nutrients should be in place in advance of the impacts from the development in order to comply with the Habitats Regulations 2017 [2]. Where a development is phased or has distinct stages, the mitigation requirements may vary and change between stages. However, the development must ensure there is sufficient mitigation in place at each stage to achieve nutrient neutrality. Mitigation solutions should not undermine efforts to bring a Site of Special Scientific Interest (SSSI) from an unfavourable to a favourable condition within a nutrient neutrality zone; i.e. an applicant’s efforts to ensure nutrient neutrality should not undermine future restoration initiatives. This may be the case, where for example, proposed mitigation land has been earmarked for restoration measures, and the implementation of mitigation measures would mean the opportunity for restoration would be lost.

1.2.5 The Proposed Development would not materially add additional nutrient loadings in the same way as new residential development (which is the primary focus for nutrient neutrality assessments) as no new overnight accommodation (and the associated new connections to sewerage networks) would be constructed. However, ES Chapter 19 Water environment, Volume I, (Document reference 6.1, DCO Volume 6) has identified the potential for nitrogen and phosphorus loads to change as a result of the construction and operation of the Proposed Development. This assessment has therefore been prepared to determine whether these

potential changes could result in adverse effects on the two nutrient sensitive catchments.

- 1.2.6 Under the Conservation of Habitats and Species Regulations 2017, a nutrient neutrality assessment (in this instance a ‘Nutrient Assessment’) must be conducted in order to secure consent for the Proposed Development. This assessment ensures that, in the case of increased nutrient loads from the Proposed Development, sufficient mitigation measures are identified to be undertaken within the nutrient sensitive catchment in order to remove/reduce the overall load.

1.3 Protected habitats

River Itchen

- 1.3.1 The River Itchen is designated as a SAC and as a SSSI, due to its assemblages of breeding birds, fish and invertebrates, as well as its lowland woodland and grass habitats and three species of water-crowfoot (*Ranunculus* sp.), a type of flowering aquatic plant. This chalk river is mainly spring fed across a catchment of 11,961 ha, restricting its range of seasonal variation [3]. It supports an abundance of faunal and floral species associated with calcium-rich riverine habitats and has therefore been identified by NE as phosphorus-vulnerable, owing to the impacts of nutrient pressures on its biodiversity.
- 1.3.2 In its most recent evidence pack [3], NE determined that water quality assessments identified elevated phosphorus concentrations within the River Itchen. Twelve of the fifteen monitoring points failed to comply with the target levels of soluble reactive phosphorus, with reductions ranging from 8% to 63% required [3]. Permitted levels of phosphorus in releases of treated effluent from WTW in the catchment have since been reduced [4].
- 1.3.3 Based on information provided in Natural England’s evidence pack [3], the main characteristics of the SAC are summarised below and in Table 1-1.
1. Vulnerability: Phosphorus
 2. Protected areas:
 - a. Hamble Estuary Eutrophic Nitrate Vulnerable Zone (NVZ) – ET3 Eutrophic Water).
 - b. Hampshire Chalk NVZ – G143 Groundwater – Hampshire Chalk.
 - c. GWSGZ0148 Drinking Water Safeguard Zone (Groundwater) - for Nitrate.
 3. Soils and geology:
 - a. 80% of the catchment composed of a chalk outcrop, with Tertiary clay and sand overlaying the chalk in the catchment’s southern tip.
 - b. Coarse gravels in fast-flowing sections.

Table 1-1 Designated features of the River Itchen Special Area of Conservation

Code	Common name	Binomial nomenclature
Habitat designations		

Code	Common name	Binomial nomenclature
H3260	River water-crowfoot	<i>Ranunculus fluitans</i>
Species designations		
S1044	Southern damselfly	<i>Coenagrion mercurial</i>
S1092	White-clawed crayfish	<i>Austropotamobius pallipes</i>
S1096	Brook lamprey	<i>Lampetra planeri</i>
S1106	Atlantic salmon	<i>Salmo salar</i>
S1163	Bullhead	<i>Cottus gobio</i>
S1355	Otter	<i>Lutra lutra</i>

The Solent

- 1.3.4 The Solent is a prime example of a major estuarine system with complex habitats (marine and estuarine) and biodiverse faunal and floral communities. It supports many specialist plant varieties and consequently provides ideal breeding and feeding grounds for several bird species. Its intertidal mudflats and seagrass beds are vital feeding grounds for both native and migratory birds [5]. This has led to its protection within both local and international (European) law as an SAC, SPA, Ramsar site and SSSI.
- 1.3.5 Nutrient influx from diffuse land pollution and wastewater releases have led to its classification as being in an “unfavourable condition”. Eutrophication is evident in the algal mats that cover the mud flats at low tide, damaging these feeding habitats and limiting the energy reserves for birdlife [6]. This affects their ability to successfully migrate in the winter months [5]. It has therefore been classified as a NVZ with restrictions regarding any new developments.
- 1.3.6 The main characteristics of the SAC, SPA, Ramsar and SSSI are summarised below and in Table 1-2, Table 1-3, Table 1-4 and Table 1-5 [5].
1. Vulnerability: Nitrogen.
 2. Protected areas:
 - a. Special Areas of Conservation: The Solent Maritime, South Wight Maritime.
 - b. Special Protection Areas: The Solent and Dorset Coast, The Solent and Southampton Water.
 - c. Ramsar site: The Solent and Southampton Water.
 - d. Sites of Special Scientific Interest: Lee-On-The-Solent to Itchen Estuary.
 - e. Marine Conservation Zones: Yarmouth to Cannes, Bembridge, The Needle.
 - f. Nitrate Vulnerable Zones: Hamble Estuary, Chichester, Langstone and Portsmouth Harbours, Newtown Harbour.
 - g. Urban Treatment Directive Protected Areas: Chichester Harbour, Newtown Harbour, Medina Estuary.
 - h. Shellfish Waters: Cowes and Medina, Approaches to Southampton Water, Pennington, Langstone Harbour.
 - i. Bathing Waters: Southsea East, Gurnard.

3. Species designations: 178017, Common Sole, *Solea solea* – Species of Principal Importance (England).
4. Soils and geology: Mainly subtidal mud and subtidal mixed sediment, with some subtidal sand and sheltered muddy gravel habitats present. These support a significant birdlife presence.

Table 1-2 Designated features of the Solent Maritime Special Area of Conservation

Code	Common name	Binomial nomenclature
Habitat designations		
H1110	Sandbanks which are slightly covered by sea water all the time	-
H1130	Estuaries	-
H1140	Mudflats and sandflats not covered by seawater at low tide	-
H1150	Coastal lagoons	-
H1210	Annual vegetation of drift lines	-
H1220	Perennial vegetation of stony banks	-
H1310	Salicornia and other annuals colonising mud and sand	-
H2120	Shifting dunes along the shoreline with marram grass ('White dunes')	<i>Ammophila arenaria</i>
H1320	Spartina swards	<i>Spartinion maritimae</i>
H1330	Atlantic salt meadows	<i>Glauco-Puccinellietalia maritimae</i>
Species designations		
S1016	Desmoulin's whorl snail	<i>Vertigo moulinsiana</i>

Table 1-3 Designated features of the Solent and Southampton Water Special Protection Area

Code	Common name	Binomial nomenclature
Species designations		
A193	Common tern	<i>Sterna hirundo</i>
A195	Little tern	<i>Sterna albifrons</i>
A191	Sandwich tern	<i>Sterna sandvicensis</i>
A176	Mediterranean gull	<i>Larus melanocephalus</i>
A192	Roseate tern	<i>Sterna dougallii</i>
A616	Black-tailed godwit	<i>Limosa limosa islandica</i>
A675	Dark-bellied brent goose	<i>Branta bernicla bernicla</i>
A137	Ringed plover	<i>Charadrius hiaticula</i>
A052	Teal	<i>Anas crecca</i>

Table 1-4 Designated features of the Lee-on-The Solent to Itchen Estuary Sites of Special Scientific Interest

Common name	Binomial nomenclature
Species designations	
Black-tailed godwit	<i>Limosa limosa islandica</i>
Dunlin	<i>Calidris alpina alpina</i>

Common name	Binomial nomenclature
Great crested grebe	<i>Podiceps cristatus</i>
Dark-bellied brent goose	<i>Branta bernicla bernicla</i>
Grey plover	<i>Pluvialis squatarola</i>
Ringed plover	<i>Charadrius hiaticula</i>
Redshank	<i>Tringa tetanus</i>
Teal	<i>Anas crecca</i>
Widgeon	<i>Anas penelope</i>
Other designations	
Aves	
Mesozoic – Tertiary	
Fish/Amphibia	
Quaternary of South Central England	
Vascular Plant Assemblage	

Table 1-5 Ramsar criteria of the Solent and Southampton Water Ramsar site

Criteria	Description
Criterion 1: Representative, rare or unique wetland types	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.
Criterion 2: Vulnerable, endangered, or critically endangered species or threatened ecological communities	<p>The site supports an important assemblage of rare plants and invertebrates. At least 33 British Red Data Book invertebrates and at least eight British Red Data Book plants are represented on site.</p> <p>The higher plants <i>Orobanche purpurea</i> and <i>Spartina maritima</i> are considered vulnerable and endangered, respectively, in the GB Red Book.</p> <p>The Mediterranean gull (<i>Larus melanocephalus</i>) is included in CITES Appendix I.</p>
Criterion 5: Regularly supports >20,000 waterbirds	51,343 waterfowl (5 year peak mean 1998/99-2002/2003)
Criterion 6: Species/populations occurring at levels of international importance	<p>Black-tailed godwit (<i>Limosa limosa islandica</i>)</p> <p>Dark-bellied brent goose (<i>Branta bernicla bernicla</i>)</p> <p>Eurasian teal (<i>Anas crecca</i>)</p>

2 Methodology

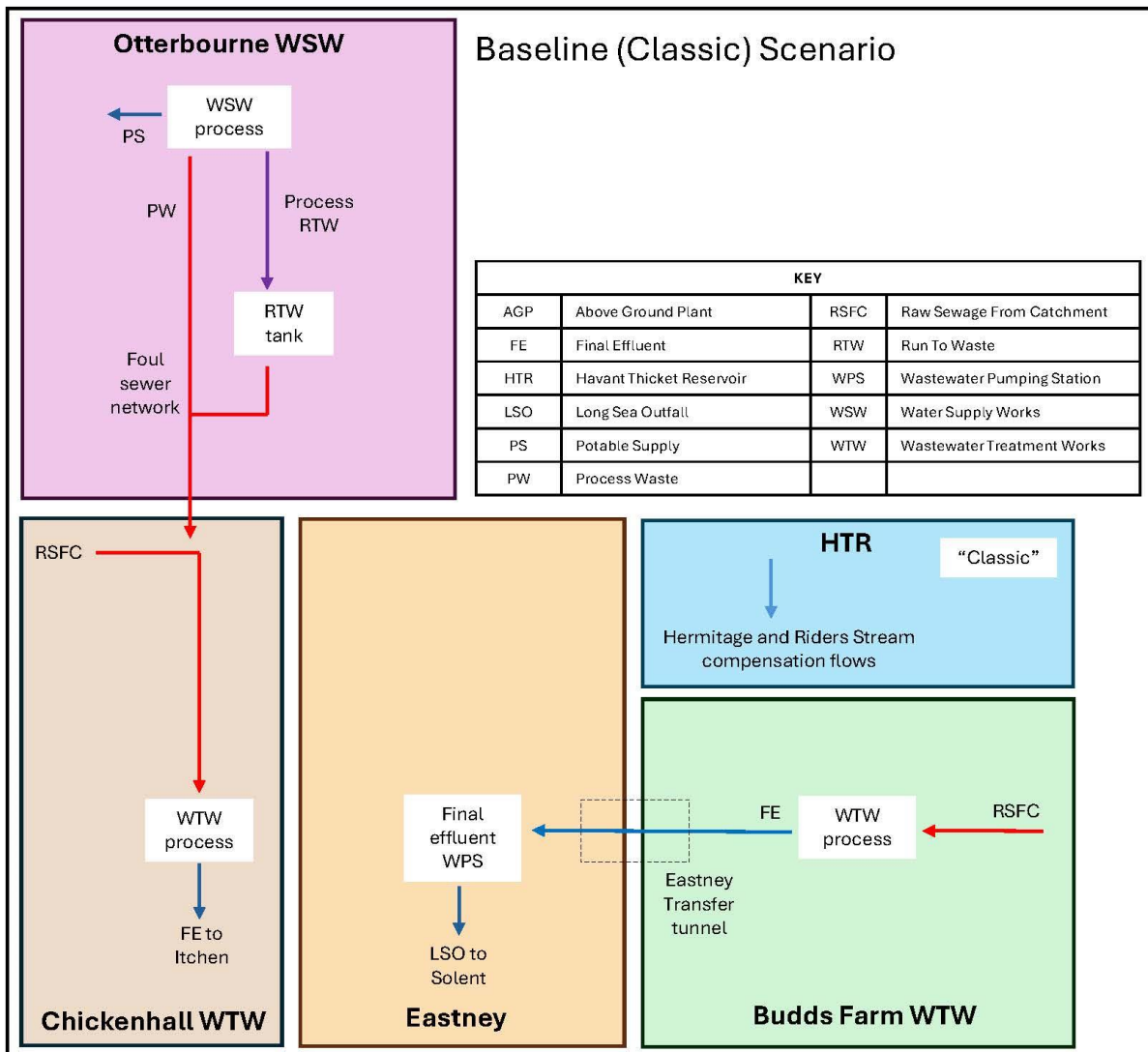
2.1 Outline of scenarios

- 2.1.1 Three scenarios have been identified for the nutrient calculations; baseline, construction, and operation:
1. **Baseline:** This scenario refers to normal operations within the Hampshire water supply area once Havant Thicket Reservoir (HTR) is operational, but before the Water Recycling Plant (WRP) site has been constructed and is operational. This scenario is described as the ‘classic’ scenario in ES Chapter 19 Water environment, Volume I (Document reference 6.1, DCO Volume 6) and ES Appendix 19.6 Havant Thicket Reservoir Compensatory Flows water quality modelling, Volume II (Document reference 6.2, DCO Volume 6).
 2. **Construction:** This scenario refers to the construction of all components of the Proposed Development.
 3. **Operation:** This scenario refers to operations within the Hampshire water supply area once the WRP site is operational. This is described as the ‘post-WRP’ scenario in ES Chapter 19 Water environment, Volume I (Document reference 6.1, DCO Volume 6) and ES Appendix 19.6 Havant Thicket Reservoir Compensatory Flows water quality modelling, Volume II (Document reference 6.2, DCO Volume 6).

Baseline scenario

- 2.1.2 Treated wastewater from Budds Farm Wastewater Treatment Works (WTW) flows to Eastney final effluent pumping station, via the Eastney Transfer Tunnel (TT), before releasing into the Solent via the Eastney Long Sea Outfall (LSO), 5.7km offshore (ES Appendix 19.5 Eastney Long Sea Outfall Solent dispersion modelling, Volume II (Document reference 6.2, DCO Volume 6)). In addition, process waste from Otterbourne Water Supply Works (WSW) joins the foul sewer network and is treated at the Chickenhall WTW. This is then released as final effluent into the River Itchen (Graphic 2-1).
- 2.1.3 For the purposes of this scenario, it is assumed that Havant Thicket Reservoir has been constructed and is operating. Under this scenario, water levels within Havant Thicket Reservoir would be maintained through spring water inputs from Bedhampton and Havant Springs over the winter periods in accordance with Portsmouth Water’s existing planning permission (ES Appendix 19.6 Havant Thicket Reservoir Compensatory Flows water quality modelling, Volume II (Document reference 6.2, DCO Volume 6)).
- 2.1.4 The natural headwater system of Riders Lane Stream will be cut off from the downstream watercourse by Havant Thicket Reservoir, and so compensatory flows will be released to maintain flows downstream (ES Appendix 19.6 Havant Thicket Reservoir Compensatory Flows water quality modelling, Volume II (Document reference 6.2, DCO Volume 6)). This would be balanced by spring water inputs into Havant Thicket Reservoir.
- 2.1.5 Graphic 2-1 illustrates the flow process under the baseline scenario within the ‘classic’ scenario.

Graphic 2-1 Process diagram for the baseline ('classic') scenario



2.1.6 The initial reservoir filling phase has not been assessed because it takes place prior to the 'classic' scenario and would not accurately reflect the baseline conditions at the time the Proposed Development is implemented.

Construction scenario

2.1.7 This scenario refers to the period of construction of the Proposed Development, which is expected to span a period of approximately five years (including enabling and commissioning works). Construction activities within the Order Limits of the Proposed Development would result in a change of land use from the baseline scenario (described in section 2.1.5). The temporary change of land use along the Pipeline between the WRP site and Otterbourne WSW and at the Above Ground Plant (AGP) sites is considered in this scenario.

2.1.8 It is expected that open-cut pipeline construction would be carried in 3km lengths from 3 no. gangs working simultaneously. Accounting for forward stripping and reinstatement, it is expected that approximately 30-40% of the Proposed Development Order Limits for the open-cut sections of pipeline would be taken out of agricultural use at any one time. As such, the calculations have taken a

precautionary approach and assumed 30% of the land would be temporarily in a low input land use, with the remaining 70% continuing in the baseline agricultural use.

- 2.1.9 The Pipeline between Budds Farm WTW and the WRP site would be installed using trenchless techniques and would not require any land use change during construction. Similarly, the pipeline from the WRP to Bedhampton Springs would be installed using a combination of trenchless, trenched and above-ground construction. The above-ground pipeline would be constructed in an area in light industrial/commercial use, without input from agriculture. As such, there would be no change in land use between the baseline and construction phase at either of these pipelines.
- 2.1.10 During construction, the reservoir would be operated in the same way as during the Havant Thicket Reservoir 'classic' scenario with no active water recycling process. The proposed pipelines and transfers are included as dashed lines (Graphic 2-3) as these are not operational during the construction phase.
- 2.1.11 Testing of washout valves during maintenance could require the release of source water within the pipelines. Any releases of source water resulting from the testing of washout valves would be collected directly by a tanker, with no source water released to the environment (land or watercourse).
- 2.1.12 The WRP site would be built on top of an historical landfill site (ES Chapter 3 Description of the Proposed Development, Volume I (Document reference 6.1, DCO Volume 6)). For the purposes of the nutrient assessment, the land use classification would not change between the baseline, construction and operation as the land use under all scenarios may be classified as designated urban commercial/industrial land. This approach is consistent with Natural England guidance on calculating nutrient budgets for land use change. The nutrient loading would therefore remain the same and can be discounted from the calculations. Furthermore, mitigation has been included in the design of the Proposed Development to limit pathways for interaction between in situ landfill waste and surface and groundwaters during construction at the WRP site, including casting piles in situ to ensure 'intimate contact' between the pile and surrounding landfill waste (ES Chapter 11 Land quality and ground conditions, Volume I (Document reference 6.1, DCO Volume 6)).

Justification for construction crews living within the catchment

- 2.1.13 Natural England's guidance [7] states the following:
- "It is assumed that anyone living in the catchment also works and uses facilities in the catchment, and therefore wastewater generated by that person can be calculated using the population increase from new homes and other accommodation."*
- 2.1.14 All construction crews are assumed to be living within the catchment and are therefore excluded from the nutrient calculations for the Proposed Development. Any nutrient loading from people working within the catchment would be assessed as part of any applications for residential development [8]. As such, if the construction crews were to be incorporated into the calculations for this project, this would introduce issues of double counting the impact on the designated sites.

- 2.1.15 The data presented below has been taken from the most recent census data for which statistics for resident, workplace and daytime populations have been calculated by the Office for National Statistics, which is from 2001³. The census data represents the resident population of those aged 16-74, noting that since the retirement age in 2001 was 65 that this data set includes both students and retirees. Data on the employment and commuting patterns have been presented in Table 2-1.
- 2.1.16 This was compared between different local authorities (Hampshire, Isle of Wight, Southampton and Portsmouth). The boundaries of these local authorities roughly cover the boundary of The Solent Catchment Area. The local authority scale was considered large enough to capture wider movements of people to and from employment, but not too large to miss smaller commutes.

Table 2-1 Residents and workplace by unitary local authorities in the study area

Population Type	Hampshire	Isle of Wight	Portsmouth	Southampton
Total resident population aged 16-74	895,199	93,393	135,628	161,625
Lives in area and works outside area but within associated area	281,875 (31%)	3,705 (4%)	23,143 (17%)	33,651 (21%)
Lives in area and works outside associated area	3,336 (1%)	310 (<1%)	838 (1%)	348 (<1%)
Lives and works in area and lives in area and does not work	609,988 (68%)	89,378 (96%)	111,647 (82%)	127,626 (79%)
Lives outside area but within associated area and works inside area	223,763	1,229	41,928	46,830
Lives outside associated area and works inside area	0	0	0	0

2.1.17 Graphic 2-2 shows the distribution of population types.

Graphic 2-2 Distribution of the population types



2.1.18 The results of the data in Table 2-1 indicate that the majority of people live and work (or live and do not work) in the same local authority district. This is particularly

³ [TT010 - Theme table on resident, workplace and daytime population - Nomis - Official Census and Labour Market Statistics](#)

high for the Isle of Wight, which is to be expected since it is an island and is therefore a more difficult commute to the mainland for work. For the remaining residents, most of them work in the adjacent districts.

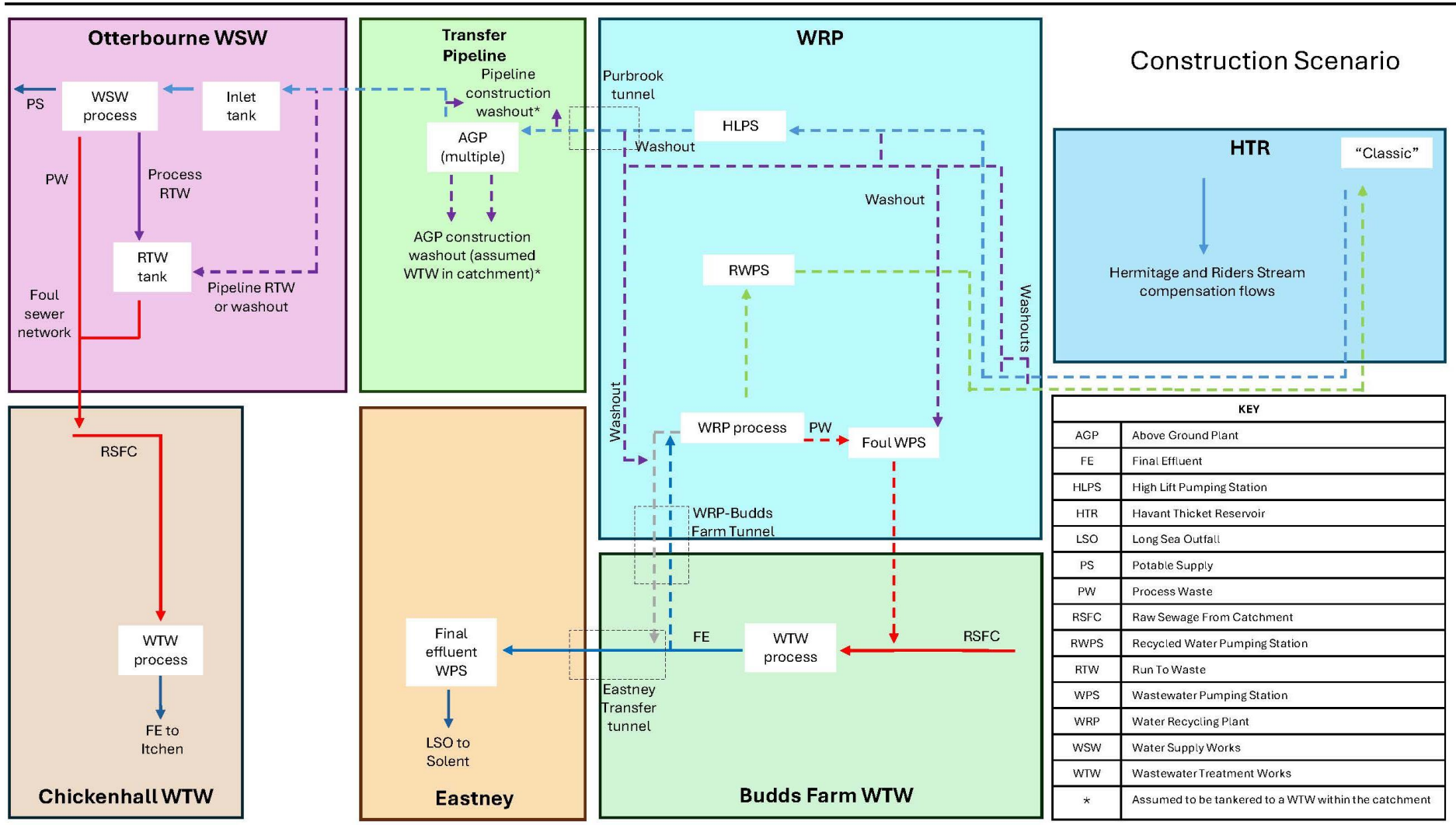
- 2.1.19 Data on the travel distances for residents⁴ was sourced from the most recent Census in 2021 and is presented in Table 2-2. The data captures all usual residents aged 16 years and over in employment. The 2021 Census captures the change in working patterns, with more residents working from home as a result of the COVID-19 pandemic.
- 2.1.20 The majority of residents travel 10km or less to work, with the majority of working residents living within 20km of work (Table 2-2). It is expected that the percentage of residents travelling further than 20km for work would be slightly lower for those living in Portsmouth and Southampton, since these are cities with employment opportunities in close proximity to the local population.

Table 2-2 Distance travelled to work

Distance travelled to work	Hampshire (%)	Isle of Wight (%)	Portsmouth (%)	Southampton (%)
Less than 2km	10	17	17	15
2km to less than 5km	10	9	17	18
5km to less than 10km	11	15	12	12
10km to less than 20km	10	15	5	5
20km to less than 30km	4	1	4	2
30km to less than 40km	2	0	1	1
40km to less than 60km	2	1	1	1
60km and over	2	1	2	2
Work mainly at or from home	35	22	25	26
No fixed place of work, offshore, or outside UK	15	17	17	18
Works within 10km	66	64	71	72
Works within 20km	76	79	75	77

⁴ [TS058 - Distance travelled to work - Nomis - Official Census and Labour Market Statistics](#)

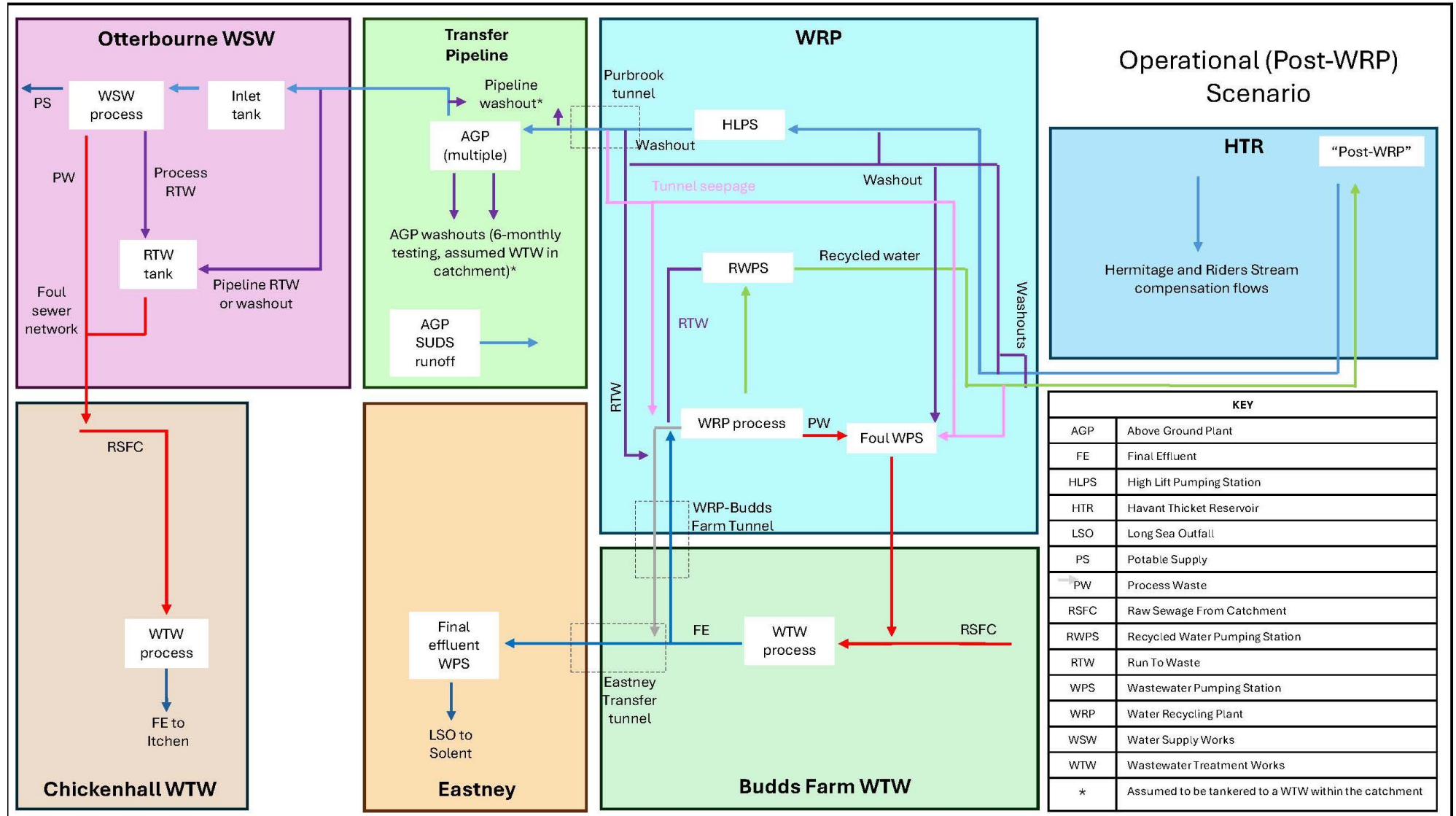
Graphic 2-3 Process diagram for the construction scenario



Operation scenario

- 2.1.21 This phase represents the 'post-WRP' scenario where the WRP site has been constructed and is operational and the water balance in Havant Thicket Reservoir is maintained by recycled water inputs and spring water inputs from Bedhampton and Havant Springs over the winter periods, and withdrawals to Otterbourne WSW [9]. Within the WRP, treated wastewater from Budds Farm WTW would be pumped through two filtering processes; micro-filtration to remove impurities that could block treatment membranes, and reverse osmosis to remove dissolved salts, impurities, bacteria and pharmaceuticals. Phosphorus would be removed using membranes within the WRP site.
- 2.1.22 The water would then be subject to an advanced oxidation process that would use ultraviolet light and hydrogen peroxide to break down any remaining impurities. To ensure the water is stable for onward pumping and blending, minerals such as calcium and magnesium salts removed during the earlier stages of treatment would be added back in (noting that nitrogen and phosphorus compounds would not be added). The recycled water would be pumped to Havant Thicket Reservoir prior to being transferred via the WRP site to Otterbourne WSW.
- 2.1.23 The nutrient load and volumes of the compensatory flows from Havant Thicket Reservoir into downstream water bodies is based on the modelling for the 'classic' and 'post-WRP' scenarios provided in ES Appendix 19.6 Havant Thicket Reservoir Compensatory Flows water quality modelling, Volume II (Document reference 6.2, DCO Volume 6).
- 2.1.24 A reject stream from the WRP (containing impurities removed from the treated wastewater) would be transferred by pipeline back to Budds Farm WTW and into the Eastney TT via a new connection at an existing release point, downstream of the existing Budds Farm WTW treated wastewater release. These would then mix and be released into the Solent as reject water at the same point as the Eastney LSO.
- 2.1.25 The nutrient calculations are informed by the outputs of the Eastney LSO release modelling undertaken on an operational scenario of 30 MI/d transferred to Havant Thicket Reservoir, and a 60 MI/d 'maximum operation' (output from the WRP to the Havant Thicket Reservoir) scenario (ES Appendix 19.5 Eastney Long Sea Outfall Solent dispersion modelling, Volume II (Document reference 6.2, DCO Volume 6)).

Graphic 2-4 Process diagram for the operation ('post-WRP') scenario



- 2.1.26 Operational staff are also assumed to already be living and using facilities within the Solent nutrient catchment, and their loading is therefore already included in the existing nutrient baseline.
- 2.1.27 Wastewater from the WRP site welfare unit and the process waste would be treated at Budds Farm WTW. The wastewater would be transferred from the WRP site foul pumping station to Budds Farm WTW, before exiting as final effluent to the WRP site. Therefore, this represents a circular process. This only applies to wastewater released to the foul sewer. Any waste from Budds Farm WTW that releases to the Eastney LSO is already accounted for in the calculations informed by the 30MI/d Eastney LSO release modelling (ES Appendix 19.5 Eastney Long Sea Outfall Solent dispersion modelling, Volume II (Document reference 6.2, DCO Volume 6)). Furthermore, nutrient loadings are also assumed to be accounted for in existing loads from residential properties in the catchments.
- 2.1.28 The 30MI/d scenario at the WRP is the worst case scenario for releases via Eastney LSO. Under the 30 MI/d scenario, more water is released to the LSO, bypassing the WRP, and as such, less water is transferred to HTR. Whilst the concentrations are low, due to lower volume of high concentration reject water, the volume is greater. In this case, the volume is the controlling factor in a greater load when compared to the 60MI/d scenario.
- 2.1.29 Tunnel seepage has also been discounted from the operational scenario calculations. As shown in Graphic 2-4, any tunnel seepage occurring between the WRP site and transfer tunnel (located westwards of the WRP site and towards the escarpment) would circulate between the WRPs foul pumping station and Budds Farm WTW (under normal operations). The design of the tunnel means that flows from groundwater are considered to be negligible (ES Chapter 19 Water environment, Volume I (Document reference 6.1, DCO Volume 6)). Emergency releases via the Eastney LSO and the run to waste from Purbrook Tunnel have also been discounted as they fall outside the normal operation context.
- 2.1.30 During normal operation, testing of washout valves would be required approximately every six months. This would generate approximately 4.5m³ of source water, which would be tankered for disposal at a WTW that is assumed to be within the Solent and Itchen nutrient neutrality catchment area. It is assumed that the Total Nitrogen (TN) and Total Phosphorus (TP) concentrations of the washouts would be consistent with the concentrations in the Havant Thicket Reservoir under the 'post-WRP' scenario. The WTW which would ultimately treat the source water collected from the washouts would be assigned based on proximity to the washouts. The nutrient loads associated with the treatment of the source water via the washouts has been calculated using the following equation [10]:

$$\text{Concentration (mg/l)} * \text{volume (l/d)} = \text{Nutrient load (kg/yr)}$$

2.2 Assumptions

- 2.2.1 Several assumptions have been made that apply across the three scenarios:
1. Construction of Havant Thicket Reservoir is assumed to have concluded prior to the commencement of the 'post-WRP' operational phase.

2. Nutrient calculations are conducted under the assumption that each scenario is occurring within 'normal operation' (non-peak) conditions.
3. Any releases required in the event of emergencies are not included in calculations.

2.3 Nutrient calculations

Tools and data sets

- 2.3.1 Nutrient calculators have been developed by NE for each of the NSN site catchments to enable developers to assess the effects of additional nutrient loads on protected sites [11], [12]. These are used for assessing the nutrient removal rates for NSN sites.
- 2.3.2 Havant Thicket Reservoir will release compensation flows into Riders Lane Stream, which lies within the Solent nutrient neutrality catchment. As the Solent is nitrogen-vulnerable, only nitrogen loads need to be considered in relation to these releases for the purposes of this nutrient neutrality assessment. Final effluent releases from Chickenhall WTW into the River Itchen lie in the phosphorus-vulnerable Itchen catchment, which is a sub-catchment within the Solent Catchment and therefore, both nitrogen and phosphorus needed to be considered for these releases.
- 2.3.3 Nutrient calculations have been derived for the three scenarios as follows:
 1. Baseline scenario: nutrient loading from current operations at Budds Farm WTW, Otterbourne WSW and Chickenhall WTW were identified to establish baseline values. Loading from Eastney LSO and from compensatory flows to Riders Lane Stream is also assessed.
 2. Construction scenario: The land use changes associated with construction activities were the focus of neutrality calculations for this period, as well as the commissioning of the pipeline via the washout.
 3. Operation scenario: Nutrient loading associated with the permanent land use change at AGPs associated with the Pipeline between the WRP site and Otterbourne WSW (pipeline Sections D – M) were assessed, alongside changes to releases from the Eastney LSO, the final effluent entering the River Itchen from Chickenhall WTW and the composition changes in compensation flows entering Riders Lane Stream following the release of recycled water into Havant Thicket Reservoir (ES Appendix 19.6 Havant Thicket Reservoir Compensatory Flows water quality modelling, Volume II (Document reference 6.2, DCO Volume 6)). Releases associated with the six-monthly maintenance of operational washouts are assessed given their release from a WTW following treatment within the Solent catchment.

Compensatory flows from HTR to Riders Lane Stream

- 2.3.4 Compensatory flows modelling (ES Appendix 19.6 Havant Thicket Reservoir Compensatory Flows water quality modelling, Volume II (Document reference 6.2, DCO Volume 6)) was used to ascertain TN concentrations for the compensatory flows to Riders Lane Stream during both the 'classic' and 'post-WRP' scenarios. TN concentrations were calculated through the addition of the modelled

(maximum) ammonia, ammonium and nitrate values for the Riders Lane Stream sample location. The volume of the 'post-WRP' compensatory flows was assumed to be the same as the baseline (1 MI/d).

- 2.3.5 The most upstream location on the Riders Lane Stream was used to avoid underestimations from downstream dilution. The Riders Lane Stream is a tributary of the Hermitage Stream which flows in a southerly direction and is released to the Solent via Langstone Harbour.

Releases via washouts

- 2.3.6 As stated in ES Chapter 3 Description of the Proposed Development, Volume I (Document reference 6.1, DCO Volume 6), the number and location of washout valves is dependent upon the final design of the Pipeline. However, for the purposes of this assessment, it was assumed that they would be required approximately every 750 m to 1km, as well as one for every trenchless crossing and one per AGP. Using ESRI ArcGIS Pro software, washout valves were therefore generated in 750 m segments (i.e. representing a worst case scenario for the number of washout valves) along the Pipeline between the WRP site and Otterbourne WSW. A total of 52 washout locations were assumed along the pipeline route between Bedhampton Springs and Otterbourne WSW to enable the total volume of water required for each commissioning washout to be calculated.
- 2.3.7 As stated in ES Chapter 3 Description of the Proposed Development, Volume I (Document reference 6.1, DCO Volume 6), during the construction phase, the pipeline commissioning would firstly comprise pressure testing, followed by a full system testing. For the pressure testing, potable water would be captured in water storage lagoon construction compounds and would undergo cleaning through the use of a silt buster. They would comprise a lined shallow bunded area of land with a volume that would vary depending on commissioning requirements. Testing would be undertaken sequentially along the Pipeline, with potable water used for testing and transported by tanker or stored in storage lagoons with a maximum capacity of 3,400 m³ between testing of different sections.
- 2.3.8 The source water for the pressure testing for the Pipeline between the WRP site and Otterbourne WSW and between the WRP site and Bedhampton Springs would be potable water from Otterbourne WSW.
- 2.3.9 The pipeline between Budds Farm WTW and the WRP site would use treated wastewater from Budds Farm WTW. This water would be returned to Budds Farm WTW for release from the Eastney LSO.
- 2.3.10 The full system testing would use water sourced from the following locations:
4. The Pipelines between Budds Farm WTW and the WRP site would use treated wastewater from Budds Farm WTW.
 5. The Pipelines between the WRP site and Bedhampton Springs would use source water from Havant Thicket Reservoir.
 6. The Pipeline between the WRP site and Otterbourne WSW would use source water from Havant Thicket Reservoir.
- 2.3.11 Following the full system testing, water would be disposed of at a licensed disposal facility. It is assumed that the receiving licensed facilities would be located within the Solent nutrient catchment.

- 2.3.12 For the anticipated biannual testing of the washout valves (2.1.30) during the ‘post-WRP’ scenario, a washout volume of 4.5 m³ (ES Chapter 3 Description of the Proposed Development, Volume I (Document reference 6.1, DCO Volume 6)), was used for each washout valve calculation. A total volume of 468 m³/yr is assumed for all the washouts valves per year.

Changing Eastney LSO final effluent volumes

- 2.3.13 Natural England’s Solent nutrient neutrality calculator was used for neutrality calculations associated with the change in final effluent release volumes from Budds Farm WTW and the WRP reject water into the Solent.
- 2.3.14 The following equation was used to calculate the nutrient loading from effluent release [10]:

$$\text{Flow (l/day)} * \text{concentration (mg/l)} * 365.25 / 1000000 = \text{Nutrient loading (kg/yr)}$$

Otterbourne WSW waste stream

- 2.3.15 The following equation was used to calculate the nutrient loading from effluent release [10]:

$$\text{Flow (l/day)} * \text{concentration (mg/l)} * 365.25 / 1000000 = \text{Nutrient loading (kg/yr)}$$

Changing land use

- 2.3.16 Land use changes are prominent under the construction scenario owing to the impact of new development on surface runoff within the Proposed Development area.
- 2.3.17 Baseline land uses along the Pipeline between the WRP site and Otterbourne WSW and at the AGPs would temporarily change during the construction period, with the assumption that agricultural inputs would halt for the duration of construction. It is assumed that baseline land uses would recommence along the Pipeline during operation, following reinstatement at the end of the construction stage. However, the AGP sites would not return to agriculture and were assumed to have a low input land use.
- 2.3.18 Agricultural runoff coefficients were used to understand the nutrient removal potential from a change of land use. Agricultural runoff coefficients are dependent on the sub-catchment, soil type, rainfall, inclusion within an NVZ, and land use. Typically, higher agricultural runoff phosphorus coefficients are observed on soils with impeded or slightly impeded drainage, with values often greater than 1.0 kg/ha/yr. Most of the sites undergoing construction lie within the Eutrophic Water NVZ, with small areas lying within the Surface water and Groundwater NVZs. One small section of Pipeline between the WRP site and Otterbourne WSW (a portion of Section G: Crockerhill to Wickham, approximately 4km in length) does not lie within any NVZ (ES Chapter 3 Description of the Proposed Development, Volume I (Document reference 6.1, DCO Volume 6)).
- 2.3.19 In order to assess the degree of land use change, changes in land use within the construction and operational scenarios were compared against the baseline

scenario. The following list summarises the source material used in the mapping of key land use parameters for the nutrient assessment:

1. Soil types: Soilscales
2. Land use: Corine database; aerial imagery
3. Nitrate Vulnerable Zones: British Geological Survey, UK Soil Observatory
4. Sub-catchment data: EA Catchment Data Explorer

2.3.20 Land use changes were calculated using the following equation [10]:

$$[Existing\ area\ (ha) * Existing\ runoff\ coefficient\ (kg/ha/yr)] - [Future\ area\ (ha) * Future\ runoff\ coefficient\ (kg/ha/yr)] = \Delta\ Land\ use\ (kg/yr)$$

Rainfall

2.3.21 Annual rainfall averages are a crucial component of nutrient calculations owing to their influence on agricultural runoff. Annual averages from the Met Office 1991 – 2020 time series were used owing to the integrity (completeness) of the records in comparison to those of the Environment Agency for these sites. Martyr Worthy⁵ station has been selected owing to its proximity (approximately 10.6km straight-line distance) to Otterbourne WTW whilst Thorney Island⁶ station (approximately 9.1km straight-line distance from Havant Thicket Reservoir) provides the annual average for the area surrounding Havant Thicket Reservoir (Table 2-3).

2.3.22 For nutrient land use calculations, the yearly average rainfall from the two stations was used (760mm, that falls into the 750 to 800mm rainfall bracket). This was used consistently for the baseline, construction and operational scenarios [10].

Table 2-3 Average annual precipitation between 1991 and 2020 by station

Month	Annual average rainfall (mm)	
	Thorney Island Station	Martyr Worthy Station
January	84.47	81.60
February	57.67	57.55
March	49.85	50.88
April	49.64	50.93
May	43.26	49.19
June	48.2	45.18
July	46.88	52.88
August	57.17	57.83
September	61.4	54.57
October	85.95	85.98
November	90.56	91.40
December	92.62	75.64
Annual	767.67	753.63

⁵ [Met Office | Martyr Worthy](#)

⁶ [Met Office | Thorney Island](#)

Total change in nutrient loading

2.3.23 As the River Itchen SAC falls within the Solent, Natural England's nutrient calculators for the Solent and River Itchen catchments, which incorporate nutrients from wastewater load changes, rainfall and current/future land cover, were used.

2.3.24 The total changes in nutrient loading were calculated using the following formula [10]:

$$\Delta \text{ Nutrient loading from release} + \Delta \text{ Nutrient loading from land use} = \text{Nutrient loading (kg/yr)}$$

2.3.25 This output indicates how much annual nutrient mitigation would be required (in kilograms) to offset any increases in nutrient loading (where appropriate).

3 Nutrient assessment

3.1 Baseline scenario

Nutrient load from Eastney LSO final effluent

- 3.1.1 The final effluent release from Eastney pumping station (PS), via the Eastney TT and Eastney LSO, was assigned an average concentration of 6.39 mg/l TN (based on mass balance calculations for Budds Farm WTW produced by Southern Water Services Limited (the 'Applicant'), summarised in **Annex A**). This value was provided by the Applicant from their mass balance calculations for Environmental Quality Standards. TP was not calculated owing to the Eastney Long Sea Outfall's location within the Solent, which is only nitrogen-vulnerable (see paragraph 2.3.3).
- 3.1.2 The flows from Budds Farm WTW were assumed to utilise a Flow to Full Treatment (FFT) of 119.2 MI/d (**Annex A**). FFT is a measure of the maximum amount of wastewater a treatment works must be able to treat at any time. The specified FFT is a permitted level that must be met prior to discharging to storm tanks. Dry Weather Flow (DWF) is the average daily flow during dry conditions. For the purposes of this assessment, the maximum volumes were needed and as such, the FFT value was used. The load is presented in Table 3-1.

Table 3-1 Nutrient (TN) load from final effluent from Eastney LSO

Release location	Operational catchment	Variable	Concentration (mg/l)	Volume (MI/d)	Load (kg/yr)
Eastney LSO	Solent	TN	6.39	119.2	278,207

Otterbourne WSW waste stream

- 3.1.3 Otterbourne WSW is predominantly supplied via abstractions from groundwater and the River Itchen. There is an existing waste stream between Otterbourne WSW and Chickenhall WTW which has a maximum permitted flow of 350 m³/d.
- 3.1.4 The TN concentrations of the abstracted water which supply the waste stream to Chickenhall WTW were derived from water quality records help by the Applicant (**Annex B**). This provides details of the baseline water quality data from the three existing water sources: River Itchen, combined boreholes and wells at Otterbourne WSW. Under the normal operating conditions, the current blend is typically 60% from groundwater sources and 40% from the River Itchen. However, the strategic direction is for the Applicant to abstract as close as possible to the full groundwater license (c. 58 MI/d). This represents a reasonable worst case with respect to nutrient supply.
- 3.1.5 As such, this assessment has used the concentrations from the wells sampling point. Ammonia, Nitrate and Nitrite concentrations taken between 2014-2025 were used as a proxy for TN, with a 95%ile concentration of 33.61 mg/l. Similarly, orthophosphate 95%ile concentrations of 0.08 mg/l were used as a proxy for TP.
- 3.1.6 Due to limitations in sampling data, it was only possible to retrieve concentrations for the source water, rather than the waste stream directly. Source water is used a

proxy for the waste stream and is compared to source water from different sources in the operational scenario.

- 3.1.7 As such, the load released to Chickenhall WTW is 4,297 kg/yr TN and 10.23 kg/yr TP.

Table 3-2 Nutrient load from waste stream at Otterbourne WSW

Release location	Operational catchment	Variable	Concentration (mg/l)	Volume (MI/d)	Load (kg/yr)
Chickenhall WTW	Itchen	TN	33.61	0.35	4,297
		TP	0.08		10.23

Nutrient load from HTR compensation flows to Riders Lane Stream

- 3.1.8 A maximum TN concentration of the compensatory flow within the baseline scenario was modelled as 13.47 mg/l according to the compensatory flows modelling (ES Appendix 19.6 Havant Thicket Reservoir Compensatory Flows water quality modelling, Volume II (Document reference 6.2, DCO Volume 6)). TP was not calculated as the Riders Lane Stream lies within the Solent nutrient neutrality catchment, making it nitrogen-vulnerable (see paragraph 2.3.3). The load is presented in Table 3-3.

Table 3-3 Nutrient (TN) load from compensation flows to Riders Lane Stream

Variable	Concentration (mg/l)	Volume (MI/d)	Load (kg/yr)
TN	13.47	1	4,920

Nutrient load from potable water supply

- 3.1.9 The baseline nutrient load from the potable supply at Otterbourne WSW is calculated for the following future flow scenarios:

5. 30 MI/d FFT
6. 90 MI/d transfer to Otterbourne WSW (60 MI/d transfer from WRP to HTR)

- 3.1.10 Concentrations of Ammoniacal Nitrogen and Total Oxidised Nitrogen were taken as a proxy for TN and produced a 95%ile concentration (2014 – 2025) of 33.61 mg/l from the Wells. A phosphorus concentration of 0.08 mg/l was also assumed.

- 3.1.11 Table 3-4 outlines the baseline nutrient load of the source water into Otterbourne WSW.

Table 3-4 Nutrient load from baseline source water supply

Flow scenario	Variable	Concentration (mg/l)	Load (kg/yr)
30 MI/d FFT	TN	33.61	368,282
	TP	0.08	876.60
90 MI/d	TN	33.61	1,104,845
	TP	0.08	2,629.80

- 3.1.12 The specified FFT is a permitted level that must be met prior to discharging to storm tanks. Dry Weather Flow (DWF) is the average daily flow during dry conditions. For the purposes of this assessment, the maximum volumes were needed and as such, the FFT value was used.

Nutrient load from baseline land use

- 3.1.13 The pipeline area covers three management catchments: East Hampshire, South East TraC and the Test and Itchen. Six land use categories can be identified across these areas:
1. Cereals
 2. General
 3. Greenspace
 4. Lowland grazing
 5. Non-agricultural urban
 6. Woodlands.
- 3.1.14 Further details of the land use types and definitions are published in Natural England’s guidance note on using nutrient neutrality calculators [13].
- 3.1.15 Land use within the catchment was assigned using the Crop Map of England (CROME)⁷. Lowland grazing is the most common land use category found across the operational catchments, attributing to 45% of the total areas; cereal crops cover 27% of the area, whilst the third most common land use was woodland covering 13% of the overall land use. The majority of the pipeline is located within the East Hampshire operational catchment (281 hectares of 326 hectares), which consequently has most of the nitrogen load (Table 3-5). The Test and Itchen catchment covers significantly less of the pipeline area (44.8 hectares) but includes a TP loading requirement. The South East TraC catchment only covers a 0.347-hectare portion of the pipeline.

Table 3-5 Nutrient load from land use

Management catchment	Operational catchment	Variable	Load (kg/yr)
East Hampshire	East Hampshire Rivers	TN	3,404
South East TraC	Solent	TN	1
Test and Itchen	Itchen	TN	379
		TP	13

- 3.1.16 The results of this process have identified the following nutrient loads from baseline land use within the footprint of the Proposed Development:
1. TN nutrient load: 3,784 kg/yr
 2. TP nutrient load: 13 kg/yr

Total nutrient load

- 3.1.17 The baseline nutrient load constitutes of 291,208 kg/yr TN and 23.23 kg/yr of TP. More than 96% of the baseline nitrogen load is sourced from the Eastney LSO final effluent outputs (Table 3-6).

Table 3-6 Total baseline nutrient load (kg/yr)

Nutrient source	TN load (kg/yr)	TP (kg/yr)
Eastney LSO final effluent	278,207	N/A

⁷ [Crop Map of England \(CROME\) 2023](#)

Nutrient source	TN load (kg/yr)	TP (kg/yr)
Otterbourne WSW waste stream	4,297	10.23
HTR compensation flows	4,920	N/A
Land use	3,784	13
Total	291,208	23.23

3.2 Construction scenario

Nutrient load from Eastney LSO final effluent

3.2.1 Under the construction scenario, no changes would occur to the final effluent release from Eastney LSO. Release load would match the baseline concentration of an averaged 6.39 mg/l (**Annex A**). TN load therefore matches the baseline Eastney LSO final effluent load of 278,207 kg/yr.

Otterbourne WSW waste stream

3.2.2 The existing waste stream from Otterbourne WSW to Chickenhall WTW would be consistent with the baseline scenario. As such, the load released to Chickenhall is 4,297 kg/yr TN and 10.23 kg/yr TP.

Nutrient load from HTR compensation flows to Riders Lane Stream

3.2.3 No changes would occur to the HTR compensatory flow during the construction scenario. It was therefore assigned the baseline modelled maximum TN concentration of 13.47 mg/l according to the compensatory flows modelling (ES Appendix 19.6 Havant Thicket Reservoir Compensatory Flows water quality modelling, Volume II (Document reference 6.2, DCO Volume 6)). The volume was assumed to be the same as the baseline (1 Ml/d), producing the TN load of 4,920 kg/yr. TP was not calculated as the Riders Lane Stream lies within the Solent nutrient neutrality catchment, making it nitrogen-vulnerable (see paragraph 2.3.3).

Nutrient load from commissioning washouts

3.2.4 The source water for the pressure testing for the Pipeline between Bedhampton Springs and Otterbourne WSW would be potable water from Otterbourne WSW. Once the pressure testing has been completed, the water would be disposed of at a licensed disposal facility.

3.2.5 Water supplied from Otterbourne WSW can, from a phosphorus neutrality perspective, be treated at any disposal facility, including within the Itchen catchment; as the water from Otterbourne WSW would have originated from within the Itchen catchment, disposal at a licensed facility within the Itchen catchment represents a circular process. However, the risks associated with the introduction of invasive non-native species (INNS) to the Itchen catchment preclude the use of disposal facilities in this catchment (cf. INNS Biosecurity Plan (Document reference 7.10, DCO Volume 7)). As such, it is assumed that the water would be disposed of at a licensed facility within the Solent catchment (excluding the River Itchen catchment, which is located inside the Solent catchment). From a nitrogen perspective, the water would be sourced from and returned to the Solent catchment. As such, this represents a circular process within the Solent catchment.

- 3.2.6 Pressure testing of the Proposed Development would comprise passing water through all sections of the Pipeline as follows
1. The Pipelines between Budds Farm WTW and the WRP site would use treated wastewater from Budds Farm WTW.
 2. The Pipelines between the WRP site and Bedhampton Springs would use source water from Havant Thicket Reservoir.
 3. The Pipeline between the WRP site and Otterbourne WSW would use source water from Havant Thicket Reservoir.
- 3.2.7 Between Budds Farm WTW and the WRP site, water would be sourced from and returned to Budds Farm WTW. As such, this represents a circular process within the Solent catchment.
- 3.2.8 Following the full system testing, water originating from Havant Thicket Reservoir would be disposed of at a licensed disposal facility located within the Solent catchment (excluding the River Itchen catchment, which is located inside the Solent catchment). As the water has originated within the Solent catchment, disposal at a licensed facility within the Solent catchment represents a circular process.

Nutrient load from land use

- 3.2.9 The land within the above-ground construction footprint of the Proposed Development would be taken out of its current agricultural use and would therefore no longer receive nutrient inputs such as fertiliser or animal waste for the duration of construction. There would be a suite of measures in place to manage runoff and the mobilisation of soils and nutrients during the construction activities. As such, a low input land use, such as greenspace, is deemed the most appropriate analogue for this land from the options provided in Natural England’s nutrient calculator [13].
- 3.2.10 The nutrient runoff coefficients for phosphorus and nitrogen loading were derived from the Nutrient Neutrality Generic Methodology (2022) [14]. The results indicate a reduction in TN and TP load from the baseline (see Table 3-7).

Table 3-7 Nutrient load from land use that have been converted to low input land use

Management catchment	Operational catchment	Variable	Load (kg/yr)
East Hampshire	East Hampshire Rivers	TN	2,644
South East TraC	Solent	TN	1
Test and Itchen	Itchen	TN	306
		TP	9.39

- 3.2.11 The results of this process have identified the following nutrient loads from construction land use within the footprint of the Proposed Development:
1. TN load: 2,951 kg/yr
 2. TP load: 9.39 kg/yr

Total nutrient load

3.2.12 During the construction scenario both TN and TP shows a decrease in load due to the change in land use (Table 3-8).

Table 3-8 Annual nutrient load for the construction scenario

Nutrient source	TN load (kg/yr)	TP load (kg/yr)
Eastney LSO final effluent	278,207	N/A
Otterbourne WSW	4,297	10.23
HTR compensation flows	4,920	N/A
Land use	2,951	9.39
Total	290,375	19.62

3.3 Operation scenario

Nutrient load from Eastney LSO final effluent

- 3.3.1 Final effluent release from Eastney PS (via the Eastney TT and Eastney LSO) was assigned a modelled average TN concentration of 8.47 mg/l for the combined release under the 30 MI/d FFT scenario (**Annex A**) (see section 3.1 for a description of FFT). Under the 30 MI/d FFT scenario, 78.12 MI/d remains after WRP take off, which is combined with a reject waste stream of 10.94 MI/d, giving a combined flow to the Eastney LSO of 89.15 MI/d (**Annex A**). The considerable decrease in volume during the operational scenario (in comparison to baseline volume from Eastney LSO) is a controlling factor in the load reduction.
- 3.3.2 Under the 60 MI/d scenario, the assigned modelled TN concentration of 20.16 mg/l for the combined release was used. Under the 60 MI/d scenario the combined flow to Eastney LSO is 26.98 MI/d (**Annex A**).
- 3.3.3 The 30 MI/d is the worst case scenario for the nutrient loading to Eastney as a result of a greater volume discharging via the long sea outfall.

Table 3-9 Nutrient (TN) load from Eastney LSO release during operation

Release location	Nutrient catchment	Variable	Scenario	Concentration (mg/l)	Volume via Eastney LSO (MI/d)	Load (kg/yr)
Eastney LSO	Solent	TN	30 MI/d FFT	8.47	89.15	275,800
			60 MI/d	20.16	26.98	198,666

Otterbourne WSW waste stream

3.3.4 In the operational scenario, water supplied to Otterbourne WSW and ultimately the waste stream to Chickenhall WTW would be sourced from Havant Thicket Reservoir. It is assumed that the concentrations of the water in the waste stream would be the same as that abstracted from Havant Thicket Reservoir. As such, the waste stream would have a worst case concentration of 3.49 mg/l for TN and 0.031 mg/l for TP (withdrawal water quality envelope worst case).

3.3.5 The total flow to Chickenhall WTW is assumed to remain at the maximum permitted flow of 350 m³/d. The total waste stream at Otterbourne WSW would therefore release 446 kg/yr of TN and 3.96 kg/yr of TP into Chickenhall WTW.

Table 3-10 Nutrient load from Otterbourne run to waste

Nutrient catchment	Variable	Concentration (mg/l)	Volume (m ³ /d)	Load (kg/yr)
Itchen	TN	3.49	350	446
	TP	0.031		3.96

Potable water supply

3.3.6 Source Water from Havant Thicket Reservoir would be transferred to Otterbourne WSW, from where it would be distributed to the water supply network following full drinking water treatment. This would include the supply of households within the River Itchen catchment.

3.3.7 The water transferred to Otterbourne WSW prior to drinking water treatment processing in the 'post-WRP' scenario would have maximum concentrations of 3.49 mg/l for TN and 0.031 mg/l for TP, inclusive of the phosphate removal membranes at the WRP. The nutrient concentrations of the transferred source water are considerably lower than previously abstracted from source water sources at Otterbourne (33.61 mg/l for TN and 0.08 mg/l for TP).

3.3.8 As such, the source water supplied from HTR would have a lower concentration when compared to that of existing source water from the groundwater and River Itchen supplied through Otterbourne WSW. The source water would be treated to drinking water standards prior to distribution.

3.3.9 Under the 30 MI/d FFT scenario at the WRP, 30 MI/d of source water would be transferred to Otterbourne WSW where it would subsequently be distributed into the water supply network. This volume of transferred water is considered to be a replacement for 30 MI/d that is abstracted from the source water sources in the baseline. Therefore, the load in the source water for the operational scenario is 38,242 kg/yr for TN and 339.68 kg/yr for TP. As such, given the volumes are consistent and the source water has a lower concentration, it can be concluded that the replacement source water is unlikely to increase nutrient loads into the Itchen catchment when distributed into the potable network.

3.3.10 Similarly, under the 60 MI/d scenario at the WRP, 90 MI/d would be transferred to Otterbourne WSW. The load from the source water is 114,725 kg/yr for TN and 1,019.05 kg/yr for TP.

3.3.11 As such, under the 60 MI/d scenario, it is also unlikely there would be an increase in nutrient loads into the Itchen catchment from the potable network.

Table 3-11 Nutrient load from potable supply

Flow scenario	Variable	Concentration (mg/l)	Load (kg/yr)
30 MI/d FFT	TN	3.49	38,242
	TP	0.031	339.68
90 MI/d	TN	3.49	114,725
	TP	0.031	1,019.05

Nutrient load from HTR compensation flows to Riders Lane Stream

3.3.12 Compensatory flow TN concentration for the ‘post-WRP’ scenario was modelled as 6.81 mg/l (a maximum value) according to the compensatory flows modelling (Table 3-11) (ES Appendix 19.6 Havant Thicket Reservoir Compensatory Flows water quality modelling, Volume II (Document reference 6.2, DCO Volume 6)). The volume of the ‘post-WRP’ compensatory flows was assumed to be the same as the baseline (1 Ml/d). In this scenario, a reduced concentration is the controlling factor in the load reduction.

Nutrient load from operational washout valve testing

3.3.13 The ‘post-WRP’ washout volume of 4.5m³ from each set of tests (each valve would be tested twice yearly, as set out in ES Chapter 3 Description of the Proposed Development, Volume I (Document reference 6.1, DCO Volume 6)) was doubled for each washout valve calculation in order to ascertain the volume on an annual basis.

3.3.14 Under the operation scenario, washout nutrient concentrations were assumed to be the same as concentrations in worst case releases from the Havant Thicket Reservoir: 3.49 mg/l for TN. A total volume of 468 m³/yr would be captured and tankered to an appropriate treatment works within the Solent catchment, which would be operating to TN permitted limits above the concentration of the washouts. The TN load associated with the biannual testing of the washouts that would be tankered away is 1.63 kg/yr TN (Table 3-12).

Table 3-12 Nutrient loads associated with six-monthly testing washouts

Variable	Volume (m ³ /yr)	Load from washout valves (kg/yr)
TN	468	1.63

Nutrient load from land use

3.3.15 After construction it is assumed that the land returns to the original baseline land use (Table 3-13). The AGPs represent permanent infrastructure and would remain in a low input land use through the operation phase.

Table 3-13 Nutrient load from land use

Management catchment	Operational catchment	Variable	Load (kg/yr)
East Hampshire	East Hampshire Rivers	TN	3,350
South East Trac	Solent	TN	1
Test and Itchen	Itchen	TN	379
		TP	13

3.3.16 The following represent the total nutrient loads calculated for land use changes within the footprint of the Proposed Development during the ‘post-WRP’ scenario:

1. TN nutrient load: 3,730 kg/yr
2. TP nutrient load: 13 kg/yr

Total nutrient load

3.3.17 Total nutrient load in the operational phase is presented in Table 3-14.

Table 3-14 Total nutrient load for the operation scenario

Nutrient source	TN load (kg/yr)	TP load (kg/yr)
Eastney LSO final effluent (30 MI/d FFT scenario)	275,800	N/A
Otterbourne WSW waste stream	446	3.96
HTR compensation flows	2,488	N/A
Washouts	2	N/A
Land use	3,730	13
Total	282,466	16.96

3.4 Changes in nutrient loading

Comparison of nutrient loads

- 3.4.1 Overall, there would be a net reduction in TN load in both the construction and operational phases compared to the current baseline load (Table 3-15). This is due to an overall decrease in final effluent volumes released from Eastney LSO as well as lower nutrient concentrations in the compensation flows to Riders Lane Stream.
- 3.4.2 Similarly, there would also be a reduction in TP load in both the construction and operational phases compared to the current baseline load (Table 3-16). This is due to a load reduction from a change in land use during the construction phase and a reduction in the concentrations in the waste stream at Otterbourne WSW during the operational phase.
- 3.4.3 Potential nutrient reductions from potable supply are not included within the total nutrient loads presented in Table 3-15 and Table 3-16. Due to data limitations, the calculations presented in this assessment only consider the concentration of the source water, rather than the potable supply. The source water would be treated to drinking water standards and distributed across the supply network. This assessment has taken the approach that whilst the concentrations of the source water in the operation and considerably lower than the baseline, the actual nutrient load saving, if any, cannot be calculated. A conservative approach has therefore been taken that there would be no change in nutrient load. As a result, no mitigation is needed for either TN or TP.

Table 3-15 Comparison of TN loads per scenario (kg/yr)

Nutrient source	Load per scenario (kg/yr) and change against baseline scenario				
	Baseline	Construction	Construction phase loading	Operation	Operation phase loading
Eastney LSO final effluent	278,207	278,207	▶ No change	275,800	▼ -2,407
Otterbourne WSW waste stream	4,297	4,297	▶ No change	446	▼ -3,851
HTR compensation flows	4,920	4,920	▶ No change	2,488	▼ -2,432
Washouts	N/A	No load increase	▶ No change	2	▲ +2
Otterbourne WSW potable supply	No load increase	No load increase	▶ No change	No load increase	▶ No change
Land use	3,784	2,951	▼ -833	3,730	▼ -54
Total	291,208	290,375	▼ -833	282,466	▼ -8,742

Table 3-16 Comparison of TP loads per scenario (kg/yr)

Nutrient source	Load per scenario (kg/yr) and change against baseline scenario				
	Baseline	Construction	Construction phase loading	Operation	Operation phase loading
Otterbourne WSW waste stream	10.23	10.23	▶ No change	3.96	▼ -6.27
Land use	13	9.39	▼ -3.61	13	▶ No change
Total	23.23	19.62	▼ -3.61	16.96	▼ -6.26

3.5 Alternative reservoir fill scenarios

- 3.5.1 As described in section 2.1, nutrient loads have been calculated for three scenarios; baseline, construction, and operation. These scenarios were informed by the outputs of water quality modelling undertaken for Havant Thicket Reservoir (ES Appendix 19.11 Havant Thicket Reservoir water quality modelling, Volume II (Document reference 6.2, DCO Volume 6)) and compensatory flows from the reservoir (ES Appendix 19.6 Havant Thicket Reservoir Compensatory Flows water quality modelling, Volume II (Document reference 6.2, DCO Volume 6)). The water quality modelling compared baseline water quality with predicted water quality in two operational scenarios; the 'classic' operation scenario, which represents the period of reservoir operation prior to introduction of recycled water from the WRP, and the 'post-WRP' operation scenario, which represents the period of reservoir operation following introduction of recycled water from the WRP.
- 3.5.2 However, it is possible that changes to the reservoir construction programme could result in alternative scenarios for the filling and operation of the reservoir. For example, recycled water could be introduced to the reservoir before the initial post-fill stabilisation⁸ described in ES Appendix 19.11 Havant Thicket Reservoir water quality modelling, Volume II, (Document Reference 6.2, Volume 6).
- 3.5.3 In order to evaluate whether changes to the reservoir fill scenarios could affect water quality, statistical analysis (including a Wilcoxon signed-rank test⁹ and a Cohen's d¹⁰ test) was used to compare model outputs and determine whether there were any significant differences. The findings of this analysis are reported in full in ES Chapter 19 Water environment, Volume I (Document reference 6.1, DCO Volume 6). The statistical analysis demonstrated that changes to reservoir fill scenarios would result in very small differences in the predicted concentrations of nutrients in water in Havant Thicket Reservoirs and downstream water bodies that would receive compensatory flows.
- 3.5.4 While the timing of source water inputs might change, the quality of the recycled water, spring water and inputs from the hydrological catchment would remain constant. Consequently, reservoir water quality would align with the 'post-WRP' phase of the original operational scenario once the reservoir has stabilised. This means that alternative reservoir fill scenarios are not considered to result in changes to nutrient loads.

⁸ Defined as the initial few years after initial inundation when terrestrial biomass is decomposed or mineralised, resulting in much higher fluxes of organic and inorganic matter than is observed once the reservoir has stabilised.

⁹ Wilcoxon signed-rank test: a non-parametric statistical procedure used to determine if the median difference between paired samples is significantly different from zero, i.e. tests if one group is significantly higher or lower than the other.

¹⁰ Cohen's d test: a statistical test to quantify the size of effect when comparing two groups of data.

4 Summary

- 4.1.1 This report assesses the potential changes in nutrient loading associated with the construction and operation of the Hampshire Water Transfer and Water Recycling Project within the Solent and River Itchen catchments. Nutrient calculations have been undertaken for three scenarios: baseline, construction, and operation.
- 4.1.2 Following Dutch Nitrogen Joint Cases ruling requirements, under baseline conditions, the TN load was calculated at 291,208 kg/year and TP at 23.23 kg/year, with most of the nitrogen attributed to final effluent releases from Eastney Long Sea Outfall.
- 4.1.3 During the construction phase, nutrient loads remained broadly consistent with baseline levels for TN (290,375 kg/year), while TP decreased to 19.62 kg/year due to temporary land use changes along part of the pipeline. Pipeline commissioning releases from washouts were not considered to increase nutrient loading, as they would be tankered to treatment works within the Solent catchment, rather than within the Itchen catchment. This means that neither TN or TP loads would increase during the construction phase, and on this basis no mitigation is required.
- 4.1.4 In the operational phase, the total TN load was reduced to 282,466 kg/year, representing a net decrease of 8,742 kg/year compared to baseline. This reduction is primarily due to lower final effluent volumes released via Eastney LSO and reduced nutrient concentrations in compensation flows to Riders Lane Stream. Similarly, the total TP load in the operational phase was reduced to 16.96 kg/yr, representing a net decrease of 6.27 kg/yr. This means that neither TN or TP loads would increase during the operation phase, and on this basis no mitigation is required.
- 4.1.5 As such, no mitigation is needed for either TN or TP during the construction and operation phases of the Proposed Development. The Proposed Development would therefore considered to be nutrient neutral.

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Annex A Mass balance calculations for Budds Farm WTW and the WRP

A.1 Mass balance calculations: 60 MI/d

Parameter	Unit	Budds Farm Final Effluent			Recycled Water (to Havant Thicket Reservoir)			Non-Chemical Waste Release (to Eastney LSO)			Total Chemical Waste Release (to Foul)			Final Effluent after WRP take off			Combined Release		
		Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Daily flow	MI/d	81.56	81.56	81.55	60.00	60.00	60.00	21.42	21.42	21.42	0.16	0.16	0.16	5.57	5.57	5.57	26.98	26.98	26.98
Total Nitrogen	mg/l as N	0.76	6.39	11.10	0.04	0.33	1.07	3.13	23.73	39.65	0.73	6.40	11.15	0.76	6.39	11.10	2.64	20.16	33.77
	kg/d	61.82	520.90	905.42	2.22	19.57	63.93	67.02	508.42	849.37	0.12	1.00	1.74	4.22	35.55	61.79	71.24	543.97	911.15
Total Phosphorus	mg/l as P	0.76	2.97	4.97	0.01	0.04	0.13	5.18	13.69	21.49	0.73	2.97	4.98	0.76	2.97	4.97	4.27	11.48	18.09
	kg/d	61.82	242.33	405.32	0.80	2.40	7.99	111.05	293.23	460.44	0.12	0.46	0.78	4.22	16.54	27.66	115.27	309.76	488.10

A.2 Mass balance calculations: 30 MI/d FFT

Parameter	Unit	Budds Farm Final Effluent			Recycled Water (to Havant Thicket Reservoir)			Non-Chemical Waste Release (to Eastney LSO)			Total Chemical Waste Release (to Foul)			Final Effluent after WRP take off			Combined Release		
		Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Daily flow	MI/d	41.01	41.01	41.01	29.95	29.95	29.95	10.94	10.935	10.94	0.10	0.10	0.10	78.21	78.21	78.21	89.15	89.15	89.15
Total Nitrogen	mg/l as N	0.76	6.39	11.10	0.04	0.33	1.07	3.08	23.37	39.06	0.69	5.85	10.20	0.76	6.39	11.10	1.04	8.47	14.53
	kg/d	31.08	261.91	455.24	1.11	9.77	31.92	33.68	255.61	427.14	0.07	0.57	1.00	59.28	499.55	868.33	92.96	755.16	1,295.46
Total Phosphorus	mg/l as P	0.76	2.97	4.97	0.01	0.04	0.13	5.09	13.47	21.15	0.69	2.71	4.54	0.76	2.97	4.97	1.29	4.26	6.95
	kg/d	31.08	121.84	203.80	0.40	1.20	3.99	55.69	147.26	231.31	0.07	0.27	0.44	59.29	232.40	388.72	114.97	379.66	620.03

A.3 Mass balance calculations: 30 MI/d DWF

Parameter	Unit	Budds Farm Final Effluent			Recycled Water (to Havant Thicket Reservoir)			Non-Chemical Waste Release (to Eastney LSO)			Total Chemical Waste Release (to Foul)			Final Effluent after WRP take off			Combined Release		
		Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Daily flow	MI/d	41.01	41.01	41.01	29.95	29.95	29.95	10.94	10.935	10.94	0.10	0.10	0.10	46.11	46.11	46.12	57.05	57.05	57.05
Total Nitrogen	mg/l as N	0.76	6.39	11.10	0.04	0.33	1.07	3.08	23.37	39.06	0.69	5.85	10.20	0.76	6.39	11.10	1.20	9.64	16.46
	kg/d	31.08	261.91	455.24	1.11	9.77	31.92	33.68	255.61	427.14	0.07	0.57	1.00	34.95	294.54	511.98	68.63	550.15	939.11
Total Phosphorus	mg/l as P	0.76	2.97	4.97	0.01	0.04	0.13	5.09	13.47	21.15	0.69	2.71	4.54	0.76	2.97	4.97	1.59	4.98	8.07
	kg/d	31.08	121.84	203.80	0.40	1.20	3.99	55.69	147.26	231.31	0.07	0.27	0.44	34.95	137.02	229.19	90.64	284.28	460.50

Annex B Source water quality at Otterbourne WSW

B.1 Surface source water quality (2015 – August 2025)

Parameter	Units	5%ile	Mean	95%ile
Algae (total count)	number/ml	58.00	617.27	2108
Alkalinity	mg/l as CaCO ₃	227.56	247.35	266
Aluminium	µg/l	7.77	29.37	76.45
Ammonia	mg/l as NH ₄	0.01	0.02	0.03
Bromide	µg/l	45.60	54.32	60.67
Calcium	mg/l as Ca	110.90	118.50	126.10
Carbon (total organic)	mg/l	1.00	1.42	2.20
Chloride	mg/l	20.60	21.86	23.39
Colour liquid filtered	mg/l Pt/Co	2.40	4.01	7.83
Conductivity	µS/cm	503.00	539.98	574.00
Fluoride	mg/l	0.06	0.07	0.09
Iron	µg/l	9.87	53.37	149.2
Magnesium	mg/l	1.83	1.94	2.12
Manganese	µg/l	1.06	4.90	13.70
Nitrate	mgNO ₃ /l	29.2	3348	37.60
Nitrite	mgNO ₂ /l	0.02	0.04	0.06
pH	pH units	7.84	8.03	8.18
Phosphate (ortho)	mg/l as P	0.04	0.07	0.09
Potassium	mg/l	1.39	1.60	1.96
Sodium	mg/l	9.70	10.52	11.60
Solids (suspended at 105 °C)	mg/l	1.40	7.52	22.76
Sulphate	mg/l	13.30	14.34	15.60
Temperature	°C	7.50	12.08	16.50
Transmittance	%	86.98	93.16	95.50
Turbidity	NTU	0.52	4.98	16.46

B.2 Source water quality for the combined boreholes (2015 – August 2025)

Parameter	Units	5%ile	Mean	95%ile
Algae (total count)	number/ml	N/A	N/A	N/A
Alkalinity	mg/l as CaCO ₃	230.08	244.51	261.05
Aluminium	µg/l	0.9	5.39	14.40
Ammonia	mg/l as NH ₄	0.00	0.01	0.02
Bromide	µg/l	56.00	62.36	67.90
Calcium	mg/l as Ca	108.00	112.46	116.00
Carbon (total organic)	mg/l	0.50	0.66	0.83
Chloride	mg/l	18.72	19.29	20.09
Colour liquid filtered	mg/l Pt/Co	0.60	1.41	2.80
Conductivity	µS/cm	497	528.67	555
Fluoride	mg/l	0.07	0.09	0.13
Iron	µg/l	0.70	3.46	7.28
Magnesium	mg/l	1.91	2.05	2.49

Parameter	Units	5%ile	Mean	95%ile
Manganese	µg/l	0.14	0.81	2.60
Nitrate	mgNO ₃ /l	27.67	31.15	33.54
Nitrite	mgNO ₂ /l	N/A	N/A	N/A
pH	pH units	7.09	7.24	7.34
Phosphate (ortho)	mg/l as P	N/A	N/A	N/A
Potassium	mg/l	1.09	1.22	1.31
Sodium	mg/l	9.26	9.72	10.49
Solids (suspended at 105 °C)	mg/l	N/A	N/A	N/A
Sulphate	mg/l	10.93	11.66	12.44
Temperature	°C	10.80	11.54	12.67
Transmittance	%	97.50	97.94	98.40
Turbidity	NTU	0.05	0.15	0.35

B.3 Source water quality for the wells (2014 – June 2025)

Parameter	Units	5%ile	Mean	95%ile
Algae (total count)	number/ml	N/A	N/A	N/A
Alkalinity	mg/l as CaCO ₃	243.42	266.54	284.38
Aluminium	µg/l	3.42	14.42	35.30
Ammonia	mg/l as NH ₄	0.00	0.01	0.01
Bromide	µg/l	58.40	65.99	76.15
Calcium	mg/l as Ca	117.55	124.67	133.0
Carbon (total organic)	mg/l	0.60	0.74	0.97
Chloride	mg/l	21.72	23.49	25.66
Colour liquid filtered	mg/l Pt/Co	0.60	2.40	3.00
Conductivity	µS/cm	542.00	580.20	620.00
Fluoride	mg/l	0.08	0.09	0.12
Iron	µg/l	0.70	9.46	34.25
Magnesium	mg/l	2.20	2.42	2.57
Manganese	µg/l	0.22	0.77	2.60
Nitrate	mgNO ₃ /l	28.60	31.07	33.60
Nitrite	mgNO ₂ /l	N/A	N/A	N/A
pH	pH units	7.04	7.20	7.33
Phosphate (ortho)	mg/l as P	0.05	0.06	0.08
Potassium	mg/l	1.23	1.38	1.48
Sodium	mg/l	10.56	11.51	12.77
Solids (suspended at 105 °C)	mg/l	N/A	N/A	N/A
Sulphate	mg/l	13.10	14.75	17.10
Temperature	°C	10.88	11.64	12.50
Transmittance	%	96.20	97.21	98.05
Turbidity	NTU	0.08	0.23	0.61



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