University of Kent Sites BCD Nutrient Neutrality Assessment

DATE:	16 October 2025	**CONFIDENTIALITY:**	Confidential
SUBJECT:	University of Kent Canterbury Disposal Sites BCD: Nutrient Neutrality Assessment		
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INTRODUCTION

The University of Kent (UoK) has identified the potential to promote 92.1 hectares of land for a housing led development of 2,000 homes on land to the north of their existing University Campus in Canterbury. The land, referred to as Sites BCD, is being promoted through the Canterbury City Council (CCC) Local Plan process.

This Technical Note has been prepared as part of ongoing discussions regarding the promotion of Sites BCD in the Local Plan, to outline the proposed strategy for addressing nutrient neutrality.

The requirement to demonstrate nutrient neutrality has arisen following a November 2018 European Court of Justice decision regarding the Habitats Directive. This resulted in Natural England (NE) requiring all new developments that could increase nutrient loads in catchments affecting Special Protection Areas (SPAs), Special Areas of Conservation (SACs) and Ramsar sites that are deteriorating because of nutrients, to demonstrate nutrient neutrality.

The local planning authority (LPA) for the development, CCC, must be satisfied that the new development can achieve both phosphorus and nitrogen neutrality before consenting the project.

The nutrient neutrality assessment detailed below establishes that the proposed development can achieve both nitrogen and phosphorus neutrality.

SITE LOCATION

The proposed allocation site is shown in Figure 1, with the University's land holdings shown in Figure 2. The CCC wastewater treatment works (WWTW) sewerage network map[1] (Figure 3) shows that the development site is located adjacent to the sewerage catchment for Canterbury WWTW, while Figure 1 demonstrates that the site is physically located in the Sarre Penn river catchment, which is a tributary of the Great Stour.

The Stodmarsh Lakes are designated as an SPA, SAC, Ramsar site and a Site of Special Scientific Interest (SSSI). The lakes are at risk of deterioration caused by eutrophication from elevated nitrogen and phosphorus levels in the River Stour. The proposed development must therefore be nutrient neutral to avoid any nutrient impacts to the lakes.

Additional University land holdings, including land parcel F, could be converted from agricultural use into a permanent low nutrient land use (conservation meadow or woodland) as part of the nutrient mitigation strategy for the development. Land parcel E has been excluded from consideration due to the presence of a Scheduled Ancient Monument across much of the Site whilst the access road corridor within the University Campus is also excluded from the calculations used in this assessment.

[1] https://canterburycc.maps.arcgis.com/apps/webappviewer/index.html?id=86372bea6bf746ff9ba0ab0da0f2a52c

Figure 1 Site Location

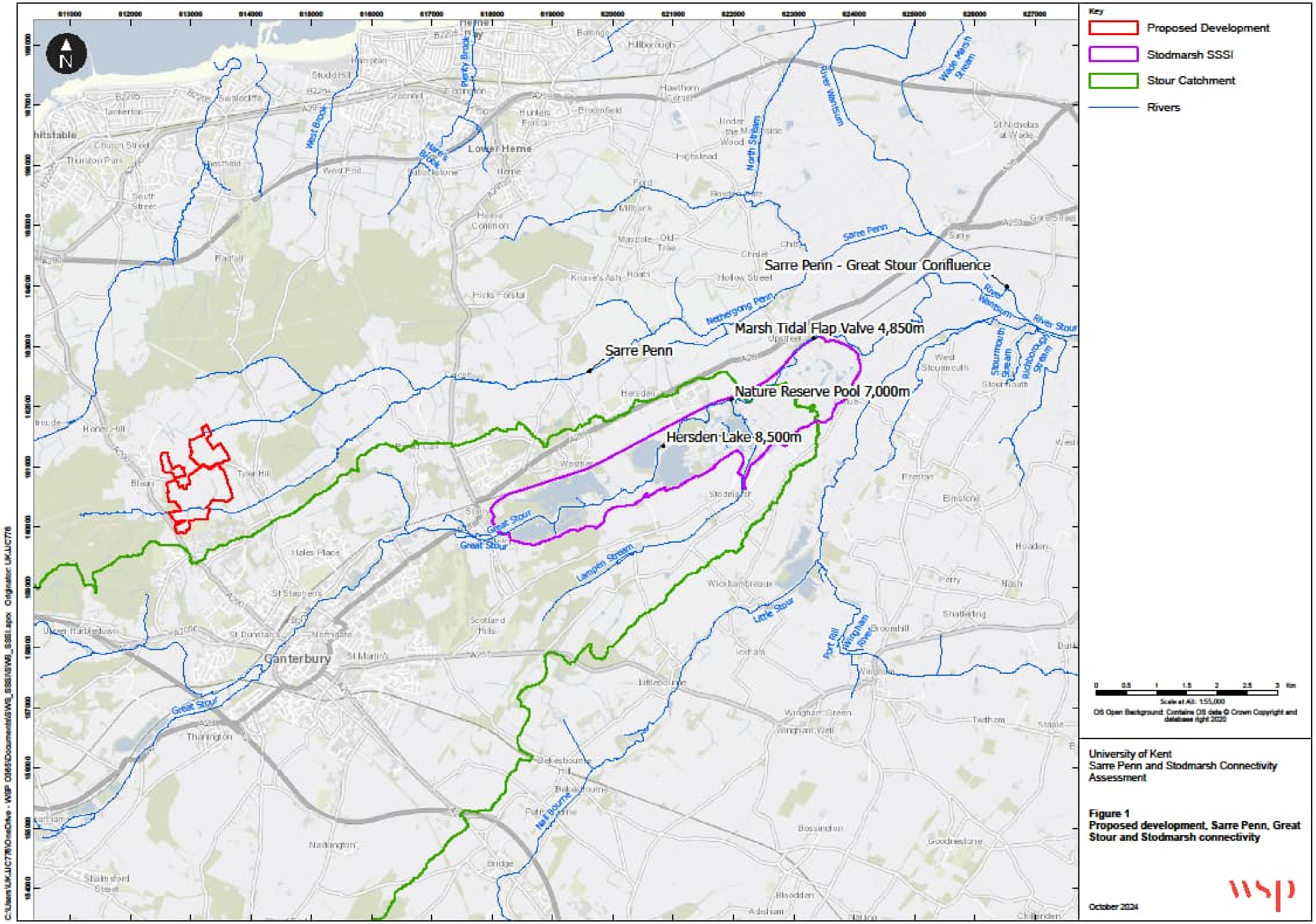


Figure 2 Development Land Parcels

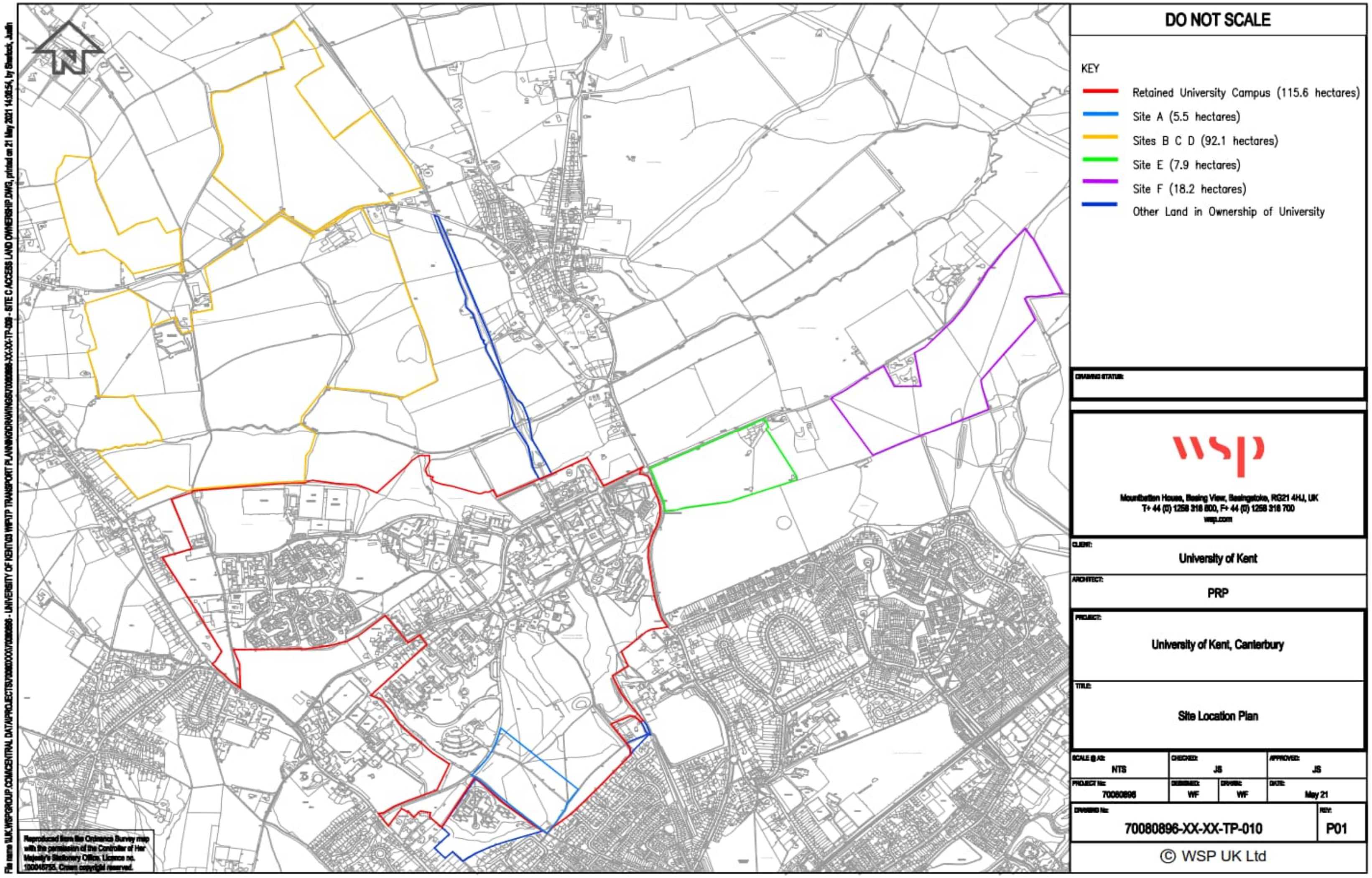
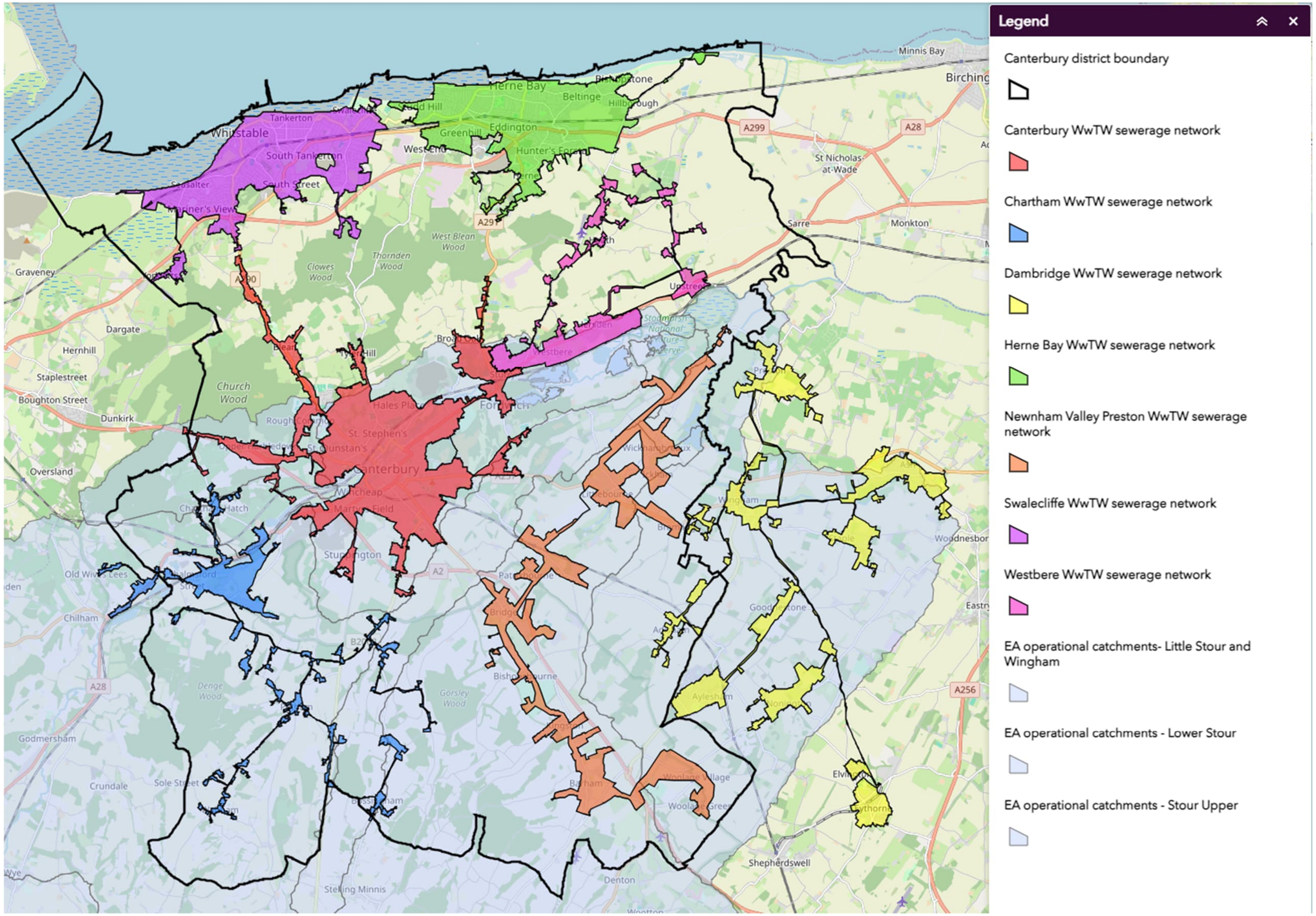


Figure 3 CCC Wastewater Treatment Works Sewerage Network Map



WASTEWATER TREATMENT WORKS

Based on the WWTW catchment mapping, the proposed development would discharge foul flows to Southern Water's Canterbury WWTW.

The Levelling Up and Regeneration Act 2023 (LURA) imposes a statutory requirement on water companies to upgrade large WWTWs (defined as having a population equivalent >2,000) to consent limits of 0.25mg/l for TP and 10mg/l for TN. Canterbury WWTW must be upgraded to achieve these consent limits prior to 1 April 2030.

NE's nutrient load calculation method requires that the wastewater nutrient load must be calculated based on the relevant WWTW discharging at 90% of its consent limit. Values of 0.225mgTP/l and 9.0mgTN/l have therefore been used to calculate the wastewater nutrient loads generated by the proposed development.

ON-SITE WWTW

An alternative to Canterbury WWTW would be to treat foul flows through an on-site WWTW. Such a system could achieve discharge consent limits as low as 0.10mg/l for TP and 5mg/l for TN.

An on-site WWTW would be operated by a company approved by Ofwat under the New Appointments and Variations (NAV) process[2]. Severn Trent Connect[3] and other companies can fulfil the NAV role, which would include designing, permitting, building and operating & maintaining the works in perpetuity (defined as the 80 – 125 year design life of the development).

An indicative capital cost for a system serving 1,800 homes is £6.1M[4]. This includes feasibility studies, environmental assessment, planning, design and construction, but excludes costs for a discharge pipeline.

Operating and maintenance costs would be recovered through the standard sewerage charges levied on each property and would provide financial sustainability, in perpetuity.

As the proposed development is located in the Sarre Penn sub-catchment, any on-site WWTW would likely discharge to the Sarre Penn. The *Sarre Penn and Stodmarsh Connectivity Assessment* (WSP, 2024) concluded that '*the discharge into the Sarre Penn of high-quality treated effluent from an on-site WWTW serving the proposed development would not have an adverse impact on the Stodmarsh site.*' This conclusion was based on the limited hydrological connectivity between the Sarre Penn and the Stodmarsh site. Subject to agreement with the regulators, the use of an on-site WWTW would therefore be likely to avoid any nutrient impact to the Stodmarsh site – delivering nutrient neutrality for the proposed development without requiring additional mitigation.

INPUT DATA FOR NUTRIENT LOAD CALCULATIONS

The nutrient load calculations have been based on NE's latest nutrient load calculator issued in February 2024[5]. This method requires the use of site-specific input data for the river catchment, rainfall, soil drainage type and the presence (or absence) of a Nitrate Vulnerable Zone (NVZ). These are used by the calculator to derive site-specific nutrient export rates for the existing and proposed land uses.

The existing land use area has been based on the total area of land parcels B, C & D (92.1 ha) and the existing classification as arable / cereal has been taken from paragraph 2.1 of the Agricultural Land Classification and Soil Resources Report (Reading Agricultural Consultants April 2021).

The areas of each future non-urban land use in parcels B, C and D have been based on the Landscape and Green Infrastructure Design Strategy. The residential urban land use area has been assumed as the balance of the 92.1 ha area of land parcels B, C & D. The land use areas are presented in **Table 1**.

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[2] https://www.ofwat.gov.uk/regulated-companies/markets/nav-market/
[3] https://www.st-connect.co.uk/
[4] Capital cost of £5.25M quoted in November 2022 and increased by the Bank of England CPI inflation calculator to August 2025 prices.
[5] Nutrient_Calculator_Stodmarsh_SAC_and_Ramsar_V_03_01_5

Table 1 – Current and Future Land Use Areas (Ha) for the Development (Land Parcels B, C and D)

Land Use	Current (ha)	Future (ha)
Arable / Cereal	92.1	0.00
Residential Urban Land	0.00	49.10
Greenspace	0.00	41.20
Community Food Growing (Allotments)	0.00	1.80
Total Site Area (Ha)	**92.10**	**92.10**

Additional input data include the:

- Number of residential units proposed for the development: 2,000.
- Number of residents per residential unit: 2.4.
- Volume of wastewater generated: 120 litres per person per day.
- Application of sustainable drainage system (SuDS) nutrient removal efficiency estimated at 48.2% for TP and 30% for TN in accordance with CIRIA C808[6] and C815[7]. This assumes the SuDS consist of lined dry grassed swales conveying surface water to lined wet ponds for treatment, prior to discharging to a watercourse. These values have been applied to the surface water nutrient load components and have been deducted from the final development nutrient loads.

All input values and their derivation are detailed in the nutrient load calculations in **Appendix A**.

NITROGEN & PHOSPHORUS LOAD CALCULATIONS

Nutrient load calculations have been undertaken for two foul flow treatment strategies:

1. All occupations and foul flow discharges to Canterbury WWTW commencing after 1 April 2030 (Canterbury WWTW).
2. All occupations and foul flow discharges to an on-site WWTW (On-site WWTW).

Each foul flow strategy has been tested twice, taking into account:

- The use of NE's default percentage impermeable area (PIMP[8]) values of 80% for TP and 100% for TN (Default PIMP).
- The use of a site-specific PIMP value of 49.5% for the future urban residential land use, which significantly reduces the TP export rate for this land use and reduces the overall nutrient loads from the development (Site-Specific PIMP).

A summary of the load calculations is provided in Tables 2 – 5 with a comparison of the nutrient loads in Table 6. The full calculations are presented in **Appendix A**.

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[6] https://www.ciria.org/ItemDetail?iProductCode=C808F&Category=FREEPUBS
[7] https://www.ciria.org/ItemDetail?iProductCode=C815F&Category=FREEPUBS
[8] PIMP is a measure of the percentage of a land use class area that is impermeable (e.g.roofs, roads, driveways, footpaths, etc) and which will generate higher runoff rates than permeable areas such as gardens and landscaped areas.

Table 2 – Nitrogen and Phosphorus Loads – Canterbury WWTW Default PIMP

Load Element	TP Load (kg/year)	TN Load (kg/year)
Wastewater load (A)	47.34	1893.46
Future land use load (B)	68.14	787.35
Existing land use load (C)	29.31	1691.50
SuDS Nutrient Removal (D)	32.42	188.38
Future nutrient load (= A + (B – C - D))	53.74	800.93
Precautionary buffer (20%)	10.75	160.19
Future nutrient load	**64.49**	**961.11**

Table 3 – Nitrogen and Phosphorus Loads – Canterbury WWTW Site-Specific PIMP

Load Element	TP Load (kg/year)	TN Load (kg/year)
Wastewater load (A)	47.34	1893.46
Future land use load (B)	33.27	787.35
Existing land use load (C)	29.31	1691.50
SuDS Nutrient Removal (D)	15.61	188.38
Future nutrient load (= A + (B – C - D))	35.68	800.93
Precautionary buffer (20%)	7.14	160.19
Future nutrient load	**42.82**	**961.11**

Table 4 –Nitrogen and Phosphorus Loads – On-Site WWTW Default PIMP

Load Element	TP Load (kg/year)	TN Load (kg/year)
Wastewater load (A)	18.93	1363.29
Future land use load (B)	68.14	787.35
Existing land use load (C)	29.31	1691.50
SuDS Nutrient Removal (D)	32.42	188.38
Future nutrient load (= A + (B – C - D))	25.34	270.76
Precautionary buffer (20%)	5.07	54.15
Future nutrient load	**30.41**	**324.91**

Table 5 –Nitrogen and Phosphorus Loads – On-Site WWTW Site-Specific PIMP

Load Element	TP Load (kg/year)	TN Load (kg/year)
Wastewater load (A)	18.93	1363.29
Future land use load (B)	33.27	787.35
Existing land use load (C)	29.31	1691.50
SuDS Nutrient Removal (D)	15.61	188.38
Future nutrient load (= A + (B – C - D))	7.28	270.76
Precautionary buffer (20%)	1.46	54.15
Future nutrient load	**8.73**	**324.91**

Table 6 – Comparison of Nitrogen & Phosphorus Loads for the Four Options

WWTW Strategy & PIMP Option	TP Load (kg/year)	TN Load (kg/year)
Canterbury WWTW Default PIMP	64.49	961.11
Canterbury WWTW Site-Specific PIMP	42.82	961.11
On-site WWTW Default PIMP	30.41	324.91
On-site WWTW Site-Specific PIMP	8.73	324.91

The calculations confirm that:

- Foul flow treatment through Canterbury WWTW post-2030 would generate TN loads of 961.11kg/year and between 42.82kg/year and 64.49kg/year for TP depending on the selected PIMP value (which would need to be agreed with NE). These loads would need to be mitigated for the development to achieve nutrient neutrality.
- Foul flow treatment through an on-site WWTW would generate TN loads of 324.91kg/year and TP loads of between 8.73kg/year and 30.41kg/year depending on the selected and agreed PIMP value. However, should NE agree that the Sarre Penn lacks hydrological connectivity with the Stodmarsh site, these loads would not affect the site, in which case the proposed development would be nutrient neutral.
- Agreeing a site-specific PIMP value with Natural England would reduce the TP load from each paired scenario by 21.7kg/year.

MITIGATION OPTIONS

Potential mitigation options are outlined below.

Agricultural Land Conversion – Land Parcel F

Land parcel F may be available for conversion to a low nutrient land use such as woodland or conservation meadow. This would partially mitigate the nutrient loads that would be generated from the proposed development. Using Google imagery and GIS we have estimated that land parcel F consists of, approximately:

- 13.5 ha of lowland grazing.

- 4.7 ha of arable / cereal.

As detailed in the calculations provided in Appendix A, if converted to a low nutrient land use, land parcel F could provide:

- Phosphorus mitigation of 8.16 kg/year.
- Nitrogen mitigation of 145.23 kg/year.

This would not be sufficient to deliver nutrient neutrality for any of the scenarios. However, it could provide partial mitigation and would reduce reliance on other mitigation approaches.

Agricultural Land Conversion – Other Land

The residual nutrient loads requiring additional mitigation, after deducting the mitigation from land parcel F, are detailed in Table 7. This table also presents the area of additional cereal land conversion that would be required to mitigate the remaining TP loads (which are much more difficult to mitigate than the TN load). The areas have been based on a typical cereal TP export rate of 0.32kg/ha/year, from which is deducted the low nutrient land use TP export rate (0.02kg/ha/year) to derive a beneficial export rate reduction of 0.30kg/ha/year. The residual TP loads for each scenario have been divided by 0.30kg/ha/year to calculate the area of arable land required to be converted to mitigate each scenario[9].

Table 7 – Areas of Arable Land Conversion required to Mitigate the Three WWTW Scenarios

WWTW Scenario	TP Load (kg/year)	TN Load (kg/year)	Area of Cereal Conversion to Mitigate Residual TP Load (ha)
Canterbury WWTW Default PIMP	56.33	815.88	188
Canterbury WWTW Site-Specific PIMP	34.66	815.88	116
On-site WWTW Default PIMP	22.25	179.68	75
On-site WWTW Site-Specific PIMP	0.57	179.68	11*

Notes: * see footnote No 9.

At a typical cost of approximately £27,000/ha of arable land[10], the mitigation of residual nutrient loads by converting cereal land to a low nutrient land use would have a land purchase cost of £3.2M – £5.1M for the Canterbury WWTW options, and £0.3M – £2.1M for the on-site WWTW options (if they require mitigation). However, if the University already owns such land, it would not incur a land purchase cost but instead a potential loss of farm tenancy income. In both case, significant additional costs would be incurred for the low nutrient land use creation process and in-perpetuity management.

Nutrient Mitigation Credits

Stour Environmental Credits (SEC) is a non-profit local government run company that is developing nutrient mitigation schemes in the Stodmarsh catchment. Mitigation credit pricing is not yet known. However, SEC is based on the Norfolk Environmental Credits (NEC) model and will be generating credits in the same manner. NEC is selling phosphorus credits for £59,500 per kilogram of phosphorus. It is likely that SEC credits will be priced similarly or even slightly higher. It is also likely that phosphorus credits will include an allocation of nitrogen mitigation and so the purchase of additional nitrogen credits is unlikely to be necessary.

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[9] The converted area required to mitigate the TN load is 48ha for the Canterbury WWTW options and 11ha for the on-site WWTW options and so all land conversion areas detailed in the table, other than for the on-site WWTW site-specific PIMP option, would also mitigate nitrogen. The 11ha required for the on-site WWTW PIMP option is based on the area needed to mitigate the TN load and would also mitigate the TP load (which would itself require only 2ha.

[10] https://rural.struttandparker.com/article/english-estates-farmland-market-review-summer-2024/ One hectare is 2.47 acres.

As the number of mitigation credits will be limited by seed funding and revenue turnover, and demand is likely to significantly exceed supply (at least initially), SEC will allocate credits based on the relevant LPA's prioritisation of planning allocations and applications in their district.

Based on a credit price of £59,500 per kilogram of TP, the estimated cost of mitigating the full nutrient loads (refer Table 6) through the purchase of mitigation credits[11] is:

- Canterbury WWTW Default PIMP: £3.84M.
- Canterbury WWTW Site-Specific PIMP: £2.55M.
- On-site WWTW Default PIMP: £6.1M capital cost of the WWTW plus £1.81M mitigation credits[12].
- On-site WWTW Site-Specific PIMP: £6.1M capital cost of the WWTW plus £0.34M mitigation credits[13].

Using a site-specific PIMP value could reduce the mitigation cost for each paired scenario by approximately £1.29M – £1.5M.

The cost of mitigating either of the Canterbury WWTW options is lower than the estimated capital cost of constructing an on-site WWTW (plus additional mitigation credits if required).

CONCLUSIONS

The nutrient loads for two foul flow treatment strategies (Canterbury WWTW and On-Site WWTW) have been calculated for two scenarios (Default PIMP and Site-Specific PIMP).

The use of an on-site WWTW would incur a capital cost estimated at £6.1M, excluding the potentially significant cost of constructing a discharge pipeline to the Sarre Penn. This approach may deliver nutrient neutrality without further mitigation, subject to NE agreeing that the Sarre Penn is hydrologically disconnected from the Stodmarsh sites. If NE does not agree, then additional mitigation would be required – through agricultural land conversion or the purchase of mitigation credits from SEC.

The use of Canterbury WWTW would generate larger nutrient loads than an on-site WWTW. This would increase the cost of mitigation through agricultural land conversion or the purchase of mitigation credits from SEC. However, these options would not incur the capital cost of an on-site WWTW and so would be considerably more cost effective than either of the on-site WWTW options.

Given that Canterbury WWTW will be upgraded by 1 April 2030, new homes from the development would not be occupied until after that date, and mitigation credits are now becoming available in the Stodmarsh catchment, it is considered that the use of Canterbury WWTW is now likely to be the preferred option. To reduce mitigation costs as far as practicable, a site-specific PIMP value should be agreed with Natural England.

Based upon the strategies identified and options presented above the proposed development can achieve nutrient neutrality.

[11] If land parcel F mitigation is deducted from the full nutrient load, the credit cost to mitigate the residual nutrient loads (refer Table 7) would reduce to, respectively, £3.35M, £2.06M, £6.1M capital cost of the WWTW plus £1.33M mitigation credits, and £6.1M capital cost of the WWTW plus <£0.1M mitigation credits.

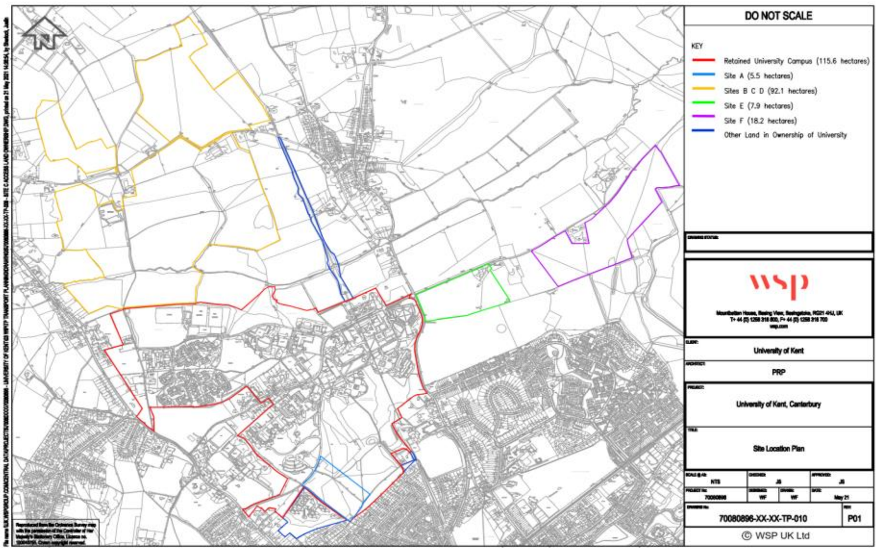
[12] If Natural England accepts that the Sarre Penn is hydrologically disconnected from the Stodmarsh site, there would be no requirement to purchase mitigation credits.

[13] If Natural England accepts that the Sarre Penn is hydrologically disconnected from the Stodmarsh site, there would be no requirement to purchase mitigation credits.

APPENDIX A – NUTRIENT LOAD CALCULATIONS

Existing Landuse Areas

Parcel	Area (ha)	Existing Landuse	Future Landuse
A	5.5	Amenity Grassland and Woodland	Amenity Grassland and Woodland
B, C & D	92.1	Arable	Proposed Development Site
E	7.9	Arable	University Sports Pitches - Open Urban
F	4.7	Arable / Cereal	Potential Phosphorus Mitigation Area
	13.5	Lowland Grazing	Potential Phosphorus Mitigation Area
Total	123.7		



2 Site and climatic conditions

General features, land form and drainage

2.1 The areas surveyed collectively extend to around 123.5ha of agricultural land primarily in arable use. Area A is under permanent grass and is cut for hay annually.

READING AGRICULTURAL CONSULTANTS

April 2021

WSP UK Limited
Agricultural Land Classification and Soil Resources

at

University of Kent, Canterbury Campus

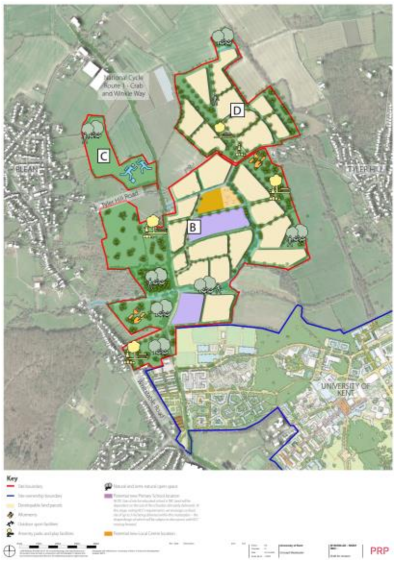
Beechwood Court,
Long Toll, Woodcote,
RG8 0RR

01491 684 233
www.reading-ag.com

Future Landuse

Landuse	Landuse Classification	Area (ha)
Urban	Residential Urban Land	49.10
Sports Pitches	Greenspace	4.10
Parks and Garden	Greenspace	3.90
Amenity Green Spaces and Green Corridors	Greenspace	12.80
Natural and Semi Natural Open Space	Greenspace	19.00
Play	Greenspace	1.40
Allotments	Community Food Growing	1.80
Total Area		92.10

Totals	Residential Urban Land	49.10
	Greenspace	41.20
	Community Food Growing	1.80
	Total	92.10



Landscape and Green Infrastructure Design Strategy

The green and blue network created responds to the varied and rich context, including Blean Woods to the West and Daw's Wood to the east. Green and blue corridors already run across the site, with Sarre Penn, National Cycle Route 1 and the Crab and Winkle railway all providing linear habitats.

Key landscape considerations include:

1. A comprehensive drainage network spread across the site's open spaces, with ample capacity to not overwhelm the Sarre Penn stream and its habitats.
2. Provision of new varied open spaces to achieve the 20% BNG target of policy DS21.
3. Retain and enhance denser areas of planting, alongside a new area of woodland to mitigate the impact on the Ancient Woodland.
4. The majority of the open space is provided to the west, including new sports pitches in close proximity to Blean. More natural open spaces can be found to the south west, closer to Blean Woods SAC.
5. Green corridors through the site are to be enhanced and further connected, allowing for enhanced pedestrian and cycle access to both the surrounding villages and Canterbury city centre.
6. By using hedgerows to dictate open space locations, the field pattern has largely been retained.
7. Providing varied open space types, to ensure feasible access to nature and leisure for all residents.
8. Compensatory woodland to mitigate for the small amount of Ancient Woodland removed to facilitate the spine road. Depending on access requirements, the woodland can be designated as 'semi natural and natural open space'.

Open space provision

Type	Draft LP requirement (ha)	Provided (ha)
Semi natural and natural open space	18.7	19.0
Parks and gardens	3.7	3.9
Amenity green spaces and green corridors*	10.5	12.8
LAP and LEAP	1.2	1.2
NEAP / destination play	1.4	1.4
Outdoor sports pitches	4.1	4.1
Allotments	1.8	1.8

*Includes green routes between parcels with access roads.

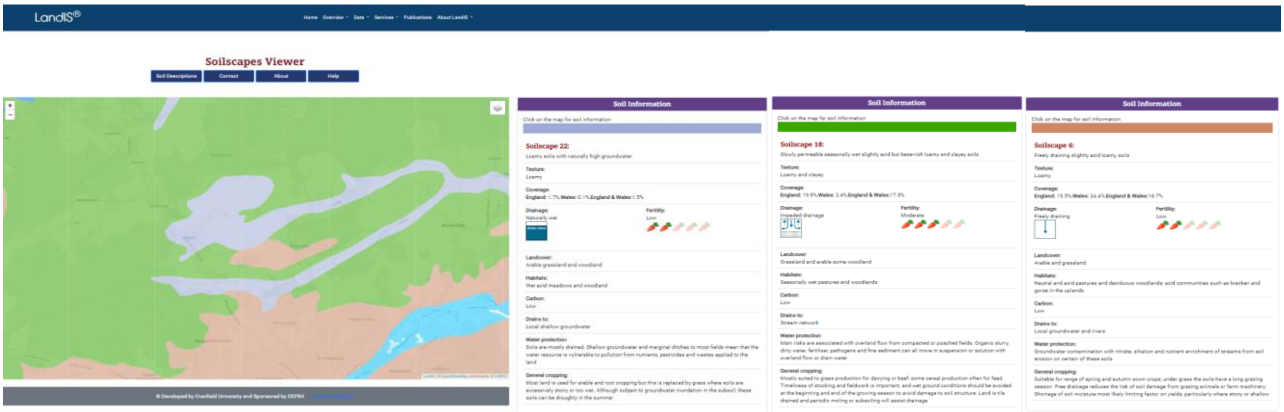
Landscape and green infrastructure design strategy

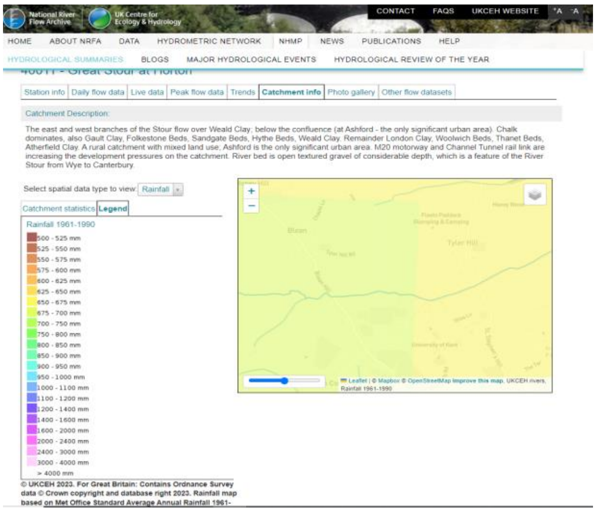
Key

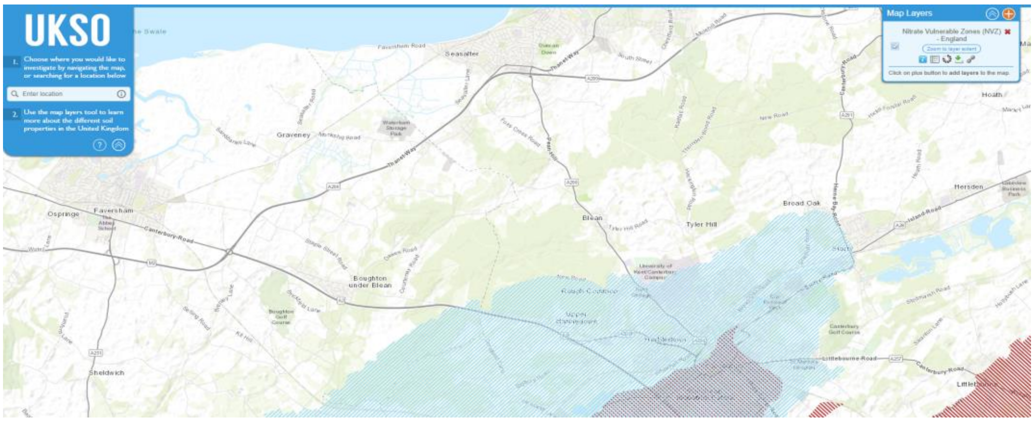
- Site boundary
- Green corridors and green routes
- Natural and semi-natural open space
- Existing tree planting mitigation
- Amenity green spaces and green corridors, and parks and gardens
- Ancient woodland
- Compensatory habitat for ancient woodland of approximately 1ha, within natural and semi natural open space
- *Development parcel*
- *Primary education parcel*
- *Community hub*

Catchment, Soils, Rainfall & NVZ Data

Catchment: Lower Stour
Soils: Impeded drainage to naturally wet, with a small area of free draining. Natural England classification is 'variable'.
Rainfall: 675 - 700mm
NVZ: No







Urban P Export Rate & PIMP - Derivation of Site-Specific Total Phosphorus Export Coefficients for Three Urban Landuses

Table A.3: EMCs for nitrogen and phosphorus for three key types of urban land use.

Land use	Nitrogen event mean concentration (mg N/l)	Phosphorus event mean concentration (mg P/l)
Residential	2.85	0.41
Commercial/industrial	1.52	0.30
Open urban land	1.68	0.22

The EMCs were combined with a standard method for calculating urban runoff which requires only rainfall as an input. The HR Wallingford Modified Rational Method was used, as shown in equation 1.

Equation 1

$$L = R * Pr$$

Where:

L = annual average runoff (mm)

R = annual average rainfall (mm)

Pr = percentage runoff (%)

$$Pr = 0.829 * PIMP + 0.078 * U - 20.7$$

$PIMP$ = the percentage of land that is impervious (whole number)

U = catchment wetness index. Calculated by (use 41 if rainfall over 760 mm):

$$U = -129.5 + (0.424 * R) - (2.28 * 10^{-4} * R^2) - (4.56 * 10^{-8} * R^3)$$

For phosphorus, the value for PIMP was set as 80%, as this has been suggested as the proportion of impervious surfaces once urban creep (the paving over of pervious surfaces) reaches a maximum. The use of an 80% PIMP value, while high, accounts for the potential increases in impervious surfaces that may occur over the lifetime of a development. Research has also suggested that non-paved gardens account for between 19-27% of the entire urban area. As gardens are the primary type of permeable surface within residential areas, the use of an 80% PIMP value is considered to be precautionary as an area with 19% coverage by non-paved gardens would indicate that around 80% of the remaining urban residential area would be impermeable surfaces.

Values based on 80% PIMP specified by Natural England

Variable	Residential Urban			Commercial/Industrial			Open Urban		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
L - Annual average runoff (mm)	328.36	341.15		328.36	341.15		328.36	341.15	
R - Annual average rainfall (mm)	675	700		675	700		675	700	
Pr - Percentage runoff (%)	48.65	48.74		48.65	48.74		48.65	48.74	
PIMP - Percentage of land that is impervious (%)	80.00	80.00		80.00	80.00		80.00	80.00	
U - Catchment wetness index (use 41 if rainfall > 760mm)	38.79	39.94		38.79	39.94		38.79	39.94	
Annual runoff (mm)	328.36	341.15		328.36	341.15		328.36	341.15	
Annual runoff (m)	0.33	0.34		0.33	0.34		0.33	0.34	
Volume per hectare (m3/ha/yr)	3283.60	3411.47		3283.60	3411.47		3283.60	3411.47	
TP EMC (mg/l)	0.41	0.41		0.3	0.3		0.22	0.22	
TP EMC (kg/l)	0.0004	0.0004		0.0003	0.0003		0.0002	0.0002	
TP Export Rate (kg/ha/yr)	1.35	1.40	1.37	0.99	1.02	1.00	0.72	0.75	0.74

Site-specific values

The development consists of 2,000 homes in a developable area of 51.79ha, which gives a development density of 39units/ha.
The development density of 39units/ha is considered to be medium density, which has typical PIMP of 45%.
Urban creep is accounted for by addition of 10% of the total PIMP to the site-specific value.

Site-specific PIMP:	45.00%
10% urban creep uplift:	4.5%
Site specific mean PIMP for the residential landuse:	49.50%

Variable	Residential Urban			Commercial/Industrial			Open Urban		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
L - Annual average runoff (mm)	157.69	164.16		328.36	341.15		328.36	341.15	
R - Annual average rainfall (mm)	675	700		675	700		675	700	
Pr - Percentage runoff (%)	23.36	23.45		48.65	48.74		48.65	48.74	
PIMP - Percentage of land that is impervious (%)	49.5	49.5		80	80		80	80	
U - Catchment wetness index (use 41 if rainfall > 760mm)	38.79	39.94		38.79	39.94		38.79	39.94	
Annual runoff (mm)	157.69	164.16		328.36	341.15		328.36	341.15	
Annual runoff (m)	0.16	0.16		0.33	0.34		0.33	0.34	
Volume per hectare (m3/ha/yr)	1576.89	1641.55		3283.60	3411.47		3283.60	3411.47	
TP EMC (mg/l)	0.41	0.41		0.3	0.3		0.22	0.22	
TP EMC (kg/l)	0.0004	0.0004		0.0003	0.0003		0.0002	0.0002	
TP Export Rate (kg/ha/yr)	0.65	0.67	0.66	0.99	1.02	1.00	0.72	0.75	0.74

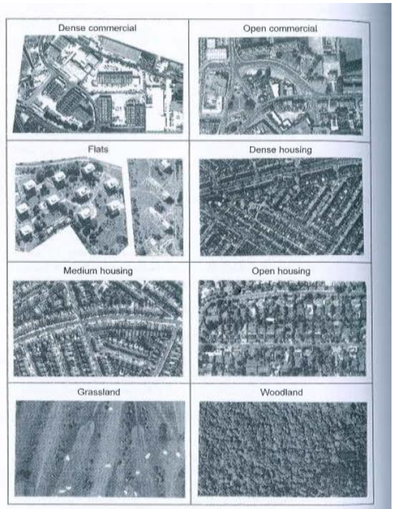


Fig. 11.1 Various land use categories in London (developed by Thames Water Utilities Ltd on their Beckton and Crossness sewerage modelling projects in association with consulting engineers BGP Reid Crowther Ltd and Montgomery Watson Ltd and reproduced with permission)

Table 11.2 Approximate percentage imperviousness of land-use types in London

Land-use category	*PIMP*
Dense commercial	100
Open commercial	65
Dense housing	55
Flats	50
Medium housing	45
Open housing	35
Grassland	<10
Woodland	<10

CIRIA C808 SuDS P Removal Analysis

1. CIRIA C808 states that 100% removal can be achieved for all runoff that can be infiltrated. A small area of the development has freely draining soils that may support this approach, but it has not been included in this assessment.

2. As the majority of the site is underlain by naturally wet soils, or those with impeded drainage, the analysis is based on an assumption that the SuDS treatment train will consist of dry grassed swales (lined, to prevent nitrogen infiltration as required by CIRIA C815) leading to lined wet ponds prior to offsite discharge to a watercourse.

3. C808 states that total phosphorus consists of 55% particulate P and 45% dissolved P and provides removal efficiencies for a range of SuDS features.

4. A nominal TP load of 1kg/year has been analsyed to calculated the TP removal efficiency of a lined swale leading to a lined wet pond. The removal efficiency could be increased if the SuDS treatment train consists of additional treatment features.

Phosphorus Form	**Nominal P Load (kg/year)**	**SuDS P Removal (%) Lined Dry Grassed Swale**	**Output P Load (kg/year)**	**SuDS P Removal (%) Lined Wet Pond**	**Output P Load (kg/year)**
Particulate P	0.55	14	0.47	38	0.29
Dissolved P	0.45	0	0.45	50	0.23
Total P	1.00				0.52
TP Removal Efficiency					**48.2%**

CIRIA C815 SuDS N Removal Analysis

1. CIRIA C815 states that nitrogen can not be removed through infiltration. All SuDS treatment features must therefore be lined to prevent infiltration.

2. The analysis is based on an assumption that the SuDS treatment train will therefore consist of lined dry grassed swales leading to lined wet ponds prior to offsite discharge to a watercourse.

3. CIRIA C815 specifies that this SuDS treatment train can achieve an N removal efficiency of **30%** if the features are designed and constructed in accordance with CIRIA C753 The SuDS Manual.

University of Kent Nutrient Neutrality Calculation - Canterbury WWTW Default PIMP

Notes

1. The development will discharge foul flows to Canterbury WWTW.
2. Canterbury WWTW will have a post-2030 total phosphorus discharge consent limit of 0.25mg/l and a total nitrogen discharge consent limit of 10mg/l as required by the Levelling Up and Regeneration Act (LURA).
3. Natural England's nutrient neutrality calculation guidance specifies the use of 90% of a WWTW permit consent limit and this has been applied to the TP and TN permit limits.
4. The existing land use areas have been taken from the Reading Agricultural Consultants report summarised in the Existing Landuse tab.
5. The future non-residential land use areas have been taken from the *Landscape and Green Infrastructure Design Strategy* , contained in *A Vision for Development: Landscape and Green Infrastructure Extract, PRP, December 2024* .
6. The future residential land use area has been calculated by subtracting the total non-residential land use area (43.0ha) from the total site area of 92.1ha.
7. A SUDS total phosphorus removal efficiency of 48.2% and a total nitrogen removal efficiency of 30% have been adopted in accordance with CIRIA C808 and CIRIA C815 based on a SuDS treatment train of lined grassed swales leading to lined wet ponds then offsite discharge to a watercourse.
8. The future urban land use phosphorus export rates are based on Natural England's conservative PIMP value of 80%. The nitrogen export rates are based on NE's N-specific PIMP value of 100%.
9. The occupancy rate of 2.4/unit has been taken from NE's calculator.
10. The wastewater volume has been increased to 120lppd based on Natural England's revised calculation method. There may be an opportunity to reduce this to 110lppd with agreement from CCC.
11. The underlying drainage ranges from naturally wet to impeded drainage with a small area of freely draining. The calculations have been assessed on Natural England's classification as 'variable' which generates a TP export rate of 0.32kg/ha/year for cereals. The export rate is 0.55kg/ha/year for areas that have impeded drainage, and just 0.05kg/ha/year for freely draining. Once the masterplan is finalised it may be beneficial to accurately map soil drainage to calculate more accurate existing land use nutrient loads to offset against the development's loads.

LOAD CALCULATION

Site Characteristics

Total site area (ha)	92.10
Number of homes (No.)	2000
No. of residents per unit (No.)	2.40
Wastewater volume (litres/person/day)	120
Total wastewater generated (litres/day)	576000

Wastewater Load

	Total Phosphorus	Total Nitrogen
WWTW consent limit (mg/l)	0.25	10.00
90% of WWTW consent limit (mg/l)	0.23	9.00
Total nutrient load from wastewater (mg/day)	129600	5184000
Total nutrient load from wastewater (mg/yr)	47336400	1893456000
Total nutrient load from wastewater (kg/yr)	**47.34**	**1893.46**

Existing Landuse Load

		Nutrient Export Rate (kg/ha/year)		Total Nutrient Load (kg/year)	
Existing Landuse	**Area (ha)**	**Total Phosphorus**	**Total Nitrogen**	**Total Phosphorus**	**Total Nitrogen**
Arable / cereal	92.10	0.32	18.37	29.31	1691.50
Total	**92.10**	**-**	**-**	**29.31**	**1691.50**

Future Landuse Load

		Nutrient Export Rate (kg/ha/year)		Total Nutrient Load (kg/year)	
Future Landuse	**Area (ha)**	**Total Phosphorus**	**Total Nitrogen**	**Total Phosphorus**	**Total Nitrogen**
Residential Urban Land	49.10	1.37	12.79	67.26	627.94
Greenspace	41.20	0.02	3.00	0.82	123.61
Community Food Growing	1.80	0.03	19.89	0.05	35.80
Total	**92.1**	-	-	**68.14**	**787.35**

SUDS Mitigation (refer CIRIA C808 C815 SuDS Removal tab for details)

	Total Phosphorus	Total Nitrogen
Total nutrient load from urban land draining to the SUDS (kg/year)	67.26	627.94
Calculated SUDS removal efficiency (%)	48.2%	30.0%
Total nutrient reduction (kg/year)	32.42	188.38

Future Nutrient Load

Load Contribution	Total Phosphorus	Total Nitrogen
Wastewater load (kg/year) (A)	47.34	1893.46
Future landuse load (kg/year) (B)	68.14	787.35
Existing landuse load (kg/year) (C)	29.31	1691.50
SuDS nutrient removal (kg/year) (D)	32.42	188.38
Future nutrient load (kg/year) (= A + (B - C - D))	53.74	800.93
Precautionary buffer (kg/year) (20%)	10.75	160.19
Future nutrient load (kg/year)	**64.49**	**961.11**

University of Kent Nutrient Neutrality Calculation - Canterbury WWTW Site-Specific PIMP

Notes

1. The development will discharge foul flows to Canterbury WWTW.
2. Canterbury WWTW will have a post-2030 total phosphorus discharge consent limit of 0.25mg/l and a total nitrogen discharge consent limit of 10mg/l as required by the Levelling Up and Regeneration Act (LURA).
3. Natural England's nutrient neutrality calculation guidance specifies the use of 90% of a WWTW permit consent limit and this has been applied to the TP and TN permit limits.
4. The existing land use areas have been taken from the Reading Agricultural Consultants report summarised in the Existing Landuse tab.
5. The future non-residential land use areas have been taken from the *Landscape and Green Infrastructure Design Strategy* , contained in *A Vision for Development: Landscape and Green Infrastructure Extract, PRP, December 2024* .
6. The future residential land use area has been calculated by subtracting the total non-residential land use area (43.0ha) from the total site area of 92.1ha.
7. A SUDS total phosphorus removal efficiency of 48.2% and a total nitrogen removal efficiency of 30% have been adopted in accordance with CIRIA C808 and CIRIA C815 based on a SuDS treatment train of lined grassed swales leading to lined wet ponds then offsite discharge to a watercourse.
8. The future urban land use phosphorus export rates have been optimised based on a site-specific PIMP value (49.5% including a 10% uplift for urban creep) for a medium density development (39 units/hectare) as detailed in the Urban P Export Rate & PIMP tab. The nitrogen export rates are those specified by Natural England.
9. The occupancy rate of 2.4/unit has been taken from NE's calculator.
10. The wastewater volume has been increased to 120lppd based on Natural England's revised calculation method. There may be an opportunity to reduce this to 110lppd with agreement from CCC.
11. The underlying drainage ranges from naturally wet to impeded drainage with a small area of freely draining. The calculations have been assessed on Natural England's classification as 'variable' which generates a TP export rate of 0.32kg/ha/year for cereals. The export rate is 0.55kg/ha/year for areas that have impeded drainage, and just 0.05kg/ha/year for freely draining. Once the masterplan is finalised it may be beneficial to accurately map soil drainage to calculate more accurate existing land use nutrient loads to offset against the development's loads.

LOAD CALCULATION

Site Characteristics

Total site area (ha)	92.10
Number of homes (No.)	2000
No. of residents per unit (No.)	2.40
Wastewater volume (litres/person/day)	120
Total wastewater generated (litres/day)	576000

Wastewater Load

	Total Phosphorus	Total Nitrogen
WWTW consent limit (mg/l)	0.25	10.00
90% of WWTW consent limit (mg/l)	0.23	9.00
Total nutrient load from wastewater (mg/day)	129600	5184000
Total nutrient load from wastewater (mg/yr)	47336400	1893456000
Total nutrient load from wastewater (kg/yr)	**47.34**	**1893.46**

Existing Landuse Load

		Nutrient Export Rate (kg/ha/year)		Total Nutrient Load (kg/year)	
Existing Landuse	**Area (ha)**	**Total Phosphorus**	**Total Nitrogen**	**Total Phosphorus**	**Total Nitrogen**
Arable / cereal	92.10	0.32	18.37	29.31	1691.50
Total	**92.10**	**-**	**-**	**29.31**	**1691.50**

Future Landuse Load

		Nutrient Export Rate (kg/ha/year)		Total Nutrient Load (kg/year)	
Future Landuse	**Area (ha)**	**Total Phosphorus**	**Total Nitrogen**	**Total Phosphorus**	**Total Nitrogen**
Residential Urban Land	49.10	0.66	12.79	32.39	627.94
Greenspace	41.20	0.02	3.00	0.82	123.61
Community Food Growing	1.80	0.03	19.89	0.05	35.80
Total	**92.1**	-	-	**33.27**	**787.35**

SUDS Mitigation (refer CIRIA C808 C815 SuDS Removal tab for details)

	Total Phosphorus	Total Nitrogen
Total nutrient load from urban land draining to the SUDS (kg/year)	32.39	627.94
Calculated SUDS removal efficiency (%)	48.2%	30.0%
Total nutrient reduction (kg/year)	15.61	188.38

Future Nutrient Load

Load Contribution	Total Phosphorus	Total Nitrogen
Wastewater load (kg/year) (A)	47.34	1893.46
Future landuse load (kg/year) (B)	33.27	787.35
Existing landuse load (kg/year) (C)	29.31	1691.50
SuDS nutrient removal (kg/year) (D)	15.61	188.38
Future nutrient load (kg/year) (= A + (B - C - D))	35.68	800.93
Precautionary buffer (kg/year) (20%)	7.14	160.19
Future nutrient load (kg/year)	**42.82**	**961.11**

University of Kent Nutrient Neutrality Calculation - On-Site WWTW Default PIMP

Notes

1. The development will discharge foul flows to an on-site WWTW.
2. The on-site WWTW will have a total phosphorus discharge consent limit of 0.10mg/l and a total nitrogen discharge consent limit of 7.2mg/l (it may be possible to reduce this to 5mg/l).
3. Natural England's nutrient neutrality calculation guidance specifies the use of 90% of a WWTW permit consent limit and this has been applied to the TP and TN permit limits.
4. The existing land use areas have been taken from the Reading Agricultural Consultants report summarised in the Existing Landuse tab.
5. The future non-residential land use areas have been taken from the *Landscape and Green Infrastructure Design Strategy* , contained in *A Vision for Development: Landscape and Green Infrastructure Extract, PRP, December 2024* .
6. The future residential land use area has been calculated by subtracting the total non-residential land use area (43.0ha) from the total site area of 92.10ha.
7. A SUDS total phosphorus removal efficiency of 48.2% and a total nitrogen removal efficiency of 30% have been adopted in accordance with CIRIA C808 and CIRIA C815 based on a SuDS treatment train of lined grassed swales leading to lined wet ponds then offsite discharge to a watercourse.
8. The future urban land use phosphorus export rates have been based on Natural England's conservative PIMP value of 80%, andf nitrogen export rates on NE's N-specific PIMP value of 100%.
9. The occupancy rate of 2.4/unit has been taken from NE's calculator.
10. The wastewater volume has been increased to 120lppd based on Natural England's revised calculation method. There may be an opportunity to reduce this to 110lppd with agreement from CCC.
11. The underlying drainage ranges from naturally wet to impeded drainage with a small area of freely draining. The calculations have been assessed on Natural England's classification as 'variable' which generates a TP export rate of 0.32kg/ha/year for cereals. The export rate is 0.55kg/ha/year for areas that have impeded drainage, and just 0.05kg/ha/year for freely draining. Once the masterplan is finalised it may be beneficial to accurately map soil drainage to calculate more accurate existing land use nutrient loads to offset against the development's loads.

LOAD CALCULATION

Site Characteristics

Total site area (ha)	92.10
Number of homes (No.)	2000
No. of residents per unit (No.)	2.40
Wastewater volume (litres/person/day)	120
Wastewater generated (litres/day)	576000

Wastewater Load

	Total Phosphorus	Total Nitrogen
WWTW consent limit (mg/l)	0.10	7.20
90% of WWTW consent limit (mg/l)	0.09	6.48
Total nutrient load from wastewater (mg/day)	51840	3732480
Total nutrient load from wastewater (mg/yr)	18934560	1363288320
Total nutrient load from wastewater (kg/yr)	**18.93**	**1363.29**

Existing Landuse Load

		Nutrient Export Rate (kg/ha/year)		Total Nutrient Load (kg/year)	
Existing Landuse	**Area (ha)**	**Total Phosphorus**	**Total Nitrogen**	**Total Phosphorus**	**Total Nitrogen**
Arable / cereal	92.10	0.32	18.37	29.31	1691.50
Total	**92.10**	**-**	**-**	**29.31**	**1691.50**

Future Landuse Load

		Nutrient Export Rate (kg/ha/year)		Total Nutrient Load (kg/year)	
Future Landuse	**Area (ha)**	**Total Phosphorus**	**Total Nitrogen**	**Total Phosphorus**	**Total Nitrogen**
Residential Urban Land	49.10	1.37	12.79	67.26	627.94
Greenspace	41.20	0.02	3.00	0.82	123.61
Community Food Growing	1.80	0.03	19.89	0.05	35.80
Total	**92.1**	-	-	**68.14**	**787.35**

SUDS Mitigation (refer CIRIA C808 C815 SuDS Removal tab for details)

	Total Phosphorus	Total Nitrogen
Total nutrient load from urban land draining to the SUDS (kg/year)	67.26	627.94
Calculated SUDS removal efficiency (%)	48.2%	30.0%
Total nutrient reduction (kg/year)	32.42	188.38

Future Nutrient Load

Load Contribution	Total Phosphorus	Total Nitrogen
Wastewater load (kg/year) (A)	18.93	1363.29
Future landuse load (kg/year) (B)	68.14	787.35
Existing landuse load (kg/year) (C)	29.31	1691.50
SuDS nutrient removal (kg/year) (D)	32.42	188.38
Future nutrient load (kg/year) (= A + (B - C - D))	25.34	270.76
Precautionary buffer (kg/year) (20%)	5.07	54.15
Future nutrient load (kg/year)	**30.41**	**324.91**

University of Kent Nutrient Neutrality Calculation - On-Site WWTW Site-Specific PIMP

Notes

1. The development will discharge foul flows to an on-site WWTW.
2. The on-site WWTW will have a total phosphorus discharge consent limit of 0.10mg/l and a total nitrogen discharge consent limit of 7.2mg/l (it may be possible to reduce this to 5mg/l).
3. Natural England's nutrient neutrality calculation guidance specifies the use of 90% of a WWTW permit consent limit and this has been applied to the TP and TN permit limits.
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6. The future residential land use area has been calculated by subtracting the total non-residential land use area (43.0ha) from the total site area of 92.10ha.
7. A SUDS total phosphorus removal efficiency of 48.2% and a total nitrogen removal efficiency of 30% have been adopted in accordance with CIRIA C808 and CIRIA C815 based on a SuDS treatment train of lined grassed swales leading to lined wet ponds then offsite discharge to a watercourse.
8. The future urban land use phosphorus export rates have been optimised based on a site-specific PIMP value (49.5% including a 10% uplift for urban creep) for a medium density development (39 units/hectare) as detailed in the Urban P Export Rate & PIMP tab. The nitrogen export rates are those specified by Natural England.
9. The occupancy rate of 2.4/unit has been taken from NE's calculator.
10. The wastewater volume has been increased to 120lppd based on Natural England's revised calculation method. There may be an opportunity to reduce this to 110lppd with agreement from CCC.
11. The underlying drainage ranges from naturally wet to impeded drainage with a small area of freely draining. The calculations have been assessed on Natural England's classification as 'variable' which generates a TP export rate of 0.32kg/ha/year for cereals. The export rate is 0.55kg/ha/year for areas that have impeded drainage, and just 0.05kg/ha/year for freely draining. Once the masterplan is finalised it may be beneficial to accurately map soil drainage to calculate more accurate existing land use nutrient loads to offset against the development's loads.

LOAD CALCULATION

Site Characteristics

Total site area (ha)	92.10
Number of homes (No.)	2000
No. of residents per unit (No.)	2.40
Wastewater volume (litres/person/day)	120
Wastewater generated (litres/day)	576000

Wastewater Load

	Total Phosphorus	Total Nitrogen
WWTW consent limit (mg/l)	0.10	7.20
90% of WWTW consent limit (mg/l)	0.09	6.48
Total nutrient load from wastewater (mg/day)	51840	3732480
Total nutrient load from wastewater (mg/yr)	18934560	1363288320
Total nutrient load from wastewater (kg/yr)	**18.93**	**1363.29**

Existing Landuse Load

		Nutrient Export Rate (kg/ha/year)		Total Nutrient Load (kg/year)	
Existing Landuse	**Area (ha)**	**Total Phosphorus**	**Total Nitrogen**	**Total Phosphorus**	**Total Nitrogen**
Arable / cereal	92.10	0.32	18.37	29.31	1691.50
Total	**92.10**	**-**	**-**	**29.31**	**1691.50**

Future Landuse Load

		Nutrient Export Rate (kg/ha/year)		Total Nutrient Load (kg/year)	
Future Landuse	**Area (ha)**	**Total Phosphorus**	**Total Nitrogen**	**Total Phosphorus**	**Total Nitrogen**
Residential Urban Land	49.10	0.66	12.79	32.39	627.94
Greenspace	41.20	0.02	3.00	0.82	123.61
Community Food Growing	1.80	0.03	19.89	0.05	35.80
Total	**92.1**	-	-	**33.27**	**787.35**

SUDS Mitigation (refer CIRIA C808 C815 SuDS Removal tab for details)

	Total Phosphorus	Total Nitrogen
Total nutrient load from urban land draining to the SUDS (kg/year)	32.39	627.94
Calculated SUDS removal efficiency (%)	48.2%	30.0%
Total nutrient reduction (kg/year)	15.61	188.38

Future Nutrient Load

Load Contribution	Total Phosphorus	Total Nitrogen
Wastewater load (kg/year) (A)	18.93	1363.29
Future landuse load (kg/year) (B)	33.27	787.35
Existing landuse load (kg/year) (C)	29.31	1691.50
SuDS nutrient removal (kg/year) (D)	15.61	188.38
Future nutrient load (kg/year) (= A + (B - C - D))	7.28	270.76
Precautionary buffer (kg/year) (20%)	1.46	54.15
Future nutrient load (kg/year)	**8.73**	**324.91**

Nutrient Mitigation Available from Land Parcel F

Soilscape 18 impeded drainage

Existing Nutrient Loads

Landuse	Area (ha)	P Export Rate (kg/ha/yr)	N Export Rate (kg/ha/yr)	P Load (kg/yr)	N Load (kg/yr)
Arable/ Cereal	4.7	0.55	20.17	2.59	94.80
Lowland Grazing / Permanent Grass	13.5	0.44	7.78	5.94	105.03
Total				**8.53**	**199.83**

Future Nutrient Loads

Landuse	Area (ha)	P Export Rate (kg/ha/yr)	N Export Rate (kg/ha/yr)	P Load (kg/yr)	N Load (kg/yr)
Woodland / Conservation Meadow	18.2	0.02	3.00	**0.364**	**54.60**

Available Nutrient Mitigation

	TP	TN
Existing Nutrient Load (kg/year)	8.53	199.83
Future Nutrient Load (kg/year)	0.36	54.60
Available Nutrient Mitigation (kg/year)	**8.16**	**145.23**