

LOCAL PLAN REVIEW

WATER ENVIRONMENT

SUPPLEMENTARY PAPER



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1. Introduction

- 1.1. The National Planning Policy Framework states that strategic policies in development plan documents should make 'sufficient provision' for infrastructure for:
 - water supply
 - wastewater
 - flood risk and coastal change management
- 1.2. Planning Practice Guidance recommends that in formulating plans, LPA's give consideration to the environmental and infrastructure capacity of the borough's water cycle. In order to consider water supply and water treatment, this section addresses the key risks associated with the Local plan review. Flood risk is dealt with primarily through the strategic Flood Risk Assessment.
- 1.3. This report sets out the key water quality and quantity matters arising in relation to the Local Plan Review, in order to give consideration to relevant issues and to bring together published evidence in order to underpin the emerging plan.

2. Evidence base

- 2.1. In producing this draft plan, Maidstone Borough Council has given consideration to the impact of the plan on water quality and quantity/supply in order that growth can be delivered in a sustainable way.
- 2.2. MBC has used a suite of evidence to understand the environmental and infrastructure capacity of the water systems in the borough. This includes:
 - Kent Water for Sustainable growth study 2017
 - Infrastructure Capacity Study 2020
 - Infrastructure Delivery Plan 2021
 - Strategic Flood Risk Assessment 2020
 - Evidence to support the delivery of nutrient neutral development, including baseline nutrient budgets, and supporting evidence in respect to Heathlands.
 - Maidstone Water Cycle Study 2010
 - The Sustainability Appraisal of the Local Plan Review
- 2.3. In its Regulation 18 Preferred Approaches consultation comments, the Environment Agency highlighted the need for an addendum to the 2010 Water Cycle Study to address matters surrounding climate change and nutrient neutrality in the Stour. Because MBC was already working on two workstreams to address both those matters, and reliance could be made on the relatively recent Kent Water for Sustainable Growth study, it was agreed by the Environment Agency that an updated water cycle study was not required for this local plan review cycle. However, MBC has committed to undertaking a full water cycle study following adoption of

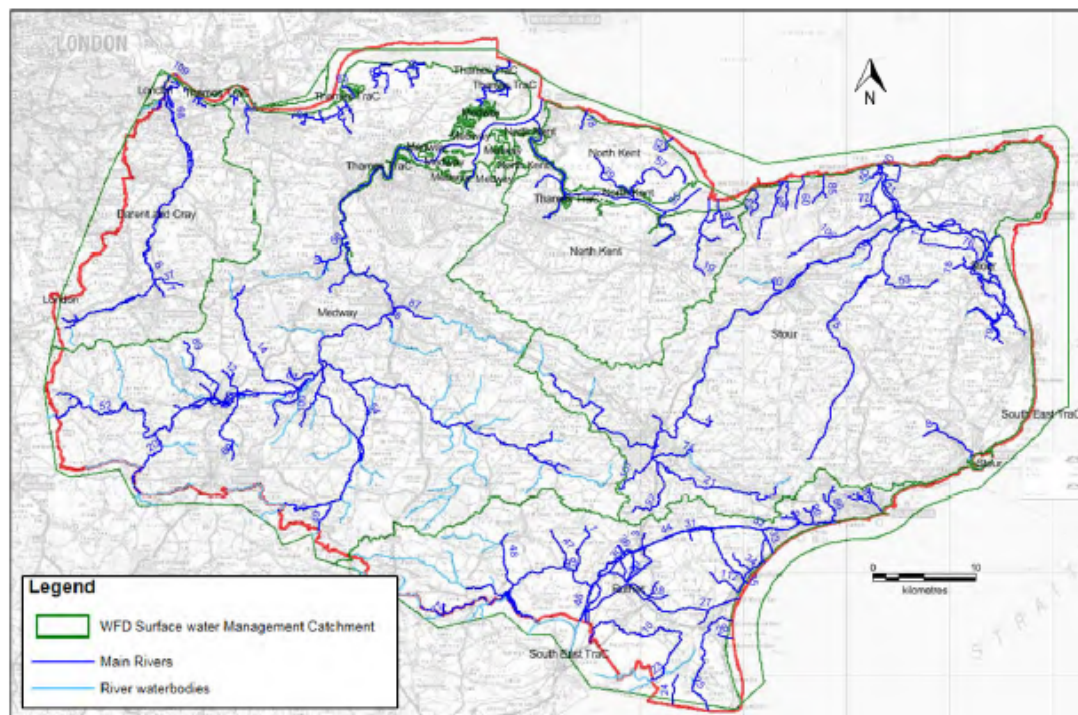
this plan in order to inform future plan reviews as this will allow future updates to permit levels to be taken into account.

3. Statements of Common ground

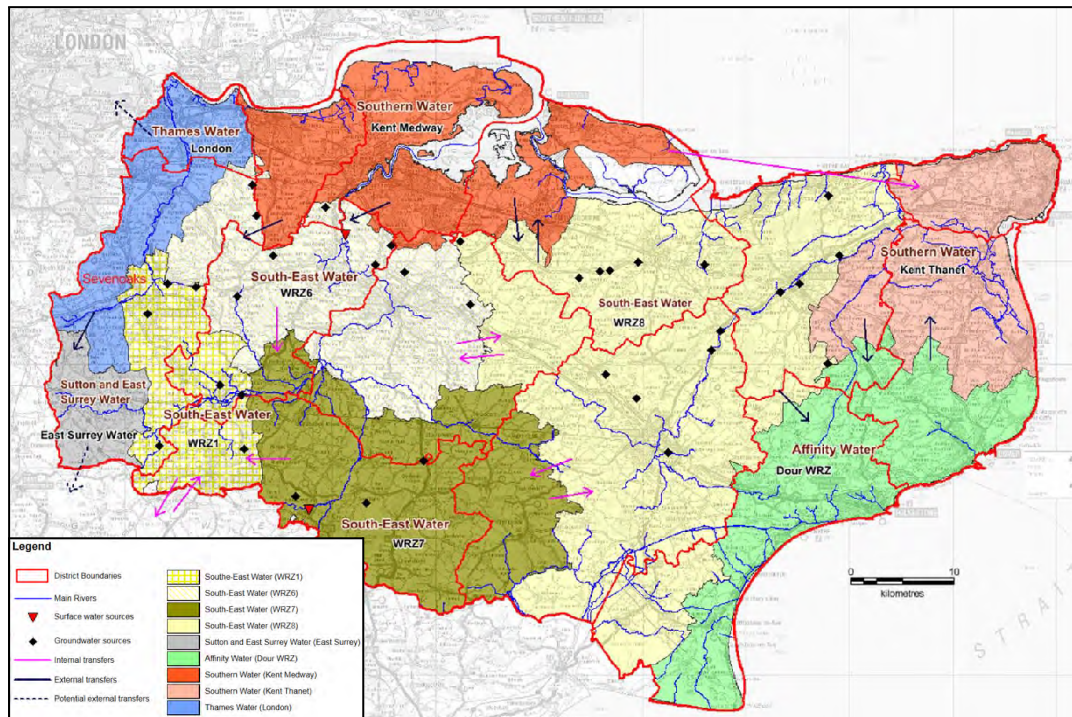
- 3.1. Statements of common ground have been drafted between Southern Water, the Environment Agency and Kent County Council as lead drainage board. These statements address matters relating to water quality and flooding.

4. Maidstone catchments

- 4.1. The borough of Maidstone lies predominantly within the Water framework Directive surface water catchment of the River Medway, however the far north the borough extends into the North Kent catchment, and a small part of the borough lies within the Stour catchment.



- 4.2. A number of Water Resources Zones serve the borough as indicated in the map below



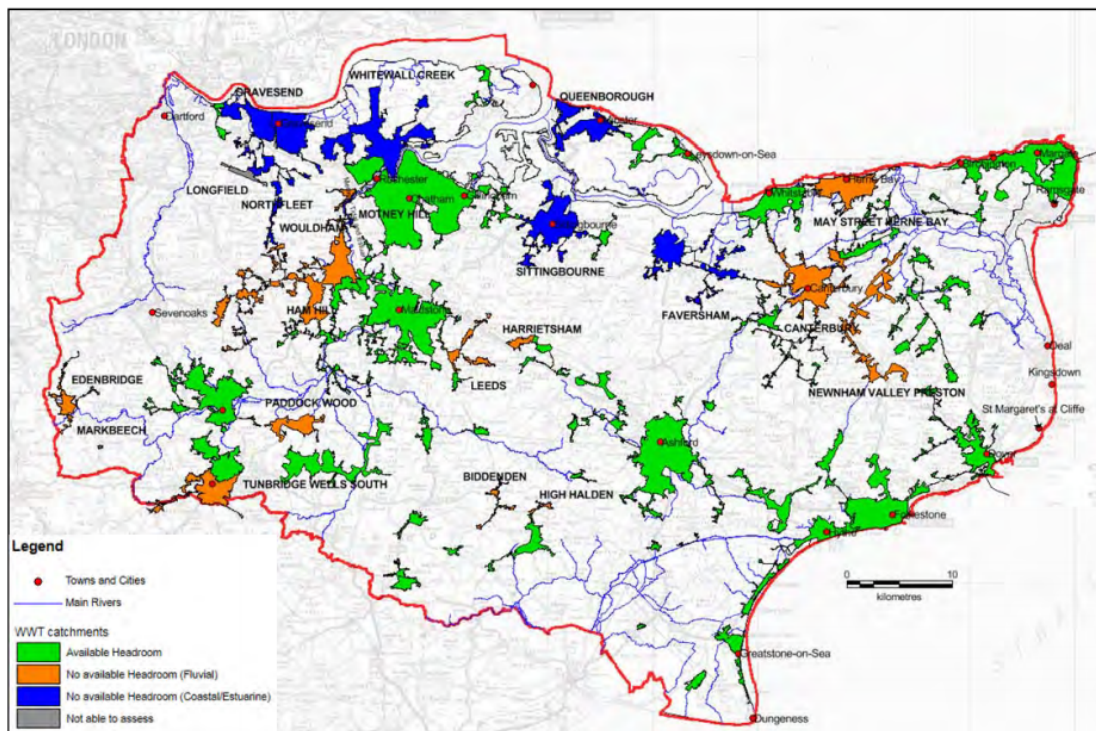
- 4.3. By way of these river basins, there are a number of hydrological linkages to European sites, these are: The Stodmarsh SAC, SPA and Ramsar; the Medway Estuary and Marshes SPA and Ramsar; the Swale SPA and Ramsar and; the Thames Estuary and Marshes SPA and Ramsar.

5. Waste water

- 5.1. Maidstone is served by a range of Wastewater Treatment Works (WwTWs). Water companies have statutory obligation to provide water and wastewater services and cannot object to a plan or refused connections. New development will require the payment of a network reinforcement charge to pay for infrastructure associated with that development.
- 5.2. Discharge permit levels for wastewater leaving WwTW's are set by the Environment Agency and these permits seek to limit the discharge of pollutants that are known to be of particular concern. However, whilst modern WWTW's can be efficient at removing most pollutants, cost and technology limitations mean that it is not possible to remove all pollutants.

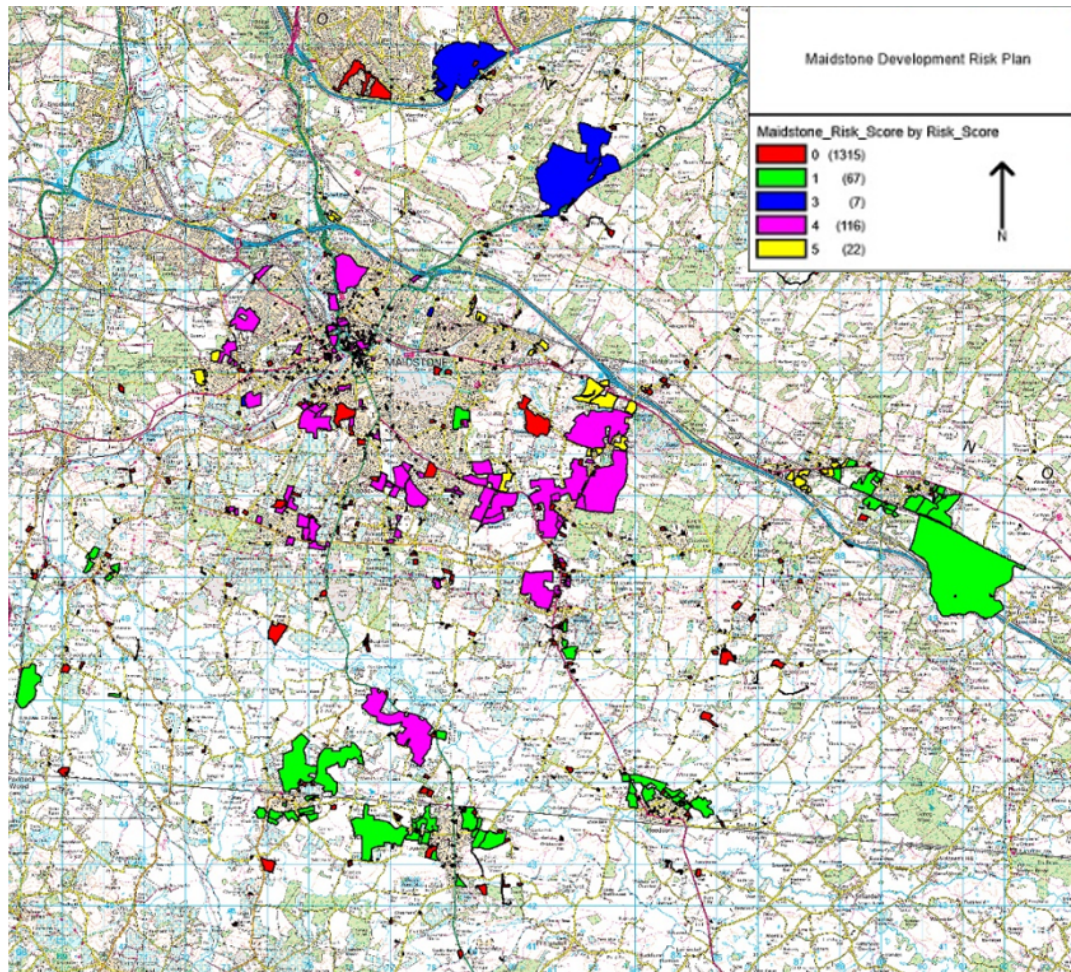
Wastewater risks

- 5.3. Potential wastewater risks include potential capacity issues at WwTW's along with water quality. The Kent Water for Sustainable Growth Study assessed the capacity of these works with projected growth in the adopted Local Plan, and the majority of WwTW's had capacity to meet the planned growth in the adopted local plan.



- 5.4. Any growth over and above that which may arise from the Local Plan Review has been considered through engagement with infrastructure providers from an early stage of the plan making process. Southern Water provided a 'development risk score' for sites which graded risk on a score of 1 (very low risk) to 5 (very high risk). The risks scores were draw from a combination of data: WPS hydraulic risk score to identify the risk of adding additional flow upstream of a WPS; catchment level hydraulic risk based on model predicted flow conditions and; a regional hydraulic risk assessment based on model data and MapInfo data held by Southern Water. This demonstrated that broadly speaking, the sites around the RSC's and LV's, including the garden community at Lenham Heath, were at a lower risk (1). Urban and edge of urban sites were generally high risk (4) and the garden community at Lidsing was identified as medium risk (3).¹

¹ Email from Southern Water to MBC 03/03/20. Note that this did not take into account the yet to be issued Natural England advice note on nutrient neutrality in the Stour.



- 5.5. Notwithstanding these headline risk scores, delivery of the larger garden community sites are likely to come forward with solutions that will not be reliant upon existing wastewater infrastructure, which at present is contributing significantly to high levels of nutrients in the Stour. In Heathlands for example, wastewater will be dealt with through a bespoke solution that addresses the need for increased capacity whilst delivering net nutrient neutrality.
- 5.6. The remainder of the growth in the Plan Review centres around Maidstone and the smaller settlements to the south. Whilst it is acknowledged that there may be limited existing wastewater capacity in Maidstone itself, and that additional capacity will need to be delivered, this location represents a sustainable area for growth that maximises opportunities for regeneration and utilisation of existing infrastructure. Evidence suggests that the smaller settlements are best placed to accommodate growth in terms of wastewater infrastructure.²
- 5.7. Through consultations on the Local Plan Review and IDP, several sites have been identified in the following locations that need reinforcement in order to maintain an efficient and effective wastewater system. These locations include: south east Maidstone, north of Maidstone, east of

² Email from Southern Water to MBC 03/03/20. Note that this did not take into account the yet to be issued Natural England advice note on nutrient neutrality in the Stour.

Maidstone, Headcorn, Staplehurst, Marden, Lenham and the rural periphery.

6. Water supply

- 6.1. The Water for Sustainable Growth Study undertaken by Kent County Council, Boroughs, water companies, wastewater suppliers and the Environment Agency provided background on water supply quantity and quality to information to inform the Local Plan Review. Water supply is delivered predominantly by South East Water, with the exception of land close to the area surrounding the M2 motorway in the North West of the borough, supplied by Southern Water. Water Resource Zones (WRZ) within Maidstone include South East Water WRZ6, WRZ7, WRZ8, and Southern Water Kent Medway. The majority of the water sources serving these zones come from groundwater, ie, aquifers. MBC has engaged with South East Water through its infrastructure evidence.

Water supply pressures and risks

- 6.2. Water Stressed Areas – final classification (2013)³ identified the area covered by South East Water as being under significant stress at that time. The report took into account demand arising from growth, along with climate change scenarios, and concluded that the region served by South East Water would remain at the highest level of stress classification.
- 6.3. The Kent Water for Sustainable Growth Study indicates that parts of the north east and east of the borough are suspected of or subject to abstraction pressures and these could be exacerbated by climate change. These pressures are as a result of a combination of factors including population increase. South East Water, which serves the majority of the borough, seeks to manage future demand through the following measures: leakage reduction; regional transfer; re-use schemes and; a water efficiency strategy.
- 6.4. Local Plans can help alleviate some of the future pressures on the system by requiring that new housing development is built to higher water efficiency standards of 110 litres per person per day⁴. For this reason, Policy LPRQ&D 1 sets water efficiency standards across all new housing development in the borough at an expected consumption of 110l pppd.
- 6.5. No new projects have been identified by providers in the IDP.

7. Water Quality

- 7.1. Wastewater infrastructure and water supply are intrinsically linked to overall water quality since a significant degree of pollution to watercourses in Maidstone occurs as a consequence of WwTW outflow and hydrological overload. The Local Plan Review has sought to consider water quality via

³ Defra (2013) Water stressed areas: final classification

⁴ The Building Regulations (2010), Approved Document G, Sanitation, hot water safety and water efficiency.

a range of evidence, including the Sustainability Appraisal, the Kent Water for Sustainable Growth Study, and the Habitat Regulations Assessment.

7.2. The Environment Agency has identified Groundwater Source Protection Zones. These areas are defined to protect areas of groundwater that are used for potable supply, including public / private potable supply. These are categorized from Zone 1 (most sensitive) to Zone 3 (least sensitive). The east of Heathlands lies in Zone 3 meaning that infiltration should be limited here. Additionally, the northernmost part of the Leeds Langley growth corridor lies within Zone 3.

7.3. The Water framework Directive classification of surface water bodies in Maidstone are detailed below:

Waterbody	Current Status	2027 target status	Overall	Ammonia	Dissolved Oxygen	Phosphate
Beult	Moderate	Moderate	Moderate	High	Good	Moderate
Beult at Yalding	Moderate	Moderate	Moderate	High	High	Moderate
Len	Moderate	Moderate	Moderate	High	High	Moderate
Loose Stream	Moderate	Moderate	Moderate	High	High	Moderate
Lower Teise	Moderate	Good	Good	High	High	Not Assessed
Marden Mill Stream	Moderate	Moderate	Moderate	High	High	Moderate
Medway at Maidstone	Moderate	Moderate	Moderate	High	High	Poor
Mereworth Stream	Moderate	Good	Good	High	High	Good
Mid Medway from Eden Confluence to Yalding	Moderate	Moderate	Moderate	High	High	Poor
Sherway	Moderate	Moderate	Moderate	High	Moderate	Moderate
Teise and Lesser Teise	Moderate	Good	Good	High	High	Good
Tributary of Beult at	Moderate	Moderate	Moderate	Good	Good	Moderate

Sutton Valence						
Upper Beult	Moderate	Good	Good	High	Good	Good

- 7.4. The sustainability appraisal (SA) considered the plan's impact on water quality. This assessment tested the overall strategy, development management policies and site allocations for their ability to maintain and improve the quality of the borough's waters and to achieve sustainable water resources management. The SA concluded that without mitigation, all growth scenarios had the potential to impact on water quality, but that mitigation can offset this impact. Additionally, it noted that the creation of garden communities can deliver greater opportunities to design-in water efficiency which can help to reduce developments impact on water quality.
- 7.5. To ensure that the plan delivers growth whilst adequately reducing or mitigating its impact on water quality, the plan secures a range of measures to ensure that water quality objectives are met, including LPRSP14(a) and individual allocation policies.

Stodmarsh and the Stour Catchment

- 7.6. In June 2021 Natural England issued an advice letter and methodology (updated November 2020) to local authorities in relation to nutrient neutrality in the catchment of the river Stour. The letter highlighted the requirement for LPA's to undertake appropriate assessments where a plan or project could result in additional nitrogen and phosphorous being discharged into the Stour catchment. Whilst agriculture and urban development make some contribution to elevated phosphorous and nitrogen levels, most concentrations arise from treated wastewater discharge from wastewater treatment works.
- 7.7. For Maidstone, the requirement ensure nutrient neutrality in new development affects planned growth in the Lenham and Lenham Heath areas which lie within the Stour river catchment, with circa 1,000 dwellings in the Lenham Broad Location and 5,000 dwellings in the Heathlands Garden Community. To seek a solution, a range of options to address nutrient neutrality were explored as set out below.

Background

- 7.8. The nutrient overloading of the Stour has principally arisen from wastewater treatment works discharge. The Environment Agency sets the permit levels which wastewater infrastructure providers, in this case Southern Water, are expected to meet. For Lenham WWTW which would serve planned development in the Lenham and Lenham Heath areas, the permit limits are as follows:

Southern Water Waste Water Treatment Works Continuous Discharges considered as part of WINEP investigation * (waterbody/ catchment into which it discharges in brackets)	Total Phosphorous Limit current (planned permit by 2024 in brackets)	Total Nitrogen Limit current	Population Equivalent (2020)
Lenham Wwtw (Upper Great Stour)	1 mg/l (OSM only) (0.5 mg/l by 2024)	None	3,206

- 7.9. Whilst the permit limit for total phosphorous will reduce to 0.5mg/l by 2024, which in comparison to other WwTW's in the catchment is a relatively low level, the Environment Agency has not set a limit for total nitrogen. This means that discharges of this nutrient are unconstrained, and as a consequence development in the Lenham and Lenham Heath areas will need to mitigate or offset significant levels of nitrogen from WwTW discharge.

Nutrient budgets

- 7.10. As a starting point, MBC sought to understand the potential impact of the advice letter on development in the Lenham area and the nature of the development called for a mixed approach to assessment. The broad location made up of a number of sites with different developers and site promoters, and these have ambitions for the timing of site delivery. Given the different aspirations of the Lenham broad location sites, it was felt that the most appropriate means to establish a solution for MBC to take the lead.
- 7.11. Heathlands as a standalone development with a single site promoter, along with the critical mass and lead in times, was considered to be better placed to develop a standalone scheme to mitigate or offset nitrates. Additionally, Heathlands occupies the area around and downstream of the WWTW which enables the creation of interceptor wetlands which must be located between the source of the pollution and the site, in this case Stodmarsh SAC, SPA/Ramsar.
- 7.12. The nutrient budgets for Heathlands were undertaken by the promoter as this facilitated an iterative approach to developing a masterplan to incorporate any offsetting and mitigation. For the Broad Location, MBC commissioned its own study to understand the scale of the impact on these sites, and this is provided in the technical note and report appended to this document.
- 7.13. Whilst the nutrient budgets were based on a range of assumptions, the headline conclusions of the budgets for the Lenham broad location are that if reliance were to be made on the Lenham WWTW, then the land

demand for arable reversion⁵ to woodland would amount to 711ha. Options to deliver wetland downstream of the Lenham WWTW to serve the broad location are restricted by land ownership.

Upgrades to existing wastewater infrastructure

- 7.14. Because of the land burden that arable reversion would place on the delivery of the Lenham broad location, MBC investigated the potential to use financial contributions to deliver upgrades to Lenham WWTW in order to reduce the cost of achieving nutrient neutrality. Whilst there has been some developer interest in using such means to deliver a cost-effective solution, it is understood that the regulatory framework within which Southern Water operates does not allow the company to take receipt of fund for upgrades.

Package treatment plants

- 7.15. Consideration was given as to whether there was scope to deliver wastewater treatment on a site-by-site basis through package treatment plants with the discharge of treated water into the wastewater network. However, the November 2020 update to the Natural England methodology ruled out this option on account of the water company's obligation to only treat water to permit levels, consequently there would be no net decrease in overall nutrient discharge levels would occur.

Discharge outside of the Stour catchment

- 7.16. Southern Water were approached to establish whether there was scope for the WWTW at Harrietsham, which discharges treated water into the river Len, to take sewage discharge from some or all of the Lenham broad location. Whilst Southern Water were open to this as a solution, pipework constraints in Harrietsham limits the capacity of the network to take all but a small portion of discharge from the broad location.

Combined solution for the Garden Community and Lenham broad location

- 7.17. As previously highlighted, the garden community has the potential to deliver a solution based upon new wastewater treatment infrastructure, combined with wetlands to offset any residual nutrients. The nutrient neutrality review is set out in a separate document appended to the Habitat Regulations Assessment.
- 7.18. In summary however, additional capacity could be built into the new WwTW at Heathlands, which could serve the broad location. Additional residual nutrients can then be accommodated by on-site wetlands. The cost of this would be borne by Lenham broad Location developments, however delivery of these sites has been pushed back in the trajectory to

⁵ Arable reversion refers to the conversion from agricultural land to a use that generates lower nutrients. The land take for arable reversion was calculated using a catchment average for non-urban land use.

coincide with deliver of the first units at the Heathlands Garden Community.

- 7.19. Furthermore, it is anticipated that other short and long term solutions will come forward. Kent Wildlife Trust is working to deliver land reversion schemes in the Stour catchment for which credits could be traded with developers. On a catchment wide basis, MBC along with other authorities are working in partnership to identify possible solutions to regulatory blockages. Finally, MBC are working with landowners to capture nutrient credits from new woodland creation in the borough.

8. Habitats Regulations Assessment

- 8.1. The Habitats Regulation Assessment screened in a range of sites in respect to the potential impact of the plan on water quality. These are: the Stodmarsh SAC and SPA/Ramsar; the Thames Estuary and Marshes SPA/Ramsar; Swale SPA/Ramsar; and the Medway Estuary and Marshes SPA/Ramsar. These sites underwent further consideration through an appropriate assessment which concluded the following:
- 8.2. Whilst development in the plan had the potential to adversely impact on the Medway Estuary and Marshes and the Thames Estuary and marshes SPA/Ramsar sites, WwTW capacity upgrades combined with a requirement in policy LPRSP14(a) will mitigate against this.
- 8.3. Stodmarsh SAC and SPA/Ramsar is the subject of elevated nitrogen and phosphorous, both of which are discharged as a result of WwTWs. The mitigation described earlier in this report has been assessed as adequate to deliver nutrient neutrality.

9. Flood risk

- 9.1. A Strategic Flood Risk Assessment was undertaken to take account of best practice, the latest guidance and the most up to date information;
- Using the latest flood risk datasets, assess the flood risk to and from the borough from all sources, now and in the future, as well as assess the impact that cumulative land use changes and development in the area will have on flood risk;
 - Identify updated requirements for site-specific flood risk assessments and the application of Sustainable Drainage Systems;
 - To provide a comprehensive set of maps presenting flood risk from all sources that can be used as part of the evidence base for the Local Plan Review; and
 - Provide the flood risk data to inform the application of the Sequential Test and, if necessary, the Exception Test.

- 9.2. Additionally, the Sustainability Appraisal considered the plan against the need to avoid and mitigate flood risk.
- 9.3. The Strategic Flood Risk Assessment, combined with the requirement for site level flood risk assessments at planning application stage, will help ensure that new development in the borough is not subject to flooding, or does not exacerbate flooding elsewhere.

10. Climate change

- 10.1. The water cycle should be considered within the context of climate change and the potential for this to exacerbate winter rain and summer drought.
- 10.2. Through its climate change and related policies, Maidstone is seeking a range of measures to mitigate against climate change. This includes the requirement for the higher standard of 110l per person per day for new housing development in the plan. The Water Cycle Study 2010 and the 2020 SFRA suggest that some Rural Service Centres are affected by significant surface water runoff which leads to problems at the WwTW's. To minimise the impact of new development on flooding, the Local Plan Review includes a requirement for new development to incorporate Sustainable Urban Drainage Systems on all new qualifying development sites.

11. Conclusion

- 11.1. This document has set out the main issues and risks associated with the water environment of Maidstone Borough. It highlights the steps MBC has taken to identify ways in which development in the plan can be delivered in a way that minimises or negates its impact on the water environment. These measures include taking into account water quality and quantity pressures in developing its spatial strategy, as well as incorporating measures within local plan policies.
- 11.2. MBC will continue to place significant emphasis on the protection of its water environment, and has made a commitment to further review its Water Cycle Study in advance of the next Local Plan Review.

Appendix 1 – Lenham Broad Location baseline nutrient budgets



Maidstone Local Plan - Lenham

Nutrient Impact Assessment and Mitigation Screening

On behalf of **Maidstone Borough Council**

Project Ref: 332410501/200 | Rev: A | Date: April 2021

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For and on behalf of Stantec UK Limited				

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A	09/04/2021	For Information	KT	PD	PJ

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1 Introduction

1.1 Scope of the Report

1.1.1 This Nutrient Impact Assessment and Mitigation Screening (NIAMS) has been prepared by Stantec on behalf of our Client, Maidstone Borough Council, to support the local plan development for sites in Lenham, Kent.

1.1.2 The purpose of this NIAMS is to undertake an initial desk based assessment of the development proposals and a high level review of potential mitigation options should they be required. The assessment will make suitable recommendations to further work where appropriate.

1.1.3 The information given within this report is based on publicly available data at the time of writing and no discussions with consultees have been undertaken.

1.2 Sources of Information

1.2.1 The NIA has been prepared base on the following sources of information:

- 'Advice on Achieving Nutrient Neutrality for New Development in the Stour Catchment in Relation to Stodmarsh Designated Sites' (version 2) prepared by Natural England dated November 2020;
- Nitrate Vulnerable Zone Designation 2017 – Eutrophic Waters (Estuaries and Coastal Waters) dated June 2016;
- Defra Magic Map website ^[6];
- River Basin Management Plan '*Thames River Basin District*' prepared by DEFRA and EA, dated 2015.

1.3 Development Proposals

1.3.1 As part of the Local Plan development, there are 8 proposed allocated residential developments within Lenham which lie in the Stour catchment as defined in the Natural England guidance.

1.3.2 Each site contains varying numbers of proposed dwellings, greenspace, play provision and other masterplan requirements.

1.3.3 Based on the location of all the sites, it has been assumed that the foul drainage from each will go to Lenham Wastewater Treatment Works (WwTW).

⁶ <https://magic.defra.gov.uk/MagicMap.aspx>

1.3.4 Plans showing existing land uses, hydrological setting and WwTW catchment are provided in Appendix A. A copy of concept masterplans for each site are presented in Appendix B to J.

2 Planning Policy and Guidance

2.1 National Planning Policy and Legislation

The Water Framework Directive

2.1.1 The Water Framework Directive (WFD) (Commission of the European Communities, 2000) (ref 13.2) establishes a framework for a European-wide approach to action in the field of water policy. Its ultimate aim is to ensure all inland and near shore watercourses and water bodies (including groundwater) are of 'Good' status or better, in terms of ecology, and also chemical, biological and physical parameters, by the year 2027. Therefore, any activities or developments that could cause detriment to a nearby water resource or prevent the future ability of a water resource to reach its potential status, must be mitigated to reduce the potential for harm and allow the aims of the Directive to be realised.

2.1.2 The Environment Agency (EA) Catchment Data Explorer website has water quality data available for watercourses. This includes background data on the catchment, the existing standards of water quality and expected standards of water quality the watercourse is expected to achieve by set dates which are reviewed on a seven yearly cycle. Also included are any national or local protected areas.

The Conservation of Habitats and Species and Planning Regulations 2018

2.1.3 The objective of the Habitats Directive is to protect biodiversity through the conservation of natural habitats and species of wild fauna and flora. The Habitats Directive is legislation for the protection, management and exploitation of such habitats and species. The first non-statutory stage is a preliminary 'screening' to determine whether the plan or project is likely to have a significant effect on a protected site and the second stage is for an assessment to be undertaken to determine the impact of development proposals on the site's conservation objectives.

2.1.4 Regulation 63 is *assessment of implications for European sites and European offshore marine sites*. Which states *before deciding to undertake, or give any consent, permission or other authorisation for, a plan or project which is likely to have a significant effect on a European site or a European offshore marine site must make an appropriate assessment of the implication of the plan or project for that site in view of that site's conservation objectives.*

2.2 Local Planning Policy

Advice on Achieving Nutrient Neutrality for New Development in the Stour Catchment in Relation to Stodmarsh Designated Sites

2.2.1 Natural England prepared the '*Advice on Achieving Nutrient Neutrality for New Development in the Stour Catchment in Relation to Stodmarsh Designated Sites*' (version 2) guidance in November 2020. This guidance was developed to be applied to all types of development that would result in a net increase in population served by a wastewater system, including new homes, student accommodation, tourism attractions and tourist accommodation.

2.2.2 In relation to planning context, the guidance explains that there are likely significant effects on internationally designated sites due to the increase in wastewater from the new developments coming forward; this includes Special Protection Area (SPA), RAMSAR sites, Special Areas of Conservation (SAC), Site of Special Scientific Interest (SSSI) and National Nature Reserve (NNR). Appropriate assessments should be undertaken with conclusions capable of removing all reasonable scientific doubt as the effects of the works proposed on the protected site

concerned. The guidance states that '*the achievement of nutrient neutrality, if scientifically and practically effective, is a means of ensuring that development does not add to existing nutrient burdens.*'

2.2.3 The environmental context is highlighted by Natural England's assessment of designated site conditions in the Stodmarsh SPA/SAC/SSSI to evaluate the levels of nitrogen and phosphorous within the water environment resulting in them being classified as: Unfavourable No Change, Unfavourable Recovering, or Favourable High Risk.

2.2.4 The guidance provides a methodology for calculating the nutrient budgets. The calculation of nutrient budgets for new development shows that development either avoids harm to protected sites or provides the level of mitigation required to ensure that there are no adverse effects. The methodology is for all types of development that would result in a net increase in population served by a wastewater system, including new homes, student accommodation, tourism attractions and tourist accommodations. As these developments will have inevitable wastewater implications.

2.2.5 The Stodmarsh water environment is internationally important for its wildlife and is protected under the Water Environment Regulations (2017) and the Conservation of habitats and Species Regulations (2017) as well as national protection for many parts of the floodplain catchment. The high levels of nitrogen and phosphorous inputs into this water environment are causing eutrophication at part of these designated sites.

2.2.6 DEFRA and partnership funded Catchment Sensitive Farming (CSF) programmes work with agriculture to reduce diffuse agricultural sources of pollution such as fertiliser and slurry runoff. Agricultural phosphorous is not considered to require separate consideration in the Stour catchment, and many measures primarily aimed at addressing agricultural nitrogen will also help reduce agricultural diffuse phosphorous. In addition, the wastewater treatment works (WwTW) that enter into the catchment of Stodmarsh are the subject of an

investigation under Water Industry National Environment Programme (WINEP) which will determine the extent of the connection of WWTW and sewerage assets to the Stodmarsh lakes and to what extent the existing WWTW discharges and other company assets are contributing to the existing water quality failures and risk of failures. The primary objective of the WINEP investigation is to assess what improvements are required (if any) to the water company assets needed to enable the achievement of the agreed lake standards.

Environment Agency River Basin Management Plan – Thames River Basin District

2.2.7 The purpose of the River Basin Management Plan is to provide a framework for protecting and enhancing the benefits provided by the water environment. The plan sets objectives for each quality element in every water body, including an objective for the water body as a whole. For most water bodies, the default objective status is 'Good'. However, for some water bodies a less stringent objective may have been set where natural conditions, technical feasibility or disproportionate cost make the improvement of the water body impractical.

2.2.8 The plan provides a framework for action and future regulation by summarising the existing mechanism that is used to manage the quality of the water environment. It also summarises the type of action and who needs to do this to achieve the statutory objectives.

2.2.9 The report states that '*pollution from wastewater is affecting 45% of waterbodies and pollution from rural areas is affecting 27% of water bodies*' in the river basin district. For the Medway catchment the priority river basin management issues are physical modifications to the river, water quality, and water flows and availability.

Environment Agency Basin Management Plan – South East Basin District

2.2.10 The purpose of the River Basin Management Plan is to provide a framework for protecting and enhancing the benefits provided by the water environment. The plan sets objectives for each quality element in every water body, including an objective for the water body as a whole. For most water bodies, the default objective status is 'Good'. However, for some water bodies a less stringent objective may have been set where natural conditions, technical feasibility or disproportionate cost make the improvement of the water body impractical.

2.2.11 The plan provides a framework for action and future regulation by summarising the existing mechanism that is used to manage the quality of the water environment. It also summarises the type of action and who needs to do this to achieve the statutory objectives.

2.2.12 The report states that '*pollution from wastewater is affecting 40% of waterbodies and pollution from rural areas is affecting 30% of water bodies*' in the river basin district. For the Stour catchment the priority river basin management issues are low fish populations, high phosphate levels resulting from point-source discharges from wastewater treatment works, diffuse run-off from urban areas and agriculture, and low flows due to abstraction for public supply, commerce, and agriculture.

3 Assessment the Impact of Nutrients

3.1 Achieving Nutrient Neutrality

3.1.1 There is evidence showing high levels of nitrogen and phosphorous input to the environment causing eutrophication at sites with environmental designations. These nutrient inputs are often currently caused by wastewater from existing housing and agricultural sources, and there is uncertainty as to whether new growth will further deteriorate designated sites.

3.1.2 One way to address this uncertainty if for new developments to achieve nutrient neutrality. Nutrient neutrality is a means of ensuring that that development does not add to existing nutrient burdens and this provides certainty that the whole of the scheme is deliverable in line with the requirements of the Conservation of Habitats and Species Regulation 2017 (as amended).

3.1.3 Natural England have set out the planning and environmental context for nutrient neutral approach as well as a practical methodology to calculating how nutrient neutrality can be achieved, discussed previously in **Section 2.2**. Natural England's guidance states that *'the achievement of nutrient neutrality, if scientifically and practically effective, is a means of ensuring that development does not add to existing nutrient burdens'*.

Types of Nitrogen

3.1.4 The key measurement is total nitrogen (TN), i.e. both organic and inorganic forms of nitrogen (N), because this is what is available for plant growth. TN is the sum of inorganic forms – nitrate-nitrogen ($\text{NO}_3\text{-N}$), nitrite-nitrogen ($\text{NO}_2\text{-N}$), ammonia – and organically bonded nitrogen.

3.1.5 TN in sewage final effluent from Wastewater Treatment Works (WwTW) is measured when there is a permit with a total nitrogen limit consent. Nitrate is normally the largest component of total nitrogen, but quantities of organic nitrogen are significant.

Types of Phosphorous

3.1.6 The forms of phosphorous need to be recognized when calculating nutrient budgets. The key measure for still and very slow flowing waters such as lakes or ditches is total phosphorous (TP) (plus in most cases total nitrogen) because this is available for algae and plant growth. For rivers the designated sites standards are for Soluble Reactive Phosphorous (SRP) as both an annual and a growing season mean. The relationship between SRP and TP is not straight forward and can vary between, and even within catchments. Modern WwTW permits usually have values for total phosphorous and the Environment Agency guidance on technically achievable limit (TAL) is for total phosphorous.

3.1.7 Total phosphorous (TP), has been chosen for the current methodology as it is applicable to the lake habitats at Stodmarsh. Though there is some uncertainty from these different forms of phosphorous, this is taken into account at the end of the methodology by the addition of a correction factor.

3.2 Methodology

3.2.1 The methodology outlined by Natural England for calculating Nutrient Neutrality is split into 4 stages.

3.2.2 For some parts of Lenham, the surface water flows lie outside of the Stour catchment and thus the existing nutrients are not contributing to the failures or risk of failures of the Stodmarsh designated site and cannot be used to offset the nutrient from wastewater. Therefore, only

Stages 1 and 4 of the Natural England methodology are required to complete the assessment (paragraph 4.7 of the Natural England Nutrient Neutrality guidance November 2020).

Stage 1

3.2.3 The aim of Stage 1 is to calculate TN and TP in kilograms per annum derived from the development that would exit the WwTW after treatment.

3.2.4 To determine the additional population the occupancy rate of 2.4, based on the latest Office for National Statistics figure, is applied to the Net number of New Houses as detailed within the sites development proposals. The figure of 2.4 is suitably precautionary and is based on best available evidence.

3.2.5 The nutrient load is calculated from the scale of water used and thus the higher water efficiency standards under the building regulations would minimise the increase in nitrogen from the development. It is Natural England's view that it is reasonable for the authorities to assume that households will achieve the 110 litres per person per day target in perpetuity and this precautionary approach should be adopted in the calculation.

3.2.6 For most planning applications the WwTW provider is not confirmed until after the planning permission is granted. The nutrient calculation should be based on the permit levels of the most likely WwTW.

Stage 2

3.2.7 The aim of Stage 2 is to adjust the Nitrogen/Phosphorous Load to offset the existing nutrient load from current land.

3.2.8 The nutrient loss from agricultural land has been modelled using a Farmscoper model run for the Stour Management Catchment for Stodmarsh. This model has been used to estimate the loss of nutrients from different farm types in relevant catchments and these are provided in **Table 3.1**.

Farm Type	Nitrate-Nitrogen (kg/ha)	Phosphorous (kg/ha)
Cereals	27.3	0.36
Dairy	58.3	0.49
General Cropping	27.9	0.28
Horticulture	18.5	0.18
Pig	60.3	0.34

Lowland Grazing	12.2	0.24
Mixed	31.5	0.27
Poultry	60.3	0.34
Average for catchment area	23.5	0.28

Table 3.1 Farming types and average nutrient loss per farm type in Stour management catchment area.

3.2.9 It is recommended that the selection of the farm type is based on last 10 years land use and professional judgement as to what the land would revert to in the absence of the proposed development. There may be areas of a greenfield development site that are not currently in agricultural use and have not been used as such for the last 10 years. In these cases, there is

no agricultural input into the land. If these sites are in private ownership and they are not subject to unmanaged recreational use (such as dog walking), these areas should be given a baseline nutrient leaching value of 5 kg N/ha/yr and 0.14kg P/ha/yr for nitrogen and phosphorous respectively. These figures cover nitrogen and phosphorous loading from atmospheric deposition, pet waste and nitrogen fixing legumes.

3.2.10 For the redevelopment of urban land, the nitrogen and phosphorous leaching rates would be 14.3 kg N/ha/yr and 0.83 kg P/ha/yr in Stage 2 and 14.3 kg N/ha/yr and 0.83 kg P/ha/yr in Stage 3. If there is no change in site area, these areas can be excluded from the calculation.

Stage 3

3.2.11 The aim of Stage 3 is to adjust the nitrogen and phosphorus loads to account for land uses with the proposed development. This includes the nutrient load from the proposed urban development and from the new open space including any Suitable Alternative Natural Greenspace (SANG), Nature Reserves or Bird Refuge Areas. Where there is no proposed change to land use, this land should be excluded from the nitrogen budget as there will be no change to nutrient load from this area.

3.2.12 The land use change element of the methodology underestimate total nitrogen leaching. Therefore, it is advised that a precautionary buffer approach is adopted.

Stage 4

3.2.13 The aim of Stage 4 is to calculate the net change in the Total Nitrogen and Total Phosphorus load that would result from the development.

3.2.14 The net change is calculated by the difference between the Total Nitrogen and Total Phosphorous load calculated for the proposed development and that for the existing land use, using the best available data and evidence. A precautionary buffer is used to recognise that uncertainty with the data and ensures the approach is precautionary.

3.2.15 A nutrient budget calculation has been undertaken for each development and are presented in Appendix A to J.

4 Need for Mitigation

4.1 Nutrient Surplus

4.1.1 If there is a nutrient surplus, then mitigation is required to achieve nutrient neutrality.

4.2 Options for Mitigation

4.2.1 Mitigation can be 'direct' through upgrading sewage treatment works and through alternative measures, e.g. interceptor wetlands or 'indirect' by offsetting the nitrogen generated from new development by taking land out of nitrogen intensive uses, e.g. where fertiliser is applied to crops. Mitigation measures will need to be secured for the duration over which the development is causing the effects, generally 80-125 years.

4.2.2 Natural England guidance suggest the following types of mitigation:

- Conversion of agricultural land for community and wildlife benefits: Permanent land use change by converting agricultural land with higher nitrogen/ phosphorous loading to alternative uses with lower nitrogen/ phosphorous loading,
- On-site options: increase the size of the SANGs and Open Space provision for the development on agricultural land that reduces the nitrogen/ phosphorous loss from this source. This land can buffer existing nature reserves and ancient woodland. It can also create priority habitats such as heathland, saltmarsh, wetland or conservation grassland.
- Off-site options: to acquire, or support others in acquiring, agricultural land elsewhere within the Stour river catchment area.
- Woodland Planting: Woodland planting on agricultural land is a means of securing permanent land use change without necessitating land purchase. The minimum level of woodland planting required to be considered land use change is 20% canopy cover at maturity. In very broad terms, this equates to 100 trees per hectare, although this is dependent on the type of trees planted and there are also options that this can be achieved by natural regeneration, especially if adjacent to existing native woodland. In the Stour Valley this should be achieved by use of native broadleaf species of local provenance, to secure wider biodiversity gains and reduce risk of non-native species and disease spread to the existing internationally protected woodland in the valley. A nitrogen leaching rate from semi-natural native woodland planting is likely to equate to 5kg/ha/yr and phosphorous of 0.02 kg/ha/yr.
- Wetlands: Wetlands can be designed as part of a sustainable urban drainage (SUDs) system, taking urban runoff stormwater; discharges from Wastewater Treatment Works (WwTWs) can be routed through wetlands; or the flow, or part of the flow, of existing streams or rivers can be diverted through wetlands provided this does not adversely alter the ecological status of the river and does not increase flood risk. Environment Agency advice should always be sought in design of any wetland creation scheme.

- WwTW upgrades: Upgrades to WwTW that are managed by the water sector are undertaken through a specific water industry regulatory process. Securing upgrades to WwTW can only be achieved via this regulatory process.

4.2.3 Detailed consideration should be given to the location and catchment of the proposed mitigation measures in relation to the impact of the development on the designated sites.

4.2.4 A mitigation screening exercise has been undertaken for each development and are presented in Appendix A to J.

5 Summary

5.1.1 This NIAMS has been prepared to support local plan development at Lenham, Kent. The information given within this report is based on publicly available data at the time of writing and no discussion with consultees have been undertaken.

5.1.2 Based on the locality of all sites, that the foul water will be treated at Lenham Wastewater Treatment Works.

5.1.3 A nutrient neutrality assessment was undertaken based on each sites proposals individually and is presented in the appendices. Each assessment concludes that there is a need for mitigation on all the sites and the appended notes provide a screening of potential options.

5.1.4 Mitigation measures will need to be secured for the duration over which the development is causing the effects, generally 80-125years. Natural England guidance suggests a range of options that should be used in combination with each other.

Appendix A Baseline Data

Figure 1 – Existing Land Use

Figure 2 – Lenham Wastewater Treatment Works catchment

Figure 3 –Surface Water catchments



Client

Maidstone Borough
Council

MAIDSTONE LOCAL PLAN - LENHAM

Existing Land Use

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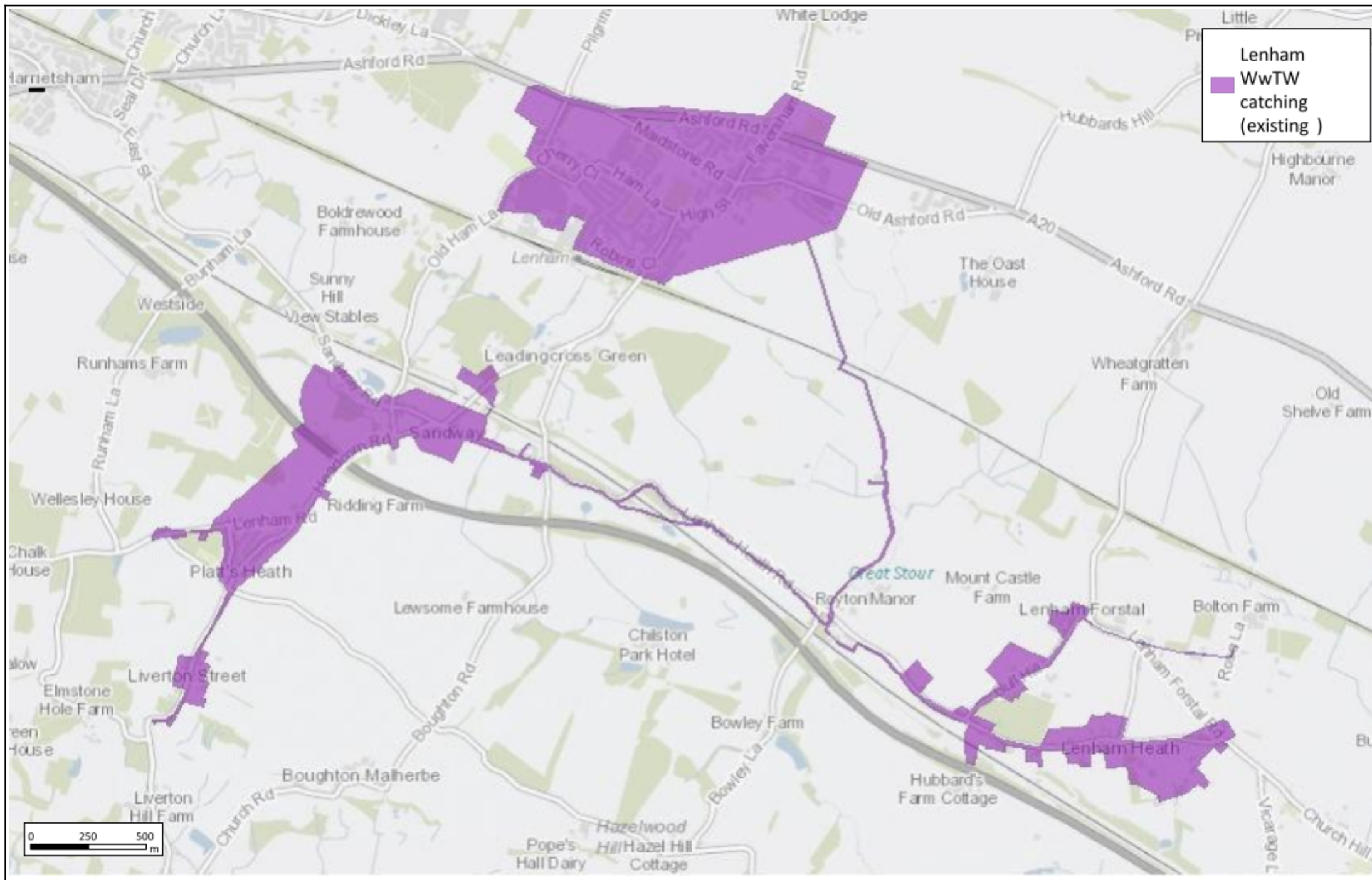
Date: 09/04/2021

Drawn: KT

Checked: PJ

Figure 01

Rev A





Client

Maidstone Borough
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MAIDSTONE LOCAL PLAN - LENHAM

Southern Water Lenham Wastewater
Treatment Works Catchment

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Figure 02

Rev A





Client

Maidstone Borough
Council

MAIDSTONE LOCAL PLAN - LENHAM

Surface Water Catchment

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics,
CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User
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Figure 03

Rev A

Job Name: Maidstone Local Plan - Lenham

Job No: 332410501/200

Note No: TN001

Date: 19th March 2021

Prepared By: K Thistlethwaite

Subject: Nutrient Impact Assessment and Mitigation Screening – Progress Note

1 Introduction

1.1 Scope

1.1.1 This technical note provides an update on the progress of the Nutrient Impact Assessment and Mitigation Screening (NIAMS) which is being prepared by Stantec on behalf of our Client, Maidstone Borough Council, to support the local plan development for sites in Lenham, Kent.

1.1.2 The technical note presents the preliminary results from an initial desk-based assessment of the development proposals undertaken and the screening of potential mitigation options should they be required.

2 Development Proposals

2.1.1 As part of the Local Plan development, there are 8 proposed allocated residential developments within Lenham which also lie in the Stour catchment as defined by the Natural England guidance.

2.1.2 Each site contains varying numbers of proposed dwellings, greenspace, play provision and other masterplan requirements. A summary of which is presented in Table 2.1 alongside the existing land uses. A copy of concept masterplans for each site are appended to this note. Based on the location of all the sites, it has been assumed that the foul drainage from will go to Lenham Wastewater Treatment Works (WwTW).

		Site 1	Site 2	Site 3	Site 4	Site 4a	Site 4b	Site 5	Site 5a	Site 6	Site 7	Site 8
Houses	Net number of new houses	100	110	230	110	50	72	360	136	50	53	102
Current land use (ha)	Urban						1.57			1.88		
	Lowland Grazing			9.65	3.76	1.57	1.3				1.82	
	Woodland		3.96		0.1		0.03					
	Cereals	11.89						18.6	8.09			5.2
Proposed Land uses	Urban including play and sport	6.37	2.81	8.58	3.59	1.13	2.22	13.4	5.36	1.88	1.71	4.6

(ha)	Greenspace/SANG	5.52	1.15	1.09	0.25	0.44	0.69	4.7	2.73		0.11	0.7
	Allotment							0.5				

Table 2.1 Development proposals and existing land use summary

3 Assessment of Nutrient Impact.

3.1 Methodology

- 3.1.1 The calculation for the nutrient budget resulting from the proposed development providing an assessment of the nutrient impacts has been undertaken for the site following the methodology outlined by Natural England which will be presented in Section 3 of the NIAMS.

Stage 1

- 3.1.2 The aim of Stage 1 is to calculate TN and TP in kilograms per annum derived from the development that would exit the WwTW after treatment. The guidance indicates that Southern Water have a current TP permit of 1mg/l and no TN permit, so the suggested value of 27 mg/l has been applied.
- 3.1.3 The guidance indicates that Southern Water have a proposed new phosphorous permit level for Lenham by 2024 of 0.5mg/l. As result a scenario based on the 2024 permit has also been calculated. The 2024 scenario should only be applied to mitigation strategies of development proposals which will not be built and occupied until after 2024.
- 3.1.4 The occupancy rate has been set at 2.4, and the water usage as 110 litres per person per day, as recommended by Natural England.

Stage 2

- 3.1.5 The aim of Stage 2 is to adjust the Nitrogen/Phosphorous Load to offset the existing nutrient load from current land.
- 3.1.6 Table 2.1 detailed the existing land use for each site, to which the farming types and average nutrient loss per farm type in Stour management catchment area presented by Natural England have been applied.

Stage 3

- 3.1.7 The aim of Stage 3 is to adjust the nitrogen and phosphorus loads to account for land uses with the proposed development.
- 3.1.8 The areas for the proposed development are shown in Table 2.1. Following the natural England guidance, all play provision and sport pitches have been included within the new urban area.

Stage 4

- 3.1.9 The aim of Stage 4 is to calculate the net change in the Total Nitrogen and Total Phosphorus load that would result from the development.

3.1.10 The nutrient budgets estimated, including a 20% precautionary buffer, for all of the sites are presented in Table 3.1.

	Nitrogen requiring mitigation (kg/TN/yr)	Phosphorus requiring mitigation (kg/TN/yr)
Site 1	65.1	13.7
Site 2	374.8	15.0
Site 3	730.6	32.5
Site 4	350.9	15.2
Site 4a	155.1	6.5
Site 4b	220.9	8.7
Site 5	786.9	47.9
Site 5a	267.9	18.0
Site 6	156.1	5.8
Site 7	168.8	7.3
Site 8	230.2	14.2

Table 3.1 Calculated Nutrient Budget

3.1.11 The nutrient budgets using the 2024 scenario estimated, including a 20% precautionary buffer, for all of the sites are presented in Table 3.2.

	Nitrogen requiring mitigation (kg/TN/yr)	Phosphorus requiring mitigation (kg/TN/yr)
Site 1	65.1	7.9
Site 2	374.8	8.7
Site 3	730.6	19.2
Site 4	350.9	8.9
Site 4a	155.1	3.6
Site 4b	220.9	4.5
Site 5	786.9	27.1
Site 5a	267.9	10.2

Site 6	156.1	2.9
Site 7	168.8	4.3
Site 8	230.2	8.3

Table 3.2 Calculated Nutrient Budget using the 2024 scenario.

3.1 Nutrient Surplus

3.1.1 If there is a nutrient surplus, then mitigation is required to achieve nutrient neutrality. The results shown in Tables 3.1 and 3.2 indicate that both presently and in 2024 all sites will require mitigation to ensure no adverse effect on the integrity of the designated sites.

4 Mitigation Optioneering

4.1 Screening Exercise

4.1.1 Mitigation can be 'direct' through upgrading sewage treatment works and through alternative measures, e.g. interceptor wetlands or 'indirect' by offsetting the nitrogen generated from new development by taking land out of nitrogen intensive uses, e.g. where fertiliser is applied to crops. Mitigation measures will need to be secured for the duration over which the development is causing the effects, generally 80-125years.

4.1.2 Detailed consideration should be given to the location and catchment of the proposed mitigation measures in relation to the impact of the development on the designated sites.

4.1.3 A variety of options are presented within the Natural England guidance. Based on these, a selection of options have been considered and screened based on their ability to achieve nutrient neutrality and their feasibility within the existing masterplan.

4.1.4 The mitigation screening considers the current WwTW permit scenario only, in order to adopt a conservative approach.

4.1.5 To note, the calculation outcomes presented below are currently draft, final calculations including workings will be presented within the final NIAMS.

4.2 Arable Reversion

4.2.1 Natural England guidance notes that one way of achieving nutrient neutrality is to acquire, or support others in acquiring agricultural land which would then be converted to a less intensive form of management with lower, or zero nutrient inputs. This could include, for example, woodland planting or wildlife sites.

4.2.2 The guidance provides estimated (modelled) rates of nutrient loss from a variety of types of agricultural land. Estimated loss rates are also provided for zero-input amenity grassland and woodland. Based on these figures, and the target reductions to achieve

nutrient neutrality, it is possible to estimate the area of land under each farm type that would need to be converted.

4.2.3 Based on these estimated reductions, the area of each type of farmland that would need to be converted to achieve the target reductions for phosphorus is as shown in Table 4.1.

Farm type	Site 1				Site 2				Site 3				Site 4			
	Conversion to zero-input grassland		Conversion to woodland		Conversion to zero-input grassland		Conversion to woodland		Conversion to zero-input grassland		Conversion to woodland		Conversion to zero-input grassland		Conversion to woodland	
	Area (ha) N neutrality	Area (ha) P neutrality	Area (ha) N neutrality	Area (ha) P neutrality	Area (ha) N neutrality	Area (ha) P neutrality	Area (ha) N neutrality	Area (ha) P neutrality	Area (ha) N neutrality	Area (ha) P neutrality	Area (ha) N neutrality	Area (ha) P neutrality	Area (ha) N neutrality	Area (ha) P neutrality	Area (ha) N neutrality	Area (ha) P neutrality
Cereals	2.9	62.3	2.9	40.3	16.8	68.4	16.8	44.3	32.8	147.9	32.8	95.7	15.7	69.3	15.7	44.8
Dairy	1.2	39.1	1.2	29.1	7.0	43.0	7.0	32.0	13.7	93.0	13.7	69.2	6.6	43.5	6.6	32.4
General Cropping	2.8	97.8	2.8	52.7	16.4	107.5	16.4	57.9	31.9	232.5	31.9	125.2	15.3	108.8	15.3	58.6
Horticulture	4.8	342.5	4.8	85.6	27.8	376.2	27.8	94.0	54.1	813.6	54.1	203.4	26.0	380.9	26.0	95.2
Pigs	1.2	68.5	1.2	42.8	6.8	75.2	6.8	47.0	13.2	162.7	13.2	101.7	6.3	76.2	6.3	47.6
Lowland Grazing	9.0	137.0	9.0	62.3	52.1	150.5	52.1	68.4	101.5	325.4	101.5	147.9	48.7	152.4	48.7	69.3
Mixed	2.5	105.4	2.5	54.8	14.1	115.7	14.1	60.2	27.6	250.3	27.6	130.2	13.2	117.2	13.2	60.9
Poultry	1.2	68.5	1.2	42.8	6.8	75.2	6.8	47.0	13.2	162.7	13.2	101.7	6.3	76.2	6.3	47.6

TECHNICAL NOTE



Average for catchment	3.5	97.8	3.5	52.7	20.3	107.5	20.3	57.9	39.5	232.5	39.5	125.2	19.0	108.8	19.0	58.6
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Table 4.1 Estimated arable reversion areas to achieve neutrality.

Farm type	Site 4a				Site 4b				Site 5				Site 5a			
	Conversion to zero-input grassland		Conversion to woodland		Conversion to zero-input grassland		Conversion to woodland		Conversion to zero-input grassland		Conversion to woodland		Conversion to zero-input grassland		Conversion to woodland	
	Area (ha) N neutrality	Area (ha) P neutrality	Area (ha) N neutrality	Area (ha) P neutrality	Area (ha) N neutrality	Area (ha) P neutrality	Area (ha) N neutrality	Area (ha) P neutrality	Area (ha) N neutrality	Area (ha) P neutrality	Area (ha) N neutrality	Area (ha) P neutrality	Area (ha) N neutrality	Area (ha) P neutrality	Area (ha) N neutrality	Area (ha) P neutrality
Cereals	7.0	29.7	7.0	19.2	9.9	39.6	9.9	25.6	35.3	217.7	35.3	140.9	12.0	81.9	12.0	53.0
Dairy	2.9	18.7	2.9	13.9	4.1	24.9	4.1	18.5	14.8	136.8	14.8	101.9	5.0	51.5	5.0	38.4
General Cropping	6.8	46.6	6.8	25.1	9.6	62.2	9.6	33.5	34.4	342.1	34.4	184.2	11.7	128.8	11.7	69.3
Horticulture	11.5	163.2	11.5	40.8	16.4	217.7	16.4	54.4	58.3	1197.4	58.3	299.4	19.8	450.7	19.8	112.7
Pigs	2.8	32.6	2.8	20.4	4.0	43.5	4.0	27.2	14.2	239.5	14.2	149.7	4.8	90.1	4.8	56.3

TECHNICAL NOTE



Lowland Grazing	21.5	65.3	21.5	29.7	30.7	87.1	30.7	39.6	109.3	479	109.3	217.7	37.2	180.3	37.2	81.9
Mixed	5.9	50.2	5.9	26.1	8.3	67.0	8.3	34.8	29.7	368.4	29.7	191.6	10.1	138.7	10.1	72.1
Poultry	2.8	32.6	2.8	20.4	4.0	43.5	4.0	27.2	14.2	239.5	14.2	149.7	4.8	90.1	4.8	56.3
Average for catchment	8.4	46.6	8.4	25.1	11.9	62.2	11.9	33.5	42.5	342.1	42.5	184.2	14.5	128.8	14.5	69.3

Table 4.1(continued) Estimated arable reversion areas to achieve neutrality.

Farm type	Site 6				Site 7				Site 8			
	Conversion to zeroinput grassland		Conversion to woodland		Conversion to zeroinput grassland		Conversion to woodland		Conversion to zeroinput grassland		Conversion to woodland	
	Area (ha) N neutrality	Area (ha) P neutrality	Area (ha) N neutrality	Area (ha) P neutrality	Area (ha) N neutrality	Area (ha) P neutrality	Area (ha) N neutrality	Area (ha) P neutrality	Area (ha) N neutrality	Area (ha) P neutrality	Area (ha) N neutrality	Area (ha) P neutrality
Cereals	7.0	26.3	7.0	17.0	7.6	33.3	7.6	21.5	10.3	64.5	10.3	41.8
Dairy	2.9	16.5	2.9	12.3	3.2	20.9	3.2	15.6	4.3	40.6	4.3	30.2
General Cropping	6.8	41.3	6.8	22.2	7.4	52.3	7.4	28.2	10.1	101.4	10.1	54.6

Horticulture	11.6	144.5	11.6	36.1	12.5	183.1	12.5	45.8	17.1	355.0	17.1	88.7
Pigs	2.8	28.9	2.8	18.1	3.1	36.6	3.1	22.9	4.2	71.0	4.2	44.4
Lowland Grazing	21.7	57.8	21.7	26.3	23.4	73.3	23.4	33.3	32.0	142.0	32.0	64.5
Mixed	5.9	44.5	5.9	23.1	6.4	56.4	6.4	29.3	8.7	109.2	8.7	56.8
Poultry	2.8	28.9	2.8	18.1	3.1	36.6	3.1	22.9	4.2	71.0	4.2	44.4
Average for catchment	8.4	41.3	8.4	22.2	9.1	52.3	9.1	28.2	12.4	101.4	12.4	54.6

Table 4.1(continued) Estimated arable reversion areas to achieve neutrality.

4.3 Onsite Package Treatment Plant and Surface Water Wetland

4.3.1 The guidance provides an alternative Stage 1 methodology for sites which propose to discharge foul water to an onsite package treatment plant (PTP) rather than a connecting to the Southern Water system. Applying this method allows for the calculation of PTP efficiency rates required in order to achieve neutrality and from which the implied concentration in the effluent can be estimated. The calculation of implied concentration allows for checking against industry standard limits, thus determining the feasibility of using a PTP to achieve neutrality.

4.3.2 Also presented in the guidance, are the median removal rate for wetlands based on Land et al, (2016). The rates are 93g/m²/yr TN and 1.2 g/m²/yr TP (or just under a tonne/ha/year TN and 12 kg/ha/yr TP). These can be used to estimate the area of wetland required to treat the surface water (only) resulting from the site, which in combination with a PTP could be used to achieve neutrality.

4.3.3 Applying this method, Table 4.2 shows the calculated PTP efficiency rates and implied effluent concentrations alongside the estimated surface water wetland size.

	Site 1	Site 2	Site 3	Site 4	Site 4a	Site 4b	Site 5	Site 5a	Site 6	Site 7	Site 8
N Efficiency Rate require to achieve neutrality	61.4	97.9	70.9	76.2	95.4	83.7	83.2	80.7	93.6	95	83.4
P Efficiency Rate require to achieve neutrality	98.2	99.8	99.1	99.3	99.7	98.9	99.2	99.1	98.7	99.7	99.2
Implied effluent concentration of N	33.69	1.87	25.38	20.73	3.98	14.18	14.64	16.85	5.58	4.35	14.44
Implied effluent concentration of P	0.44	0.05	0.21	0.18	0.08	0.28	0.19	0.22	0.32	0.09	0.19
Surface water wetland area (ha)	0.6	0.25	0.7	0.3	0.1	0.2	1.2	0.5	0.2	0.1	0.4

Table 4.2 Onsite PTP and surface water wetland parameters

4.4 Integrated Catchment Wetlands

4.4.1 Integrated Constructed Wetlands (ICWs) are natural treatment technologies that efficiently treat many different types of water and could be an offsite option for sites in order to achieve nutrient neutrality.

4.4.2 Although the removal performances vary, the majority of the studies that reported efficiency of ICW systems treating agricultural drainage water showed improvement of water quality. These systems exhibit average removal of 1175 kg TN/ha/yr and 157 kg TP/ha/yr⁷⁸⁹.

4.4.3 Based on rates presented by Natural England and those stated above from other studies, the ICW sizing estimates are presented as a range in Table 4.3. It is recommended that the values calculated using Natural England guidance should be used in the first instance until such a time as the higher removal rates are accepted by relevant stakeholders including Natural England.

	Site 1	Site 2	Site 3	Site 4	Site 4a	Site 4b	Site 5	Site 5a	Site 6	Site 7	Site 8
Area (ha) required to achieve Neutrality	0.09 - 1.14	0.32 - 1.25	0.62 - 2.71	0.30 - 1.27	0.13 - 0.54	0.19 - 0.73	0.67 - 3.99	0.23 - 1.50	0.13 - 0.48	0.14 - 0.61	0.20 - 0.18

Table 4.3 Estimated ICW sizing range

DOCUMENT ISSUE RECORD

Technical Note No	Rev	Date	Prepared	Checked		Reviewed (Discipline Lead)	Approved (Project Director)
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⁷ Wallace and Knight, Small Scale Constructed Wetland Treatment Systems: Feasibility, Design Criteria and O&M Requirements (WERF, 2006)

⁸ Kadlec and Wallace, Treatment Wetlands, 2nd Edition (CRC Press, 2009)

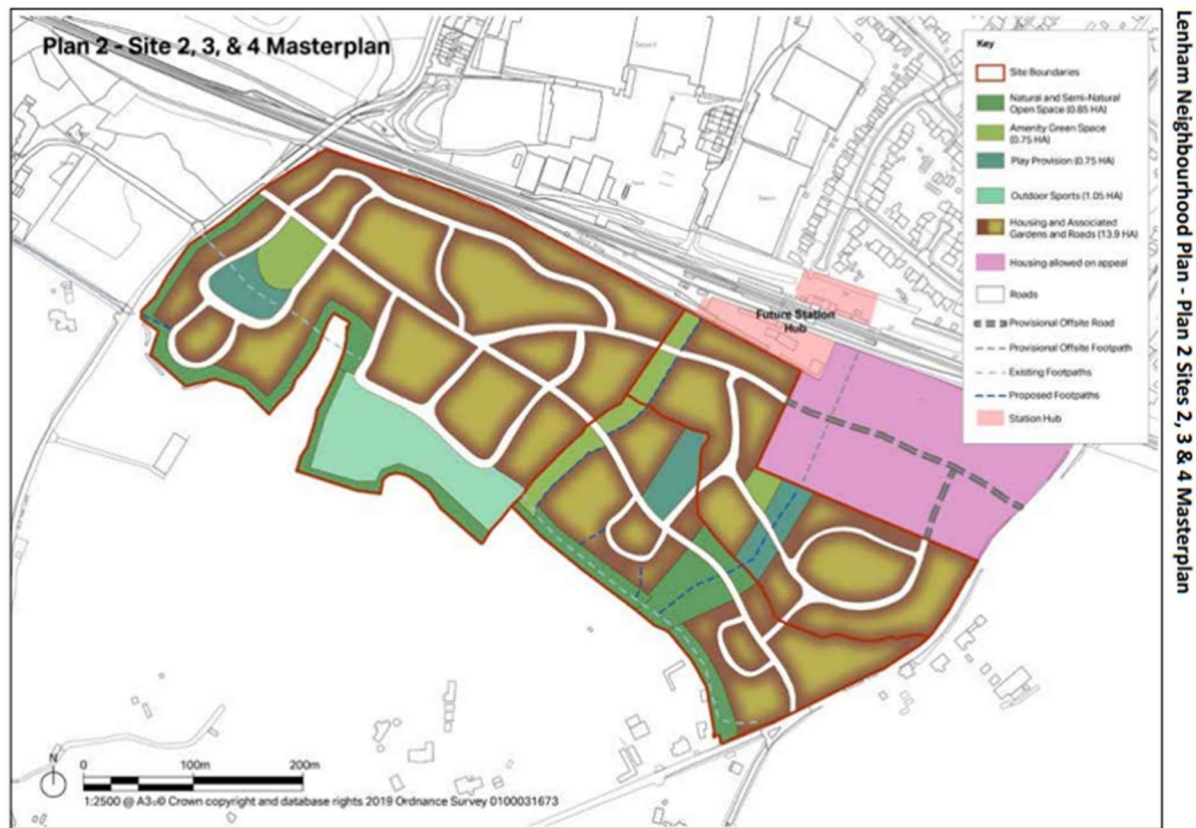
⁹ "Designing wetlands for specific application", in Wetland Technology: Practical information on the design and application of treatment wetlands, ed. Langergraber, Dotro, Nivala, Stein, Rizzo (2019)

Site 1



Appendix B

Site 2, 3 and 4



Site 4a

[illegible]

Appendix D

Site 4b



Appendix E

Site 5, 6, and 7



Appendix F

Site 5a



Appendix G

Site 8

