LITTLEBOURNE, EVENHILL

LITTLEBOURNE, CANTERBURY

NUTRIENT NEUTRALITY ASSESSMENT AND MITIGATION STRATEGY

GLADMAN

DOCUMENT REFERENCE:

21045-NUT-RP-01 | P01

WATER | ENVIRONMENT

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Authorisation and Version Control

This Nutrient Neutrality Assessment was commissioned by Gladman to investigate and mitigate against the concerns raised by Natural England regarding the nutrient neutrality of the proposed development near Littlebourne, Canterbury and the potential adverse effects on downstream designated sites.

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Approver:	Guy Laister Director	

for and on behalf of Water Environment Limited

Document Version History

Rev	Date	Comments	Auth	Chck	Appr
P01	20/01/2023	Draft Issue	CMG	GL	GL
C01	14/02/2023	Final Issue	CMG	GL	GL

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EXECUTIVE SUMMARY

In 2018, the European Court of Justice refined the definition of plans and projects and ruled that mitigation needs to be in place to ensure that there will be no significant adverse impacts on the conservation status of designated sites. Additional nutrient loading to designated sites already in an unfavourable conservation status is effectively therefore not permissible unless mitigation is in place. This ruling has come to be known as 'The Dutch Case'.

In the Stour River catchment in East Kent, developments could adversely impact the designated site known as Stodmarsh. Several of the nature reserve lakes of which the Stodmarsh is composed are in a state of eutrophication (an unfavourable conservation status) and therefore the ruling of the Dutch Case applies. All developments in the catchment have to demonstrate 'nutrient neutrality' in order to ensure no adverse effect on the integrity of the designated site, meaning that the nutrients generated by the development must be less than or equal to the nutrients generated by the existing land use.

The application site is 15.77 ha in size and is located on the southwestern edge of Littlebourne, a village located approximately 3.5 km to the east of Canterbury in Kent.

The proposal is the development of up to 300 dwellings and their associated infrastructure, green areas and amenities.

The Dover Connectivity Study, undertaken on behalf of Dover District Council confirms that impacts of nutrients in treated effluent from Dambridge WwTW on Stodmarsh are negligible. Based on the methodology used in the study, impacts from all nutrient sources upstream of the Stourmouth Pumping Station are considered negligible. The proposed development is located upstream of the Stourmouth Pumping Station, and so this argument will apply.

Wastewater will be treated onsite before discharge of final effluent to the Nail Bourne, which is a tributary of the Little Stour. The onsite treatment works will be operated by an Ofwat-licensed water company.

ABBREVIATIONS

Acronym	Definition
AA	Appropriate Assessment
EA	Environment Agency
CCC	Canterbury City Council
DDC	Dover District Council
DCS	Dover Connectivity Study
HRA	Habitats Regulations Assessment
LPA	Local Planning Authority
NE	Natural England
SAAR	Standard Annual Average Rainfall
SPA	Special Protection Area
SSSI	Sites of Special Scientific Interest
SuDS	Sustainable Urban Drainage
TN	Total Nitrogen
TP	Total Phosphorus
WwTW	Wastewater Treatment Works

1 INTRODUCTION

1.1 The application site is 15.77 ha in size and is located on the southwestern edge of Littlebourne, a village located approximately 3.5 km to the east of Canterbury in Kent, under the jurisdiction of Canterbury City Council (CCC), who act as the Local Planning Authority (LPA).

1.2 The application is for the erection of up to 300 dwellings with public open space, landscaping, sustainable drainage systems (SuDS), and vehicular access point.

1.3 As the site lies within the catchment of a European and internationally designated site – Stodmarsh – a Habitats Regulations Assessment (HRA) is required.

Background

1.4 A HRA refers to the several distinct stages of assessment which must be undertaken in accordance with the Conservation of Habitats and Species Regulations 2017 (as amended) to determine if a plan or project may affect the protected features of a habitats site (any site which would be included within the definition at Regulation 8 of the Conservation of Habitats and Species Regulations 2017) before deciding whether to undertake, permit or authorise it.

1.5 A significant effect should be considered likely if it cannot be excluded on the basis of objective information and it might undermine a site's conservation objectives. A risk or a possibility of such an effect is enough to warrant the need for an Appropriate Assessment (AA) to be carried out by the competent authority. 'Appropriate' is not a technical term. It indicates that an assessment needs to be proportionate and sufficient to support the task of the competent authority in determining whether the plan or project will adversely affect the integrity of the habitats site. An AA must contain complete, precise, and definitive findings and conclusions to ensure that there is no reasonable scientific doubt as to the effects of the proposed plan or project.[1]

1.6 In 2018, the European Court of Justice refined the definition of plans and projects in the so-called 'Dutch case' ruling that mitigation needs to be certain at the time of assessment to ensure that there will be no adverse effect on the conservation status of European designated sites which already exceed compliance limits[2].

1.7 Nutrient neutrality is a means of ensuring that a plan or project does not add to existing nutrient burdens. Where nutrient neutrality is properly applied and the existing land does not undermine the conservation objectives, Natural England (NE) considers that an adverse effect on integrity alone and in combination can be ruled out[3].

1.8 In the Stour Valley River catchment in East Kent, developments could adversely affect Stodmarsh, which is designated a Site of Special Scientific Interest (SSSI), Special Protection Area (SPA), Special Area of Conservation (SAC) and Ramsar site. Several of the nature reserve lakes at Stodmarsh are in a state of eutrophication (an unfavourable conservation status) and therefore the ruling of the Dutch Case applies.

1.9 The practical implication of the Dutch Case across England is the necessity to mitigate increases in nutrient loading from new development including nutrients contained in surface water runoff and an increase in wastewater flows to any of the Wastewater Treatment Works (WwTW) in the relevant catchment.

[1] Guidance on the use of Habitats Regulations Assessment – https://www.gov.uk/guidance/appropriate-assessment – accessed 11/2022
[2] Joined Cases C-293/17 and C-294/17 of the European Court of Justice
[3] Wood, A., Wake, H., and McKendrick-Smith, K. (2022) 'Nutrient Neutrality Principles' Natural England Technical Information Note, TIN186

Scope of Study

1.10 The main objectives of this study are to:

- Provide an overview of NE's position with respect to water quality within the Habitats Site;
- Present calculations, based on the absence of any mitigation measures, to outline the potential increase in nutrient loading as a result of the proposed development; and
- Outline the mitigation strategy proposed to manage surface and wastewater from the proposed development and present supporting calculations to ensure that, from the first occupation of the dwellings, the proposed development is nutrient neutral.

2 WATER QUALITY IN STODMARSH

Stodmarsh Designated Sites[4]

2.1 The Stodmarsh SSSI is designated by NE for the following features of interest:

- Wetland habitats including extensive reedbeds, swamp and fen communities;
- Open water habitats including lakes, ditches, and lagoons;
- Diverse breeding and non-breeding bird communities. Two rare British birds – Cetti's warbler and bearded tit – breed here in nationally significant numbers;
- Varied invertebrate fauna, including multiple scarce moth species;
- An assemblage of vascular plants.

2.2 The Stodmarsh SPA is designated for the following features and supported species:

- Bittern (Non-Breeding);
- Gadwall (Breeding and Non-Breeding);
- Hen Harrier (Non-Breeding);
- Shoveler (Non-Breeding);
- Breeding bird assemblage;
- Waterbird assemblage;

2.3 The Stodmarsh Ramsar Site is designated, under criteria 2 of the Ramsar Convention, for:

- Wetland invertebrate assemblage;
- Wetland plant assemblage;
- Assemblage of rare wetland birds;
- Bearded tit populations (Breeding and Wintering);
- Bittern (Wintering);
- Gadwall (Breeding and Wintering);
- Hen Harrier (Wintering);
- Shoveler (Wintering);

2.4 The Stodmarsh SAC is designated for the following qualifying species:

- Desmoulin's whorl snail;

2.5 The focus of this letter is on the evidence of degrading water quality in the Stodmarsh SSSI, SPA, Ramsar and SAC, henceforth referred to as the 'Habitats Sites'.

[4] Designatedsites.naturalengland.org.uk (Accessed 01/2023)

Total Nitrogen and Total Phosphorus

2.6 It has been found that the nutrients of the highest significance in terms of water quality in the Habitats Sites are Total Nitrogen (TN) and Total Phosphorus (TP).

2.7 TN includes organic and inorganic forms of nitrogen, both of which are available for plant growth and can contribute to algal blooming. TN is the sum of inorganic forms of nitrogen – nitrate nitrogen (NO_3-N), nitrite nitrogen (NO_2-N) and ammoniacal nitrogen (NH_3-N and NH_4-N) – and organically bonded nitrogen.

2.8 TP includes all phosphorus components – phosphate phosphorus (PO_4-P), dissolved organic phosphorus and particulate phosphorus in algal and bacterial cells – and also includes mineral particles such as clay.

Water Quality

2.9 The condition of the Habitats Sites which support the designated features is in part dependent on the water quality within them. The occurrence of excessive nutrients in the Habitats Sites can impact the competitive interactions between high plant species, and between higher plant species and algae, which can result in dominance in attached forms of algae, and a loss of characteristic plant species.

2.10 Changes in plant growth and community composition can have implications for the wider food web and the species present. Increased nutrients and the occurrence of eutrophication can also affect the dissolved oxygen levels in the waterbody, which can also impact the biota within the Habitats Sites.

2.11 Algal Bloom and fish kill events have been observed in one of the Habitats Sites Lakes (SSSI Unit 010). Assessments by NE have described the condition of this lake as 'unfavourable' and indicated high nutrient levels. TP has been measured at 1000 µg/l where the target for SSSI lakes is 49 µg/l. Eutrophication, which arises as a result of increased water nutrient levels, can lead to a reduction of fish and macrophyte populations. This in turn impacts food availability for SPA/Ramsar birds and the qualifying invertebrate community. The reason for this adverse condition is quoted as 'Freshwater pollution – Water Pollution – Discharge'.

2.12 The lake within SSSI Unit 007 has also been described as 'unfavourable' and has been found to fail in reaching nationally agreed water quality targets, including an excess of nitrogen and phosphorus. The reason for this adverse condition is quoted as 'Freshwater pollution – Water Pollution – Agriculture/Runoff'.

2.13 Lakes within Units 001, 002 and 005 are described as in 'Favourable' or 'Unfavourable – recovering' condition and thus are not of concern for this assessment.

2.14 Concentrations of TN and TP have been recorded within the lakes in SSSI Units 007 and 010 above the NE SSSI Favourable Condition Targets (FCTs) of 49 µg/l TP and 1.5 mg/l TN. It is important to understand the mechanism by which these nutrients enter the Habitats Sites. Some of the major sources of TN and TP have been identified as the following[5][6]:

- WwTWs which outfall into the Stour upstream of the Habitats Sites;
- Runoff from urban and agricultural land;
- Flood waters from the River Great Stour (during both high flow and tidal events); and

[5] APEM, Stodmarsh SSSI, SPA and NNR Lake Hydrology Project Phase 1, April 2016
[6] ATKINS, Stodmarsh Lake Hydrology Study, May 2016

- Recycling of Nutrients within lake 007 itself.

2.15 In the case of TP, it has been estimated[6], that the dominant source of phosphate in the River Stour is WwTWs, accounting for 50% – 80% of concentrations in the river adjacent to the Habitats Sites.

Strategic Approach

2.16 Where sites are already in unfavourable condition due to elevated nutrient levels, NE considers that competent authorities will need to carefully justify how further inputs from new plans and projects, either alone or in combination, will not adversely affect the integrity of the site given the conservation objectives.[7]

2.17 As the site is located within the Little Stour and Wingham Operation Catchment of the Stour Management Catchment, recent studies regarding the hydrological connectivity between the Little Stour and the Habitats Sites will be considered.

[7] Natural England (16 March 2022) Letter to LPA Chief Executives and heads of planning 'Advice for development proposals with the potential to affect water quality resulting in adverse nutrient impacts on habitats sites.'

3 SITE DESCRIPTION

Location

3.1 The application site, henceforth referred to as 'the Site', is 15.77 ha in size and is located on the southwestern edge of Littlebourne, a village located approximately 3.5 km to the east of Canterbury in Kent.

3.2 The site boundary and location in respect to the Habitats Site is shown in Figure 1. The site is located in the Little Stour and Wingham Operational Catchment, and sewage from the development would normally be conveyed to Newnham Valley WwTW.

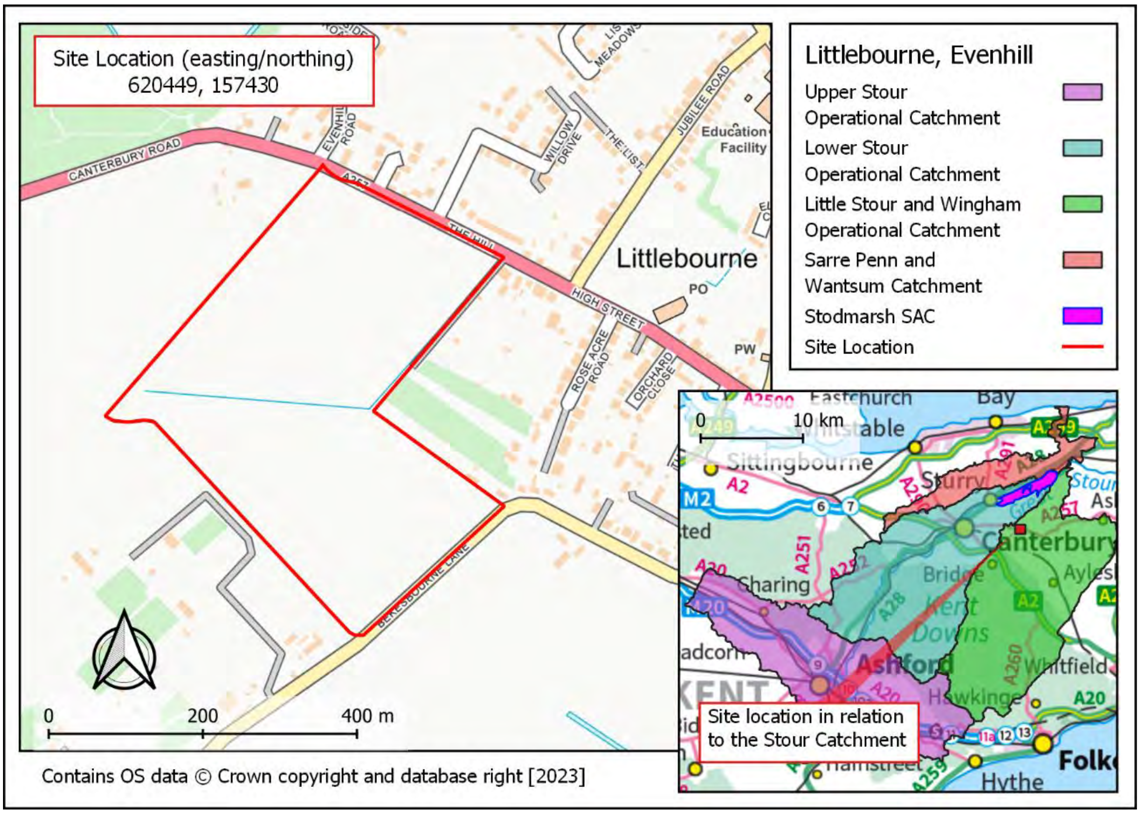

Figure 1: Location of Site

Proposed Development

3.3 The application is for the erection of up to 300 dwellings with public open space, landscaping, SuDS, and vehicular access point. All matters are reserved except for means of access.

3.4 The development framework plan for the proposed scheme is attached in Appendix A.

4 THE DOVER CONNECTIVITY STUDY

Summary

4.1 Dover District Council (DDC) engaged with NE and environmental consultants APEM, to determine the potential impacts of the districts proposed housing growth on the water quality at the Habitats Sites.

4.2 This led to the production of the Dover Connectivity Study[8] (DCS), which modelled the link between the Little Stour and the Habitats Sites. In particular, the DCS inspected the link between Dambridge WwTW and the Habitats Sites, and came to the conclusion that there was limited connectivity between the two.

4.3 In a letter written to DDC by NE on the 25th of August 2022, NE agreed with the conclusion that there is extremely limited connectivity between Dambridge WwTW and the Habitats Sites.

4.4 Additionally, NE agreed that the locations considered within the connectivity study were appropriate to determine the extent of any connectivity.

4.5 The final modelling report was issued by APEM following comments on the 12th of September 2022.

4.6 DDC have since concluded that nutrient neutrality does not apply to the district[9], and that planning applications which have been held up by the issue may now be determined without the need for an AA of the implications of the application on the Habitats Sites.

Details of the study

4.7 Dambridge WwTW lies within the area administered by DDC, and it discharges treated final effluent into the Wingham tributary of the Little Stour.

4.8 Stodmarsh is upstream of the point where the Little Stour (and Wingham) enter the Great Stour, but as the river is tidal, there is potential for upstream flow of nutrients during incoming tides.

4.9 DDC therefore commissioned an investigation into the potential connectivity between Dambridge WwTW and the Habitats Sites, and if so, under what conditions.

4.10 This was done using a modelling approach, whereby a tracer was added into the Little Stour downstream of Dambridge WwTW, at a high concentration, and the concentration at two points within the Habitats Sites was measured.

4.11 The modelling approach looked at several different conditions, and it found that in the worst-case scenario (highest concentration at the Habitats Sites), the tracer was diluted over 990,000 times between the tracer location and the receptor (Habitat Sites).

Applicability to the Site

4.12 NE agreed that, based on the results of the DCS, it could be concluded that there would be negligible impact from Dambridge WwTW on the water quality at the Habitats Sites.

4.13 The tracer was not applied at the outfall of Dambridge WwTW, as one might expect of a study looking specifically at the impact of Dambridge WwTW. Instead, it was applied 6.5 km downstream of Dambridge WwTW, at Stourmouth Pumping Station. The pumping station

[8] APEM (2022). Stodmarsh Water Quality Modelling. APEM Scientific Report P00006031. Dover District Council, September 2022, Final, 32 pp.
[9] https://www.dover.gov.uk/Planning/Stodmarsh-Nutrient-Neutral-Methodology.aspx

controls the flow from the upper Little Stour to the lower Little Stour – i.e. water only flows when the pumps are running.

4.14 The reason the tracer was applied so far downstream from Dambridge WwTW, is that the modelling was done based on a larger, extant model for flows in Great Stour, and the extent of this model along the Little Stour was Stourmouth Pumping Station.

4.15 This was a reasonable (and precautionary) decision, especially as the Stourmouth Pumping Station controls all flows from the upper Little Stour.

4.16 The conclusion of this study can be extended such that all flows passing through the Stourmouth Pumping Station would have a negligible impact on the Habitats Sites, as at the location of the tracer is representative of all flows in the Wingham and Little Stour catchment – i.e. the study captures the entire catchment, not only from the point that Dambridge WwTW, even if the study focussed specifically on Dambridge WwTW.

4.17 Any nutrient sources originating upstream of the Stourmouth Pumping Station would be diluted by at least as much as concluded in this study – 990,000 times – and quite likely more, depending on the distance upstream, as dilution would occur in the Wingham and Little Stour watercourses in addition to the tidal River Stour.

4.18 If this level of dilution was sufficient to conclude that Dambridge WwTW would have a negligible impact on the Habitats Sites, then the same conclusion should be made about all nutrient sources originating from upstream of the Stourmouth Pumping Station.

4.19 As the Site is located upstream of the Stourmouth Pumping station, this argument should also apply here.

5 MITIGATION STRATEGY

5.1 There are two sources of nutrients from the site: surface water and wastewater. Surface water from the site will eventually discharge to the Little Stour upstream of the Stourmouth Pumping Station, and so will have a negligible impact on the Habitats Sites based on the DCS and assessment in Chapter 4.

5.2 Wastewater from the site would normally be discharged to Newnham Valley WwTW, however, there have been cases in the past where the sewerage for Newnham Valley WwTW was flooded by groundwater infiltration, and wastewater had to be tankered to Canterbury WwTW[10] – which discharges upstream of the Habitats Site, and therefore the DCS does not apply to it.

5.3 To avoid this issue, it is proposed to treat wastewater onsite, before discharge of treated effluent to the Nail Bourne, a tributary of the Little Stour. This would ensure that the DCS applies to the Site, and has the added advantage of not putting additional strain on the already failing infrastructure associated with Newnham Valley WwTW.

5.4 The wastewater treatment system would be an aerated reed bed system, situated downstream of twin septic tanks. This would be designed and constructed by ARM Ltd, who are specialists in the field of reed bed construction and operated by Severn Trent Connect (STC), who are an Ofwat-licensed water company. ARM have prepared an outline proposal, which is included in Appendix B.

5.5 STC have prepared a letter of support for the proposed wastewater treatment strategy, which has been included in Appendix B. The letter confirms:

- STC are an Ofwat-regulated water company appointed by the Secretary of State to provide wastewater and surface water management services in England and Wales;
- Having assessed all relevant site constraints and considering the scale of the development STC are confident that a WwTW can be delivered and adopted on this site;
- The treatment strategy will comprise either an aerated reedbed system, designed and constructed by ARM Ltd, or an STC designed and built onsite WwTW; both of which shall be adopted, maintained and operated in the long-term by STC in their capacity as the local statutory wastewater undertaker;
- STC would operate the WwTW complying with any Environment Agency (EA) discharge permits; and
- STC will apply to the EA for the required permit having commenced the necessary studies (including a water quality and quantity study).

[10] Southern Water (2014), Nailbourne Infiltration Reduction Plan

6 CONCLUSIONS

6.1 Following the conclusions of the DCS, it has been shown, through a wastewater treatment strategy, that the site will not have an impact on the Habitats Sites.

6.2 The DCS concludes that Dambridge WwTW will have a negligible impact on the Habitats Sites, through the modelling of a tracer applied at Stourmouth Pumping Station. This report has expanded on the conclusion to argue that any nutrient source upstream of Stourmouth Pumping Station will have a negligible impact on the Habitats Sites. This is consistent with the conclusions reached by DDC, who have concluded that the district of Dover is no longer affected by the water quality and nutrient neutrality advice issued by NE in relation to the Habitats Sites.

6.3 The development will treat wastewater onsite, as there have been incidences of flooding in the local sewerage, leading to the tankering of wastewater to Canterbury WwTW, which lies upstream of the Habitats Site. This will ensure that the conclusions of the DCS apply to the Site, and has the added advantage of not putting additional strain on the already failing infrastructure associated with Newnham Valley WwTW.

6.4 The onsite wastewater treatment will be performed through a system operated by a licenced Ofwat water company. They will be responsible for its maintenance, and this will be funded through collection of wastewater bills.

APPENDIX A: DRAWINGS

Development Framework Plan: FPCR Dwg No. 09538-FPCR-XX-XX-DR-L-0001 Issue 05

NOTES

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Ordnance Survey base mapping - supplied by client.

0 25 50 75 100m

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KEY

Site Boundary	15.77ha
Residential Development (up to 320 dwellings at 35dph)	9.17ha
Pumping Station	0.023ha
Waste Water Treatment Works	0.15ha
Potential Location of Allotments	0.028ha
Community Facilities (shop etc.)	
Main Road with Avenue Tree Planting and Footpath / Bicycle Route	
Secondary Road	
Vehicular Access Locations	
Pedestrian and Cyclist Access Locations	
Surfaced Footpath / Bicycle Route	
Informal Footpath Routes, Mown and through Native Tree Belt	
Proposed Individual Tree Planting / Avenue Trees	
Proposed Native Tree Groups, Scrub and Hedgerows	
Proposed Native Tree Belts	
Existing Trees, Tree Groups and Hedgerows	
Play Provision 0.39ha (LAP/LEAP 0.18ha and 0.21ha NEAP)	
Community Orchard	
Variety of Species Rich Grass Mixes	
Bulb Planting	
Proposed Attenuation Basins	
Wetland Area	0.46ha

DRAFT

09538
Littlebourne, Canterbury
Gladman Developments Ltd.

DEVELOPMENT FRAMEWORK

WIP 1:1250 @ A1
18 November 2022 JPF / KMN
09538-FPCR-XX-XX-DR-L-0001 issue 05
Project Code - Originator - Zone - Level - Type - Role - Drawing Number

fpcr

masterplanning
environmental assessment
landscape design
urban design
ecology
architecture
arboriculture

FPCR Environment and Design Ltd
Lockington Hall
Lockington
Derby
DE74 2RH

t: 01509 672772
e: mail@fpcr.co.uk
w: www.fpcr.co.uk

File: K:\9500\9538\LANDS\Plans\09538-FPCR-XX-XX-DR-L-0001-P05.vwx

APPENDIX B: SUPPORTING DOCUMENTATION

ARM Outline Proposal: Project Ref. R4722-1

Severn Trent Connect Letter of Support

DESIGN & CONSTRUCTION SERVICES

Littlebourne Development // Gladman Developments Ltd.

OUTLINE PROPOSAL

Project Reference R4722-1 // 15th December 2022

Aerated Reed Bed Solution at Littlebourne Development, Canterbury.

Prepared for

Mark Heath

Technical Manager

Under contract to

Gladman Developments Ltd.

Prepared by

ARM Ltd

15th December 2022

Contact

Neil McCarthy

ARM Ltd, Rydal House, Colton Road, Rugeley, Staffordshire, WS15 3HF, United Kingdom

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PROJECT No.	R4722-1		**REVISION DATE:**	15/12/2022
PROJECT TITLE:	Littlebourne Development		**AUTHOR:**	NM
CLIENT REF:	Land South of A257, Littlebourne		**CHECKED:**	DJC

1. CLIENT/PROJECT INFORMATION

Gladman Developments Ltd. have contracted ARM Ltd. to provide an *outline* proposal for the design and construction of a reed bed system, to treat domestic wastewater at a proposed new 312 unit housing development located on land south of the A257, Littlebourne, Canterbury, Kent, CT3 1TA .

The development is now entering the planning stages and requires a proposal for a full treatment system, independent of local sewerage infrastructure to support this. This proposal will be accompanied by other supporting information. The proposed system will discharge into a local water course.

2. ARM LTD CAPABILITY

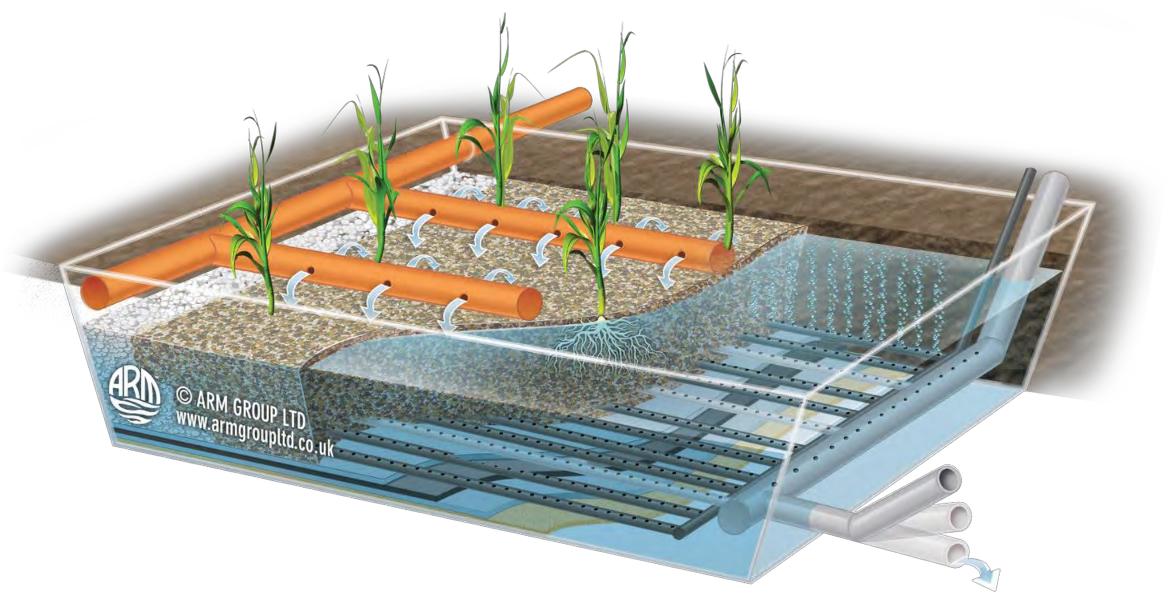
ARM Ltd has a complete understanding of what is required to secure a treatment system that not only satisfies the TOTEX and technical performance requirements, but also considers its impact on the environment. The knowledge we have gained in the design, construction and refurbishment of over eight hundred wetland systems provides us with an important and unique insight into the need for reliable, robust, environmentally sensitive Nature Based Solutions. ARM Ltd maintain several safety, quality and environmental accreditations including:

- UVDB Achilles Verify - Category B2 (Audited)
- Alcumus Safe Contractor
- SMAS Worksafe - SSIP (Principal Contractor) Accreditation
- ISO 9001:2015 – Quality Management
- ISO 14001:2015 Environmental Management
- Member of the Constructed Wetland Association

3. PROPOSED SOLUTION

Our proposed treatment solution is an aerated reed bed, that will be situated downstream of a *twin* septic tank arrangement.

Fig 1. Illustration of typical aerated reed bed.



4. DESIGN DETAILS

We have based our design on the following flow and pollutant concentrations. The data was provided by the client, Mark Heath at Gladman Developments Ltd. in an email and proforma dated 11th November 2022 and is also determined using British Water Flow and Load standards and guidance.
ARM Ltd recommend that prior to a *firm* proposal being issued *confirmed* data is provided by the client or via a flow and load survey, and an ARM site visit is undertaken.

The following design details are based on the above client supplied information and British Water standards.			
Nature of effluent:	Domestic Wastewater		
Average Daily Flow	90	m^3/d	
Influent concentrations:	500	BOD5	mg per litre average
	583	TSS	mg per litre average
	67	NH_4-N	mg per litre average
Required discharge levels:	20	BOD5	mg per litre average
	30	TSS	mg per litre average
	10	NH_4-N	mg per litre average
Ground Survey:	Not supplied		

5. MAIN SCOPE OF WORK

I. Provide a design that meets the required specifications
II. Excavation and installation of 2 No. septic tanks
III. Excavation and creation of reed bed formation, using site won material
IV. Supply and installation of liner and liner protection
V. Supply and installation of media
VI. Supply and plant reeds
VII. Supply and install aeration equipment, including control panel and duty & standby blowers mounted in an enclosure on a concrete base
VIII. Design and construct all required chambers within the termination points
IX. Supply and install all pipework required for the proper functioning of the reed bed system between the termination points*
X. Commissioning of the system

*Termination points are an inlet pipe connection 1m upstream of the septic tanks and outlet pipe 1m downstream of the reed bed outlet level control chamber

6. ASSUMPTIONS AND PRINCIPAL EXCLUSIONS FROM SCOPE OF WORK

- Removal of spoil from site
- Importation of formation material to site (if required)
- Pumping equipment
- Any pipework or other materials beyond the termination points indicated above
- Supply, connection or relocation services
- Creation of permanent access roads
- Supply and installation of ground stabilisation materials
- Supply of water/effluent to the reed bed to carry out the drop test on the liner
- Flow and Effluent quality testing
- Dewatering
- Temporary treatment
- ARM Ltd assumes that there will be adequate and unimpeded vehicular access to the site during normal work hours (20T vehicle deliveries).
- ARM Ltd assumes the execution of the project programme of works on site is completed in a single continuous period of working following mobilisation to site.

Construction (Design and Management) Regulations 2015

Where the client requires ARM Ltd to provide specific works and services related to CDM compliance, including appointment to the role of Principal Designer or Principal Contractor then the scope of those works and service must be pre-agreed prior to contractual engagement. ARM Ltd reserves the right to amend the fee proposal, programme, bill of quantities and activity schedules in the event that the client subsequently requires additional CDM works and services beyond the pre-agreed scope of works and services.

Control of non-native invasive plant species

In accordance with the Wildlife and Countryside Act 1981, should we find any non-native invasive species within the site or construction area, we will be unable to remove spoil and/or arisings off site for disposal and will notify the Project Manager of their presence.

Bird Nesting/Wildlife

Birds nesting/wildlife within the construction area can delay work. A pre-construction ecological / environmental survey should be completed prior to starting on site . ***For reed bed works, attention is focused on the bird breeding season usually between March and August.***

7. FOOTPRINT AND PRICE INDICATION

The reed bed requires an optimum footprint of 24m x 24m and an optimum head loss of 1.5m. The *combined* footprint, including septic tanks will be approximately 25m x 50m.

Fig 2. To approx. scale sketch of total combined area of *approx*. 1250m^2 (*for illustration purposes only*).

Fig 3. Client indication of potential location for system (*for illustration purposes only*).

The guide footprints above, and prices below are based on indicative information supplied by the client, and ideal conditions have been assumed. The price range is for budgetary purposes only and may be subject to change as a result of ground/site conditions, amendments to the effluent characteristics, changes to design specifications, any subsequent extensions to the Scope of Works and effects of Brexit. All prices quoted are exclusive of VAT and if applicable, will be added at the appropriate rate at time of invoicing.

Our price for a *turnkey* package will be of the order of:

£220,000 to £240,000

8. ARM LTD SERVICES

There are a number of support services that ARM Ltd offer. We would be happy discuss any aspects of the services detailed below with you and can be contacted at **info@armgroupltd.co.uk** or telephone on **01889 583811**.

Support Service

- Drawings for planning applications
- Environmental Permit applications
- Water quality sampling and monitoring to establish performance
- Wastewater treatability trials
- Reed planting
- Reed Bed Maintenance & Servicing contracts
- Operator Training

Asset Assessment

- Site survey assessing condition of the reeds
- Extent of sludge build up on and in the gravel matrix and condition of the hydraulic flow path
- Review design based on current and future loads and recent performance data
- Sampling and monitoring program including influent flows\loads
- Verbal and written report of the assessment complete with conclusions, recommendations and indicative prices of any required remedial work

Refurbishment and Remedial Services

- Removal of surface sludge. These are designed to be short term option prior to a full refurbishment.
- Refurbish the reed bed back to 'as built' conditions
- Retrofit with latest technologies to enhance capability, e.g. aeration
- Re-engineering to improve performance

9. ABOUT FORCED BED AERATION™

Reed Bed Treatment Solutions and Forced Bed Aeration

General Introduction

Reed beds have been used informally for water treatment for thousands of years. The formalisation of this knowledge into an applicable technology in the 1960s has resulted in the rapid expansion of their use globally and their acceptance as a front-line method of water treatment in both the municipal and industrial sectors.

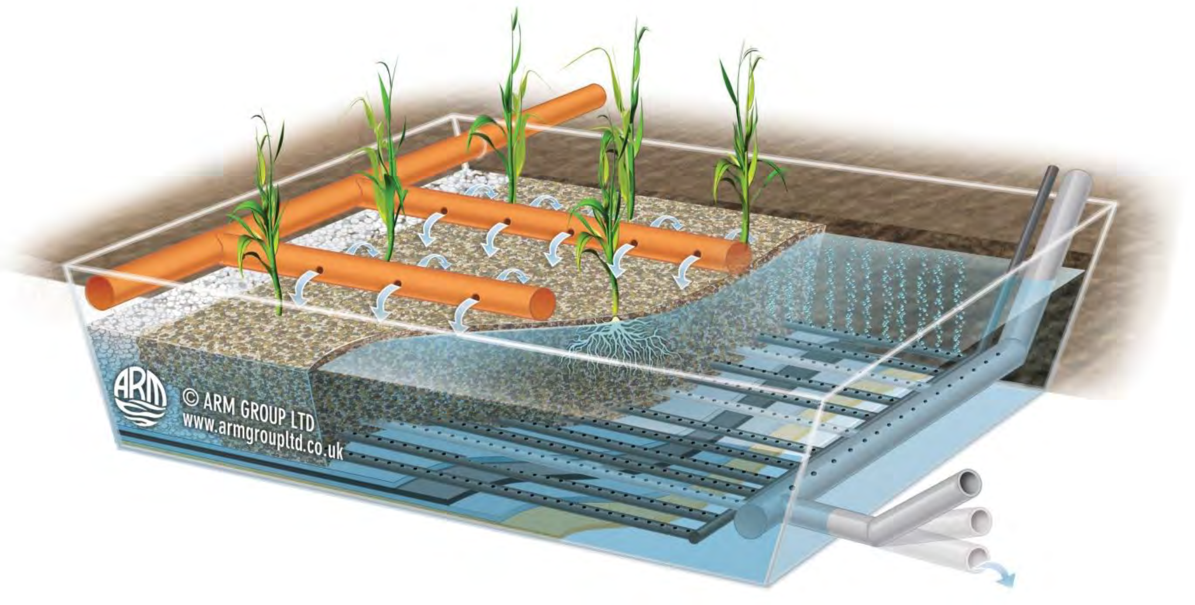
Initial systems were based very much on horizontal, saturated (flooded) flow across the reed bed, and these were very much reliant on the diffusion of air from the atmosphere into the bed to 'fuel' oxygen driven microbial degradation. These systems were, and still are, used for low level effluent 'polishing' treatment

Over the past 20 years the increased demand for more sustainable, low carbon footprint water treatment solutions has led to a sharp rise in the use of constructed Wetlands with a parallel increase in understanding how these systems function and can be optimised to provide much higher levels of treatment. Subsequent and ongoing client driven innovation has led to a range of different wetland system types and designs which can provide high levels of treatment across a broad range of effluents from the municipal and industrial sectors.

We now see wetland systems capable of treating raw sewage right through to discharge and including full sludge management. There are 3000 of these systems used in France alone. We see specialised sludge treatment reed bed systems which trap solids on their surface and compost them while liquors pass down through the bed for treatment by the microbial biomass which grows naturally in the beds.

More recently, within the past 10 years we have seen the development, and rapid uptake, of gently aerated reed bed systems which offer significantly more treatment capability along with much more consistent performance. This results in reduced size requirements which in turn, lowers capital costs and makes the technology viable for smaller sites.

Here is an example of an ***aerated***, **vertical flow** reed bed.



As highlighted above the aeration effectively fuels the aerobic microbial degradation improving treatment capacity by up to 15 times per unit area compared to passively operated systems.

As opposed to horizontal flow systems, which receive flows and loads along one narrow edge, the **vertical flow** system distributes the effluent across the whole surface area of the reed bed resulting in a much lower hydraulic and contaminant load per square metre. This results in a reduced clogging rate, longer life and a broader and more efficient development of the biomass across the whole of the reed bed.

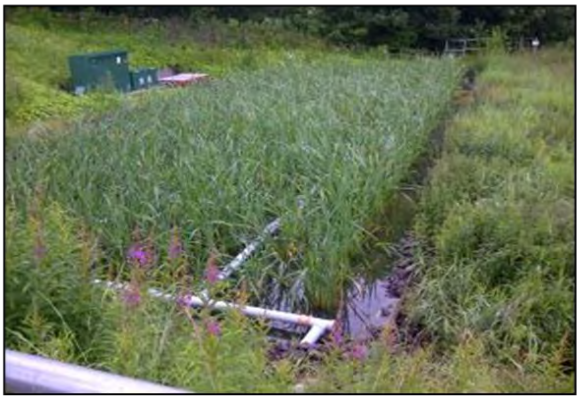
Solids are trapped on the surface of and within the bed medium (usually specified gravel) which acts as a filter and because solids comprise approximately 50% organic matter they are substantially degraded by microbial activity. The remaining inorganic/mineral matter is either filtered out in the bed as effluent moves down through it or settles to the bottom of the bed.

The effluent passes down through the bed washing over the microbial biomass which grows on the media and effectively degrades the BOD and ammonia. This process is fuelled by the oxygen carried in the air moving counter currently upward from the bottom of the bed.

A network of effluent collection pipes in the bottom of the bed collects the treated effluent and transports it to the next stage of treatment or to a local water course.

What is a Reed Bed Treatment System?

Man-made, lined, wetland designed to remove a specific level of contaminant/pollutant load from a wastewater stream



Constructed Wetland is usual *international* term for treatment reed beds.

Why use them……

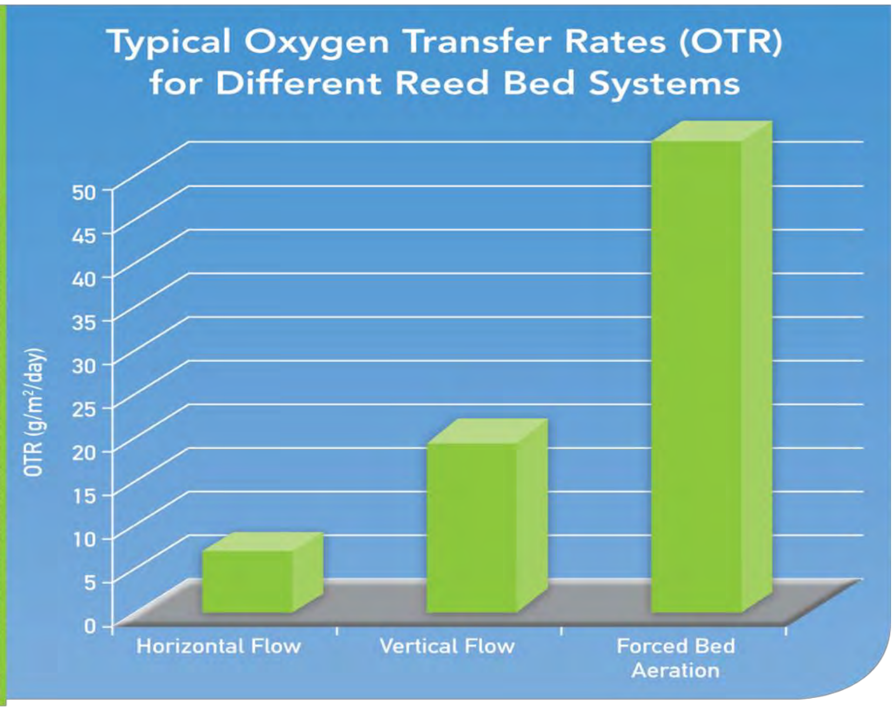
- Protect & Create Environment
- Promotes Biodiversity/Habitat
- Sensitive stakeholder sites - National Parks, AONB, SSSI etc.
- Robustness with No moving parts
- Low Energy requirements
- Low Maintenance
- Low Lifetime costs
- Attractive Amenity
- Promotes sustainability agenda/Eco PR

Their simplicity, with few or no moving parts make them a reliable, robust treatment solution with low maintenance and power requirements resulting in low lifetime costs compared to the mechanical treatment alternatives.

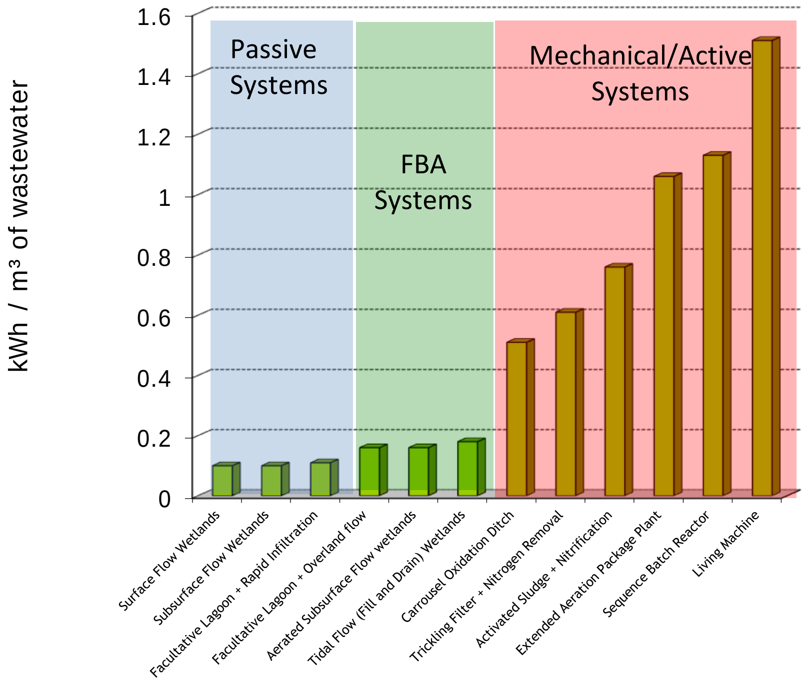
Performance

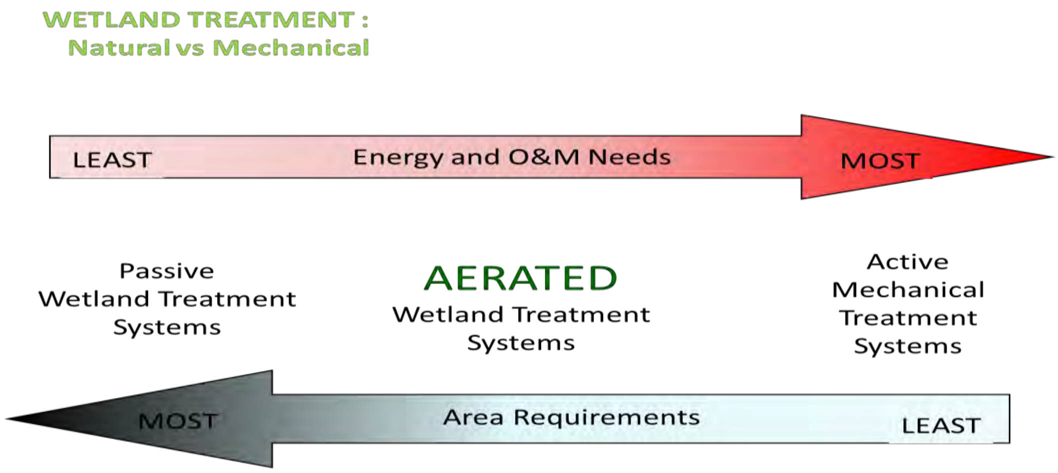
The chart below provides a comparison of oxygen transfer rates seen in passive wetlands and aerated systems using Forced Bed Aerated system (FBA).

The use of lightly blown air also adds an element of flexibility in that we can potentially turn the air off and on as required. This can also be useful in the event of seasonal and other variations in load which may arise.



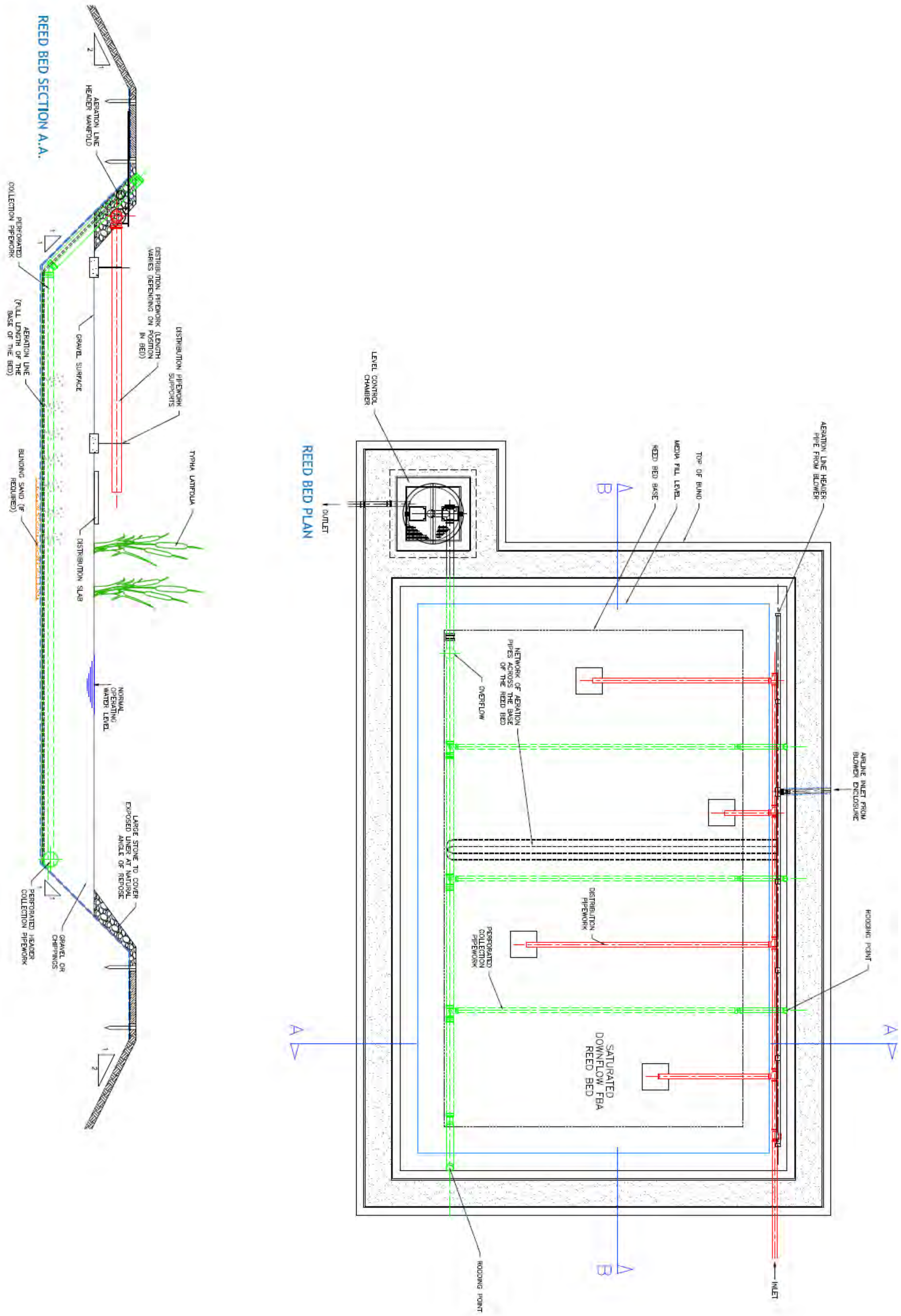
Forced Bed Aeration requires the use of a small blower system with a nominal rating of a few kW, the actual rating would be confirmed in detailed design. The power requirement for these systems is a small proportion of that required per unit of effluent treated in more mechanical systems such as SAFs or Oxidation Ditches. The chart below provides an indication of power usage comparison for different water treatment methods.





Effectively Forced Bed Aeration power consumption though slightly larger than that of passive wetland systems is a small proportion of that for standard mechanical treatment methods but provides a significant increase in performance from standard reed beds in terms of higher load capabilities and more consistent performance.

10.Typical sectional drawing of aerated reed bed.



11.Images of reed beds.


WELCOME TO ST HUGH'S SEWAGE TREATMENT WORKS
WATER...
Think about how much water you use in a day.
Every time you flush the toilet, or wash your hands, have a shower or bath, wash your clothes, use a dishwasher or cook food you use water. The average person in the UK uses 160 litres of water per day – that's the same as 80 large bottles of fizzy drink.
SEWAGE...
Water coming out of a tap is clean but it becomes dirty very quickly.
Just think about what you flush down the toilet, or when you wash dirty plates in the dishwater. The water becomes contaminated with bits of food, oils, detergents such as soap, washing powders and cleaning products.
This dirty water is known as sewage. It is very important not to flush wet wipes and cotton buds down the toilet as they cause blockages and flooding making treating sewage very difficult – it's important to remember to "Bin it, don't block it!"
Sewage contains several types of pollutants, organic matter (from food, human waste), ammonia (from urine), solid matter and nasty bacteria known as pathogens. These pollutants can be very harmful to wildlife and humans if they come into contact with raw (untreated) sewage. Would you want to swim in raw sewage? It would make you very sick if you did. It is very important to treat the sewage to remove these pollutants before putting the treated water back into a river, lake or the sea.
TREATMENT...
This sewage treatment works accepts all the sewage flow from the school.
STAGE 1 SEPTIC TANK:
All the dirty water produced goes into underground pipes and into a big underground tank called a septic tank. This is the first stage of treatment. Dirty water collects in this tank and the big solid matter settles to the bottom of the tank and forms sludge. The liquid stays at the top of the tank.
STAGE 2 REED BED:
The liquid part then flows out of the tank, into the reed bed stage of the treatment. The liquid part will still contain many pollutants, including organic matter, ammonia and the very fine particles that are too small to settle in the septic tank, these are known as suspended solids.
The reed bed is where biological treatment takes place. Certain types of 'good' bacteria feed on the organic matter and ammonia and turn it into harmless carbon dioxide, water and nitrogen. This biological treatment occurs in the natural environment. If raw sewage was discharged into the stream, the naturally occurring bacteria would feed on the organic matter, using up oxygen in the water in the process, making the stream very low in oxygen which can kill fish and other species. However, if this biological treatment can be set up artificially, in a controlled area such as a 'treatment' reed bed before it reaches the stream, this stops any harm to the stream ecosystem.
STAGE 3 DISCHARGE TO STREAM:
The treated water can now be safely introduced into the stream.
Here you can see the liner has been laid out and gravel is being spread by a digger.
How a reed bed looks just after it is constructed and planted with reeds.
The finished reed bed eventually forms a small ecosystem.
HOW SEWAGE TREATMENT WORKS:
School
RAW SEWAGE FROM SCHOOL
Septic Tank
(sludge & scum removed)
MANHOLE
MANHOLE
SCUM
BAFFLE
WASTEWATER
BAFFLE
SLUDGE
Reed Bed
WASTEWATER SENT TO REED BED FOR TREATMENT
River
TREATED WATER DISCHARGES TO RIVER
Reed beds attract all sorts of life such as damselfly, spiders, reed warblers and ducks to name a few – see what you can discover or spot next time you visit the reed bed area.
REED BEDS...
How they are built & how flow is passed through it for treatment.
Wetlands can occur naturally such as swamps, reed beds, and marshes. Artificial reed beds are built to achieve the same conditions found in natural wetlands and are used all over the UK to treat sewage. They consist of a hole in the ground that is lined to prevent the sewage from going into the ground. This liner is then filled with gravel and is planted with reeds.
Bacteria grow on the surface of the gravel. The liquid from the septic tank is trickled onto the top of the reed bed through pipes and flows down through the gravel. The bacteria digest the organic matter and ammonia in this liquid but uses up the oxygen that is in the water. Once the oxygen is gone, the bacteria stop working so we blow extra air bubbles into the gravel to make sure the bacteria have enough oxygen to survive.
The gravel also acts to trap the suspended solids, by physically filtering solid matter out of the liquid. Bacteria also live on the roots of the reeds, and the roots grow through the gravel, keeping the gaps open for the liquid to flow through. Once the liquid has passed through the reed bed it is discharged into the stream. Most of the pollutants have been removed so that the water quality is very good so it does not pollute the stream ecosystem.
HOW THE REED BED WORKS:
INLET DISTRIBUTION PIPE
FROM SEPTIC TANK
COLLECTION PIPE
GRAVEL
AERATION PIPES
LEVEL CONTROL ARM & DISCHARGE PIPE
TREATED WATER
ST HUGH'S
OXFORDSHIRE
St Hugh's and ARM Ltd worked hard to create the sewage treatment works and look forward to seeing the wildlife it encourages into the area. The work has provided a sustainable treatment facility set to service the school and help protect the environment for many years. You can help do your part by remembering 'Bin it, don't block it!'
www.armgroupltd.co.uk
01889 583 811

SUSTAINABLE WASTEWATER TREATMENT

Think about how much water you use in a day. You use water every time you flush the toilet, wash your hands, have a shower or bath, wash your clothes, use a dishwasher or cook food.

The average person in the UK uses 200 litres of water per day. All this water goes down the drains where it mixes together and is known as 'sewage'. Sewage contains several types of pollutants, organic matter (from food, human waste) ammonia (from urine), solid matter and pathogens. These pollutants can be very harmful to wildlife and humans if they come into contact with this raw (untreated) sewage. It is very important to treat the sewage to remove these pollutants before putting the treated water back into the ecosystem.

SEPTIC TANK

All the sewage produced at the Raymond Priestley Centre is collected in an underground septic tank via a network of drains. This is the first stage of treatment. Dirty water collects in this tank and separates into a liquid part and a solid part. The larger solid matter settles to the bottom of the tank forming a sludge, which gets sucked up and taken away by tanker.

The liquid part then flows out of the tank, into the reed bed stage of the treatment. The liquid part will still contain many pollutants, including organic matter, ammonia and the very fine particles that are too small to settle in the septic tank, these are known as suspended solids.

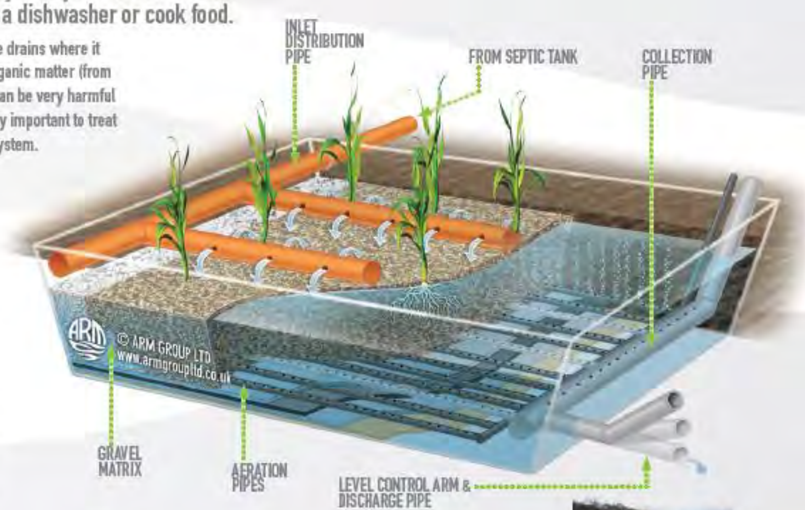
REED BED

The reed bed is where the biological treatment takes place. Certain types of bacteria feed on the organic matter and turn it into carbon dioxide, water and nitrogen. This treatment occurs naturally in the ecosystem. If raw sewage was discharged into the lake, naturally occurring bacteria would feed on the organic matter, using up oxygen in the water. The reduction in oxygen levels in the water would kill fish and other aquatic species. However, if this biological treatment can be set up artificially, in a controlled process area before it reaches the lake, this stops any harm to the ecosystem.

Bacteria grow on the surface of the gravel. Liquid from the septic tank is trickled onto the reed bed and flows down through the gravel, coming into contact with the bacteria which break down the organic matter and ammonia. This process uses oxygen in the water which is replenished via the aeration pipes at the base to ensure that aerobic treatment continues to work efficiently.

The gravel also acts to trap the suspended solids, by physically filtering the solids out of the liquid. Bacteria also live on the roots of the reeds, and the roots grow through the gravel, keeping the gaps open for the liquid to flow through.

Once the liquid has passed through the reed bed it is discharged into a soakaway, which is a system of pipes buried underneath the ground that allows the water to soak into the ground and eventually find its way into the lake.



THE RAYMOND PRIESTLEY CENTRE

The Raymond Priestley Centre is a residential outdoor education centre owned by the University of Birmingham.

The centre has an occupancy level of approximately 8000 bed nights per annum. Although there are seasonal variations to occupancy, the dirty water produced on site equates to an average flow of $5m^3/d$, peaking at $10\ m^3/d$. To help you visualise how much water that is, it is 5000 x 1 litre drink bottles.

The water coming into the reed bed from the septic tank contains 420 mg/L BOD, this is the measure of carbonaceous organic matter. The reed bed is designed to reduce this to 20mg/L in compliance with our Environment Agency permit.

The Raymond Priestley Centre has for many years been committed to the long term sustainable use of the outdoors. The reed bed installation is an example of how we are working to minimize our impact upon our environment. We hope it will encourage discussion and lead to actions that promote the development of innovative solutions to worldwide sustainable living.

www.armgroupltd.co.uk

01889 583 811

Letter of support
Wastewater strategy

Land off A257; Littlebourne, Canterbury

Author: William Mackveley
Date: December 2022

ST Connect

SEVERN TRENT

Letter of support: Wastewater strategy

ONSITE WASTEWATER STRATEGY FOR LAND OFF A257 NEAR LITTLEBOURNE, CANTERBURY.

ST Connect have been appointed by Gladman to work alongside their technical advisors to develop a feasible foul water drainage and treatment strategy, at their proposed development known as Land Off A257 near Littlebourne, Canterbury.

ST Connect

ST Connect are an Ofwat-regulated water company appointed by the Secretary of State to provide wastewater and surface water management services in England and Wales. We have a strong track record for designing, building, owning and operating wastewater treatment assets (including foul and surface sewerage infrastructure) and are part of the wider Severn Trent Group, which in its portfolio has one of the UK's largest water and sewerage companies.

We are familiar with the environmental challenges to developments resulting from both a chronic lack of available sewerage capacity, and nutrient pollution; as a result, we are helping our clients to develop effective wastewater management strategies. The company is well placed to do this, given our experience and effective relationships with the statutory environmental regulators.

Proposed wastewater treatment and disposal strategy summary

Foul sewage from all properties will be collected and conveyed through a separate foul-only sewerage system to the onsite wastewater treatment system. Following treatment to the required standards, final effluent will be discharged into a drainage system out falling into the Nail Bourne, a tributary of the Little Stour.

Having assessed all relevant site constraints and considering the scale of the development we are confident that a wastewater treatment system can be delivered and adopted on this site. In our role as environmental stewards, we are promoting an adaptive treatment strategy which considers both nature-based solutions and hard-engineered solutions; neither system requires chemical dosing for effective treatment.

Our adaptive treatment strategy will comprise either an ST Connect designed and built onsite wastewater treatment works (WwTW), or an ARM designed and built reed bed treatment system. The chosen system will be adopted, maintained, and operated in the long-term by ST Connect in our capacity as the local statutory wastewater undertaker.

ST Connect would operate the wastewater treatment system complying with an Environment Agency (EA) discharge permit (including any parameters required by Natural England following a formal consultation) which does not form part of the Stodmarsh catchment.

Asset and treatment process resilience

Detailed designs of the two treatment systems have not yet been commissioned, however ST Connect (in partnership with ARM Limited for the reed bed option), will propose to construct a state-of-the-art facility, either an advanced form of activated sludge treatment e.g., "*STC1000*", or a forced bed aeration reed bed system, see appendix.

Both systems are particularly resilient to catchment contamination events or natural variation of inbound wastewater concentration, due to the significant dilution factors provided by the large balancing tank in the case of the STC1000, or the holding/septic tank at the head of the reed bed system. The treatment processes will be configured to allow for bolt-on technologies to meet more stringent permits; should they become required in the future.

We will design in capacity and asset redundancy which shall all but remove the risk of permit compliance failure. In a worst-case scenario of significant system failure, raw and/or part-treated sewage shall be isolated and tankered to a suitable off-site facility for safe treatment and disposal.

Sludge management

Organic sludges generated during the treatment process which cannot be treated onsite will be periodically removed by tanker for further processing at a nearby sludge treatment centre to generate sustainable energy from biogas. The remaining by-product, sludge cake is sold as an organic fertiliser. It should be noted that were farmers within the Stodmarsh catchment to use this source of fertiliser, it would act as a direct replacement of other sources of fertilisers (such as inorganic chemical fertilisers).

Long-term asset performance

The onsite treatment system will be designed and built to our adoptable standards, and therefore be owned and operated by ST Connect in its capacity as the local wastewater undertaker; subject to a licence variation being granted by Ofwat. The assets will therefore be considered "public" assets by the EA, which the company shall have a duty to maintain and operate effectively in perpetuity in line with its licence obligations.

The treatment system shall have in place both planned and reactive operations and maintenance arrangements to ensure the good upkeep of assets and effective wastewater treatment. In addition, the facility will benefit from remote telemetry and sensors to monitor site condition and treatment processes effectiveness.

Environment Agency wastewater discharge permit

A wastewater discharge permit from the EA will be required in order to operate the onsite treatment works. ST Connect will apply to the EA for the required permit having undertaken the necessary studies (including a water quality and quantity study). It is important to note that as a statutory wastewater undertaker, ST Connect is able to obtain discharge permits within sewered areas (within the geographic areas of appointment of other wastewater undertakers, such as Southern Water) – the EA don't distinguish between licence applications / variations made by ST Connect and those made by incumbent water companies.

Conclusion

ST Connect in its capacity as a competent sewerage undertaker, experienced in the construction and long-term operations of sewage treatment assets is satisfied that a public onsite wastewater treatment system can be designed, built, adopted, operated, and maintained within the development known as Land Off A257.

We look forward to continuing to develop the wastewater treatment strategy for this development site and are happy to be able to contribute to Canterbury City Council's housing delivery plans in a sustainable way.

Yours sincerely

W. Mackveley

William Mackveley
General Manager
Severn Trent Connect

Appendix

Onsite wastewater treatment system:

- STC 1000; and
- ARM Forced Bed Aeration Reed Bed

STC1000

Wastewater treatment processes

Inlet flows

Wastewater arriving at the WwTW passes through the inlet works, where a series of screens remove wipes, grit, and other matter not suitable for onward treatment.

Balance tank / fermenter

The screened wastewater is transferred to the covered balance tank / fermenter (BTF). The BTF serves two distinct purposes in the treatment cycle. Firstly, it is used to balance the incoming flows prior to being passed forward for processing in the Reactors. Its second function is to act as an anaerobic fermenter; crucial to enable the Phosphorus Accumulating Organisms present in the Reactors to super absorb Phosphorus.

Reactors

The Reactors use simultaneous fill and decant, whereby the treated water is discharged using a piston effect created by the introduction of the fermented, raw, screened sewage. This influent is introduced at the bottom of the tank where it is gently mixed with the settled biomass using the hyperboloid mixer. The sludge blanket remains undisturbed, whilst the clean effluent in the top of the tank is discharged.

Once the fill/decant stage is complete, and the influent has had appropriate contact time with the biomass, the aerobic and anoxic treatment stages are carried out. The duration and timing of these phases are varied dependent on specific site conditions and permit requirements.

Sludge thickening

The sludge generated by the process can be thickened using sludge thickening equipment. Thickened sludge is held in the aerated sludge storage tank, whilst supernatant is returned to the head of works.

Aerated sludge storage

Thickened sludge is stored within this tank and periodically aerated using a coarse bubble aeration grid to prevent the sludge thickening too much at the bottom of the tank and to prevent the sludge becoming septic and causing odour issues.

Final effluent discharge

The final effluent discharged from the reactors, flows through a sample chamber prior to discharging to the Nail Bourne, a tributary of the Little Stour. Should there be a restriction on the permitted discharge flow rate, then an attenuation tank can be included.

ARM Forced Bed Aeration (FBA) Reed Bed

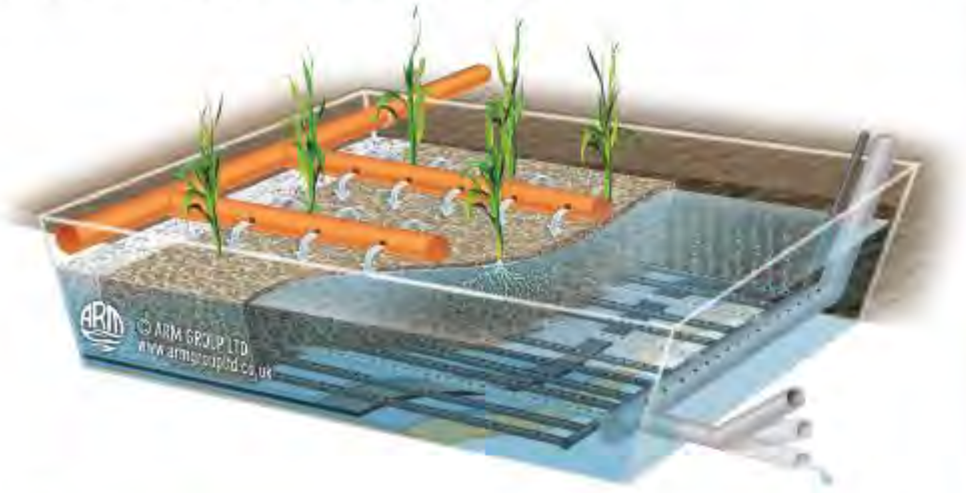
Forced Bed Aeration (FBA)

ARM™

Forced Bed Aeration™ compliments and enhances existing reed bed technology, increasing treatment capacity by up to 15 times.

Forced Bed Aeration™ (FBA™) is a new wastewater treatment technology which enhances constructed wetland treatment performance. Significantly higher contaminant removal rates are attained along with an increased consistency of performance. Developed in the USA, by our partners Naturally Wallace, FBA™ can be used in both horizontal and vertical flow constructed wetland systems. Blowing air through the wetland system makes the system oxygen unlimiting increasing the treatment capacity by up to 15 times. This new technology can treat wastewaters high in BOD, SS, NH_4-N and other organic contaminants.

Forced Bed Aeration™ reed beds can reach performance levels which have been unobtainable in standard reed bed systems with less performance variability. Aeration of horizontal and vertical flow reed beds has multiple advantages.



natural wastewater treatment

- FBA™ can completely nitrify wastewater
- FBA™ systems can be deeper than conventional reed beds therefore taking up 50% less space than passive systems.
- Plants thrive in FBA™ systems because the introduced oxygen prevents the formation of toxic products that can stunt plant growth in strongly anaerobic, passive system
- FBA™ reed beds can be divided into aerobic and anoxic zones to both nitrify and denitrify.
- FBA™ reed beds are ideal for treating fluctuating loads such as CSO's and locations with variable occupancy.
- Initial studies indicate FBA™ systems have reduced clogging rates extending the operational life of a treatment system.

Pipelines

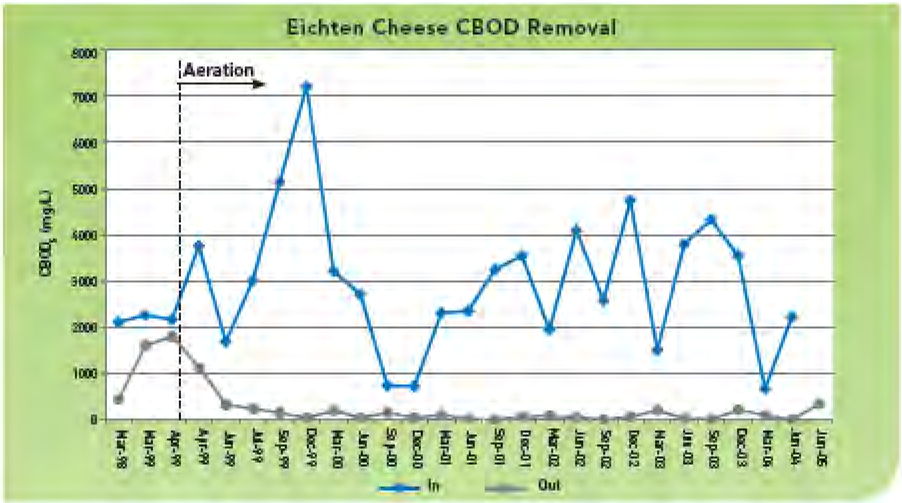
FBA™ has a unique network of pipelines which provides a constant flow of oxygen into the reed bed. Patented rootguard technology prevents root rhizomes penetrating the emission points.

Adapting FBA™

FBA™ can be retrofitted to existing reed bed systems, especially those which are overloaded. This prolongs the life of the reed bed and enhance effluent treatment.

FBA™:

- Improves treatment capability.
- Reduces clogging rates.
- Requires minimum power input.



Graph indicating the treatment performance of an FBA™ wetland system treating cheese production effluent

natural wastewater treatment