James Sweeney

From:	Appeals2
Sent:	Wednesday 26 August 2026 16:35
To:	James Sweeney
Subject:	FW: ACP-324322-26 (e-mail 1 of 2)
Attachments:	AHIA Response To PA 2026 08 25.pdf; Altemar Letter Tara Hall 26.08.26.pdf; Applicant Response to FCC to ACP 26.08.2026.pdf
Follow Up Flag:	Follow up
Flag Status:	Flagged

From: KOM.ie | Raymond O'Malley <raymond@kom.ie>
Sent: Wednesday 26 August 2026 15:24
To: Appeals2 <appeals@pleanala.ie>
Subject: ACP-324322-26 (e-mail 1 of 2)

> **Caution:** This is an **External Email** and may have malicious content. Please take care when clicking links or opening attachments. When in doubt, contact the ICT Helpdesk.

Hi There,

Please find attached a response to your letter dated 6th August 2026 in respect of the above case.

There are four attachments as follows:

1. KOM & Co. Ltd. cover letter.
2. Altemar response dated 26th August 2026
3. Response to ACP by Vertical Star Ltd. Including Appendix A and B (in e-mail 2 of 2).
4. Rob Goodbody, Historic Building Consultant, report dated 25th August 2026

Regards,

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Tara Hall, Balscadden Road, Howth

Case number: ACP-324322-26

I refer to the above case and to the submission of Fingal County Council in relation to the proposal. I refer, in particular, to the report of the Conservation Officer Section which forms part of that submission. This letter forms part of the response of the applicant to the submission and relates to matters of building conservation and architectural heritage.

Response

The description of the development is set out clearly in the application for substitute consent and at the head of the report of the Conservation Officer. It may be summarised as follows:

- Retention of demolition at lower ground floor, ground floor and first floor levels.
- Retention of part two- part three-storey extension at north elevation.
- An on-site sepcon waste water treatment plan, polishing filter and percolation area.

Despite the clear description, the Conservation Officer's report is for the most part confined to discussion of matters that do not form part of the present application. Furthermore, the report states that the architectural heritage impact assessment (AHIA) does not refer to certain changes that have been made to the building. It hardly needs to be said that the reason why the AHIA does not address those issues is because they do not form part of the development for which substitute consent is being sought. While that should be a sufficient response, it is worthwhile to explain the circumstances.

Aside from the development to which the application for substitute consent relates and the proposal for permission for further development (see ACP-324323-26), the applicant has undertaken various other works to the house. These works do not need planning permission as they constitute exempted development. What is not clear from the Conservation Officer's report is that Tara Hall is not a protected structure. Fingal County Council has had ample opportunity to add Tara Hall to the record of protected structures (RPS) and has carried out a county-wide survey of buildings to determine whether or not they should be added to the RPS. Furthermore, the National Inventory of Architectural Heritage (NIAH) has carried out its survey of the Howth area and did not include Tara Hall in its buildings deemed to be of Regional significance or above and hence worthy of being added to the RPS.

It is worth stating that the Planning and Development Act 2000, as amended, in section 51(1), sets down the requirement for a planning authority to establish a record of protected structures. This subsection defines eight categories of special interest and states that each planning authority:

> ... shall include in that record every structure which is, in the opinion of the planning authority, of such interest in its functional area.

One should note the use of the word "shall". This is not optional. It is obligatory. In the present case Fingal County Council has not included Tara Hall in the record of protected structures despite having surveyed the county for buildings of interest, while the NIAH has not included the house of worthy of inclusion in its survey. The Conservation Officer's report relates how prominent the house is and how visible it is from various locations but the Council appears to have made the conscious decision not to include the house in the RPS.

In essence, the planning authority cannot have it both ways. If the house has not been added to the RPS they cannot treat it as if it is protected.

The Conservation Officer's report cites various policies in the development plan in relation to the works done to the elevation of the house. These are irrelevant. The development plan policies have no bearing on works that do not need planning permission.

Exempted development

The works cited in the Conservation Officer's report that is exempted development are discussed here by way of clarification. As a result, they do not form part of the application for substitute consent. For context, the photograph below, taken by the present writer, shows Tara Hall as it was in 2010

Plate 1: Tara Hall in 2010

The house was painted brown and had windows divided into two panes over two, each of which had white-painted shutters on either side. The quoins were parallel and picked out in white. The roof was slated.

Plate 2: Tara Hall in 2025

The photograph above shows Tara Hall as it is today. The windows are divided into a single pane above and below a horizontal division. The quoins alternate long and short and are picked out in cream. They are not irregular, as stated by the Conservation Officer – they are regular, but alternating rather than parallel. The roof is slated with textured artificial slate.

The render and quoins now on the house are wholly in character with houses of the period. Some houses had parallel quoins, as Tara Hall did previously, but the quoins now on the house are more common in the nineteenth century. Mention is also made in the Conservation Officer's report of details of the cornice detail on the projecting porch. Whether the present cornice detail is different to the original is not relevant. What is there now is not inconsistent with the period of the house and even if it were, the change would have been exempted development.

The materials of the windows are not the same as those on the house originally and the configuration has changed to single panes above and below, rather than being divided into two panes The present one-over-one configuration is common in later nineteenth century houses. While the detail and materials would not have been appropriate on a protected structure, the applicant has been careful to insert windows that are not dissimilar to the style of nineteenth-century houses and has chosen not to instal the more common types of replacement window that are of uPVC and that are seen on many buildings throughout the administrative area of Fingal County Council, apparently without issue.

The roof has been re-slated and hence the roof covering looks new. The material is textured artificial slate. If the house had been a protected structure, it would have been appropriate to discuss with the Conservation Officer what type of slate to use and to use natural slate. In the absence of such protection the applicant was free to acquire the material from whatever source was available and has selected a covering that has the appearance of slate, which is consistent with the character of the house.

The Conservation Officer states that the house is visible from the upper deck of the East Pier and views over Balscadden Bay from the western section of Balscadden Road. This is not disputed. But what detail of the house is seen from these locations?

Plate 3: View of Balscadden Bay from near the Martello tower, 2017

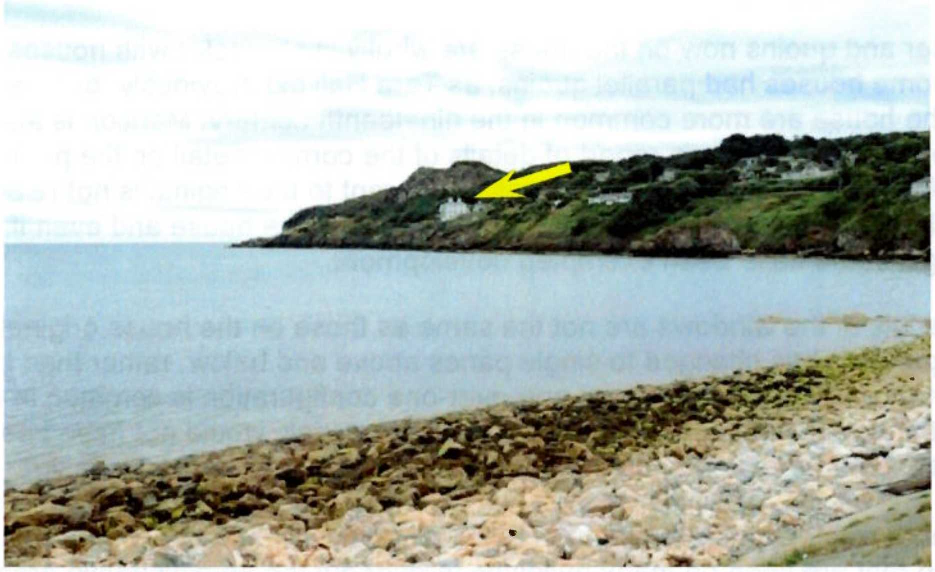

Plate 4: View from the East Pier, 2025

The view in Plate 3 above, taken in 2017 from the hill near the Martello tower shows Tara Hall in the distance, indicated by the yellow arrow. Plate 4 shows the view from the upper level of the East Pier, taken in 2025. The East Pier is currently closed to public access, but there are many views available on Google Earth to check the visibility of the house from almost every point along the pier.

As can be seen from these photographs the house is seen in the views, but only at a distance of 620 metres from the hill by the Martello tower and between 700 and 850 metres from the East Pier, depending on the exact location on the pier. There is no way that any detail can be picked out on the house from these locations and even the extension is not clearly visible.

Nowhere in the Conservation Officer's report does it mention the improvements to the appearance of the house, including the removal of the wholly inappropriate shutters that disfigured the house and that were completely out of character with a mid-nineteenth century house. Furthermore, the present choice of external colours is more consistent with the character of the house, while the former dark brown was not, and only served to emphasise the way in which the proportions of the windows were distorted by the presence of the shutters when seen from the middle distance.

In summary, it appears that the greater part of the issues that the Conservation Officer has with the works at Tara Hall relate to works that constitute exempted development and hence are beyond the scope of any functions of the planning authority.

Policies set down in the development plan have no bearing on works that are exempted development and only come into effect when a planning application or application for substitute consent is submitted. Hence these policies have no bearing on the changes to the windows, roof covering, render, quoins and much else that the Conservation Officer cites as problems.

<u>Development for Substitute Consent</u>

The works subject of this application are legitimate issues for the planning authority to comment. Of the three divisions of works for which permission is sought, as identified above and stated on the statutory planning notices, the matter of the septic tank system is not a concern for architectural heritage and hence is not addressed in this response. The other two divisions relate to the demolition of part of the rear of the building and retention of the partially constructed northern extension.

Plate 5: View of house taken with telephoto lens, seen from Martello tower

The rear extension in its present unmodified form is large. However, it is not visible from many places other than out to sea, where the viewer would normally be at a distance. The photograph below shows the house as seen from near the Martello tower and taken with a telephoto lens to make the house seem nearer. Even with the longer lens the extension is barely visible and only then on very close inspection.

The view from the house when seen from the inland end of the East Pier is also from the side and it is not easy to pick out the view of the extension. From the first turn of the pier the angle of view shows the greatest amount of the rear face of the extension. Even at that angle the distance is such that the extension is not readily visible. Using the facility of a telephoto lens again to see the house more clearly than the naked eye, as was illustrated in Plate 4 above, the photograph below illustrates the extension as seen from the East Pier.

Plate 6: Telephoto view of house from the bend in the East Pier

From that point the rear of the extension is more visible than it is closer to the shore, but the angle is such that the sky is reflected off the glass, reducing the apparent bulk of the extension.

Plate 7: View of Tara Hall from Balscadden Road

From some points to the east of Tara Hall, it is possible to see the side of the extension, as seen in Plate 7 above. From this side the extension is wholly subservient to the main house and is light in appearance, allowing the original character of the house to remain dominant.

Plate 8: View of Tara Hall from within its own grounds

The extension is not readily visible from points close to the house along Balscadden Road. From within the grounds of the house the extension is seen from the west, as is shown in the photograph in Plate 8. As with the view from the other side, the main house remains very much the dominant element, with the extension again being light in appearance, smaller, and lower.

The Conservation Officer also takes issue with the removal of the canted bay on the northern elevation despite acknowledging that it was a later, non-original, addition to Tara Hall. The same criteria apply to the canted bay on the northern side of the house as those relating to the extension – it was not readily visible from anywhere other than out at sea. The Conservation Officer has mentioned that the house is visible from the East Pier. The photograph in Plate 9 below shows a view of the house taken from the East Pier in 2010 prior to the carrying out of any works to the house. It is evident that the rear of the house is not prominent and no details could be discerned by any viewer. The casual viewer would not notice any detail, the viewer who is specifically looking for details of the house would have to use a telephoto lens or binoculars to make out that level of detail. The same applies to the view from the western end of Balscadden Road or from the hill alongside the Martello tower, as seen in the photograph in Plate 10, taken in 2017.

Plate 9: View towards Tara Hall from East Pier, 2010

Plate 10: View towards Tara Hall from Martello tower, 2017

Conclusion

The planning authority's report on this application is clearly an over-reaction to the works carried out to the house. Tara Hall now looks like a typical mid-nineteenth century house as the changes that have been made to the façade have respected its period of origin. Only from out at sea is the extension seen to its full extent. That the planning authority should adopt such trenchant negative views of the works and the proposed further development to be carried out to a building that they have decided not to include in the record of protected structures is inexplicable. This is particularly strange given the majority of the works complained of constitute exempted development.

An Coimisiún is requested to note the views of the planning authority and to grant substitute consent for the development to which this application relates.

Rob Goodbody, 25th August 2026

ALTEMAR
Marine & Environmental Consultancy

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26th August 2026

RE: SCA/02/26 Development under section 37l of the planning and development act 2000 at Tara Hall, Balscadden Road, Howth, Co. Dublin

As outlined in the site notice the development consists of "*Substitute consent for the demolition at lower ground floor, ground floor and first floor levels and the substantially constructed part two/part three storey extension at the north elevation of the existing dwelling and a new on-site sepcon waste water treatment plant with sand polishing filter and percolation area.*"

Altemar provided an AA Screening and Natura Impact Statement in relation to the development (dated 19th May 2026). This letter has been prepared in response to the correspondence received from An Coimisiun Pleanala dated 6 August 2026, case number ACP-342322-26. A submission from Fingal County Council was enclosed with it, dated 4 August 2026, reference SCA/01/26. Specifically, it addresses points 1-4 relating to Appropriate Assessment Screening and Natura Impact Statement & general ecological concerns. In relation to the points raised pleased note the following:

1. **Vegetated sea cliffs of the Atlantic and Baltic coasts [1230]**

'Table 2 of the AA Screening Report rules out wastewater/foul water pathways to Howth Head SAC (000202) by noting "Presently, there is no pathway via foul water drainage as the WWTP does not discharge to the marine environment". The Qualifying Interest habitat of Howth Head SAC "Vegetated sea cliffs of the Atlantic and Baltic coasts [1230]" is contained within the site's redline boundary immediately adjacent to the stonewall demarcating the northern extent of the garden, as illustrated in Figure 3, 4 and 5 of the NIS. The site-specific conservation objective is to maintain the favourable conservation condition of this habitat however it is noted that the overall conservation status is assessed as 'Unfavourable - Inadequate' (NPWS, 2025).

The Annex I habitat 'Vegetated sea cliffs of the Atlantic and Baltic coasts [1230]', is located 4.2m from the WWTP percolation area, as shown in the site layout plan by DaCaD Design, Drawing Number 24-1471-02. The wastewater system appears to be designed to allow wastewater to discharge via percolation into the ground. It is unclear what the quality of discharge will be at this point (discharge to percolation area) and if there is adequate depth of soil available to complete the treatment process, and if the soil itself is suitable in type, nature and depth to treat the effluent. Based on EPA mapping Rock is at or Near Surface (EPA, https://gis.epa.ie/EPAMaps/, accessed 02/07/26). Additionally, the Remedial AA Screening Report notes stone walls demolished onsite were used to "make up ground for the percolation area". This potential pathway for wastewater treated to an unknown standard, to seep/move downslope during the lifetime of the project towards the cliff face approximately 4.2m away north of the percolation area, is considered to present a risk to the Annex I Vegetated sea cliffs habitat which therefore requires further clarification and/or assessment. A hydrogeological and potentially a hydrological assessment should ideally inform the ecological assessment regarding potential impacts and risk.

Based on the above points raised, the AA reports (Remedial Screening report and NIS) are not considered to have robustly assessed the impact on individual attributes noted in the conservation documents including but not limited to the following:

- ***Attribute - Physical structure: functionality and hydrological regime. Target - No alteration to natural functioning of geomorphological and hydrological processes, including groundwater quality, due to artificial structures.*** *No hydrological or hydrogeological information has been provided to assess the potential impact on quality of water (pH, hydrocarbons, silt etc) and quantity of surface and groundwater reaching the sea cliffs from the development. This includes rerouting surface water to the wastewater outfall, thereby reducing infiltration rates and also the reduction and increase in groundwater flows through the creation of artificial barriers including the building but also pipe laying works, installation of a wastewater treatment plant and installation of a sand polishing filter and percolation area for wastewater into ground, 4.2m from the top of sea cliffs as shown in the site layout plan by DaCaD Design. As noted above, particular concern is raised regarding the quality of effluent entering the ground and the ability for the soil to treat and allow infiltration due to "Rock at or Near Surface" as demonstrated by EPA (EPA, online mapping accessed 02/07/26).*
- ***Attribute - Vegetation structure: zonation. Target - Maintain range of sea cliff habitat zonations including transitional zones, subject to natural processes including erosion and succession.*** *A report by FitzGerald Ecology (2023) on Vegetated Sea Cliffs Survey of Howth Head, Co. Dublin refers to the different zones types of sea cliffs and the importance of wetland features and vegetation as part of this habitat type. The report notes "the flushes along sea cliffs below Balscadden Road are of particular interest as these areas previously harboured a variety of rare plant species which are now generally in decline due to disturbances to their water sources upstream (Doogue 2019)." The AA reports do not assess if the alteration of hydrology and hydrogeology will negatively impact upon the Annex I sea cliff habitat within and connected to the property. Separately, it is unclear of any of these rare plant species are present within the application boundary or along the sea cliffs connected to the property as no botanical surveys were undertaken.*
- ***Attribute - Vegetation composition: negative indicator species. Negative indicator species (including non-natives) to represent less than 5% cover.*** *It is noted that the AA documents report no invasive species were recorded onsite from the site visit, however it is unclear if this specifically refers to Schedule 3 species listed under the Habitat Regulations or species recorded in the Howth area that are aggressive invaders such as Carpobrotus edulis which are referred to within the Conservation Objectives document for the site and noted to be a treat [threat] to this habitat (NPWS, 2016). Specific measures for invasive species are referred to in the Howth Head SAC and Howth Head Cost [Coast] SPA 2025-2035 Management Plan (MKO, 2025) highlighting the level of threat they pose to this habitat type. Gardens along Balscadden Road (the location of the proposed development) are highlighted with reference made to additional non-native invasive plant species Veronica x franciscana, Echium pininana and how private landowners need to provide appropriate stewardship. Additionally, no information has been provided regarding landscaping works which are referred to within the AA documents, including movement of soil and species to be used in vegetation planting including those proposed as part of the SUDS measures. The risk of introducing potentially non-native species that would be invasive and potential risk to the QI habitats, has not been considered or assessed.*
- *The surface water system proposes to use existing clay pipes previously used to transport wastewater for discharge over the sea cliff. It is unclear if a condition assessment of these pipes has been undertaken to ensure they do not leak, are broken and will operate as intended, once it is ensured that their operation will not negatively impact on the QI habitat. This includes the alteration of percolation of surface water to groundwater and discharge from within the sea cliff habitat itself, as shown in Figure 5 of the NIS.'*

In relation to part 1 of the FI above, it is outlined that: '*It is unclear what the quality of discharge will be at this point (discharge to percolation area) and if there is adequate depth of soil available to complete the treatment process, and if the soil itself is suitable in type, nature and depth to treat the effluent'.*

Vertical Star Ltd. (the civil engineers for the project) have written a response document which addresses the above as follows:

'In response to the concern about the "quality of the discharge", the company that supplied the "Sepcon" Wastewater Treatment Plant was contacted on 19 August 2026 to clarify the quality of the discharge that is expected from the unit that provides primary and secondary treatment of the effluent coming form the house.
The WWTP is located on the other side of the house to the percolation area and is pumped to the sand polishing filter located on top of the percolation area. The treated effluent percolates through the sand polishing filter then through the percolation pipework and stone to the ground.
Ken Lannery of Sepcon replied on 19 August that the unit supplied is a Sepcon BAF WWTS and the EN12566-3 certification for the Sepcon BAF treatment system is included in Appendix A. The relevant extract dealing with the effluent quality that exits the WWTS (before discharging to the sand filter) is copied out below.

Sepcon – BAF Concrete Sewage Treatment System
Biological aerated filter

Nominal organic daily load (influent)	0.32 kg BOD_5/d		
Nominal hydraulic daily load	0.90 m^3/d		
Material	Concrete		
Watertightness	Pass		
Crushing resistance (vertical load test)	Pass (also wet conditions)		
Durability	Pass		
Treatment efficiency (nominal sequences)		Efficiency	Effluent
	COD	91.7 %	61 mg/l
	BOD_5	95.5 %	15 mg/l
	NH_4-N*	94.5 %	1.7 mg/l
	SS	94.2 %	25 mg/l
Electrical consumption	1.1 kWh/d		
Number of desludging	Not more than once		

* *determined for temperatures ≥ 12 ° C in the bioreactor*

Once the treated discharge to the above standards is pumped to the sand filter it percolates through the sand filter to the percolation area below.

The expected treatment quality of the effluent after it passes through the sand filter was provided by Ken Lannery and is copied out below:

Parameter	Expected result after sand filter
BOD (Biological Oxygen Demand	<5mg/l (Ofter<1mg/l)
SS (Suspended Solids)	<5mg/l
NH4 (Ammonia)	<5mg/l
Pathogens (eg E.coli)	>99 reduction

.... In the last report submitted to An Coimisuin Pleanala in late July this year, a site characterization report and survey of the percolation area with sections demonstrating the depths of soil under the percolation stone were provided. Both sections demonstrated an average of 1.15m depth rising to 2m depth of soil over rock.'

The above is to be read in conjunction with the response document by Vertical Star Ltd. and the study referenced therein by Dr Laurance Gill *"A Comparison of Stratified Sand Filters and Percolation Trenches for On-site Wastewater Treatment".*

With consideration of the above, it is considered that the onsite wastewater treatment system will treat wastewater adequately and that there is adequate depth & quality of soil to facilitate the process.
As a precautionary measure, it is proposed to monitor the soil (orthophosphates and nitrates) down slope of the percolation and sand filter area for a period of five years post-development to ensure the treatment system is operating to specification. The results of this monitoring will be submitted to Fingal Co Co on a regular basis as agreed. If it is determined that additional mitigation measures to limit the nutrient input into the soil are required after any monitoring period, these will be agreed between the client and the council.

In relation to **bullet point 1 above**, it is noted that surface water is 'rerouted to the surface water outfall'. This is not the case as surface water from the site was always discharging to the sea outfall in the pre-development scenario. The differences now as a result of the new development is that foul water is removed entirely from the sea outfall and the surface water that formerly discharged untreated to the sea is now treated by the use of SuDS planters. The quality of effluent entering the ground and the ability for the soil to treat and allow infiltration has been considered in the engineering report outlined above. This provides a significant improvement in relation to ecology.

In relation to **bullet point 2 above**, with treatment of surface and foul water as outlined above, it is not considered that the hydrology and hydrogeology of the site and the adjacent Vegetated Sea Cliffs was/will be impacted to any measurable degree which would be significant enough to cause impacts on this habitat type. No detailed botanical surveys were undertaken on site, as the site visit revealed the main habitat between the house and the cliff face to be manicured amenity grassland. No vegetated sea cliff habit was noted within the development site.

In relation to **bullet point 3 above**, it is confirmed that the initial ecological assessment inspected the site for both Third-Schedule invasive species (S.I. No. 477/2011) and aggressive non-native/indicator species known to the Howth area (including *Carpobrotus edulis* and localized garden escapees), none of which were recorded within the development footprint. As the development relates to a retrospective domestic extension, major earthworks and soil movements are already complete, eliminating any construction-phase vector risks. Historically, the site contained amenity grassland (Google Earth Pro). The existing garden layout does not feature invasive species, and standard housekeeping practices will ensure that future landscaping or SUDS provisions remain free of high-risk non-native flora. Ecological monitoring of the site during the completion of construction works will be in place to ensure there is no potential risk to QI habitats from invasive species.

In relation to **bullet point 4 above**, this was addressed in the report submitted to An Coimisuin Pleanala in late July, (report reference 25-002r.003) and contained the following text:

"The outfall pipe referred to will now only discharge treated surface water from the site that has undergone stages of SuDS treatment. A visual condition assessment was presented in the Engineers report submitted with the original application and it is not contested that there are lower reaches of the pipework that are not in perfect condition. However, given the hazardous location of the pipework, no close inspections could have been countenanced at the time. Furthermore, repairs to pipework that is adhered to the side of a steep cliff would pose an unnecessary and unjustifiable risk to human life. There is no danger of blockage given the steepness of the pipe, and if there are leaks, the flows will regardless

reach their intended target. It is noted that FCC's own gully pipe to the immediate western boundary of the site discharges at just below soil level to the top of the cliff and rightly, no effort was made to discharge at a lower level for the common sense reasons stated above".

References to artificial barriers altering ground water flow are included in the Council comments on the scheme in the highlighted text above. It is to be noted that any introduction of new pipes in a granular bedding and percolation area stone will resupply in an easier passage of ground water with respect to the porosity of the original compacted soil compared with a granular material. Thus, no blockage or diversion of ground water as a result of the works is anticipated.

2. Kittiwake (*Rissa tridactyla*) and Other SCI Birds

The development is a extension and small-scale demolition to an *existing* property, not a major greenfield or cliff-edge excavation project. The baseline disturbance is already established by the existing residential use e.g. lawn mower etc. . Physical disturbance (vibration, and human presence) was contained entirely within the footprint of the existing building envelope. Minor works of this scale do not generate the type of heavy, continuous construction impacts (such as pile-driving or blasting) that would displace seabirds from cliff faces which are not visible from the works area. The works were set back c. 15m from the cliff face behind a stone wall which forms the boundary between the property and the cliff face, providing an additional physical buffer.

Because the works were minor and entirely self-contained, it is considered that the level of potential disturbance in the vicinity of the works was minor and not at significant levels that would significantly impact on Kittiwake, if present. The property is already part of the existing human environment. Any seabirds nesting on nearby cliffs are already habituated to human presence, residential noise, and everyday activities in the area. A small-scale retrospective extension would not have altered the baseline environmental conditions or introduce a new, permanent source of significant disturbance.

Construction took place during daylight hours and was confined to the site boundary. No artificial lighting was used at nighttime and there was no construction activity within the boundaries of the SPA. Based on the above, there was limited potential for effects on Kittiwake (or other SCI species) which may use the adjacent cliff face for breeding. Going forward, an operational lighting plan can be developed to eliminate the potential for future impacts which may arise from the works undertaken.

3. In-Combination Assessment

The submitted NIS identified all plans and projects within the Zone of Influence sharing a pathway of connectivity to the European sites affected by this development, the Howth Head SAC (Vegetated sea cliffs [1230], European dry heaths [4030]), Howth Head Coast SPA (Kittiwake [A188]), Rockabill to Dalkey Island SAC (Reefs [1170], Harbour Porpoise [1351]) and North-west Irish Sea SPA (seabird assemblage). Two directly adjacent developments sharing these same pathways - Dawn View (F25A/0626E) and Grattan Lodge (F24A/0605E) - were each the subject of their own AA Screening and NIS, both concluding, following standard mitigation, no adverse effect on site integrity, alone or in combination. No other projects sharing a comparable pathway were identified.

This conclusion applies to the subject development, as the works in this application are complete: a site inspection by Altemar confirmed that works remained within the site boundary formed by the existing stone wall and identified no visual evidence of silt or pollutant discharge to the SAC/SPA. The residual forward-looking risk is confined to the wastewater/surface water pathway and the Kittiwake breeding-season restriction addressed at Points 1 and 2 above, both already secured through the mitigation and monitoring set out in this response. Given the minor, retrospective and largely-completed nature of the works, and that the only comparable projects in the Zone of Influence have each independently concluded no adverse effect, there is no realistic pathway for residual effects to combine with those of other plans or projects. Accordingly, it is confirmed that the development, alone or in combination, will not adversely affect the integrity of any European site or the QI/SCI for which it is designated.

4. Other Non-AA Related Biodiversity/Ecological Concerns

Since the site is an existing residential property undergoing minor extension/retrospective works, its capacity to support species like common lizards or significant lepidoptera populations is heavily constrained by the built environment.
It is noted that while bats are protected under Annex IV and the Wildlife Acts, the small-scale domestic extension/demolition to an existing habited residential structure did not impact high-potential roost features. The rear section of the property which was demolished did not appear to contain features of bat roosting potential such as old stonework with hollows and/or large undisturbed cavity roofs. No mature trees of bat roosting potential exist onsite as confirmed by the site visit by Altemar Ltd. in October of 2025.

Again, we would like to reiterate the small scale, spatial separation and the minor, non-industrial nature of the works. A small residential extension does not generate underwater noise, coastal discharges, or marine-based construction activities that could affect mobile marine species or cetaceans offshore. It is respectfully noted that the development comprises a minor, localised domestic extension to an existing residential property. Due to the small-scale, domestic nature of the works and their location within an established built footprint, the potential for impacts on local protected fauna (such as bats or reptiles) is negligible. Potential impacts on foraging bats would have been greatly reduced given there was no construction lighting during nighttime and works took place during daylight hours. To comprehensively address the council's concerns regarding potential light spill from glazed elements, a detailed lighting design protocol can be implemented as previously suggested via planning condition to ensure zero negative impact on the adjoining coastal environment.

The Remedial AA Screening & Remedial Natura Impact Statement was developed using the precautionary principal. This included mitigation measures in relation to Natura 2000 sites. Mitigation measures included measures in relation to Foul drainage, Surface Water Drainage, Dust, Dirt & Noise control, Groundwater, Runoff Pollution and sediment control, Dust control, Earth works, waste management, demolition, storage/use of Materials, Plant and Equipment, Surface Water management, Vegetation and invasive species management, in addition to precautionary Kittiwake mitigation. In particular, remaining construction works will not occur from March 1st to August 31st.

We deem that sufficient information is within the AA Screening and Natura Impact Statement for ACP to make its determination.

Kindest Regards

Bryan Deegan (MCIEEM),
Managing Director,
Altemar Limited.

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26th August 2026

The Secretary
An Coimisiún Pleanála
64 Marlborough Street
Dublin 1

Case No.:	**ACP-324322-26**
Proposal:	**Substitute Consent for the retention of demolition at lower ground floor, ground floor and first floor levels and the substantially constructed part two/part three storey extension at the north elevation of the existing dwelling and a new on-site sepcon waste water treatment plant with sand polishing filter, and percolation area**
Letter Dated:	**6th August 2026**
Reply By:	**26th August 2026**

APPLICANT RESPONSE TO LOCAL AUTHORITY SUBMISSION

Dear Sir or Madam,

This is a response by the applicant, John Roe, to the submission by Fingal County Council dated 4th August 2026 in respect of the above application for substitute consent at Tara Hall, Balscadden Road, Howth, Co. Dublin. The Council's submission comprises a letter signed by Deirdre Fallon Senior Planner, a Report of the Ecologist Officer Section, and a Report of the Conservation Officer Section. Accordingly, this response has been prepared in conjunction with Bryan Deegan of Altemar Marine and Environmental Consultants; Darragh Aiken of Vertical Star Ltd.; and Rob Goodbody, Historic Building Consultant.

Before directly addressing the Council's response, the Commission is reminded this application is for substitute consent consisting of the distinct pieces of work as carefully described in the statutory notices and shown on the lodged plans. The Council's response has failed to consider the proposed works in the applicant's concurrent application for further development (ACP-324323-26), which administratively needed to be filed separately to the application for substitute consent but will presumably be considered together. Further, the planning authority response fails to acknowledge that other works have been carried out at Tara Hall as exempted development[1] and are not subject of any enforcement action. As stated in the enclosed response by Rob Goodbody, Tara Hall is not a protected structure and his response also addresses the other works at Tara Hall. The Commission is reminded that since the protected structure legislation came into force on 1st January 2000, there has been four development plans prepared and adopted by the Council but Tara Hall has not been deemed worthy of being added to the record of protected structures.

1 Note: The SAAO general restriction on exemption does not apply to the works our client has implemented as exempted development per the Regulations or the Act.

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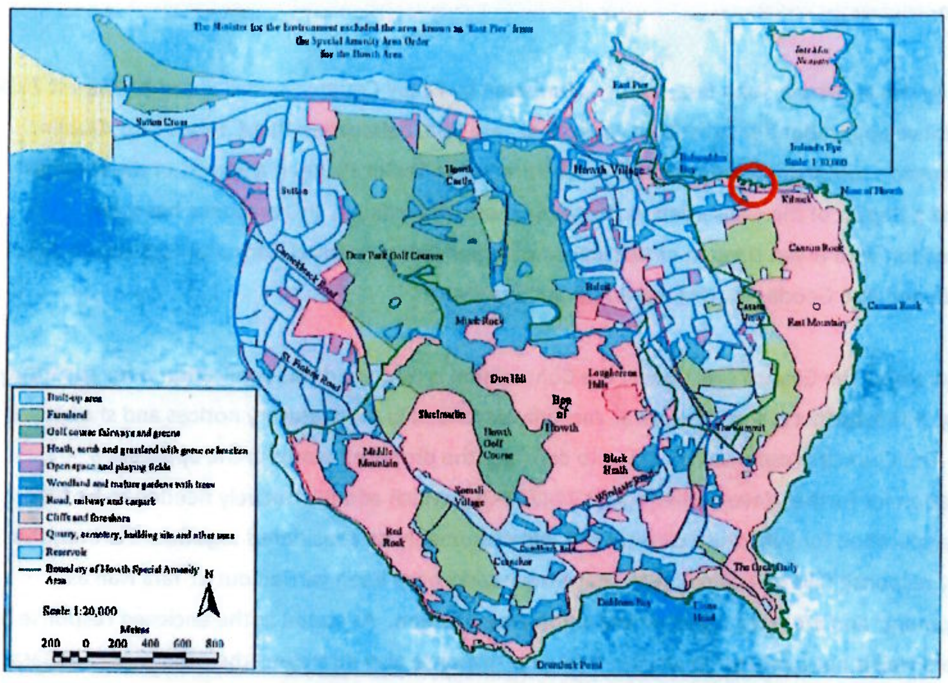
For ease of reference, this response addresses the individual parts of the Council's response in turn.

Response to Letter by Deirdre Fallon

The first five pages with the exception of the planning assessment section at the bottom of page five is text summarising the development, the site, planning history, and quoting extracts from the applicable statutory planning documents. This application includes a landscape and visual impact assessment (LVIA) and it is noted that none of the contributors from the local authority has commented on it or the verified views. This is an unusual omission as concern is expressed about the visual impact of the extension and the character of Tara Hall. The application also addresses Table 14.26 of the development plan, which expressly provides in the tenth provision that *"extensions to existing older or vernacular buildings should be taken from the historic building stock of the area but can be expressed in a contemporary architectural language"*.

With regard to development and high amenity areas, Tara Hall was already a substantial dwelling on the application site, which does not directly or indirectly contribute to the high amenity zoning. There were only limited views of the now demolished non-original extensions at the rear of Tara Hall and the existing extension plus the proposed further development will also only be partially visible. Long distance views from the east pier are such that any features of either version of the rear extensions are indecipherable.

In the Howth SAAO, Tara Hall is clearly identified as being a "built-up area" on the map on page 4 of the SAAO written statement. For ease, it is circled red on the following extract from that map:



However, Tara Hall is also deemed *"other lands within the Special Amenity Area"* and thus treated differently notwithstanding the acknowledgement that it is a built-up area. A review of the planning register confirms a number of recent planning permissions on lands within the SAAO with the same classification including Reg. Ref.: F25A/1068E, F25A/0626E, and F22A/0321. A short summary of these is set out below:

Reg. Ref.: F25A/1068E

Planning permission was granted for the refurbishment, modernisation and extension of the existing buildings at Balscadden House, which is due west of Tara Hall and also on the northern side of Balscadden Road. The Council sought an LVIA by way of further information but unlike in this application at Tara Hall, they considered it, assessed it to be acceptable, and deemed no injurious visual impact.

Reg. Ref.: F25A/0626E

Permission was granted for the demolition of the existing dwelling and its replacement with a larger dwelling (an increase of 45.32 sq.m. or 17.2%). This property is due east of Tara Hall, on the northern side of Balscadden Road and zoned high amenity. It is irrational that the SAAO is open to replacement dwellings on high amenity zoned land where the increase in floor area does not exceed 20% but this proposal where the gross floor area of the extension (per the substitute consent and further development application) is 118.5 sq.m. (or 19.1%) or a net increase of 41.55 sq.m. (or 6.7%) is inappropriate due to size and materiality.

Reg. Ref.: F22A/0321 (ABP-314842-22)

This was an application on the other side of Howth at Carrickbrack Road and the proposal comprised the demolition of a dwelling (225 sq.m.) and the construction of a replacement dwelling (1,073.2 sq.m.). The site straddled the residential and high amenity zoning objectives; the existing house was on the HA zoned land and the proposed dwelling was largely on the residential zoned land. Notwithstanding that the planning authority put it on record in their submissions to the Board that it would be proposed to add the existing dwelling to the record of protected structures, An Bord Pleanála approved the demolition of the dwelling and its replacement with one that would be 4.77 times the size of it and partially located on high amenity zoned land.

The SAAO does not contain any policy that expressly prohibits the development that has taken place at Tara Hall with or without the proposed further development in the concurrent application. Policy 3.4.2 requires that an extension *"should generally match"* the character of the existing structure but it does not obligate an extension to match the character of the existing structure. Further, table 14.26 clearly states that extensions to existing older or vernacular buildings *"can be expressed in a contemporary architectural language"*. Again, this is not an absolute provision but a contemporary extension is acceptable at Tara Hall. The advice to our client and to the Commission as set out in the various reports issued by Rob Goodbody, Historic Building Consultant, is that between the two concurrent applications, *"These two changes* [setting back the extension and reinserting the former window opes] *will ensure that the character of the original house will remain dominant when seen from the rear, with the extension reading as a later addition, subservient to the original."*

The planning authority in reference to policy 3.4.2 of the SAAO concludes as follows:

> *"The interventions made to the prominent historic building of Tara Hall, that is also sited within the Howth Special Amenity Area and a High Amenity Area, are not acceptable as they have stripped the building of the historic fabric of its roof, walls and windows, altered the detailing and inserted inappropriate materials. The size and materiality of the extension to the rear is not acceptable."*

The only part of this statement that is relevant to the application for substitute consent is the final sentence; the rest refers to works that do not require permission, they have not been subject of any enforcement action, and they are not part of this application for substitute consent or the concurrent application for further development. The former extension, now demolished, extended to 76.95 sq.m. with the majority at the lower ground floor level. The extension to be retained plus the proposed amended extension will be 118.5 sq.m. or a net increase of 41.55 sq.m (or 6.7%). The following table summarises the pre-demolition, current (per the substitute consent application) and the proposed floor areas per floor (per the application for further development) at Tara Hall.

	Pre-Demolition (sq.m.)	Current Floor Areas (sq.m.)	Proposed Floor Areas (sq.m.)
Lower Ground Floor	50.15	80.4 (+ 30.25)	79.3 (+ 29.15)
Upper Ground Floor	13.4	30.9 (+ 17.5)	28.9 (+ 15.5)
First Floor	13.4	10.3 (- 3.1)	10.3 (- 3.1)

It is submitted to the Commission that neither the gross nor net size of the extension or using contemporary materials contravenes the development plan policy, the zoning objective or the provisions of the Howth SAAO. In other words, there is no basis in terms of "size" or "materiality" to refuse permission.

It is not proposed to repeat our position in respect of the reasons for refusal under F24A/1034E as they are fully addressed on pages 2 to 5 of our cover letter dated 15th May 2026.

The Commission is referred to the enclosed report by Rob Goodbody that addresses the comments on the Architectural Heritage Impact Assessment. The AHIA focussed on the north elevation because the north elevation was the only works subject of a warning letter from the Council (an enforcement notice has subsequently been issued); all other works at Tara Hall are exempt development. Tara Hall is not a protected structure, a proposed protected structure or within an architectural conservation area or a candidate ACA.

Finally, the north elevation of Tara Hall is not distinguishable in the long range views from the east pier. The application includes a LVIA and verified views at Balscadden Road but these are not mentioned in the planning officer's comments to your office. Those assessments and the AHIA confirm that this development and the proposed further development won't affect the character of Tara Hall.

It is not accepted that insufficient information has been provided in respect of Appropriate Assessment or that additional surveys are required for a development that has already taken place. The Commission is referred to the enclosed reports by Altemar and Vertical Star Ltd. with respect to appropriate assessment.

Response to the Report of the Ecologist Officer

The Commission is referred to the following documents that address the comments of the Ecologist Officer:

- Altemar response dated 26th August 2026
- Response to ACP by Vertical Star Ltd. Including Appendix A and B.

In summary, these submissions clarify the improved drainage arrangement at Tara Hall as untreated effluent is no longer discharging into the sea; they confirm the composition of the percolation area and the projected quality of effluent; and they offer to monitor the soil down slope of the percolation and sand filter area for five years to ensure the treatment system is operating to specification. Furthermore, the ecologist has confirmed that no vegetated sea cliff habit was noted within the application site and they clarify that the initial ecological assessment inspected the site for both Third Schedule invasive species and aggressive non-native/indicator species known for Howth and none of which were found. The Altemar response also addresses the Kittiwake and other SCI Birds, in-combination assessment, and other non-AA related biodiversity/ecological concerns. Altemar concludes that there is sufficient information within the AA Screening and Natura Impact Statement for the Commission to make its determination.

Response to Report of the Conservation Officer

The Commission is referred to the enclosed report dated 25th August 2026 by Rob Goodbody, Historic Building Consultant which fully addresses the report of the conservation officer.

In addition, it is noted that the conservation officer's report cites 5 no. policies and a development management objective from the development plan; each is addressed in turn:

Policy HCAP9 – Re-use of Architectural Heritage

Champion the maintenance, repair, re-use and sensitive retro-fitting of the architectural heritage and older building stock of the County as a cornerstone of its sustainable development policy and will require that adaptative re-use and regeneration adheres to best conservation practice.

- In the preceding paragraph of the development plan, it is stated the "*two principal mechanisms within this legislation for the protection of these assets: The Record of Protected Structures (RPS) and Architectural Conservation Areas (ACAs).*" Neither of these apply to Tara Hall and the Commission is reminded that since the protected structure legislation came into force on 1st January 2000, there has been four development plans prepared and adopted by the Council but Tara Hall has not been deemed worthy of being added to the record of protected structures.

Policy HCAP21 – Built Heritage Assets

Protect and enhance the historic environment and built heritage assets, including elements of historic street furniture, paving and historic boundary treatments.

- It is our position as confirmed in the AHIA submitted to the Commission that the development for substitute consent in conjunction with the proposed modifications as set out in the application for further development would protect and enhance Tara Hall. The extensions at the rear that have been demolished were not original to Tara Hall as confirmed in the Conservation Officer's report.

Policy HCAP22 – Retention and Reuse of Existing Building Stock

Seek the retention, appreciation and appropriate revitalisation of the historic and vernacular building stock, and 20th century built heritage of Fingal in both the urban and rural areas of the County <u>by deterring the replacement buildings with modern structures</u> and <u>by protecting (through the use of Architectural Conservation Areas and the Record of Protected Structures and in the normal course of Development Management)</u> these buildings where they contribute to the character of an area and/or where they are rare examples of a structure type, a distinctive piece of architecture or have an innate value. (See also Table 14.26) [emphasis added by KOM & Co. Ltd.]

- It is submitted the first underlined part of this policy does not apply because the applicant has not replaced Tara Hall i.e. it is not proposed to demolish and replace Tara Hall with a modern structure. It is accepted part of Tara Hall has been replaced but that extension was not original to Tara Hall and the tenth provision in table 14.26 states *"extensions to existing older or vernacular buildings should be taken from the historic building stock of the area but can be expressed in a contemporary architectural language".*

- With regard to the second part that is underlined, Tara Hall is not within an ACA and nor is it a protected structure. The development management provision is set out in DMSO190 which relates to Table 14.26. it is our position that this application in conjunction with the application for further development, addresses the applicable provisions within Table 14.26 noting that the seventh, eighth and ninth provisions are not applicable to Tara Hall. The Commission is referred to the submitted Architectural Heritage Impact Assessment by Rob Goodbody that inter alia provides an analysis of historic maps, includes a building survey (plan survey drawings are also included with the application), and assesses the implications of the various aspects of the works on the architectural heritage of Tara Hall. The assessment concludes as follows with regard to the respective concurrent applications:

  Application No. 1: Substitute Consent
  It is important to note that the house is not a protected structure and is not located in an architectural conservation area. The sole concern in the assessment of these works is the potential impact on the Howth Special Amenity Area Order as some of the works involved, notably the demolition of the rear additions and canted bay and the enlargement of the windows, would have been exempted development under the terms of the Planning and Development Regulations had it not been for the existence of the SAAO.
  Application No. 2: Further Development
  The proposed modifications to the works that have been carried out include the reinstatement of the sizes of the three windows as described above, and this change is very significant. The extension is to be pulled back on its eastern side to ensure that the corner of the main house is revealed. These two changes will ensure that the character of the original house will remain dominant when seen from the rear, with the extension reading as a later addition, subservient to the original.

- Finally, the Commission will note that the tenth provision in table 14.26 states *"extensions to existing older or vernacular buildings should be taken from the historic building stock of the area but can be expressed in a contemporary architectural language".* The extension to the north elevation is very much expressed in contemporary architectural language but in conjunction with setting it back at its east elevation and the reinstatement of the original window opes at the northern elevation, the Commission is invited to agree with the considered assessment and conclusion in the architectural heritage impact assessment.

Policy HCAP23 – Heritage-led Regeneration
Require that adaptative re-use of older buildings and historic centre heritage-led regeneration adheres to best conservation practice and principles. There will be a presumption against the demolition of older buildings where restoration or adaptation is a feasible option.

- The development is not an adaptive re-use, so this policy does not apply to Tara Hall, which has always been a habitable dwelling and will remain one for the applicant. As previously stated, what has been demolished were non-original extensions and the concurrent proposed further development, which has been directed by Rob Goodbody, will safeguard Tara Hall for future generations. Further, it should be noted that the conservation officer's comments relate to works that are not subject of this substitute consent application; she is referencing exempted development works at Tara Hall.

Policy HCAP25 – Retention of Historic Fabric
Encourage the retention of the original or historic fabric such as windows, doors, wall renders, roof coverings, shopfronts, pub fronts and other significant features of older or historic buildings, whether protected or not.

- The applicant has sought to retain all original or historic features where possible. However, it must be noted and accepted by the Commission that Tara Hall is not a protected structure or within an ACA, so the works other than those subject of the two applications to your office have been conducted as exempt development and are not subject of any enforcement action at Tara Hall.

Objective DMSO190 – Structures Contributing to Distinctive Character
Where development is proposed for a site that contains a vernacular or historic building, 20th Century building of merit and/or structures that contribute to the distinctive character of the rural or urban areas of Fingal then the scheme should have regard to the direction in Table 14.26.

- Compliance with DMSO190 and table 14.26 is set out in the application cover letter but that has either been missed or ignored by the conservation officer.

Of the six policies and objectives listed by the conservation officer, she only directly references HCAP23 in her subsequent text albeit in respect of works at Tara Hall that are exempted development and not subject of this substitute consent application. Her opinion of the impact of the development, existing and proposed, is entirely predicated on her opposition to exempted development works that have taken place at Tara Hall. This was the same opinion she proffered in the previous application, PL06F.321795, at Tara Hall, which in our opinion, the Board erroneously had regard to in deciding to reject the clear recommendation of its planning inspector to grant retention permission.

Summary and Conclusion

The development is for a contemporary extension at the rear of Tara Hall that has replaced two non-original extensions to this dwelling, and an on-site Sepcon wastewater treatment system. Tara Hall is not a protected structure, it is not a proposed protected structure or in an ACA or candidate ACA. It has no formal heritage protection and despite multiple development plans since the introduction of the protected structures legislation, the Council has not deemed it worth of protected structure status. Also, the National Inventory of Architectural Heritage did not include Tara Hall in its buildings deemed to be of Regional significance.

It is not disputed that the existing extension subject of this application for substitute consent is visible and so will the proposed development, if the application for further development is approved. However, being visible does not automatically equate to affecting the high amenity of the area or detracting from the character of

Tara Hall. As demonstrated in the LVIA, the combined existing and proposed developments will have "*no significant visual or townscape impacts, and the established character and amenity of the area are preserved*".

It is not accepted that insufficient information has been provided in respect of AA or that additional surveys are required for a development that has already taken place. There is improved drainage arrangements at Tara Hall as untreated effluent is no longer discharging into the sea. The composition of the percolation area and projected quality of effluent has been clarified and the applicant will monitor the soil down slope of the percolation and sand filter area for five years to ensure the treatment system operates to specification.

The ecologist has confirmed that no vegetated sea cliff habit was noted within the application site and that the initial ecological assessment inspected the site for both Third Schedule invasive species and aggressive non-native/indicator species known for Howth and none of which were found. Altemar concluded that the level of potential disturbance in the vicinity of the works was minor and not at significant levels that would significantly impact on Kittiwake, if present. The property is already part of the existing human environment. Any seabirds nesting on nearby cliffs are already habituated to human presence, residential noise, and everyday activities in the area.

There is no realistic pathway for residual effects to combine with those of other plans or projects, so it is confirmed that the development, alone or in combination, will not adversely affect the integrity of any European site or the QI/SCI for which it is designated. Finally, due to the scale, domestic nature of the works and their location within an established built footprint, the potential for impacts on local protected fauna (such as bats or reptiles) is negligible. Accordingly, Altemar concludes that there is sufficient information within the AA Screening and Natura Impact Statement for the Commission to make its determination.

Having regard to the above and enclosed reports, the Commission is invited to dismiss the comments by Fingal County Council, and grant planning permission for the proposed further development.

Please acknowledge receipt of this response and direct all future correspondence to this office.

Regards,

Raymond O'Malley

____

Raymond O'Malley
Kiaran O'Malley & Co. Ltd.
ROM: rom

Enclosures	1.	Altemar response dated 26th August 2026
	2.	Response to ACP by Vertical Star Ltd. Including Appendix A and B
	3.	Rob Goodbody, Historic Building Consultant, report dated 25th August 2026

James Sweeney

From: Appeals2
Sent: Wednesday 26 August 2026 16:37
To: James Sweeney
Subject: FW: ACP-324322-26 (e-mail 2 of 2)
Attachments: 25-002r.004 Response to ACP August 2026 incl appendices.pdf

Follow Up Flag: Follow up
Flag Status: Flagged

From: KOM.ie | Raymond O'Malley <raymond@kom.ie>
Sent: Wednesday 26 August 2026 15:24
To: Appeals2 <appeals@pleanala.ie>
Subject: Re: ACP-324322-26 (e-mail 2 of 2)

Caution: This is an **External Email** and may have malicious content. Please take care when clicking links or opening attachments. When in doubt, contact the ICT Helpdesk.

E-mail 2 of 2.

Regards,

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From: KOM.ie | Raymond O'Malley <raymond@kom.ie>
Sent: Wednesday, August 26, 2026 3:23 PM
To: Appeals2 <appeals@pleanala.ie>
Subject: ACP-324322-26 (e-mail 1 of 2)

Hi There,

Please find attached a response to your letter dated 6th August 2026 in respect of the above case.

There are four attachments as follows:

1. KOM & Co. Ltd. cover letter.
2. Altemar response dated 26th August 2026
3. Response to ACP by Vertical Star Ltd. Including Appendix A and B (in e-mail 2 of 2).

4. Rob Goodbody, Historic Building Consultant, report dated 25th August 2026

Regards,

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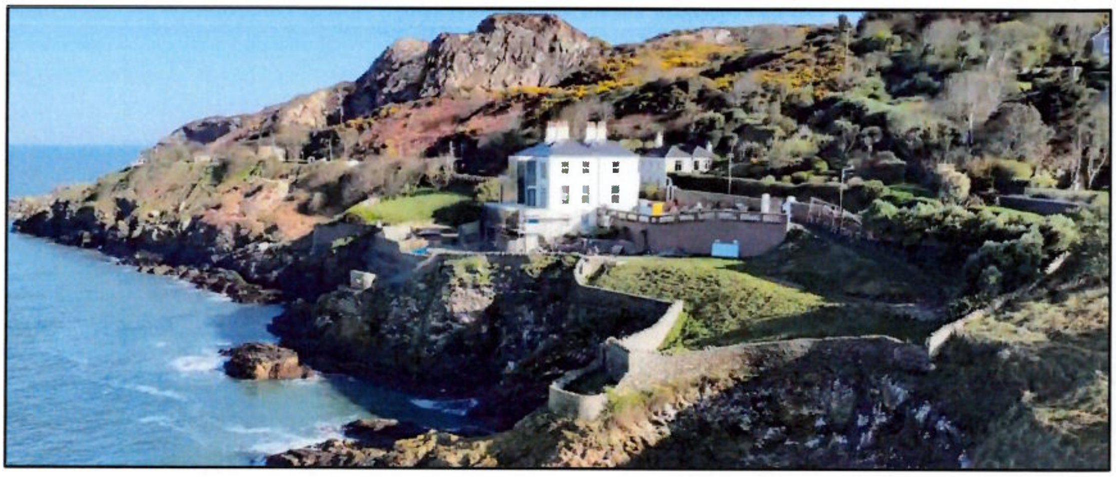

Project: **Application for Substitute Consent**
Tara Hall, Balscadden Road, Howth, North County Dublin

ACP reference: ACP-342322-26

Report: Responses to An Coimisiun Pleanala

Date: 25th August, 2026

Client	Mr. John Roe
Job Reference	25-002
Document Reference	25-002r.004

Revision	Date	Author
1st Draft	21/08/26	Darragh Aiken

Revision	Revision notes

Author Details	Details
Name:	Darragh Aiken
Company:	Vertical Star Ltd.
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Phone:	086 2682853
Qualifications:	Bachelor of (Civil) Engineering University College Dublin

Contents:

1 Introduction

This report has been prepared in response to the correspondence received from An Coimisiun Pleanala dated 6 August 2026, case number ACP-342322-26.

A submission from Fingal County Council was enclosed with it, dated 4 August 2026, reference SCA/01/26.

This report limits itself to responding to elements of Fingal's submission that are highlighted within the text, and are addressed in the following section.

2 Responses to FCC's Ecologist Officers (FCC reference SCA/01/26)

The text of Fingal County Council's report prepared by Joanne Allen-Hamilton is dated 31/07/2026 and the section relevant to this report being the percolation area is shown below.

Those sections of the report that are relevant to this response are highlighted in the extracts below.

1. Vegetated sea cliffs of the Atlantic and Baltic coasts [1230]

Table 2 of the AA Screening Report rules out wastewater/foul water pathways to Howth Head SAC (000202) by noting *"Presently, there is no pathway via foul water drainage as the WwTP does not discharge to the marine environment"*. The Qualifying Interest habitat of Howth Head SAC *"Vegetated sea cliffs of the Atlantic and Baltic coasts [1230]"* is contained within the sites redline boundary immediately adjacent to the stonewall demarcating the northern extent of the garden, as illustrated in Figure 3, 4 and 5 of the NIS. The site-specific conservation objective is to maintain the favourable conservation condition of this habitat however it is noted that the overall conservation status is assessed as 'Unfavourable - Inadequate' (NPWS, 2025).

The Annex I habitat 'Vegetated sea cliffs of the Atlantic and Baltic coasts [1230]', is located 4.2m from the WWTP percolation area, as shown in the site layout plan by DaCaD Design, Drawing Number 24-1471-02. The wastewater system appears to be designed to allow wastewater to discharge via percolation into the ground. **It is unclear what the quality of discharge will be at this point (discharge to percolation area) and if there is adequate depth of soil available to complete the treatment process, and if the soil itself is suitable in type, nature and depth to treat the effluent.** Based on EPA mapping *Rock is at or Near Surface* (EPA, https://gis.epa.ie/EPAMaps/, accessed 02/07/26). Additionally, the Remedial AA Screening Report notes stone walls demolished onsite were used to "make up ground for the percolation area". This potential pathway for wastewater treated to an unknown standard, to seep/move downslope during the lifetime of the project towards the cliff face approximately 4.2m away north of the percolation area, is considered to present a risk to the Annex I Vegetated sea cliffs habitat which therefore requires further clarification and/or assessment. A hydrogeological and potentially a hydrological assessment should ideally inform the ecological assessment regarding potential impacts and risk.

In response to the concern about the "quality of the discharge", the company that supplied the "Sepcon" Wastewater Treatment Plant was contacted on 19 August 2026 to clarify the quality of the discharge that is expected from the unit that provides primary and secondary treatment of the effluent coming form the house.

The WWTP is located on the other side of the house to the percolation area and is pumped to the sand polishing filter located on top of the percolation area. The treated effluent percolates through the sand polishing filter then through the percolation pipework and stone to the ground.

Ken Lannery of Sepcon replied on 19 August that the unit supplied is a Sepcon BAF WWTS and the the EN12566-3 certification for the Sepcon BAF treatment system is included in Appendix A. The relevant extract dealing with the effluent quality that exits the WWTS (before discharging to the sand filter) is copied out below.

Sepcon – BAF Concrete Sewage Treatment System
Biological aerated filter

Nominal organic daily load (influent)	0.32 kg BOD_5/d		
Nominal hydraulic daily load	0.90 m^3/d		
Material	Concrete		
Watertightness	Pass		
Crushing resistance (vertical load test)	Pass (also wet conditions)		
Durability	Pass		
Treatment efficiency		Efficiency	Effluent
(nominal sequences)	COD	91.7 %	61 mg/l
	BOD_5	95.5 %	15 mg/l
	NH_4-N*	94.5 %	1.7 mg/l
	SS	94.2 %	25 mg/l
Electrical consumption	1.1 kWh/d		
Number of desludging	Not more than once		

** determined for temperatures ≥ 12 °C in the bioreactor*

Once the treated discharge to the above standards is pumped to the sand filter it percolates through the sand filter to the percolation area below. A section of the sand polishing filter is given below:

The expected treatment quality of the effluent after it passes through the sand filter was provided by Ken Lannery and is copied out below:

Parameter	Expected result after sand filter
BOD (Biological Oxygen Demand	<5mg/l (Ofter<1mg/l)
SS (Suspended Solids)	<5mg/l
NH4 (Ammonia)	<5mg/l
Pathogens (eg E.coli)	>99 reduction

Kem Lannery commented further on the effluent quality after the sand filter and noted the following

*"The figures detailing the effluent quality after the sand filter (< 5 mg/l) are **performance data** derived from European testing standards and manufacturer field trials for systems sold and certified in Ireland. In a study undertaken by Dr. Laurance Gill – "A Comparison of Stratified Sand Filters and Percolation Trenches for On-site Wastewater Treatment" – Effluent samples after the sand filter were taken and documented. I have attached a copy for your reference. "*

The study he refers to is included in Appendix 2 of this report and provides further case study examples of the improvements to effluent quality by use of stratified sand filters.

In the last report submitted to An Coimisuin Pleanala in late July this year (in relation to the concurrent application for further development at this site ACP-324323-26), a site characterization report and survey of the percolation area with sections demonstrating the depths of soil under the percolation stone were provided. Both sections demonstrated an average of 1.15m depth rising to 2m depth of soil over rock.

In the last report submitted to An Coimisuin Pleanala in late July this year (in relation to the concurrent application for further development at this site ACP-324323-26), Fingal County Council were invited to come to site to witness for themselves the results obtained. Trail holes and pits showing ground makeup, rock depth and percolation area stone depths have been left open for Fingal's inspection since 20 July 2026. We understand that Fingal County Council have not inspected the site since the invitation.

Two sections are highlighted below from the report provided by FCC dated 4 August 2026.

Based on the above points raised, the AA reports (Remedial Screening report and NIS) are not considered to have robustly assessed the impact on individual attributes noted in the conservation documents including but not limited to the following:

- **Attribute - Physical structure: functionality and hydrological regime. Target - No alteration to natural functioning of geomorphological and hydrological processes, including groundwater quality, due to artificial structures.**

  No hydrological or hydrogeological information has been provided to assess the potential impact on quality of water (pH, hydrocarbons, silt etc) and quantity of surface and groundwater reaching the sea cliffs from the development. This includes rerouting surface water to the wastewater outfall, thereby reducing infiltration rates and also the reduction and increase in groundwater flows through the creation of artificial barriers including the building but also pipe laying works, installation of a wastewater treatment plant and installation of a sand polishing filter and percolation area for wastewater into ground, 4.2m from the top of sea cliffs as shown in the site layout plan by DaCaD Design. As noted above, particular concern is raised regarding the quality of effluent entering the ground and the ability for the soil to treat and allow infiltration due to *"Rock at or Near Surface"* as demonstrated by EPA (EPA, online mapping accessed 02/07/26).

- **Attribute - Vegetation structure: zonation. Target - Maintain range of sea cliff habitat zonations including transitional zones, subject to natural processes including erosion and succession.**

  A report by FitzGerald Ecology (2023) on Vegetated Sea Cliffs Survey of Howth Head, Co. Dublin refers to the different zones types of sea cliffs and the importance of wetland features and vegetation as part of this habitat type. The report notes *"the flushes along sea cliffs below Balscadden Road are of particular interest as these areas previously harboured a variety of rare plant species which are now generally in decline due to disturbances to their water sources upstream (Doogue 2019)."* The AA reports do not assess if the alteration of hydrology and hydrogeology will negatively impact upon the Annex I sea cliff habitat within and connected to the property. Separately, it is unclear of any of these rare plant species are present within the application boundary or along the sea cliffs connected to the property as no botanical surveys were undertaken.

- **Attribute - Vegetation composition: negative indicator species. Negative indicator species (including non-natives) to represent less than 5% cover.**

  It is noted that the AA documents report no invasive species were recorded onsite from the site visit, however it is unclear if this specifically refers to Schedule 3 species listed under the Habitat Regulations or species recorded in the Howth area that are aggressive invaders such as *Carpobrotus edulis* which are referred to within the Conservation Objectives document for the site and noted to be a treat to this habitat (NPWS, 2016). Specific measures for invasive species are referred to in the Howth Head SAC and Howth Head Cost SPA 2025-2035 Management Plan (MKO, 2025) highlighting the level of threat they pose to this habitat type. Gardens along Balscadden Road (the location of the proposed development) are highlighted with reference made to additional non-native invasive plant species *Veronica × franciscana, Echium pininana* and how private landowners need to provide appropriate stewardship.

  Additionally, no information has been provided regarding landscaping works which are referred to within the AA documents, including movement of soil and species to be used in vegetation planting including those proposed as part of the SUDS measures. The risk of introducing potentially non-native species that would be invasive and potential risk to the QI habitats, has not been considered or assessed.

- The surface water system proposes to use existing clay pipes previously used to transport wastewater for discharge over the sea cliff. It is unclear if a condition assessment of these pipes has been undertaken to ensure they do not leak, are broken and will operate as intended, once it is ensured that their operation will not negatively impact on the QI habitat. This includes the alteration of percolation of surface water to groundwater and discharge from within the sea cliff habitat itself, as shown in Figure 5 of the NIS.

In the first highlighted section above it is noted that surface water is *"rerouted to the surface water outfall."* We can confirm that this is not the case. The surface water from the site was always discharging to the sea outfall in the per-development scenario. The differences now as a result of the new development is that foul water is removed entirely from the sea outfall and the surface water that formerly discharges untreated to the sea outfall is now treated by the use of SuDS planters (as yet to be installed).

The last section highlighted refers to the sea outfall pipe and the disturbance to the flow of ground water resulting from the works.

The comment on the sea outfall was addressed in the report submitted to An Coimisuin Pleanala (see ACP-324323-26) in late July, (report reference 25-002r.003) and contained the following text, which is copied out below.

"The outfall pipe referred to will now only discharge treated surface water from the site that has undergone stages of SuDS treatment. A visual condition assessment was presented in the Engineers report **(see section 3.1)** *submitted with the original application and it is not contested that there are lower reaches of the pipework that are not in perfect condition. However, given the hazardous location of the pipework, no close inspections could have been countenanced at the time. Furthermore, repairs to pipework that is adhered to the side of a steep cliff would pose an unnecessary and unjustifiable risk to human life. There is no danger of blockage given the steepness of the pipe, and if there are leaks, the flows will regardless reach their intended target. It is noted that FCC's own gully pipe to the immediate western boundary of the site discharges at just below soil level to the top of the cliff and rightly, no effort was made to discharge at a lower level for the common sense reasons stated above."*

References to artificial barriers altering ground water flow are included in the Council comments on the scheme in the highlighted text above. It is to be noted that any introduction of new pipes in a granular bedding and percolation area stone will resupply in an easier passage of ground water with respect to the porosity of the original compacted soil compared with a granular material. This no blockage or diversion of ground water as a result of the works is anticipated.

APPENDIX 1:

Sepcon WWTP certification and treatment standards

TREATMENT PERFORMANCE RESULTS

PIA-SR66-1601-1010.03

Sepcon
Moyglare Road, Kilcock, Meath, Ireland

EN 12566-3
Results corresponding to EN 12566-3 and S.R. 66

Sepcon – BAF Concrete Sewage Treatment System
Biological aerated filter

Nominal organic daily load (influent)	0.32 kg BOD_5/d		
Nominal hydraulic daily load	0.90 m^3/d		
Material	Concrete		
Watertightness	Pass		
Crushing resistance (vertical load test)	Pass (also wet conditions)		
Durability	Pass		
Treatment efficiency (nominal sequences)		Efficiency	Effluent
	COD	91.7 %	61 mg/l
	BOD_5	95.5 %	15 mg/l
	NH_4-N*	94.5 %	1.7 mg/l
	SS	94.2 %	25 mg/l
Electrical consumption	1.1 kWh/d		
Number of desludging	Not more than once		

** determined for temperatures ⩾ 12 ° C in the bioreactor*

Tested by:

PIA – Prüfinstitut für Abwassertechnik GmbH
(PIA GmbH)
Hergenrather Weg 30
52074 Aachen, Germany

This document replaces neither the declaration of performance nor the CE marking.

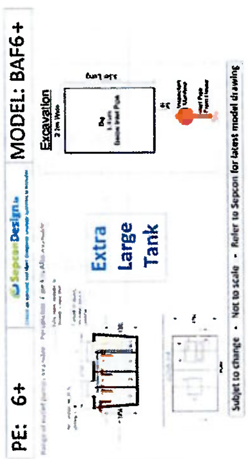
PIA – Sustainable Certification · EN 12566 · NB 1739 · geprüft – tested – testé

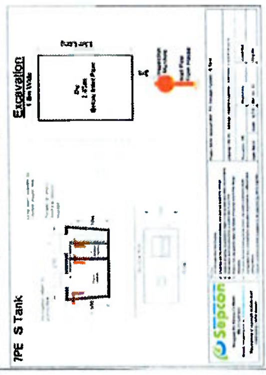
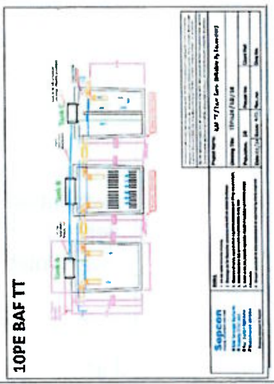
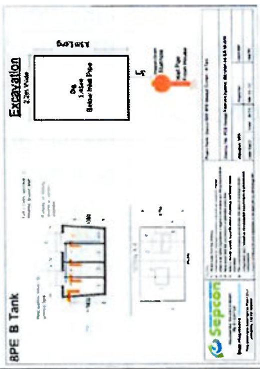
May 2024

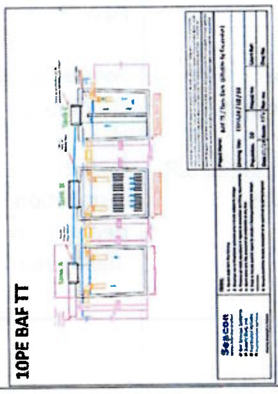
Notified Body
No.: 1739

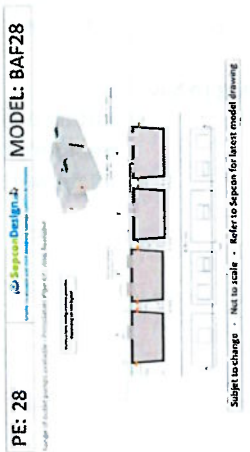
Certified according to
ISO 9001:2015

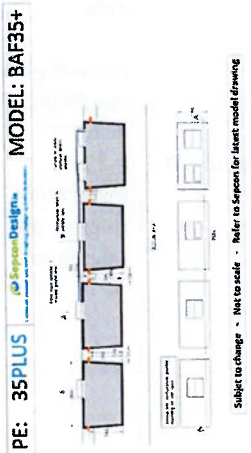
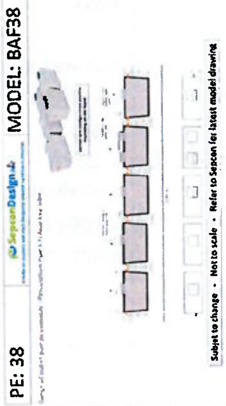
SEPCON-BAF range and its referring test reports:

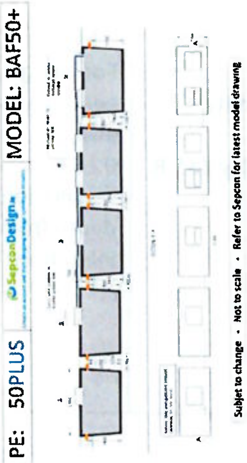
Population equivalent (PE)	Drawing of model of the range	Watertightness (EN 12566-3 Annex A)	Treatment Efficiency (EN 12566-3 Annex B)	Structural Behaviour (EN 12566-3 Annex C)	Durability
Initial type test (ITT) 6 900 l/d		Pass PIA2015-WD/NC-1508-1043.02	Pass PIA2010-123B47.02	Pass PIA2010-ST-BT0902-1003.02 For wet ground conditions also, 0.25 m installation depth from invert inlet	Pass PIA2016-DH-1601-1001.02
6 900 l/d		Pass PIA2020-WD-1601-1010	Pass Range conformity check according to S.R. 66:2015	Pass PIA2020-ST-BT1601-1010 For wet ground conditions also, 0.25 m installation depth from inlet invert	Pass PIA2016-DH-1601-1001.02

7 1,050 l/d		Pass PIA2020-WD-1601-1010	Pass Range conformity check according to S.R. 66:2015	Pass For wet ground conditions also, 0.25 m installation depth from inlet invert	Pass PIA2016-DH-1601-1001.02
7 1,050 l/d		Pass PIA2024-WD-2405-1035	Pass Range conformity check according to S.R. 66:2015	Pass For wet ground conditions also, 0.25 m installation depth from inlet invert	Pass PIA2016-DH-1601-1001.02
8 1,200 l/d		Pass PIA2020-WD-1601-1010	Pass Range conformity check according to S.R. 66:2015	Pass For wet ground conditions also, 0.25 m installation depth from inlet invert	Pass PIA2016-DH-1601-1001.02

10 1,500 l/d		Pass PIA2020-WD-1601-1010	Pass Range conformity check according to S.R. 66:2015	Pass For wet ground conditions also, 0.25 m installation depth from inlet invert	Pass PIA2016-DH-1601-1001.02
12 1,800 l/d		Pass PIA2015-WD/NC-1508-1043.02	Pass Range conformity check according to S.R. 66:2015	Pass For wet ground conditions also, 0.25 m installation depth from inlet invert	Pass PIA2016-DH-1601-1001.02

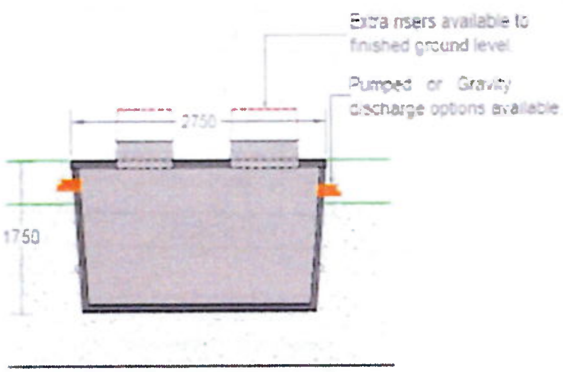
20 3,000 l/d		Pass PIA2015-WD/NC-1508-1043.02	Pass Range conformity check according to S.R. 66:2015	Pass For wet ground conditions also, 0.25 m installation depth from inlet invert	Pass PIA2016-DH-1601-1001.02
28 4,200 l/d		Pass PIA2015-WD/NC-1508-1043.02	Pass Range conformity check according to S.R. 66:2015	Pass For wet ground conditions also, 0.25 m installation depth from inlet invert	Pass PIA2016-DH-1601-1001.02

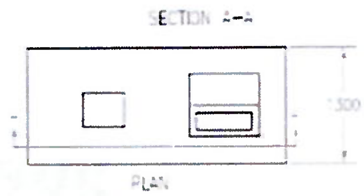
35 5,250 l/d		Pass PIA2015-WD/NC-1508-1043.02	Pass Range conformity check according to S.R. 66:2015	Pass For wet ground conditions also, 0.25 m installation depth from inlet invert	Pass PIA2016-DH-1601-1001.02
38 5,700 l/d		Pass PIA2015-WD/NC-1508-1043.02	Pass Range conformity check according to S.R. 66:2015	Pass For wet ground conditions also, 0.25 m installation depth from inlet invert	Pass PIA2016-DH-1601-1001.02

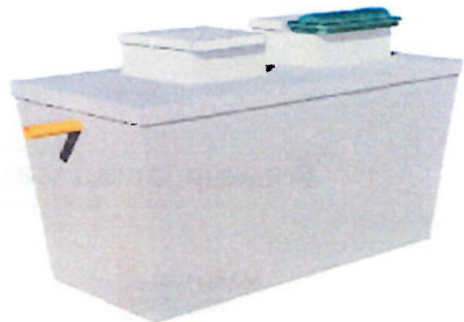
48 7,200 l/d		Pass PIA2015-WD/NC-1508-1043.02	Pass Range conformity check according to S.R. 66:2015	Pass For wet ground conditions also, 0.25 m installation depth from inlet invert	Pass PIA2016-DH-1601-1001.02
50 7,500 l/d		Pass PIA2015-WD/NC-1508-1043.02	Pass Range conformity check according to S.R. 66:2015	Pass For wet ground conditions also, 0.25 m installation depth from inlet invert	Pass PIA2016-DH-1601-1001.02

PE: 6	SepconDesign.ie Create an account and start designing sewage systems in minutes	MODEL: BAF6

Range of outlet pumps available - Percolation Pipe Kits Also Available



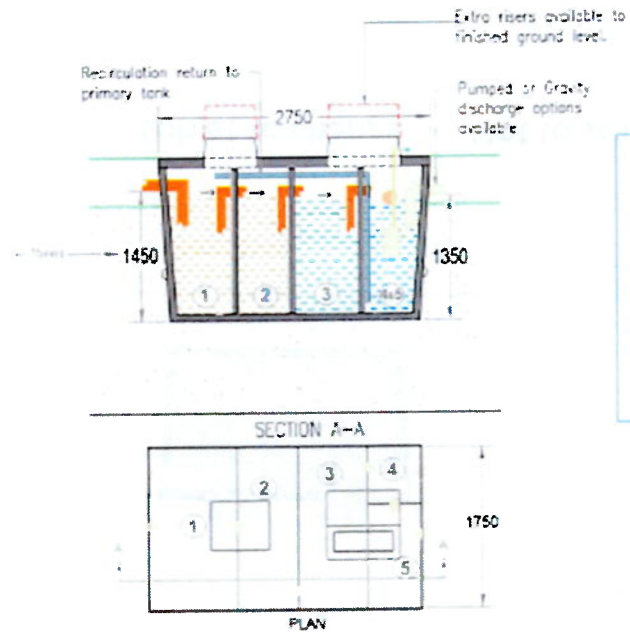




Subjet to change - Not to scale - Refer to Sepcon for latest model drawing

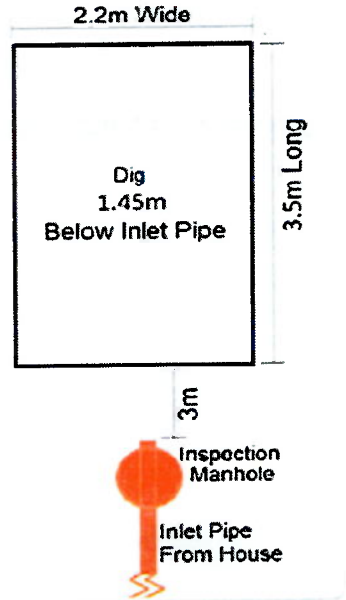
PE: 6+	SepconDesign.ie Create an account and start designing sewage systems in minutes	MODEL: BAF6+

Range of outlet pumps available - Percolation Pipe Kits Also Available



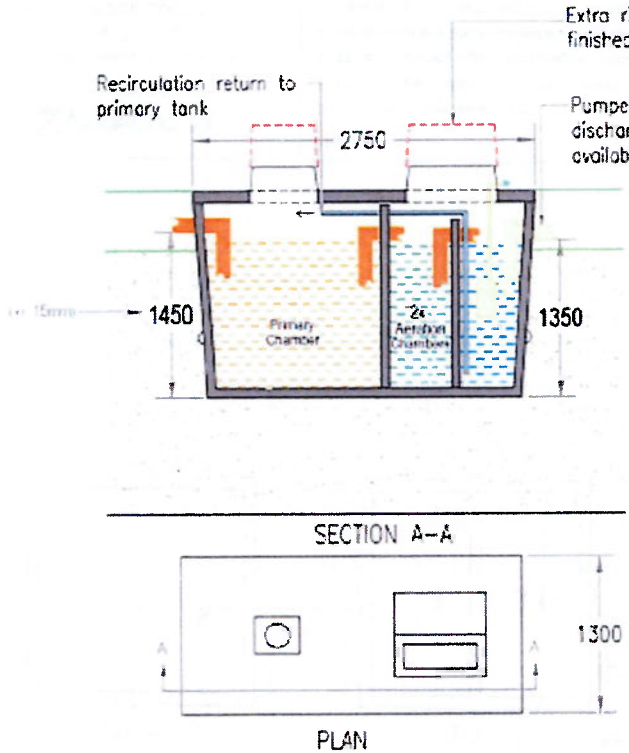
Extra Large Tank

Excavation

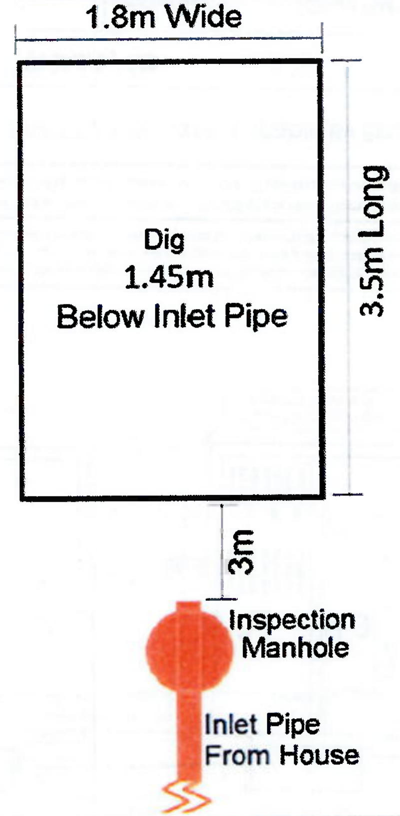


Subjet to change - Not to scale - Refer to Sepcon for latest model drawing

7PE **S** Tank



Excavation



Sepcon waste water services

Moyglare Rd, Kilcock, Co Meath

Ph: 01 6287300

Email: info@sepcon.ie Web www.sepcon.ie

Notes:

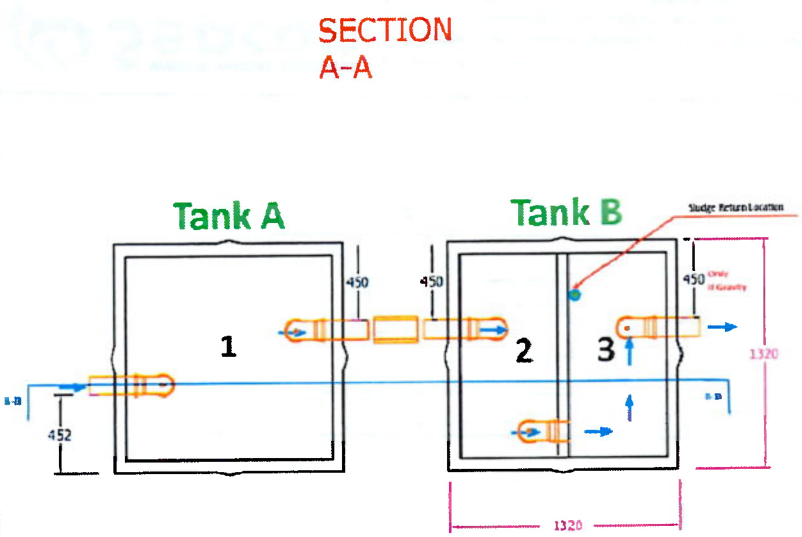
1. Do not scale from this drawing
2. Drawings are for illustration purposes only and are subject to change
3. Observe all safety regulations in regard to excavation and lifting requirements.
4. Never leave tank lids uncovered or unattended at any time.
5. Refer to the site specific report for details of loadings and further design information.
6. The cross section drawing above shows the tanks in a straight series configuration only. Consult us for excavation requirements in different tank configurations
7. Ground conditions for tank installation to be approved by clients engineer

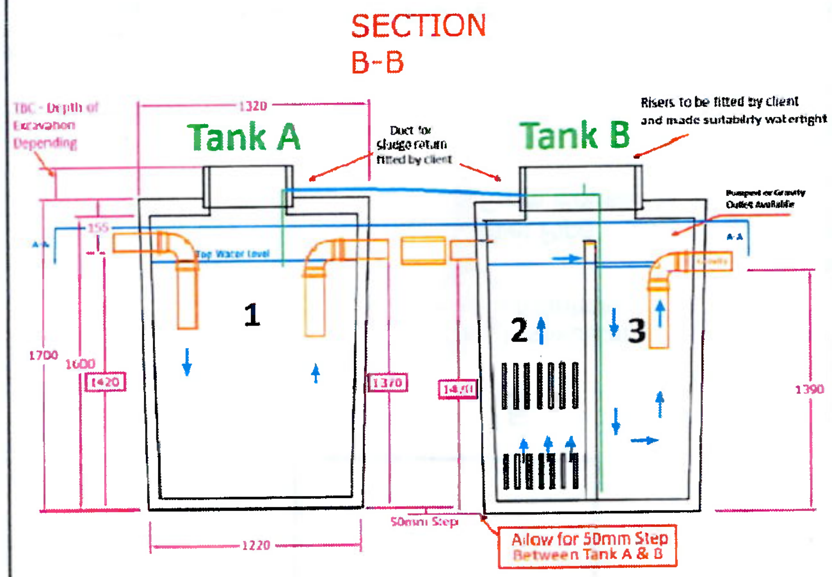
Project Name: Sepcon BAF 7PE Sewage System - S Tank

Drawing Title: PE7 Sewage Treatment System - EN12566-3 & S.R.66:2015

Population: 7PE		*Project No:*	*Client Ref:*
Date: Mar20	*Scale:* N.T.S	*Rev no:* S3	*Dwg No:*

7PE BAF TT





The client should ensure that the equipment used to lift the tanks, along with rigging gear/chains, is suitability adequate to lift and place the tanks into the excavation safely. If in doubt consult a lifting specialist. Never stand at or near of a suspended tank. Keep all persons away from the tank when lifting at all times - no exceptions!

Backfill between tanks and all connections to be with 505 grade stone from excavation base upwards or as engineer approved and lightly compacted to ensure all connections are suitability supported.

Sepcon
SEWAGE TREATMENT SYSTEMS

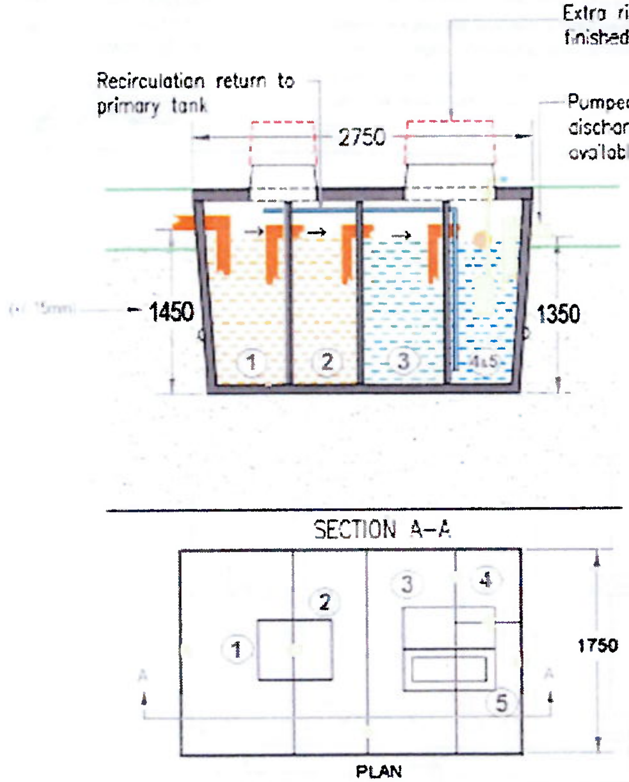
- BAF Sewage Systems
- Supply Only; and
- Full Install Options
- Nationwide Service

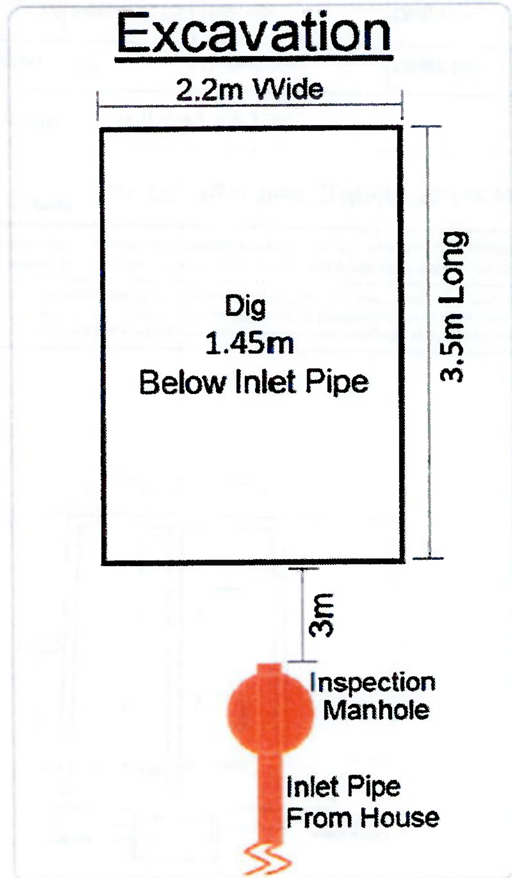
Notes:

1. Do not scale from this drawing.
2. Drawings are for illustration purposes only and are subject to change
3. Observe all safety regulations in regard to excavation and lifting requirements.
4. Never leave tank lids uncovered or unattended at any time.
5. Refer to the site specific report for details of loadings and further design information.
6. Ground conditions for tank installation to be approved by clients engineer.

Project Name: BAF TT / Twin Tank (Liftable By Excavator)			
Drawing Title: TTPIA24 / LD			
Population: 7		Project No:	Client Ref:
Date: 01/24	Scale: NTS	Rev. no:	Dwg No:

8PE B Tank





Sepcon waste water services

Moyglare Rd, Kilcock, Co Meath

Ph: 01 6287300

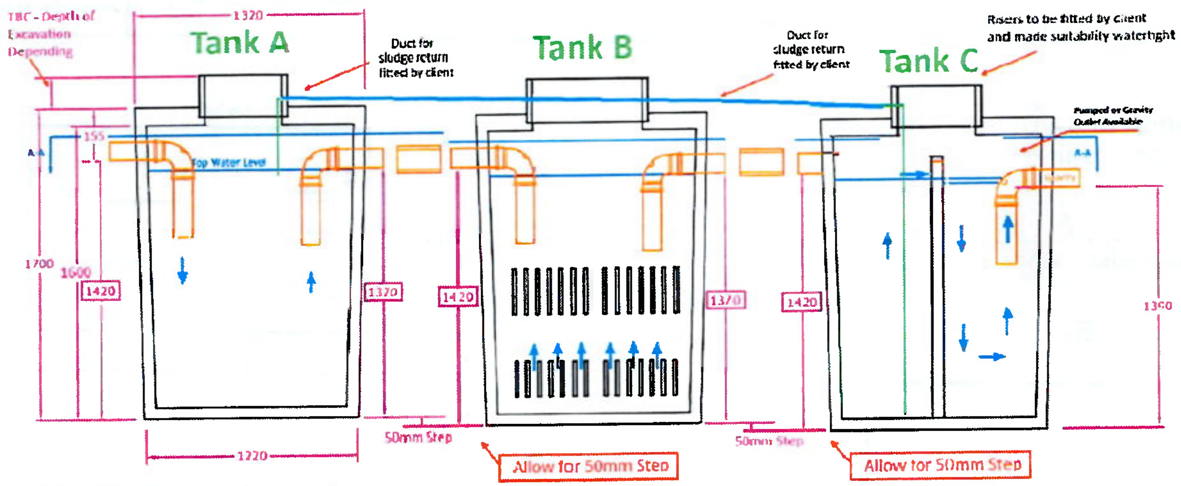
Email: info@sepcon.ie Web www.sepcon.ie

Notes:

1. Do not scale from this drawing
2. Drawings are for illustration purposes only and are subject to change.
3. Observe all safety regulations in regard to excavation and lifting requirements.
4. Never leave tank lids uncovered or unattended at any time.
5. Refer to the site specific report for details of loadings and further design information
6. The cross section drawing above shows the tanks in a straight series configuration only. Consult us for excavation requirements in different tank configurations.
7. Ground conditions for tank installation to be approved by clients engineer.

Project Name: Sepcon BAF 8PE Sewage System - U Tank			
Drawing Title: PE8 Sewage Treatment System - EN12566-3 & S.R.66.2015			
Population: 8PE		Project No:	Client Ref:
Date: Mar20	Scale: N.T.S	Rev. no: S3	Dwg No:

10PE BAF TT



The client should ensure that the equipment used to lift the tanks, along with rigging gear/chains, is suitability adequate to lift and place the tanks into the excavation safely. If in doubt consult a lifting specialist. Never stand at or near of a suspended tank. Keep all persons away from the tank when lifting at all times - no exceptions!

Backfill between tanks and all connections to be with 505 grade stone from excavation base upwards or as engineer approved and lightly compacted to ensure all connections are suitability supported.

Sepcon
SEWAGE TREATMENT SYSTEMS

- BAF Sewage Systems
- Supply Only; and
- Full Install Options
- Nationwide Service

Drawing Copyright to Sepcon

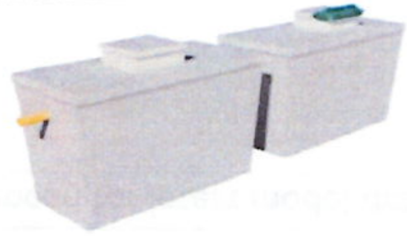
Notes:

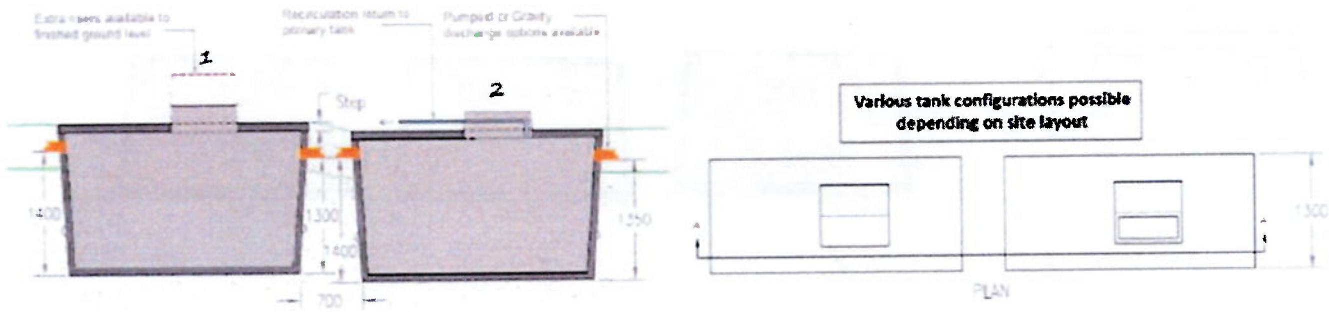
1. Do not scale from this drawing.
2. Drawings are for illustration purposes only and are subject to change
3. Observe all safety regulations in regard to excavation and lifting requirements.
4. Never leave tank lids uncovered or unattended at any time.
5. Refer to the site specific report for details of loadings and further design information.
6. Ground conditions for tank installation to be approved by clients engineer.

Project Name: BAF TT / Twin Tank (Liftable By Excavator)		
Drawing Title: TTPIA24 / LD / 10		
Population: 10	Project No:	Client Ref:
Date: 01/24 Scale: NTS	Rev. no:	Dwg No:

PE: 12	SepconDesign.ie Create an account and start designing sewage systems in minutes	MODEL: BAF12

Range of outlet pumps available - Percolation Pipe Kits Also Available



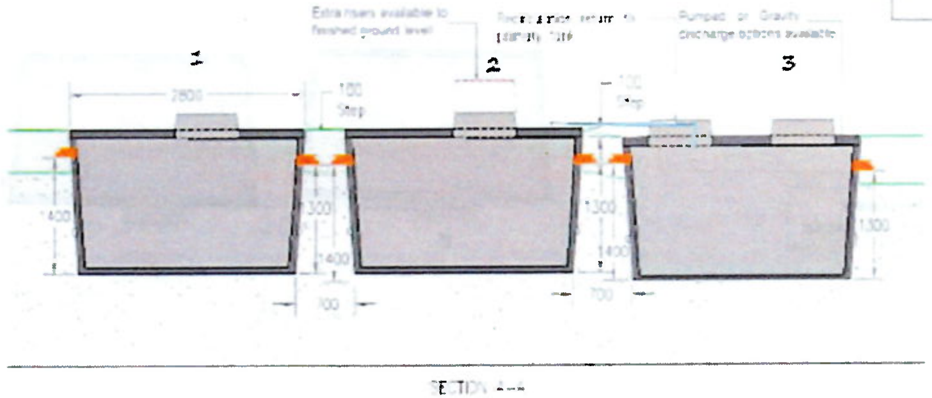


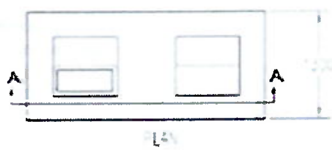
Subjet to change - Not to scale - Refer to Sepcon for latest model drawing

PE: 20	SepconDesign.ie Create an account and start designing sewage systems in minutes	MODEL: BAF20

Range of outlet pumps available - Percolation Pipe Kits Also Available

Various tank configurations possible depending on site layout



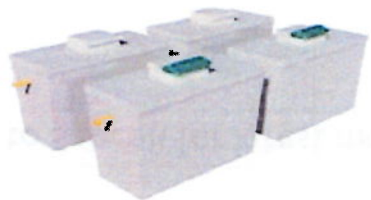


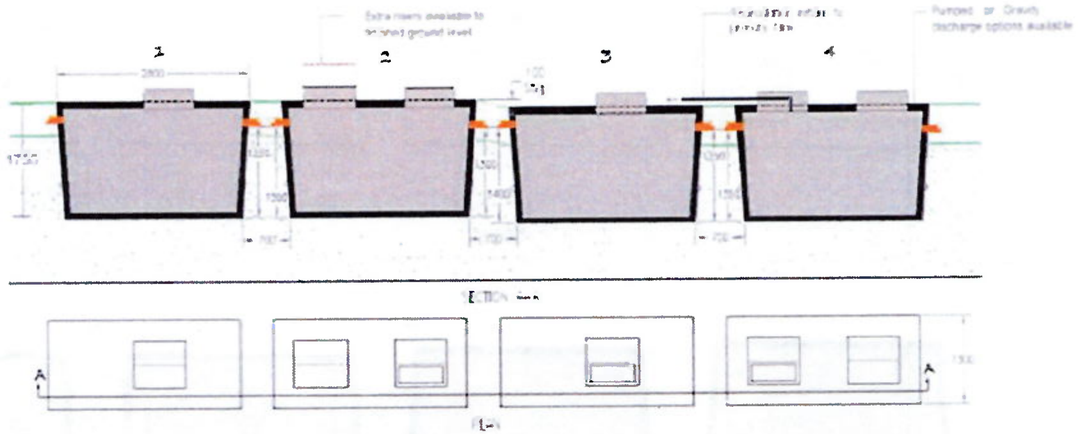
Subjet to change - Not to scale - Refer to Sepcon for latest model drawing

PE: 28	SepconDesign.ie Create an account and start designing sewage systems in minutes	MODEL: BAF28

Range of outlet pumps available - Percolation Pipe Kits Also Available

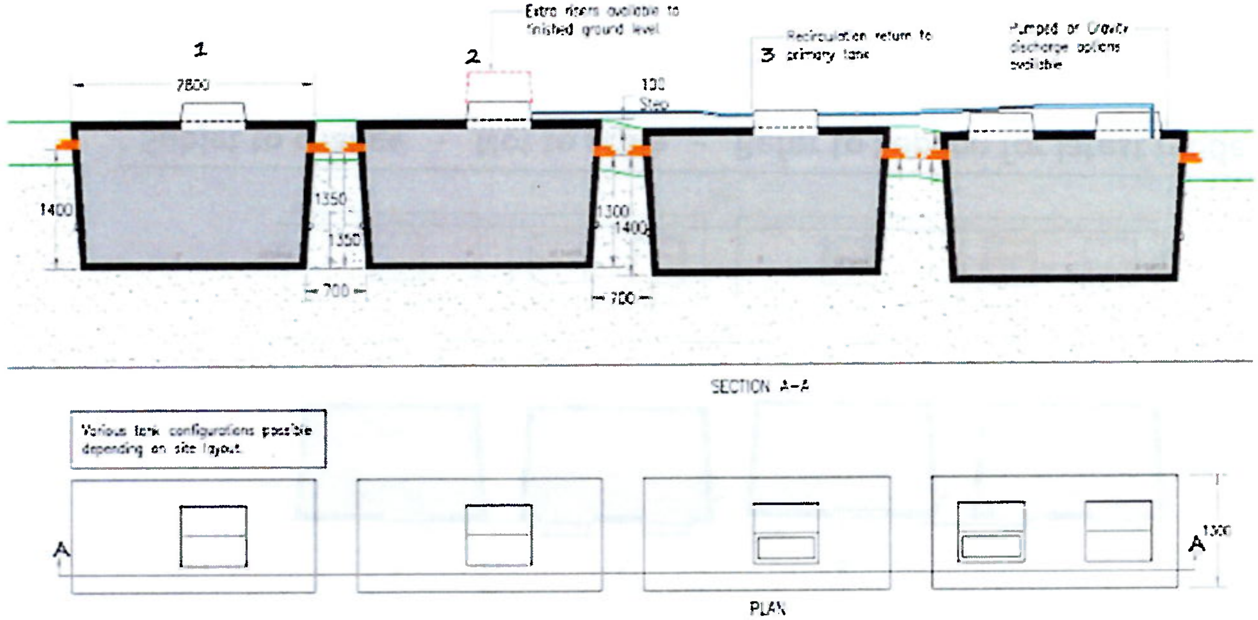
Various tank configurations possible depending on site layout





Subjet to change - Not to scale - Refer to Sepcon for latest model drawing

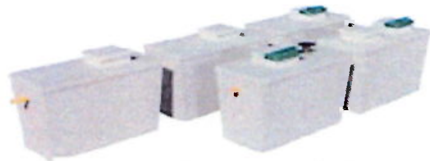
PE: 35PLUS	SepconDesign.ie Create an account and start designing sewage systems in minutes	MODEL: BAF35+



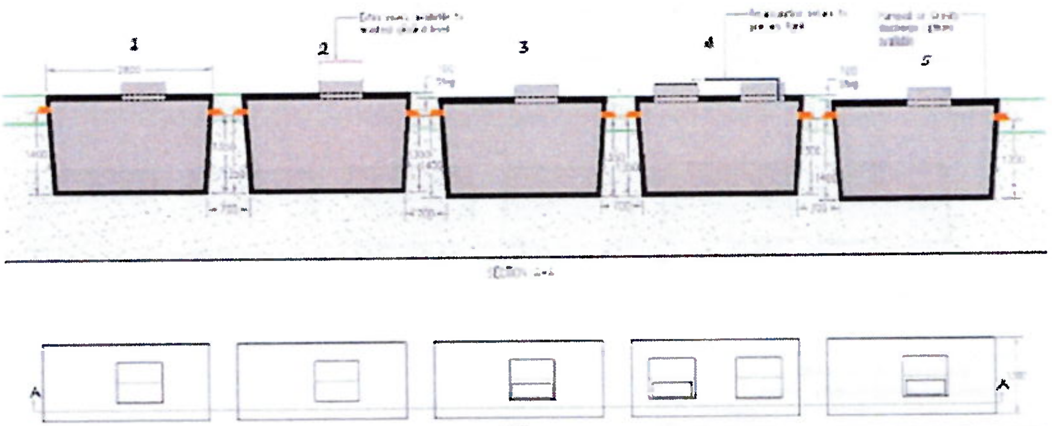
Subjet to change - Not to scale - Refer to Sepcon for latest model drawing

PE: 38	SepconDesign.ie Create an account and start designing sewage systems in minutes	MODEL: BAF38

Range of outlet pumps available - Percolation Pipe Kits Also Available



Various tank configurations possible depending on site layout

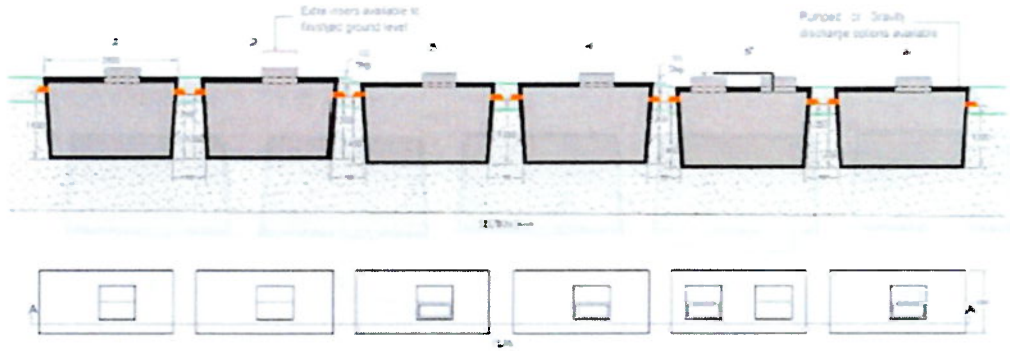


Subjet to change - Not to scale - Refer to Sepcon for latest model drawing

PE: 48	SepconDesign.ie Create an account and start designing sewage systems in minutes	MODEL: BAF48

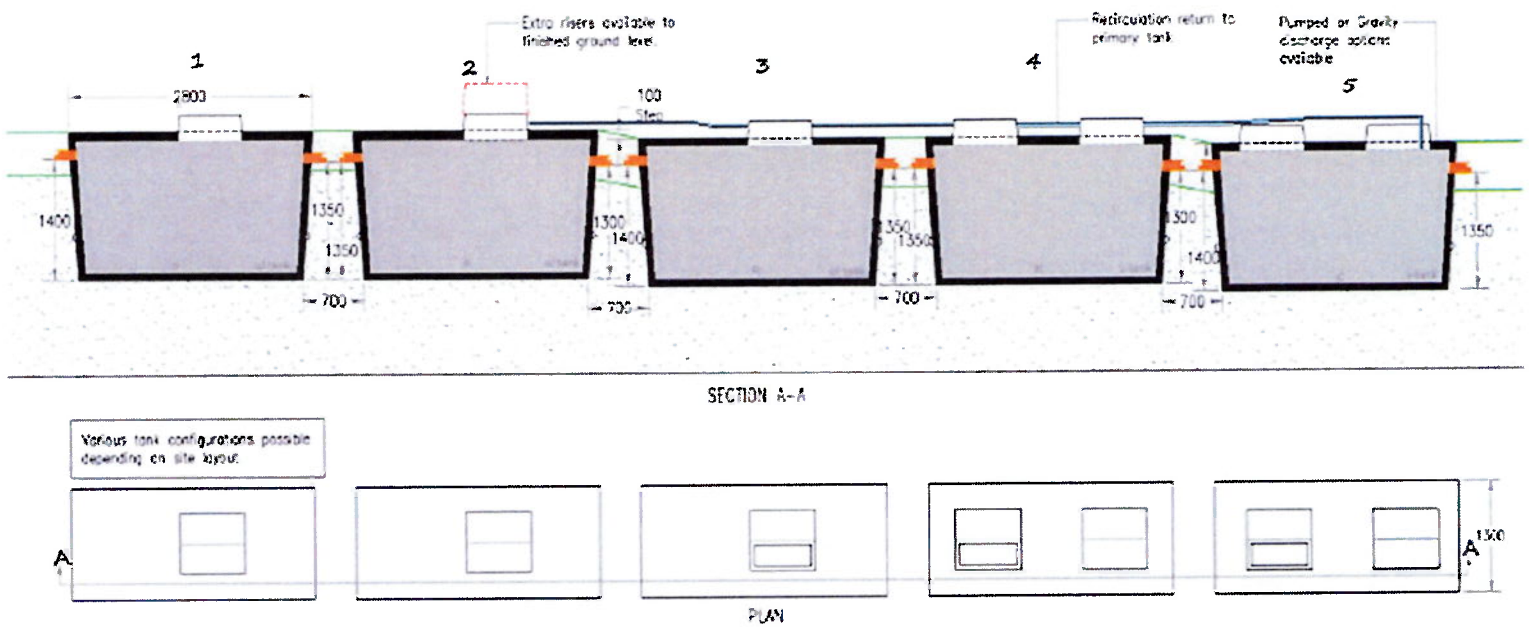
Range of outlet pumps available - Percolation Pipe Kits Also Available

Various tank configurations possible depending on site layout



Subjet to change - Not to scale - Refer to Sepcon for latest model drawing

PE: 50PLUS	SepconDesign.ie Create an account and start designing sewage systems in minutes	MODEL: BAF50+



Subjet to change - Not to scale - Refer to Sepcon for latest model drawing

APPENDIX 2: Report on Sand Filter Efficiency

Dr. Laurance Gill – "A Comparison of Stratified Sand Filters and Percolation Trenches for On-site Wastewater Treatment"

A Comparison of Stratified Sand Filters and Percolation Trenches for On-site Wastewater Treatment

Laurence W. Gill[1]; Cormac O'Súlleabháin[2]; Bruce D.R. Misstear[3]; and Paul J. Johnston[4]

Abstract: Two separate on-site wastewater treatment systems were constructed at premises in eastern Ireland, one using a conventional septic tank, the other using a septic tank followed by a naturally-aerated peat filter. The respective effluents were then split at each site whereby half was directed into percolation trenches and the other half pumped into intermittently dosed, stratified sand filters for a year. Samples were taken at different depths in the subsoil beneath both the percolation trenches and sand filters and analysed for chemical and bacteriological determinants. Samples were also taken at different layers within the sand filters which were tested at various hydraulic loading rates. Although the sand filters require a much smaller surface area, the pollutants were attenuated to the same level in the subsoil when compared to the percolation trenches. As a result of the trials, the revised recommendations for design hydraulic loading rates were 30 L/m^2 day for filters receiving septic tank effluent and 60 L/m^2 day for filters receiving secondary treated effluent.

CE Database subject headings: Wastewater; Waste treatment; Septic tanks; Trickling filters; Unsaturated soils.

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Introduction

In Ireland, wastewater from over one third of the population is treated in small-scale independent systems (DoELG et al. 2004), the most common treatment application being the conventional septic tank system with percolation area. Groundwater resources provide over 25% of all water supplies (EPA 2005) and hence protection from contamination by on-site domestic wastewater effluent is crucial. Indeed, in many areas over 30% of private domestic and farm wells are polluted by microbiological contamination (Daly 2003). Due to the ever-increasing pressure on the planning authorities for development in more rural areas, a rigorous site assessment procedure is now being introduced according to guidelines from the Irish Environmental Protection Agency (EPA 2000). This is based upon a desk study followed by an on-site trial hole inspection and percolation test which aims to determine the vulnerability of local groundwater resources which are especially at risk in areas where the bedrock or water table is close to the surface or where subsoils of high permeability underlie the site. In situations where a septic tank installation is not suitable, some form of secondary treatment system can be installed such as mechanically-aerated systems or filter systems to improve the quality of the effluent before discharge to the subsoil. One of the options promoted is the use of an intermittent stratified sand filter either as a secondary treatment unit or as a polishing filter in place of the percolation area. The immediate advantage of such a system is that it requires a much smaller plan area compared with the equivalent plot needed for a percolation field.

Field studies have been carried out into the fate of the pollutants within the subsoil beneath percolation areas (Reneau et al. 1989; Jenssen and Siegrist 1990) with many focussing particularly on the fate of pathogens (Nicosia et al. 2001; Schijven and Šimůnek 2002). The

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results, however, are difficult to extrapolate into an Irish context due to indeterminate percolation rates and different climatic conditions. Intermittent sand filters have been used effectively for wastewater treatment for individual premises up to larger scale (1700 p.e.) applications (Mottier et al. 2000). Various studies have shown that single stage intermittent sand filters, loaded organically and hydraulically at 5-20 gBOD/m^2 day and 40-100 L/m^2 day respectively, attain removal efficiencies of 90% COD, 95% BOD, 30% total nitrogen, 40% total phosphorous and 2-4 log removal of faecal coliforms (Sauer et al. 1976; Pell et al. 1990; Darby et al. 1996; Nichols et al. 1997; Widrig et al. 1998; Van Buuren et al. 1999). The effluent from sand filters can be of high quality with typical concentrations of 5 mg/L or less of BOD and SS, as well as nitrification of 80% or more of the applied ammonia (USEPA 1999). For example, more or less complete nitrification of septic tank effluent and four-log removal of faecal coliforms has been achieved using a stratified sand filter at hydraulic loading rates up to 60 L/m^2 day (Nichols et al. 1997). At higher loading rates denitrification can occur in anaerobic regions of the filter as a result of organic matter build-up promoting saturated conditions (Bahgat et al. 1999; Van Buuren et al. 1999). However, higher loading rates can have a negative influence on performance and increase filter cleaning frequency (USEPA 1985; Van Buuren et al. 1999). One study found that ponding occurred on sand filters if COD loads exceeded 47 g/m^2 day (Darby et al. 1996) and a maximum loading rate of 24 gBOD/m^2 day has been suggested (USEPA 1985). Higher loading rates up to 37 gBOD/m^2 day though have recently been demonstrated without clogging by the use of a hybrid system using a horizontal flow biofilm reactor above the filter (Rodgers et al. 2006).

The aerobic conditions in sand filters are maintained through the intermittent application of the effluent and oxygen consumption is balanced by the renewal of the air phase with atmospheric air by the means of convective and diffusive exchanges through the surface (Boller et al. 1993). The EPA (2000) recommends a hydraulic loading rate of 40–100 L/m^2

day and in general, studies have shown that slight improvements to treatment performance of filters can be gained by small-volume, short hydraulic flushes as opposed to more frequent, larger volume doses (Boller et al. 1993; Darby et al. 1996; Rodgers et al. 2006) which concurs with experience on other biofilm processes such as large-scale trickling filter applications. Dosing frequencies of between 4 and 24 times per day have been reported in the above studies and it would appear that a design value in the region of 12 doses per day gives an optimal treatment performance, although this is obviously also dependant on the overall hydraulic loading rate.

Several trials have also looked at recirculating sand filters (Gold et al. 1992; Nichols and Aboud 1995; Van Buuren et al. 1999; Christopherson et al. 2001; Healy et al. 2004) whereby a fraction of the effluent is pumped back to the join the influent normally at a recirculation ratio in the range of 3-5:1. This generally has the effect of increasing the hydraulic loading rate and dosing frequency but reducing the concentration of influent which can improve the mass transfer characteristics through the biofilm. It is also done to target nitrogen removal whereby the recirculated nitrified effluent can be passed through an anoxic zone (an upflow anaerobic process for example), to achieve denitrification before re-entering the filter (Urynowicz et al. 2007).

Phosphorous removal in sand filters is primarily due to the mineral content of the sand used and is controlled mainly by adsorption and mineral precipitation reactions. The adsorption capacity of a sand is regulated by the occurrence of natural minerals such as iron, calcium and aluminium but also affected by the chemical characteristics of the effluent (Redox potential and pH) within the filter. Although several studies have shown sorption of phosphate onto calcareous sands (Arias et al. 2001), non-calcareous sands have been shown to be effective at phosphate removal in certain cases, for example in an aluminium enriched sand (Robertson 2003).

The removal of microbiological organisms in sand filters has been measured in several studies (Van Buuren et al. 1999; Mottier et al. 2000) indicating a fall off in performance at higher loading rates (above 50 $gCOD/m^2$ day). However, the application of a 0.8m sand filter as a polishing filter for the disinfection of secondary treated effluent has been shown to be effective at hydraulic loading rates of 165–350 L/m^2 day giving 5.0-3.8 log removal of faecal coliforms respectively (Salgot et al. 1996). Several detailed studies have also looked at the removal of both virus and bacterial pathogens and indicators in laboratory sand columns. In general the removal of both bacteria and viruses has been shown to occur within the first 0.3 m depth of sand (Gross 1990; Hua et al. 2003) which has also been confirmed by a few in-situ trials carried out in the sandy subsoils (Nicosia et al. 2001) and dunes (Schijven et al. 1999) using dosed bacteriophages (viruses).

A three-year project investigating four separate sites (Gill et al. 2005a) was funded by the Irish EPA to test out the new guidelines (EPA 2000) which had been developed. The project included an ongoing field study at two sites, 7 km apart, located in County Wicklow in eastern Ireland in order to assess the effectiveness of such stratified sand filters under prevailing conditions. Two separate sites were constructed, one receiving effluent from a septic tank, the other receiving effluent from a secondary treatment peat biofilter, following which the effluent was split evenly between a stratified sand filter and two, gravity fed, 20 m long percolation trenches.

Materials and Methods

Site Selection and Construction

The site selection was carried out in strict accordance with the EPA recommendations (EPA 2000). In general, a minimum unsaturated subsoil depth of 1.2 m below septic tank percolation fields is required (or a minimum 0.6 m unsaturated subsoil for secondary treated effluent) before the site may be deemed suitable for on-site treatment of domestic wastewater effluent. In addition a falling head percolation test (Mulqueen and Rodgers 2001), known as the T-test, must fall within the specified range of 1 to 50 (minutes per 25 mm of water level fall). In this study both sites had relatively slow draining subsoils which were characterized according to BS5930 (BSI 1981) as gravelly-clayey sands. Site A had a 4000 litre septic tank installed with a T-value of 33 and Site B had a naturally-aerated peat filter (*Puraflo*®, Bord na Mona) installed downstream of a 4000 litre septic tank and subsoil of a T-value of 52.

Both sites had identical percolation areas constructed to the recommended EPA specifications consisting of 110 mm diameter, perforated PVC pipe bedded in 300 mm of gravel in a 450 mm wide trench at a slope of 1:200. The effluent was split using a modified distribution box (Gill et al. 2005b) so that half the effluent went onto the trenches and the other half pumped onto a stratified sand filter (see Fig. 1). The sand filter was designed and constructed in accordance with the EPA recommendations using the design loading rate of 60 L/m^2 day. Based on the design wastewater production rate of 180 litres per head per day, the surface area of each filter was 3 m by 2 m. The constructed filters were 1.05 m deep and comprised of layers of sand, decreasing in particle size with depth from 1.0 to 0.1 mm diameter (see Fig. 2). The effluent was pumped onto the sand filter from a pump sump with float switch which was monitored by an ultrasonic level probe (*The Probe*, Siemens Milltronics) in order to determine the flow and also the dosing frequency.

Suction lysimeters (Soilmoisture Equipment Corporation) were installed on each site to collect samples of percolating effluent in the subsoil. They were installed at the beginning (0 m), middle (10 m) and end (20 m) of each trench to nominal depths of 0.3 m, 0.6 m and 1.0 m below the invert of the percolation trenches respectively (as shown in Figure 1a), which represent depths of 1.1 m, 1.4 m and 1.8 m depth below the ground surface. Six suction lysimeters were also installed beneath each sand filter, two sets on either down-slope side of the filter at the same depths. Within the sand filters, gravity cups were installed (two per level) to capture effluent en route down through the sand matrix. A piezometer was also installed in each sand filter to monitor the depth of effluent at the base. Each site also had six tensiometers (Soil Measurement Systems) installed to obtain a profile of soil moisture tension across the percolation area, and a weather station to gain rainfall and evapotranspiration data to calculate the diluting effect of net recharge in both the subsoil sand filters throughout the year.

Composite samplers (*xian 1000*, Bühler Montec), which sampled the septic tank and secondary effluent every hour over a 24 hour period, were installed on both sites. Both sites started to receive effluent in June 2003. On the 22 December 2003 the effluent going into the trenches was blocked, hence doubling the loading rate on the filters for a period of five weeks.

Sampling and Analysis

The day before sampling all suction lysimeters were put under a suction of 50.7 kPa (50 cbar) and the gravity samplers in the sand filters were emptied. All samples were collected 24 hours later and taken directly to the laboratory for analysis. Diurnal samples were also collected from the automatic samplers. All samples were analysed for chemical parameters using the

Spectroquant Nova 60® spectrophotometer and associated reagent kits (USEPA approved) for chemical oxygen demand (COD), ammonium (NH_4-N), nitrite (NO_2-N), nitrate (NO_3-N), ortho-phosphate (PO_4-P) and chloride (Cl). Samples were also sent periodically to an accredited external laboratory and analysed for enteric bacterial indicators: total coliforms and *E. coli.*

Results and Discussion

Comparison of Trenches and Sand Filter

Chloride was used as a crude tracer for the preliminary data analysis from both sites since it does not take a significant part in any geochemical reactions (Marshall et al. 1999). Hence, chloride concentrations at the three sample positions along each trench (0 m, 10 m and 20 m) were averaged between the two trenches at the same depth. This enabled the identification of the appropriate sample points which were receiving the percolating effluent (assuming isotropic and homogeneous soil properties) and, in consequence, allowed a reasonable estimate to be made of the extent of any biomat development. This analysis was also corroborated by graphs of tensiometer measurements against effective rainfall on both sites which clearly show the more continuous effect of wetting by the effluent compared to the more seasonal wetting effect of the rainfall. For example, Fig. 3(a) shows the results from instrumentation on Site B the start of the trenches (0 m) where effluent was known to be percolating which can be compared to Fig. 3(b) at the end of the trenches (20 m) which received no effluent during the project. It should be noted that the sites were still in their first year of operation and so were in the early stages of biomat development. Trials on previous sites had demonstrated that the reduced organic loading in secondary treated effluent had inhibited the formation of a biomat, thereby preventing distribution of the effluent along the full length of the trenches (O'Súlleabháin 2005).

Loading rates at the different depths were calculated on a daily basis according to a mass balance of effluent flow plus any rainfall recharge. The rainfall available for dilution at the depth planes over the project duration, or effective rainfall, was calculated using rainfall figures and evapotranspiration figures obtained from the weather station data measured at each site based on the Penman-Monteith method (FAO 1998). The potential evapotranspiration (PE) calculation was used to calculate actual evapotranspiration (AE). Where the soil moisture deficit (SMD) was greater than 40 mm the AE was considered to occur at a slower rate than PE and was calculated using the Aslyng scale. Daily effective rainfall (recharge) was then calculated by subtracting the daily AE and accumulated SMD figures from the daily rainfall measurement.

Site A – Septic Tank Effluent

The flow from the septic tank to the percolation area was by gravity and so constantly variable but the average total flow from the dwelling (one adult and three children) was 329 L/day discharged at an average flow rate of 3.7 L/min. The mean chloride concentration from the septic tank was 76 mg/L (inter-quartile range 58 to 92 mg/L). The analysis of the chloride concentrations on Site A (see Fig. 4) reveals that the high concentrations, indicative of the septic tank effluent, are found only at the 0 m sampling points at all three depths, indicating that the development of the biomat had not yet reached 10 m along each trench.

Hence, the average loading rates measured at each depth at the 0 m sample points only are considered and compared with the same depths in the subsoil below the stratified sand filter (see Table 1). It is clear from these results that most of the effluent attenuation beneath both the trenches and the sand filter had occurred between the septic tank and the 1.1 m depth plane, with little change in the pollutant loading rates at greater depths. The loading rates for most of the parameters at this depth seem to be broadly similar for both systems.

The septic tank effluent that had been nitrified passing through the filter (as discussed later) can be seen to undergo denitrification below the sand filter between the 1.1 m and 1.4 m depth. This is evidenced by the resultant rise in pH and has probably been promoted by saturated anoxic conditions in the subsoil due to the localised high hydraulic loading rate beneath the sand filter. This same loss of nitrogen from the trench effluent starts to occur at the deeper level between 1.4 m and 1.8 m. Bacteriological analyses carried out during the trials revealed concentrations of *E. coli.* in the septic tank effluent to be 3 x 10^5 cfu/100 mL. However, all samples taken beneath the trenches or beneath the sand filter were found to be below the limit of detection (<2 cfu/100 mL) for *E. coli.* meaning that the removal had been achieved within the first 0.3 m of subsoil beneath the trenches or within the sand filter.

Site B – Secondary Treated Effluent

The flow was pumped periodically to the peat filter and then discharged by gravity to the percolation area. The average total flow from the dwelling (2 adults and 3 children) over the monitoring period was 492 L/day discharged at an average flow rate of 4.3 L/min. The mean chloride concentration from the peat filter was 59 mg/L (inter-quartile range 42 to 72 mg/L). Analysis of chloride levels at Site B (Fig. 5) shows significantly lower concentrations at the 10 m and 20 m sample positions (apart from a single peak in late October). This again suggests that the biomat has not developed far along the trench, as expected for the secondary treated effluent, and hence the 0 m sampling points have been taken to be the most representative in order to assess the pollutant attenuation.

The results for the average pollutant loadings on Site 2 are presented in Table 2. These loads reveal that the levels in the subsoil beneath the sand filter are slightly lower than beneath the trenches. The exception is the ortho-phosphate load which is significantly lower at this point beneath the sand filter compared to the trenches, although the loads do reduce with depth in the subsoil beneath the trenches which is discussed later. Interestingly, compared to the septic tank effluent in Site A, there does not appear to be the same level of denitrification occurring in the subsoil, as shown in Fig. 6, which could be due to relatively lower organic concentrations (the heterotrophic denitrifying bacteria are facultative anaerobes and need carbon in addition to using nitrate as an electron acceptor in anoxic conditions) and a faster percolating, more aerated effluent. Slight evidence of denitrification can be seen beneath the sand filter, again probably due to anoxic saturated conditions due to the higher hydraulic loading rate. The bacteriological analyses revealed a large 3-4 log removal of enteric bacteria across the peat filter with average *E. coli* concentrations of only 60 cfu/100 mL in the secondary treated effluent. All samples taken at all depths beneath the trenches or beneath the sand filter were below the limit of detection of <2 cfu/100 mL.

Sand Filter Comparison

The performance of the stratified sand filters was analysed by sampling within the filter beneath each layer of sand. The filters were subjected to a normal hydraulic loading until the end of December 2003 at which point the effluent to the trenches in both sites was blocked to promote an increased loading onto the sand filters for a five-week period, as follows.

Site A - normal loading rate = 28.6 L/m^2 day (dosing 3.5 times per day)

- high loading trial = 57.2 L/m^2 day (dosing 8.3 times per day)

Site B - normal loading rate = 41.0 L/m^2 day (dosing 7.3 times per day)

- high loading trial = 97.9 L/m^2 day (dosing 18.8 times per day)

At Site A the piezometers in the sand filters revealed no significant head at the lower hydraulic loading rate of 28.6 L/m^2 day but a continually rising head at the higher loading rate of 57.2 L/m^2 day, increasing to 0.7 m above the base after five weeks. This indicates that such a loading rate was too high for a filter receiving septic tank effluent with such a fine sand layer at the base and discharging into subsoil with a T-value of 33. At Site B, even though the subsoil has a slower percolation T-value of 52, no head level above the base was measured during either loading period indicating a much reduced biomat development due to the low organic loading compared with Site A. The organic loading rate during normal operation was 41.1 gCOD/ m^2 day which is close to suggested maximum (Darby et al. 1996) value of 47 gCOD/ m^2 day. Surprisingly the organic loading rate the during the high load trials was only 37.7 gCOD/ m^2 day due to suppressed COD concentrations during that period for some unknown reason. This would indicate that the combination of hydraulic load and biofilm build up due to the organic load during the normal filter operation was close to the limit since the filter started to back up under higher hydraulic but lower organic loading rates.

Analyses of nitrogen species are presented for the sand filters on both sites (Tables 3 and 4 and Figure 6). On Site A, at the lower hydraulic loading rate of 28.6 L/m^2 day, significant nitrification has occurred within the filter with subsequent denitrification suggested in the finer sand lower down. However, at the higher loading rate (approaching the EPA design value of 60 L/m^2 day) nitrification was not complete by the base of the filter with much of the nitrogen still in an ammoniacal form.

At Site B, the septic tank effluent was nitrified in the peat filter before being dosed onto the sand filter with the associated pH drop (due to the alkalinity requirement for the process). No particular evidence of denitrification can be seen in the sand filter presumably due to the combination of unsaturated, aerated conditions in the filter with low organic loads and a shortage of carbon, thus inhibiting the denitrifying bacteria. This pattern is similar at the higher loading levels although there was evidence of denitrification again in the lower fine sand layer arising from localised saturation at this higher hydraulic loading rate. An interesting comparison with the Site A sand filter (Figure 6), reveals that a much larger drop in total nitrogen occurs in the upper sand layer receiving the high organic load than in the corresponding layer dosed with secondary treated effluent. The organic loading rate during normal operation was 8.8 gCOD/ m^2 day and 10.4 gCOD/ m^2 day during the high load trials. The load removal was however was worse at the higher hydraulic loading rate, which to some extent contradicts the evidence in the literature stating a general improvement in performance at higher dosing frequencies.

The concentrations of ortho-phosphate passing through both filters have been noticeably reduced as seen in the subsoil results (Tables 3 and 4). A plot of the process efficiency of both filters with depth (Fig. 7) reveals an almost total removal of phosphate (k= 1.16) for hydraulic loadings in the range of 24-57 L/m^2 day. However, at the higher loading rate of 97.9 L/m^2 day the removal efficiency is markedly reduced indicating that the residence time in the filters is not sufficient for the adsorption removal process to take place effectively. This indicates that, in terms of phosphorous removal using this sand specification, a design hydraulic loading rate of 60 L/m^2 day appears to be a reasonable value for incorporation into the national guidelines. Samples of the three different sands used in the sand filters were analysed using X-ray diffraction analysis (Phillips PW1720) to reveal the respective mineral composition. Apart from the expected predominance of quartz, goethite (Fe_2O_3) was also found in the coarse and medium sands but not in the fine sand sample. Hence, the iron oxide will be acting as a site for cation exchange with the soluble phosphate. This is validated by the results which show that the largest removals were found in the medium sand layer (see Fig. 8) which was only 100 mm thick but contained the highest levels of goethite.

Finally, analysis of *E. coli* removal through the sand filters and into the subsoil below at the different loading rates for the septic tank effluent (Fig. 9), reveals a correlation between overall removal and hydraulic loading rate: removal coefficient k = –8.7 at 28.6 L/m^2 day and k = –4.6 at 57.2 L/m^2 day. Complete removal has occurred at the lower loading rate whilst there are still viable concentrations of *E. coli* discharging to the subsoil at the higher rate. In general, the main removal of bacteria occurred in the top few centimetres of the sand as reported in other studies (Hua et al. 2003). Interestingly, no such correlation for *E. coli* against hydraulic loading rate was found for Site B, with all samples below the limit of detection by the base of the sand filter irrespective of loading rate.

Conclusions

A detailed study on two sites receiving different quality effluent revealed that both treatment systems greatly reduced the chemical and biological loading rates of domestic wastewater effluent, reducing the potential for groundwater pollution. In both cases the majority of both chemical and biological treatment had occurred before the 1.1 m depth within the subsoil. The introduction of stratified sand filters discharging directly to the subsoil appears to achieve the same overall level of treatment on both sites as the standard percolation trenches which require a much larger area of land. However, the results indicate that for septic tank effluent the recommended hydraulic loading rate on relatively slowly draining subsoils should not exceed 30 L/m^2 day both due to ponding problems in the base of the filter and also to ensure the effective removal of enteric bacteria. This is low compared to other studied systems but gives a comparable organic loading rate at the top end of the spectrum due to the relatively concentrated septic tank effluents found in Ireland. Ortho-phosphate removal in the filters is related to the mineral composition of the sand used. In these trials a maximum loading rate of 60 L/m^2 day appeared to be the optimum for phosphate removal. However, it should be acknowledged that the removal efficiency would reduce over time as the potential adsorption sites become full.

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Table 1. Average loading rates at Site A under trenches (at 0 m sampling position) and under sand filter. *Note: 329 L/day split evenly between trenches and sand filter.*

Parameter	Loading Rate (g/day)						
	Septic tank effluent	1.1 m depth*		1.4 m depth*		1.8 m depth*	
		Beneath Trench	*Beneath Sand Filter*	Beneath Trench	*Beneath Sand Filter*	Beneath Trench	*Beneath Sand Filter*
COD	**246.3**	23.9	*15.6*	19.6	*12.6*	16.7	*13.7*
NH_4-N	**8.1**	0.9	*0.31*	1.2	*0.27*	0.6	*0.37*
NO_2-N	**0.09**	0.05	*0.02*	0.12	*0.01*	0.07	*0.01*
NO_3-N	**0.4**	3.6	*2.81*	3.4	*1.92*	1.0	*1.36*
Total N	**8.6**	4.6	*3.13*	4.7	*2.19*	1.7	*1.74*
Ortho-P	**1.57**	0.07	*0.05*	0.04	*0.01*	0.02	*0.01*
pH	**7.68**	6.80	*7.10*	6.78	*6.71*	6.97	*6.99*

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Table 2. Average loading rates at Site B under trenches (at 0 m sampling position) and under sand filter. *Note: 492 L/day split evenly between trenches and sand filter.*

Parameter	Loading Rate (g/day)						
	Secondary treated effluent	1.1 m depth*		1.4 m depth*		1.8 m depth*	
		Beneath Trench	*Beneath Sand Filter*	Beneath Trench	*Beneath Sand Filter*	Beneath Trench	*Beneath Sand Filter*
COD	**53.1**	28.0	*24.1*	22.0	*19.0*	22.0	*16.4*
NH_4-N	**1.64**	0.94	*0.59*	0.74	*0.65*	0.52	*0.54*
NO_2-N	**0.06**	0.10	*0.02*	0.08	*0.02*	0.03	*0.01*
NO_3-N	**10.4**	12.9	*10.85*	12.7	*9.60*	12.1	*8.51*
Total N	**13.1**	13.7	*11.45*	13.2	*10.27*	12.5	*9.06*
Ortho-P	**2.13**	1.71	*0.06*	1.32	*0.01*	0.20	*0.03*
pH	**6.39**	6.04	*6.68*	6.17	*6.63*	6.58	*6.86*

* depth below ground level

Table 3. Average nitrogen and ortho-PO_4 loads (g/day) in sand filter (Site A).

Note: figures in brackets indicate values during high loading trial.

Effluent sample	NH_4-N	NO_2-N	NO_3-N	*Total N*	Ortho-P	pH
Septic tank	8.08 (9.77)	0.09 (0.06)	0.40 (0.38)	*8.57* *(9.33)*	1.57 (1.02)	7.8 (7.2)
Coarse sand **(depth 0.3 m)**	5.38 (11.90)	0.08 (0.10)	0.85 (0.83)	*6.29* *(12.82)*	0.89 (1.09)	7.8 (7.3)
Medium sand **(depth 0.475 m)**	2.85 (10.00)	0.10 (0.05)	2.87 (0.18)	*5.76* *(10.22)*	0.36 (0.09)	7.7 (7.5)
Fine sand **(depth 0.75 m)**	1.44 (7.49)	0.07 (0.04)	2.38 (0.29)	*3.87* *(7.82)*	0.29 (0.11)	7.3 (7.3)

Table 4. Average nitrogen ortho-PO_4 loads (g/day) in sand filter (Site B).

Note: figures in brackets indicate values during high loading trial.

Effluent sample	NH_4-N	NO_2-N	NO_3-N	*Total N*	Ortho-P	pH
Septic tank	11.95 (35.46)	0.09 (0.40)	0.79 (5.02)	*12.83* *(40.88)*	2.24 (4.29)	7.3 (7.1)
Peat filter	1.64 (6.83)	0.06 (0.08)	11.42 (18.39)	*13.12* *(25.29)*	2.07 (3.69)	6.4 (6.1)
Coarse sand **(depth 0.3m)**	0.84 (2.81)	0.10 (0.24)	11.76 (23.52)	*12.57* *(26.57)*	1.90 (3.64)	6.7 (6.3)
Medium sand **(depth 0.475 m)**	0.66 (3.89)	0.05 (0.20)	10.68 (21.86)	*11.53* *(25.95)*	1.15 (3.44)	6.9 (6.5)
Fine sand **(depth 0.75 m)**	0.75 (1.01)	0.04 (0.12)	10.94 (21.54)	*11.65* *(22.67)*	1.17 (3.07)	6.8 (6.8)

Fig. 1. Site layout: **(a)** Cross-section and depths of instrumentation **(b)** Plan view of trenches and stratified sand filter *(not to scale).*

Fig. 2. Schematic cross-section through stratified sand filter.

Fig. 3. Site B: soil moisture tension plotted against effective rainfall for: **(a)** the 0 m sample position and **(b)** the 20 m sample position.

Fig. 4. Chloride concentrations at all sampling positions along percolation trench length (Site A). *Note: three sampling depths per sampling position.*

Fig. 5. Chloride concentrations at all sampling positions along percolation trench length (Site B). *Note: three sampling depths per sampling position.*

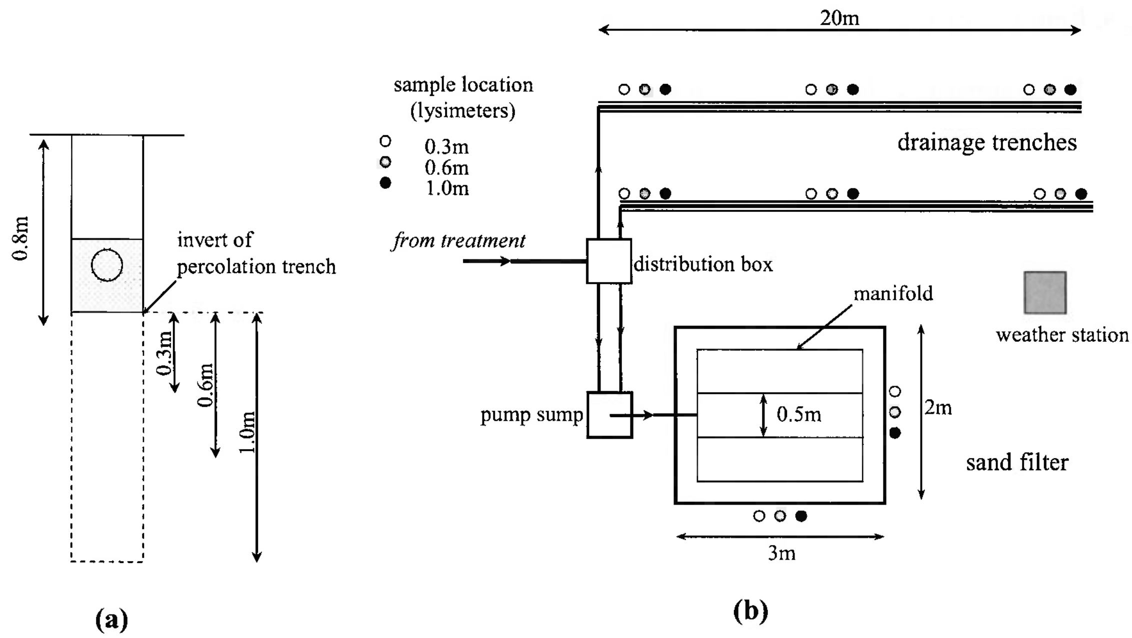
Fig. 6. Comparison of total nitrogen removal down through the filter and underlying subsoil to the subsoil beneath the trenches on: **(a)** receiving septic tank effluent and **(b)** secondary treated effluent.

Fig. 7. Graph of loading rate versus removal for ortho-phosphate for both stratified sand filters (Sites A and B) during both the high and low hydraulic loading trials.

Fig. 8. Comparison of ortho-phosphate removal down through the filter and underlying subsoil to the subsoil beneath the trenches on: **(a)** receiving septic tank effluent and **(b)** secondary treated effluent.

Fig. 9. Removal of *E. coli* with depth through the sand filter and subsoil (Site A).

N= number *E. coli*, N_0= Original number from septic tank.



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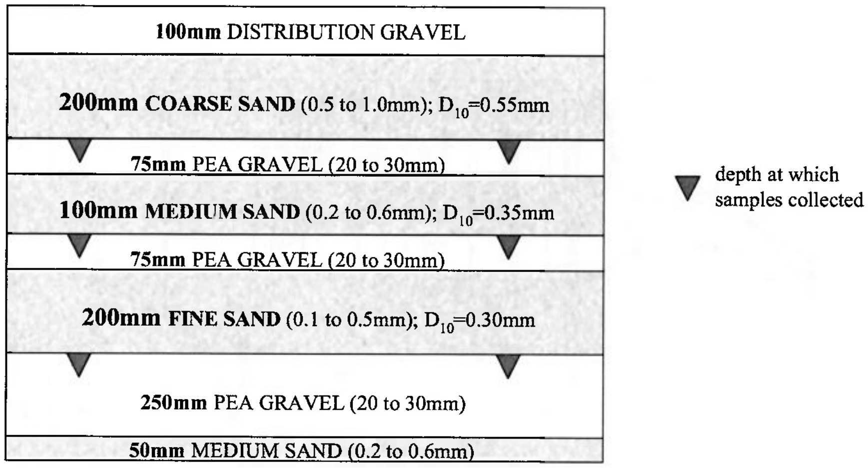
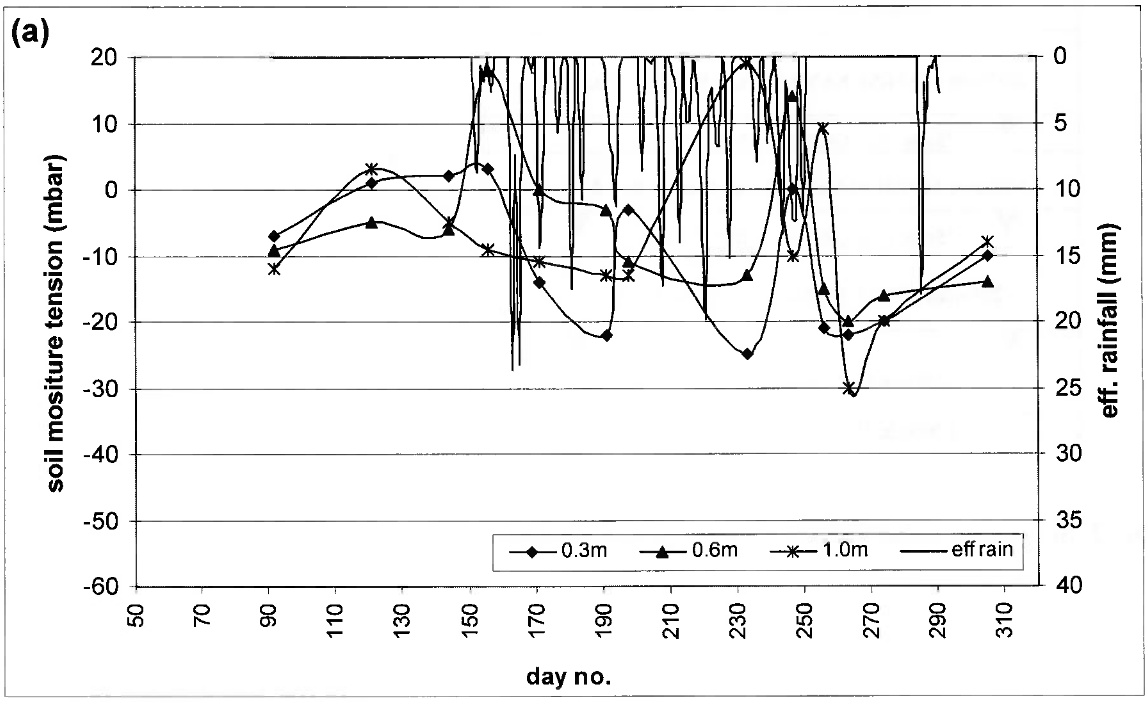


Fig. 2. Schematic cross-section through stratified sand filter.



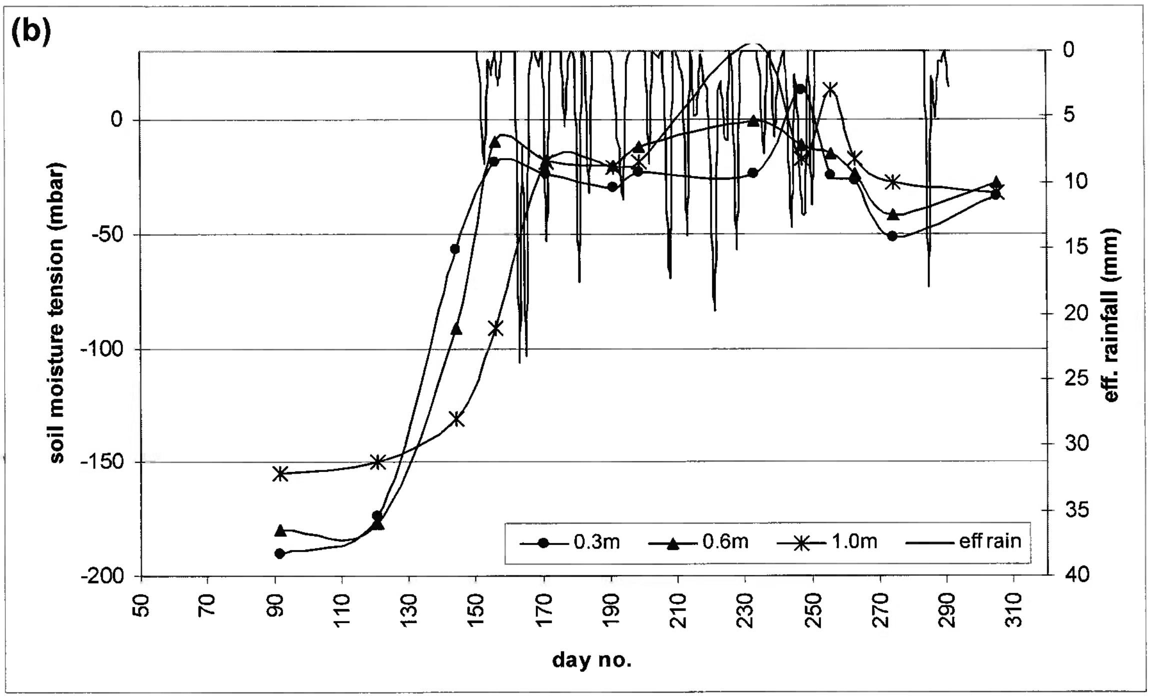


Fig. 3. Site B: soil moisture tension plotted against effective rainfall for: **(a)** the 0 m sample position and **(b)** the 20 m sample position.

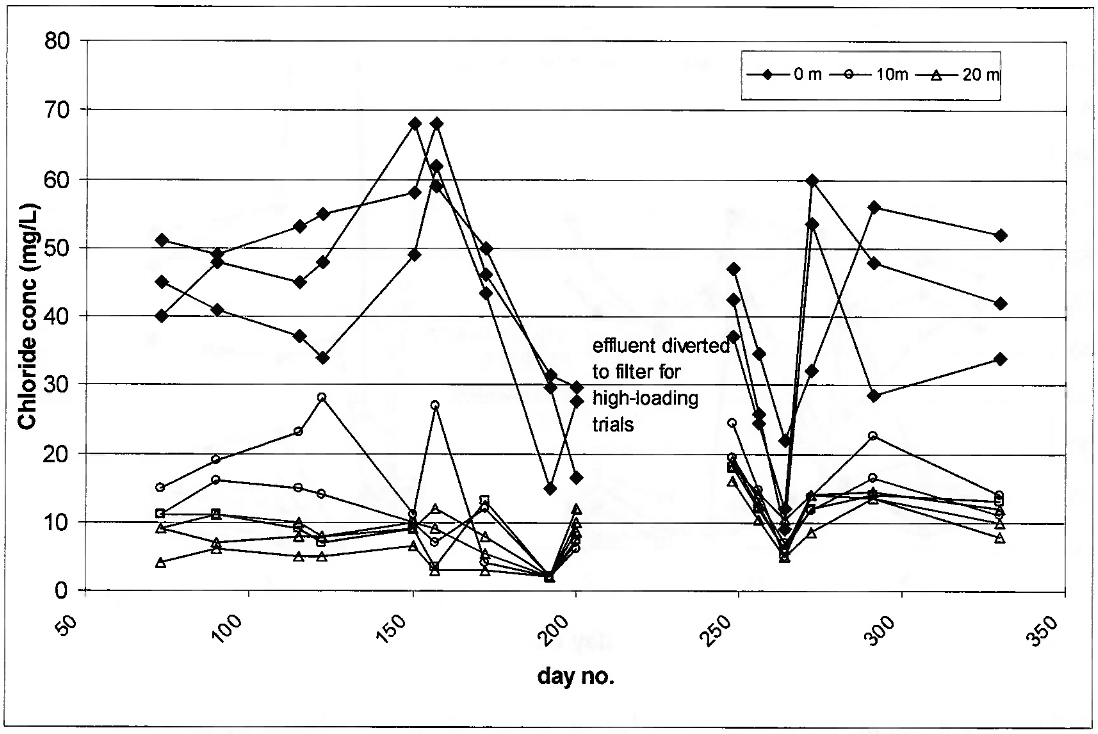


Fig. 4. Chloride concentrations at all sampling positions along percolation trench length (Site A). *Note: three sampling depths per sampling position.*

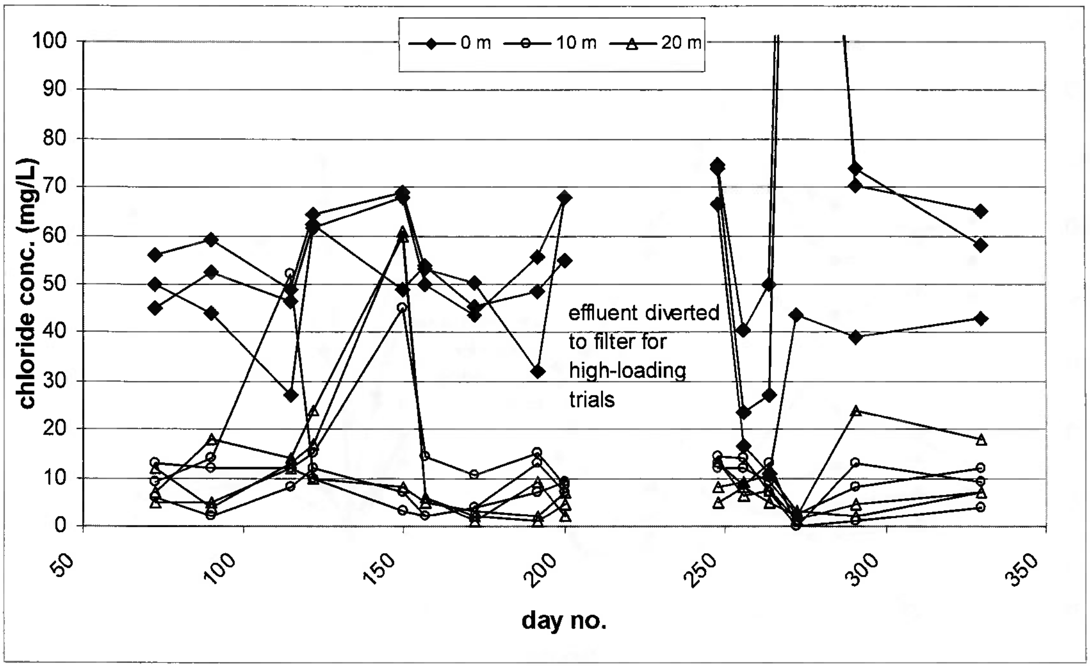
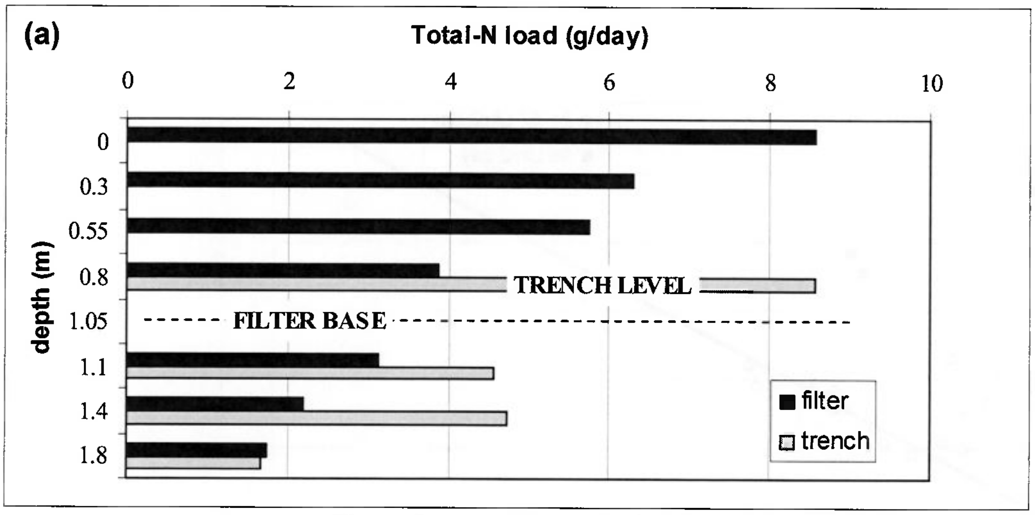


Fig. 5. Chloride concentrations at all sampling positions along percolation trench length (Site B). *Note: three sampling depths per sampling position.*



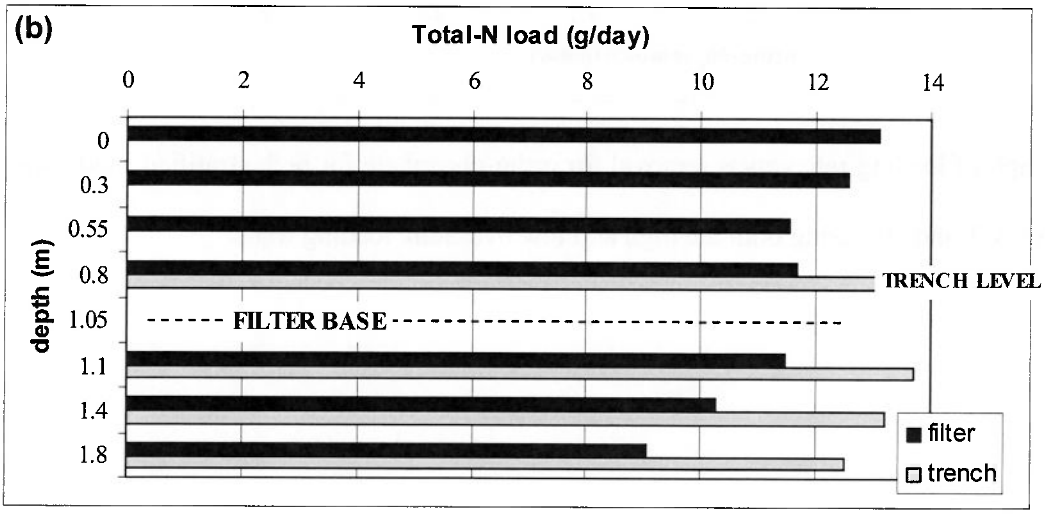
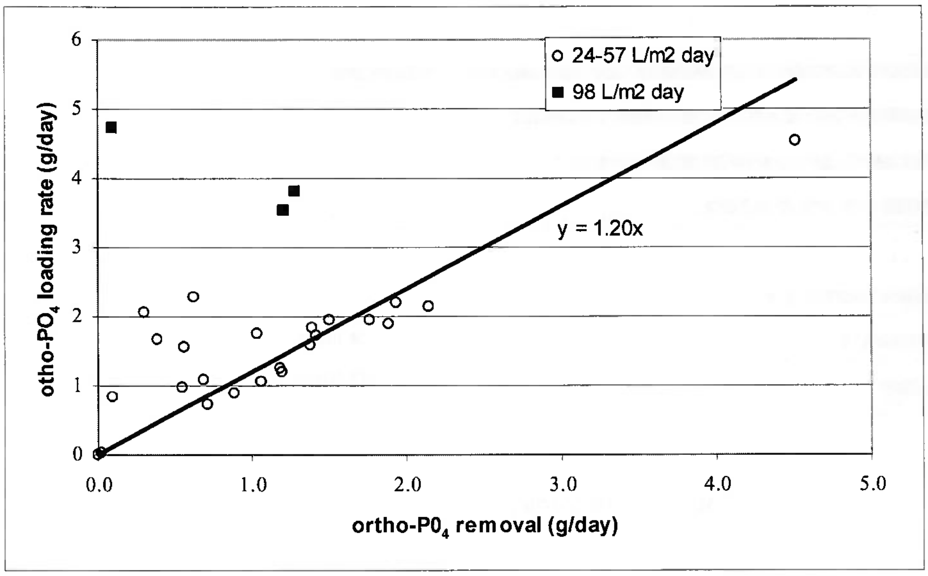


Fig. 6. Comparison of total nitrogen removal down through the filter and underlying subsoil to the subsoil beneath the trenches on: **(a)** receiving septic tank effluent and **(b)** secondary treated effluent.



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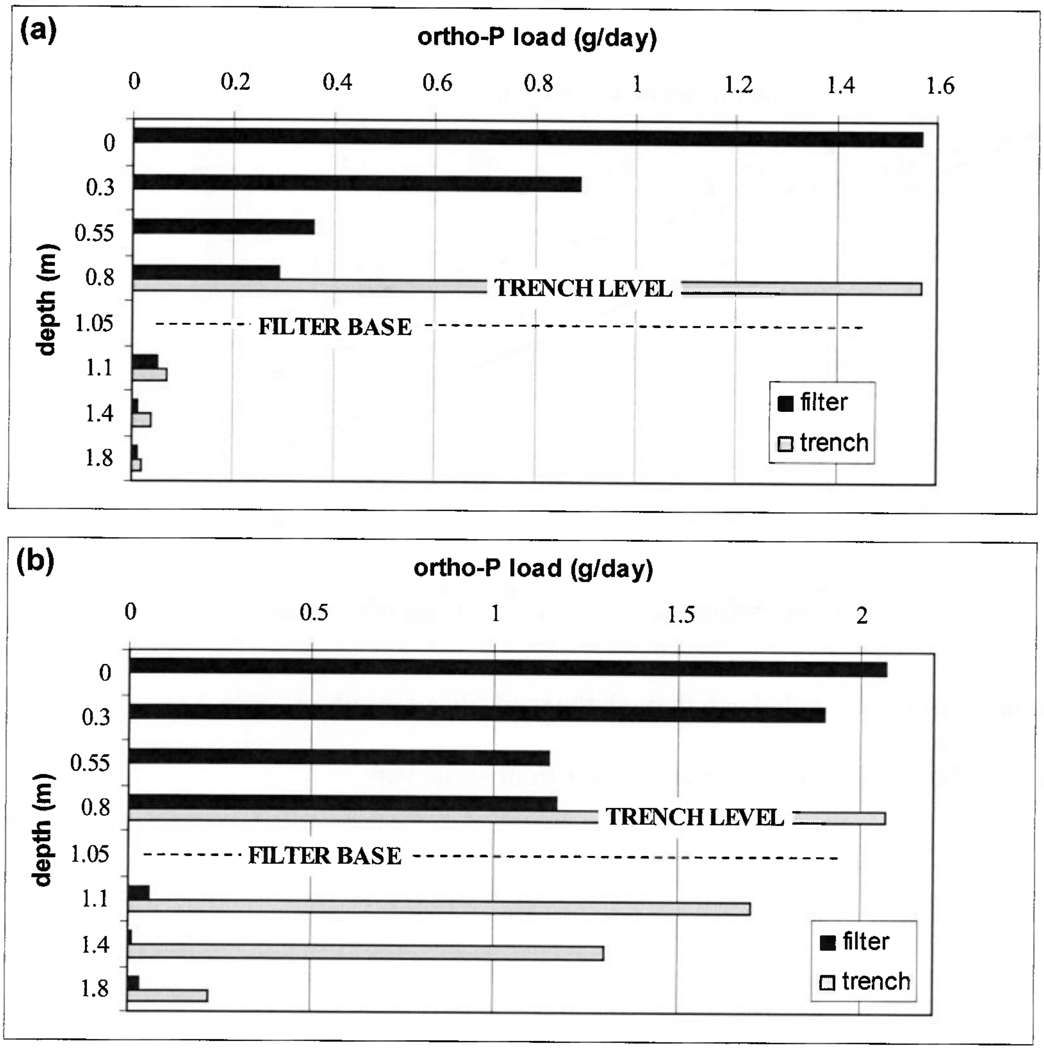
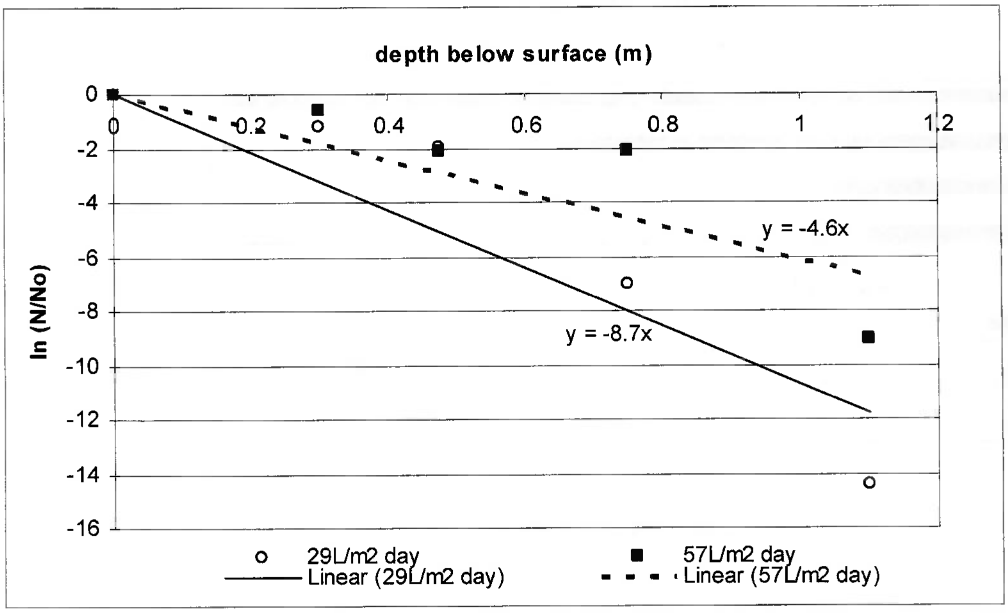


Fig. 8. Comparison of ortho-phosphate removal down through the filter and underlying subsoil to the subsoil beneath the trenches on: **(a)** receiving septic tank effluent and **(b)** secondary treated effluent.



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N= number *E. coli*, N_0= Original number from septic tank.