Flood Risk and Drainage Assessment

Killymallaght BESS

Ref	05195-7590534

Revision History

Issue	Date	Name	Latest changes
01	12/06/2024	Antonis Poulakis	First Created

Contents

1 Introduction

Killymallaght Battery Energy Storage System (BESS) is a proposed storage system with a maximum import/export capacity of 50MW, located southeast of Londonderry and just south of Newbuildings town in Northern Ireland.

This report sets out the Flood Risk and Drainage Assessment for the proposed Killymallaght BESS, which will comprise of battery storage enclosures (BSEs), associated foundations, transformers, power conversion systems (PCSs), electrical infrastructure, access track, crane hardstanding, and spares storage containers. All electrical equipment will be set on concrete foundations.

Drawing 05195-RES-LAY-DR-PT-001 included in Appendix A, shows the proposed project layout including the SuDS drainage infrastructure. The compound area within the fence measures 0.92 hectares, the total area enclosed by the red line boundary measures 3.88 hectares.

2 Relevant Guidance and Legislation Requirements

This report uses best practice and conforms with the requirements of the relevant regulatory authorities.

The key legislation and guidance adhered to are as follows:

- Derry City and Strabane District Council Local Development Plan (LDP) 2032 (Dec 2019)[1].
- Revised Strategic Planning Policy Statement (SPPS, 2015) 'Planning and Flood Risk'[2].
- Technical Flood Risk Guidance in relation to Allowances for Climate Change in Northern Ireland - DfI Water & Drainage Policy Division (Feb 2019)[3].
- Northern Ireland Flood Risk Assessment (NIFRA) 2018[4].
- The Water and Sewerage Services Act (Northern Ireland) 2016[5].
- The EU Water Framework Directive (2000/60/EC).
- Engineering in the Water Environment, Good Practice Guide, Temporary Construction Methods, First Edition, March 2009.
- The Sustainable Urban Drainage Scottish Working Party (SUDSWP) Water Assessment and Drainage Assessment Guide.
- Control of Water Pollution on Construction Sites, CIRIA C532.
- The SUDS Manual 2015. CIRIA C753.
- Geological Survey of Northern Ireland (GSNI).

[1] https://www.derrystrabane.com/getmedia/e5f6401c-bea6-4a6d-b5fd-b52bd566b083/DC-SDC_Local-Development-Plan-final-online_1.pdf
[2] https://www.infrastructure-ni.gov.uk/sites/default/files/publications/infrastructure/PPS15%20Planning%20and%20Flood%20Risk.pdf
[3] https://www.infrastructure-ni.gov.uk/sites/default/files/publications/infrastructure/technical-flood-risk-guidance-in-allowances-for-climate-change-6feb19.PDF
[4] https://www.infrastructure-ni.gov.uk/sites/default/files/publications/infrastructure/northern-ireland-flood-risk-assessment-report-2018-updated-may2019.pdf
[5] https://www.infrastructure-ni.gov.uk/sites/default/files/publications/infrastructure/water-and-sewerage-services-act-ni-2016.PDF

3 Existing Information

3.1 Site Location

The proposed site is located approximately 6.7km Southwest of Londonderry and sits on the north side of Trench Road in Derry County in Northern Ireland. The site is located 550 meters northwest of the Killymallaght Substation, to which it is proposed to be connected. Refer to Appendix A for the Site Location Plan - 05195-RES-MAP-DR-XX-001.

Access will be taken off Trench Road to the south of the site. The access track will be formed by constructing a new track starting from the existing gate at the eastern corner of the site.

3.2 Existing Land Use and Topography

A walkover survey of the site has been undertaken, and a topographical survey of the site extents carried out to confirm the existing land use and topography. The existing site land use is for agricultural purposes, confirmed by the landowner during a site walkover.

Ground levels on site fall approximately 1 in 25 to the northeast and to southeast. Elevations in the location of the proposed development vary from 113m AOD in the south corner to 109.5m AOD in the north corner of the proposed development.

A topographical survey was commissioned for the proposed development, including in its extents a section of Trench Road and of the field to the south of the development for grid connection purposes.

The topographical survey is included in ***Appendix B***.

3.3 Ground Conditions

Geological Survey of Northern Ireland (GSNI) mapping shows the site is underlain entirely by a bedrock of Dart Formation, a stratified bedrock. Bands of sandstone and mudstone Dart Formation cross the site, shown in yellow and purple respectively in Figure 1 below.

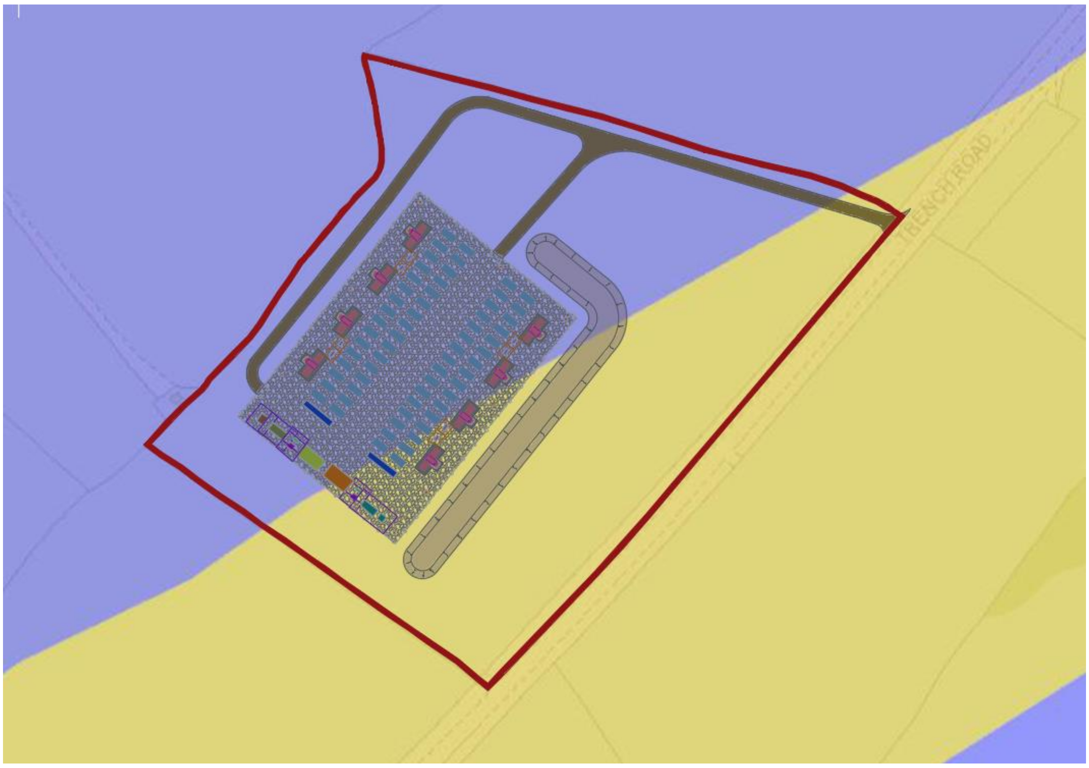


Figure 1: Bedrock Geology

GSNI mapping also indicates that some areas of site have no superficial deposits of significant thickness (>1m). An area of Diamicton Till lies in the northern part light blue as indicated in Figure 2 below.

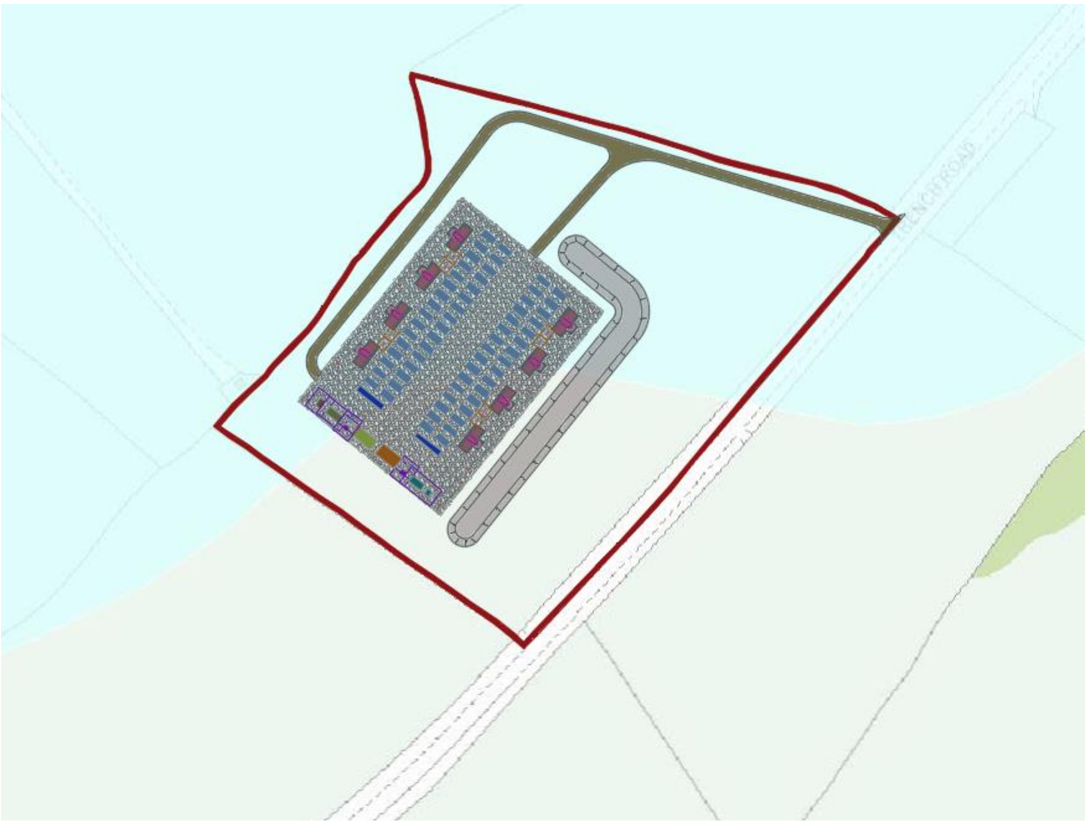


Figure 2: Superficial Deposits

HR Wallingford data classifies soil on site as Type 2, which indicates good infiltration potential. There are no boreholes found in the vicinity of the proposed development.

3.4 Existing Hydrology / Drainage

Based on the available information the site is assumed to have a good infiltration capacity. During extreme rainfall events, water drains towards Trench Road, which runs adjacent to the south site boundary. Trench Road has its own drainage system that is sufficient to accommodate the current situation.

A site visit was conducted in October 2023. Considering that the day before the site visit, a rainfall event occurred and that there was not any water ponding identified on site during the site visit, this indicates a good soil infiltration potential.

In discussions during the site visit, the landowner stated that there are historic land drains buried near the proposed site entrance that have not been maintained as the field drains sufficiently naturally.

GSNI maps indicates that the groundwater on site sits within vulnerability category 5. Category 5 indicates that groundwater is vulnerable to most water pollutants.

4 Flood Risk Screening

4.1 Overview

The proposed development is deemed not to be at risk from flooding as set out in this flood screening section.

4.2 Flooding from Fluvial Sources

Figure 3 below depicts the DfI Rivers fluvial flood risk map, with the proposed site red line boundary overlaid. As can be observed in Figure 3 the site does not lie in an area at risk of flooding from fluvial sources.

Although a flood risk area (blue zone) has been identified approximately 350m southeast of site, it is at a significant lower elevation.

Therefore, the proposed development site lies in an area with a negligible risk of fluvial flooding.

Figure 3 - Excerpt from DfI Rivers fluvial flood risk map, with proposed site boundary overlaid.

4.3 Flooding from Surface Water

Figure 4 below depicts the DfI Rivers surface water flood risk map, with the proposed site red line boundary overlaid. As can be observed in Figure 4 the site does not lie in an area at risk of flooding from surface water.

A flood risk area (purple zone) has been identified approximately 350m southeast of site at a significant lower elevation.

Therefore, the proposed development site lies in an area with a negligible risk of surface flooding.

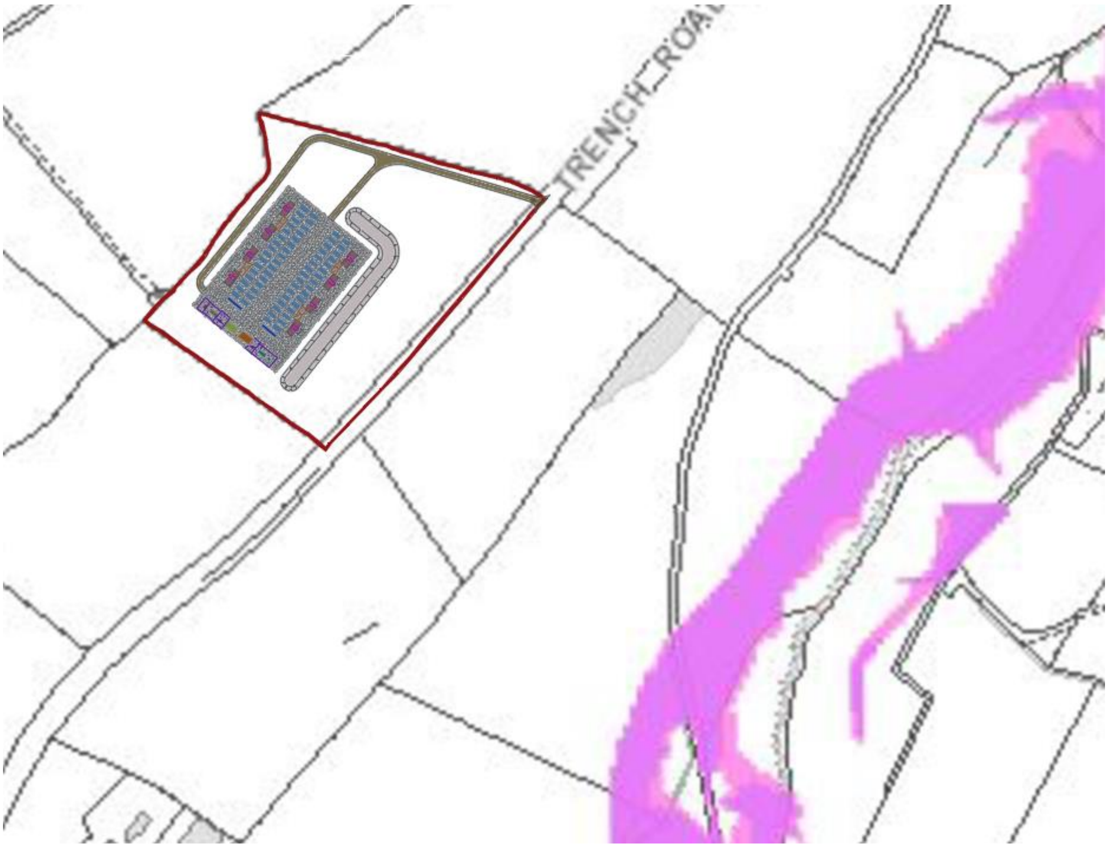


Figure 4 - Excerpt from DfI Rivers surface water flood risk map, with proposed site boundary overlaid.

4.4 Flooding from Groundwater

GSNI maps indicates that the groundwater on site sits within vulnerability category 5. Category 5 indicates that groundwater is vulnerable to most water pollutants.

There are no publicly available groundwater flood risk maps for the area. However, taking in account that the nearest water body is located approximately 500m far away and 70m lower than the development site and that there is no evidence of springs or issues in the area, it is likely that the groundwater levels will be low within the site.

Therefore, it is concluded that the proposed development site lies in an area with a low risk of groundwater flooding.

4.5 Flooding from Tidal or Sea Flooding

The development site is located outside of any area of tidal influence based on its ground elevation above ordnance datum of approximately 110m AOD.

Therefore, the proposed development site lies in an area with a negligible risk of tidal or sea flooding.

4.6 Flooding from Overland Sheet Flow

The development site is located on the peak of the existing field. The proposed location sits on higher elevation from the adjacent land parcels. Therefore, the risk from overland sheet flow is considered negligible.

4.7 Flooding from Sewers and Highway Drains

The topographical survey indicates Trench Road surface water system is in the vicinity of the development. However, the road is located approximately 10m lower than the proposed development site.

Therefore, the development is not considered at risk of flooding from sewers or highway drains.

4.8 Flooding as a Result of the Development

The development is not considered to exacerbate the flood risk of the surrounding area as runoff rates will not exceed the greenfield conditions as discussed in sections 6 & 7.

4.9 Historic Flooding

There are no known records of historic flooding within the site boundary or to the knowledge of the Landowner.

There is a historic flood location identified approximately 450m northeast of site. The flood event occurred on 23rd of August 2017 and it is recorded with reference EMSR228. The flood area is approximately 20m lower than the site and there is not a risk that this flood would affect the site.

5 Foul Drainage Strategy

5.1 Overview

There will be no permanent foul drainage from the proposed development.

Any foul drainage from the temporary welfare facilities will be self-contained and disposed off-site appropriately.

At the temporary construction compound, welfare facilities will comprise self-contained chemical toilets and additional foul drainage facilities (i.e. sinks). The temporary drainage facilities will be removed on completion of construction.

6 Surface Water Drainage Strategy

6.1 General

The SuDS Hierarchy as included in the SuDS Manual will be applied and is described below:

- Discharge to soakaway or other infiltration system.
- Discharge to existing watercourse.
- Discharge to a surface water sewer, highway drain or another drainage system.
- Discharge to a combined sewer.

The surface water drainage design will ensure that, when possible, the following requirements of PPS15: Planning and Flood Risk (Sep 2014) are met.

Regarding Water Quantity

Manage rainfall to mimic natural drainage by:

- Reducing run-off rates.
- Reducing additional run-off volumes and frequencies.
- Encouraging natural groundwater recharge.
- Reducing the impact of short duration intense storm events.

Regarding Water Quality

Minimise adverse impacts on water quality by:

- Reducing pollution and protecting the quality of receiving waters.
- Preventing direct discharge of spillage.
- Reduce the volume of surface waste runoff to sewers and so reduce storm overflows.

Regarding Amenity and Biodiversity

- Contribute to the amenity and aesthetic value of the development and the wider environment.
- Provide habitat for wildlife and enhance biodiversity.

6.2 Surface Water Management Options

6.2.1 Infiltration

Based on the hierarchy identified in Section 6.1, the preferred method of surface water discharge is via infiltration to the ground. The ground on site is anticipated to support drainage by infiltration due to the following:

- GSNI maps indicate the underlying material is a mix of mudstone and sandstone. Sandstone is characterized by a medium to high permeability.
- Greenfield runoff rate estimation tool created by HR Wallingford supports this assumption as it identifies the land as soil type 2 with runoff coefficient of 0.3 indicating potential suitability of infiltration methods.
- No standing water or boggy / waterlogged ground observed during a site visit in October 2023. The site visit followed a period of rainfall event the previous day.
- Landowner's statement that the field drains sufficiently due to good infiltration.

Infiltration testing within the site bounds will be carried out post-consent to confirm the above assumption that an infiltration solution is possible for this site.

6.2.2 Attenuate Rainwater in Basin for Gradual Release

Should the ground investigation prove that infiltration rates of the soil are not suitable for infiltration, the current design has allowed for sufficient size of basins that can attenuate surface water and discharge it, with the maximum discharge flow to be limited to pre-development runoff rates.

The attenuation basins would discharge overland within the site boundary to match the existing pre-development flow paths.

Flows from the compound would be restricted by means of two flow control devices managing the runoff rates and volumes up to the 1 in 100-year event plus climate change. Pass forward flows would be trickle fed into overland flow control ditches.

The impact on the downstream catchments would be no greater than the existing greenfield scenario.

6.3 Proposed Surface Water Management System

6.3.1 Overview

As set out in Section 6.2, an infiltration strategy has been chosen as the most appropriate surface water management system.

Without the provision of attenuation features, the proposed development will result in an increase in runoff. To ensure the water quantity and volume are suitably managed back to pre-development rates, attenuation and interception will be provided.

Surface water flows will be collected by a series of filter drains, swales and pipes before discharging into two infiltration basins.

Typically, the access tracks serving the site will be constructed from unbound granular material. Flows will be partially attenuated at source within the tracks and part shed into the adjacent soft landscaped areas. As such, the change in flow regime from the existing scenario will be minimal.

The SuDS will be constructed prior to or at the same time as the access tracks and the site compound. Interim measures such as the placement of silt fences around watercourses will be retained in place until the SuDS are established and providing sufficient silt removal.

Refer to Appendix A for the details and layout of the SuDS proposed across the site.

6.3.2 Design Criteria

A surface water drainage system has been designed in accordance with the guidance in Section 2.

The infiltration basins will be sized to contain the 1 in 100 (plus a 20% allowance for climate change) rainfall event. The 20% climate change allowance is based on the requirements of the Technical Flood Risk Guidance in relation to Allowances for Climate Change in Northern Ireland.

6.3.3 Extreme Event Flow Design

In accordance with CIRIA Report 753, an extreme event route should be considered as part of the SuDS design.

The extreme event route will remain as per the existing scenario, over vegetation down towards Trench Road east of the site and towards the adjacent field north of the site.

The infiltration basins will be located downslope of the energy storage facility. The site levels will be such that flows from any extreme events will flow over the banks of the infiltration basins and swales, away from the energy storage facility and then downslope overland away from the site. The edges of the infiltration basins will be vegetated to reduce the risk of scour during an extreme event.

6.3.4 Water Quality and Treatment

In line with the requirements noted in the PPS15: Planning and Flood Risk document listed in Section 2, a Simple Index Approach is undertaken to ensure the proposed drainage strategy provides adequate water quality treatment, as per Section 26.7.1 of the SUDS Manual 2015 (CIRIA C753).

The proposed development is considered a high pollution hazard level based on land use definitions provided in Table 26.2 of the SUDS Manual. The corresponding pollution hazard indices are denoted in Table 1.

Surface water within the proposed development will receive treatment before being infiltrated into the ground. The main stages are listed below:

1. Filtration of water through filter drain stone upstream of soakaway; mitigation indices for filter drain: TSS = 0.4, metals = 0.4, hydrocarbons = 0.4.

2. Filtration of water through swales and check dams upstream of infiltration basins; mitigation indices for swale: TSS = 0.5, metals = 0.6, hydrocarbons = 0.6.

3. Settlement and filtration through a layer of dense vegetation underlain by soil with good contamination attenuation potential of at least 300mm in depth; mitigation indices: TSS = 0.5, metals = 0.5, hydrocarbons = 0.6.

Table 1 below demonstrates how the pollution hazard index for each contaminant is satisfied by the three stages of water treatment provided as part of the proposed drainage strategy.

Table 1 – Simple Index Calculation

Contaminant Type	Stage 1	Stage 2	Stage 3	Total SUDS Mitigation Index	Pollution Hazard Index	Utilisation
TSS	0.4	0.5(0.5) =0.25	0.5(0.5) =0.25	0.90	0.8	1.13
Metals	0.4	0.6(0.5) =0.3	0.5(0.5) =0.25	0.95	0.8	1.19
Hydrocarbons	0.4	0.6(0.5) =0.3	0.6(0.5) =0.3	1.00	0.9	1.11

During the construction phase, temporary silts fences will be installed, providing an additional treatment stage of water filtration (see ***Appendix A*** for drawing).

7 Hydraulic Assessment

7.1 General

All methods and inputs are taken in accordance with the relevant guidance documents provided in Section 2.

As discussed in Section 6.2 of this report, surface water from the development will discharge to two infiltration basins along the north boundary of the site.

The inputs taken have been assumed as “worst case” and as such has determined the maximum drainage component extents required for the project. This includes assuming all permanent infrastructure (other than the access track) has an asphalt surface, and that drainage by infiltration is not possible.

The required basin volumes have been calculated as approximately 400m^3 per basin.

A detailed drainage design will be performed following the ground investigation and compound earthing design (to determine surface finishes).

Refer to Appendix C for the infiltration basin volume calculation summary.

7.2 Basin Design

7.2.1 Design Inputs and Parameters

The infiltration basin has been designed as a three-dimensional infiltration system. Design calculations have been performed in accordance with section 25.6.2 of the SuDS Manual.

The infiltration basins are sized to accommodate the peak flows calculated up to the critical 1 in 100-year event (including 20% allowance for climate change).

Rainfall intensities have been determined using the Modified Rational Method.

The site-specific design inputs and parameters have been established as below:

- Total drained area: 0.92ha (0.46ha drains to each infiltration basin);
- Runoff coefficient: 1.00;
- Soil typical infiltration rate (low bounds of ‘Good infiltration media’ as indicated in SuDS manual): 1X10-5m/s;
- Factor of Safety (F.O.S): 1.5;
- M5-60 rainfall depth: 17mm;
- Ratio M5-60 / M5-2day: 0.3.

7.2.2 Sloping-sided Structures

There is no simple analytical method for calculating the maximum water depth of infiltration basins with slope sides. The guidance provided in the SuDS Manual recommends slope-sided structures are approximated by a vertical-sided structure.

Figure 3 demonstrates the numerical conversion from a slope-sided structure to a vertical-sided structure.

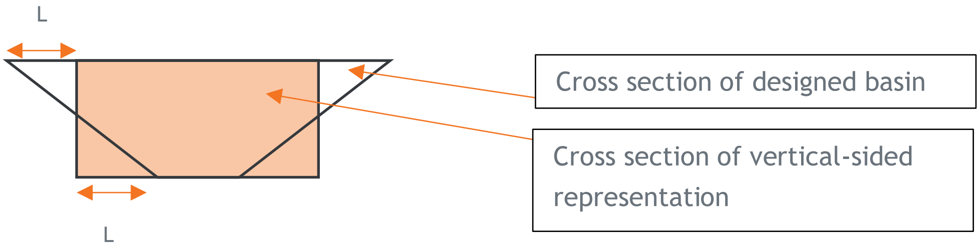


Figure 3 – Slope-side to vertical-sided structure conversion

7.2.3 Emptying Time Checks

In accordance with the guidance given in Section 25.7 of the SuDS Manual, the infiltration system should discharge from full to half-full within a reasonable time so that it can manage a subsequent rainfall event.

As per Section 25.7 of the SuDS Manual it is suggested it may be appropriate to allow longer emptying times for rainfall events greater than 1 in 30-year subject to the performance of the system and consequences of consecutive rainfall events occurring.

The risk of consequences is deemed minimal in the event of exceedance. Excess runoff will flow downslope away from the site mimicking the existing flow paths.

Therefore a 1 in 30-year rainfall event will be used as a design basis for the emptying time check.

8 Operation and Maintenance Requirements

All surface water drainage and pollution control features associated with the site will remain private and will be maintained by the site operator.

The following section outlines the proposed maintenance for the various aspects of the drainage system. If necessary, these outline maintenance proposals will be refined when the site is operational to suit specific conditions.

A maintenance record log will be maintained for all maintenance work carried out. Where problems persist on each six-monthly inspection, advice will be sought from the SuDS designer on an alternative drainage solution.

8.1 Filter Drain

The anticipated maintenance plan for the filter drains at the site is outlined in Table 2.

Table 2 – Typical Filter Drain Maintenance Requirements

Filter Drain Maintenance Schedule	
Maintenance Action	**Minimum Frequency**
Inspect filter drain /manhole for silt contamination.	Half yearly
Replace drainage stone where necessary.	Half yearly
Remove litter and debris	Half yearly
Inspect filter drain/manhole. Where pipe has become clogged with silt, the pipe will be cleared out.	Half yearly

8.2 Swale

The anticipated maintenance plan for the swale at the site is outlined in Table 3.

Table 3 – Typical Swale Maintenance Requirements

Swale Maintenance Schedule	
Maintenance Action	**Minimum Frequency**
Inspect swale for silt contamination.	Half yearly
Remove litter and debris.	Half yearly
Cut grass along swale banks.	Half yearly

8.3 Carrier Pipe

The anticipated maintenance plan for the site pipes and site compound catchpits is outlined in Table 4.

Table 4 – Typical Pipes and Catchpits Operation and Maintenance Requirements

Pipes, culverts and Catchpits Maintenance Schedule	
Maintenance Action	**Minimum Frequency**
Inspect pipe. Where pipe has become clogged with silt, the pipe will be cleared out.	Half yearly
Remove litter and debris.	Half yearly

8.4 Infiltration Basin

The anticipated maintenance plan for the infiltration basins at the site is outlined in Table 5.

Table 5 – Typical Infiltration Basin Operation and Maintenance Requirements

Infiltration Basin Maintenance Schedule	
Maintenance Action	**Minimum Frequency**
Remove litter and debris from infiltration basin	Half yearly
Inspect inlets for blockages, and clear (if required).	Half yearly
Inspect inlets for noticeable effects of erosion, suitable erosion protection measures such as reno-mattress or placement of large stones (>150mm) to dissipate water energy levels will be installed at the area affected.	Half yearly
Reseed areas of poor vegetation growth, alter plant types to better suit conditions (if required).	As required, or if bare soil is exposed over 10% or more of the soakaway treatment area

9 Conclusion

A flood risk assessment has been undertaken across the site. The site has been deemed at low risk of flooding.

An assessment of the drainage options has also been undertaken, in accordance with the SuDS manual surface water drainage hierarchy, the surface water from the site will drain via infiltration. The required basin volumes have been calculated as approximately 400m^3 per basin. The infiltration basins are sized to contain the 1 in 100 (plus a 20% allowance for climate change) rainfall event.

Infiltration testing will be undertaken on site prior to detailed design. Should the ground investigation prove that infiltration rates of the soil are not suitable for infiltration, the current design has allowed for sufficient size of basins that can attenuate surface water and discharge it, with the maximum discharge flow to be limited to pre-development runoff rates.

The drainage strategy proposed will provide sufficient water quality treatment as demonstrated using the Simple Index Approach.

Appendix A Project Drawings

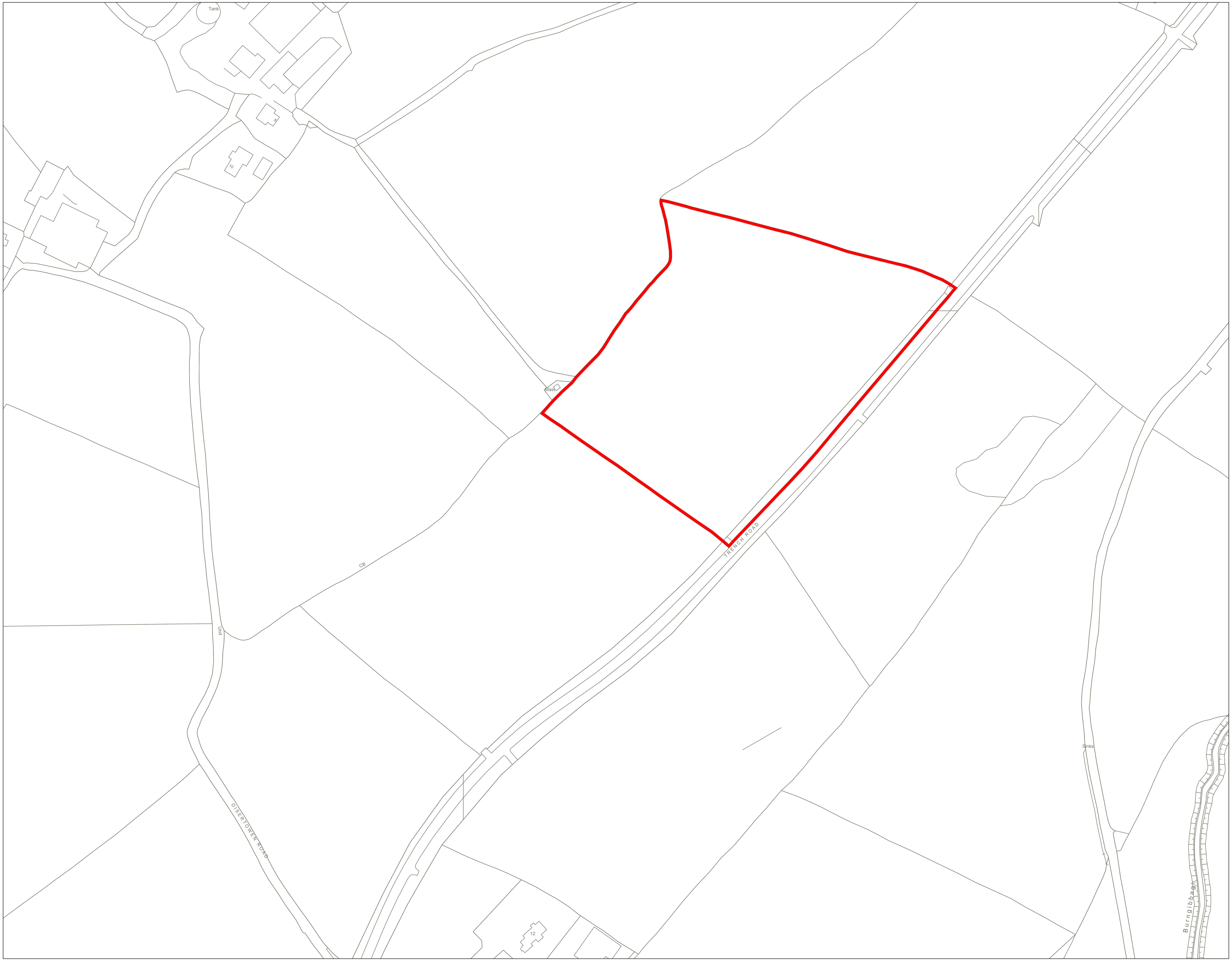
- 05195-RES-LAY-DR-PT-001 – Layout Infrastructure
- 05195-RES-MAP-DR-XX-001 – Site Location
- 05195-RES-DRN-PT-001 – Typical Drainage Details

Appendix B Topographical Survey

- 05195-RES-STE-DR-SV-002 – Topographical Survey

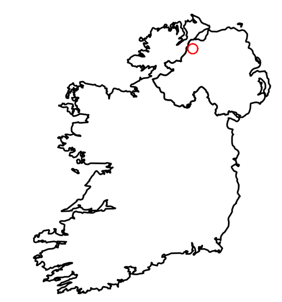
Appendix C Calculations

- Killymallaght 3-D Soakaway Design 30yr
- Killymallaght 3-D Soakaway Design 100yr

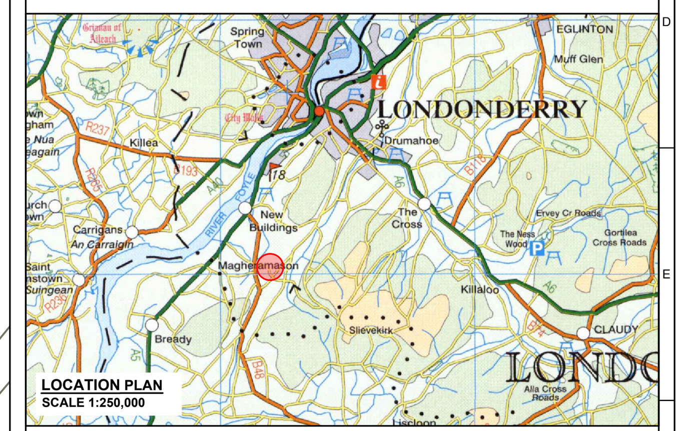


KEY:

DEVELOPMENT BOUNDARY (OUTSIDE EDGE OF LINE DENOTES BOUNDARY)



SITE LOCATION - NOT TO SCALE



0 12.5 25 50 75 100m

SCALE 1:1250

ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES
3	BM	BY APPD	PD	2024-09-27	DELETED LANDLORD'S PROPERTY
2	BM	AP	PD	2024-05-22	UPDATED DEVELOPMENT BOUNDARY
1	BM	BY APPD	PH	2024-01-18	FIRST ISSUE

PURPOSE: PLANNING	COORDINATES: TM65 IRISH GRID
SCALE: 1:1,250 @ A1	DATUM: N/A
LAYOUT DWG: N/A	T-LAYOUT NO.: N/A

PROJECT TITLE

KILLYMALLAGHT ENERGY STORAGE FACILITY

DRAWING TITLE

SITE LOCATION PLAN

RES DRAWING NUMBER	REV
05195-RES-MAP-DR-XX-001	3

BEAUFORT COURT,
EGG FARM LANE,
KINGS LANGLEY,
HERTS WD4 8LR. UK
TEL +44 (0) 1923 299200
WWW.RES-GROUP.COM

KEY:

DEVELOPMENT BOUNDARY
(OUTSIDE OF LINE DENOTES BOUNDARY)

NOTES:

1. THE TOPOGRAPHICAL SURVEY WAS CARRIED OUT ON WEEK COMMENCING 13/11/2024.
2. 0.25 METRE CONTOUR INTERVAL.

ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES
2	BM	BY APPD	PD	2024-09-27	ADDED COUNTER LEVELS, CHANGED SHEET SIZE AND SCALE
1	BM	AP	MK	2024-06-03	FIRST ISSUE

PURPOSE PLANNING	COORDINATES TM65 IRISH GRID
SCALE 1:500 @ A1	DATUM N/A
LAYOUT DWG N/A	T-LAYOUT NO. N/A

PROJECT TITLE

KILLYMALLAGHT ENERGY STORAGE FACILITY

DRAWING TITLE

TOPOGRAPHICAL SURVEY

RES DRAWING NUMBER	REV
05195-RES-STE-DR-SV-002	2

BEAUFORT COURT,
EGG FARM LANE,
KINGS LANGLEY,
HERTS WD4 8LR. UK
TEL +44 (0) 1923 299200
WWW.RES-GROUP.COM

Project: Killymallaght BESS		Number: 05195-7457985
Soakaway Design		Made by/date: A. Poulakis 11/06/2024
CIRIA METHOD		Checked/Date: J. McAlpine 12/06/2024

Notes:-

Three dimensional infiltration system design (trench) in accordance with section 25.6.2 of CIRIA report C753.

1. Inputs:-

Total drained area	4595.5	m^2
Coefficient (unbound stone finish)	1	
Effective drained area =	4596	m^2

F.O.S = 1.5 — Using table 25.2 Ciria C753 p553

n = 1 — Infiltration Swale

f = 0.00001 m/s

f/F.O.S = 0.000007 m/s

q = 0.024 m/h — Convert 'f' to m/h

r = 0.3 — From uksuds surface water volume estimation tool

Depth =	0.8	Perimeter (P) =	80	m
Length =	20	Area (A_b)=	400	m^2
Width =	20	Storage Vol =	320	m^3

2. Results:-

Testing chosen dimension at different storm durations with 30 year return period

D	D(hrs)	Intensity 'I'	Intensity + climate change 'I^{cc}' (m/h)	a	b	-bD	h_{max}
mins		m/h		$(A_b/P) - (iA_b/Pq)$	Pq/nA_b		(m)
15	0.250	0.060	0.072	-166.698	0.005	-0.001	0.200
30	0.500	0.039	0.047	-107.194	0.005	-0.002	0.257
60	1.000	0.025	0.030	-67.525	0.005	-0.005	0.323
120	2.000	0.016	0.019	-39.860	0.005	-0.010	0.381
240	4.000	0.010	0.012	-22.872	0.005	-0.019	0.435
360	6.000	0.007	0.009	-15.896	0.005	-0.029	0.451
600	10.000	0.005	0.006	-9.753	0.005	-0.048	0.457
1440	24.000	0.003	0.003	-2.975	0.005	-0.115	0.324
2160	36.000	0.002	0.003	-1.014	0.005	-0.173	0.161

Pick largest hmax result, if too high, adjust dimensions

Check Time of Emptying: (must be less than 24hrs to half empty)

$t_{s50} = (nA_b/qP) \times \log_e[(h_{max} + A_b/P)/(h_{max}/2 + A_b/P)]$

From Ciria C753, p558

And h_{max} at critical duration = **0.457**

t_{s50} **8.913** hrs

therefore OK

res	Project: Killymallaght BESS	Number: 05195-7457985	
	Soakaway Design		Made by/date AP / 11/06/2024
	CIRIA METHOD		Checked/Date JM /12/06/2024

Notes:-

Three dimensional infiltration system design (trench) in accordance with section 25.6.2 of CIRIA report C753.

1. Inputs:-

Total drained area 4595.5 m^2

Coefficient (unbound stone finish) 1

Effective drained area = 4596 m^2

F.O.S = 1.5 — Using table 25.2 Ciria C753 p553

n 1 — Infiltration Swale

f 0.00001 m/s

f/F.O.S 0.000007 m/s

q 0.024 m/h — Convert 'f' to m/h

r 0.3 — From uksuds surface water volume estimation tool

Depth = 0.8 — Perimeter (P) = 80 m

Length = 20 — Area (A_b)= 400 m^2

Width = 20 — Storage Vol = 320 m^3

2. Results:-

Testing chosen dimension at different storm durations with 100 year return period

D mins	D(hrs)	Intensity 'I' m/h	Intensity + climate change 'I^{cc}' (m/h)	a (A_b/P) - (iA_D/Pq)	b Pq/nA_b	-bD	h_{max} (m)
15	0.250	0.079	0.095	-222.014	0.005	-0.001	0.266
30	0.500	0.052	0.062	-143.597	0.005	-0.002	0.344
60	1.000	0.033	0.040	-90.701	0.005	-0.005	0.434
120	2.000	0.020	0.024	-53.593	0.005	-0.010	0.512
240	4.000	0.013	0.015	-30.962	0.005	-0.019	0.589
360	6.000	0.009	0.011	-21.768	0.005	-0.029	0.618
720	12.000	0.006	0.008	-13.650	0.005	-0.058	0.764
1440	24.000	0.003	0.004	-4.988	0.005	-0.115	0.543
2880	48.000	0.003	0.003	-2.489	0.005	-0.230	0.512

Pick largest hmax result, if too high, adjust dimensions

Check Time of Emptying: (must be less than 24hrs to half empty)

t_{s50} **= (nA_b/qP) x $\log_e$[(h_{max} +A_b/P)/(h_{max}/2 + A_b/P)]** — From Ciria C753, p558

And h_{max} at critical duration = 0.764

t_{s50} 14.286 hrs

therefore OK