NAVVY BANK PROJECT, POINT ROAD, DUNDALK, CO.LOUTH

Comhairle Contae Lú
Louth County Council

PRELIMINARY SURFACE WATER DRAINAGE PROPOSALS

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CONTENTS

1.0 DETAILS OF THE PROPOSED DEVELOPMENT

1.1 Louth County Council propose to construct a public recreational park on the site of an existing pitch and putt course at the Point Road, Dundalk. The location of the site within the general Dundalk area is shown on Fig.1.1, while an aerial view of the site and surrounding area is shown on Fig.1.2.

1.2 The facility shall offer a range of amenities including:

- family mini golf course
- children's playground
- open play area
- RV parking bays (23 bays)
- picnic area
- toilets
- mobility hub
- car parking area
- ev charging parking spaces
- bicycle parking

1.3 The development shall also provide improvements to the Point Road including new bus stop, uncontrolled pedestrian crossing point and traffic calming measures

1.4 The main vehicular and pedestrian access to the site shall off the Point Road. An additional pedestrian linkage shall be provided between the facility and the Navvy Bank walkway.

1.5 The proposed site layout is shown on Fig. 1.3

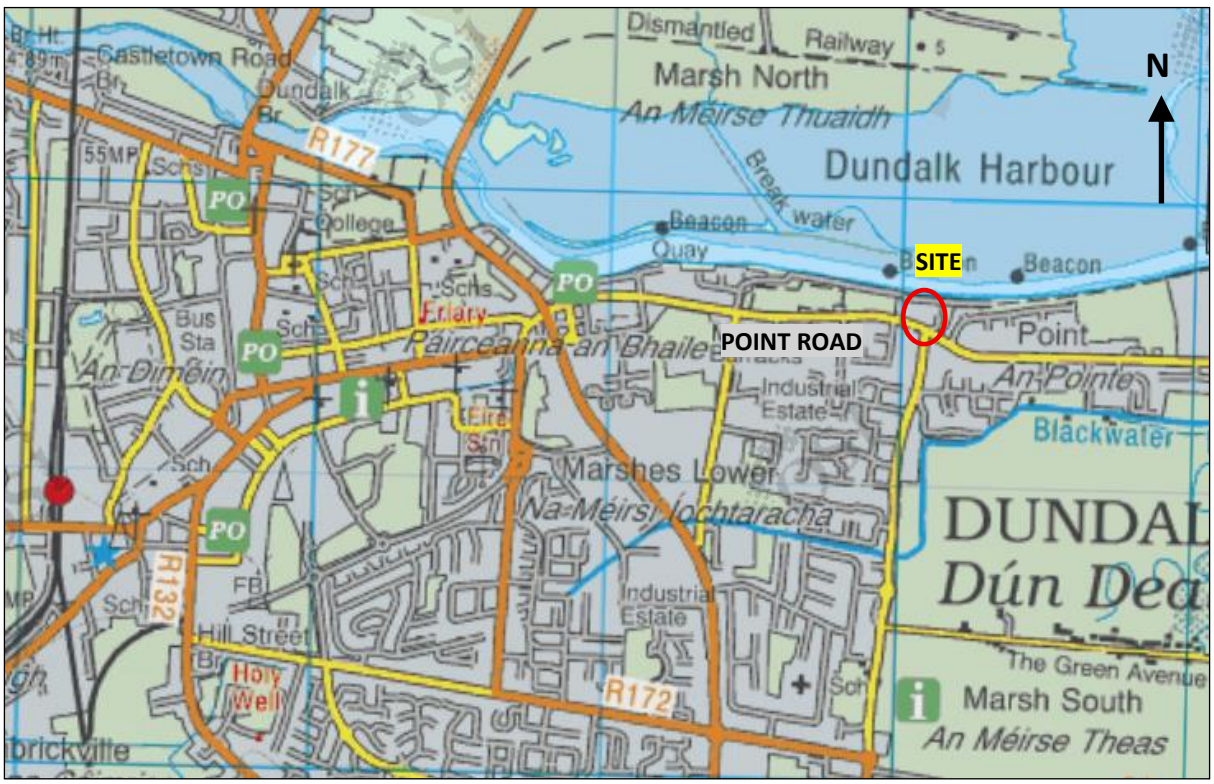


Fig.1.1 – Location Map – General

Fig.1.2 – Aerial View of Site & Surrounding Area

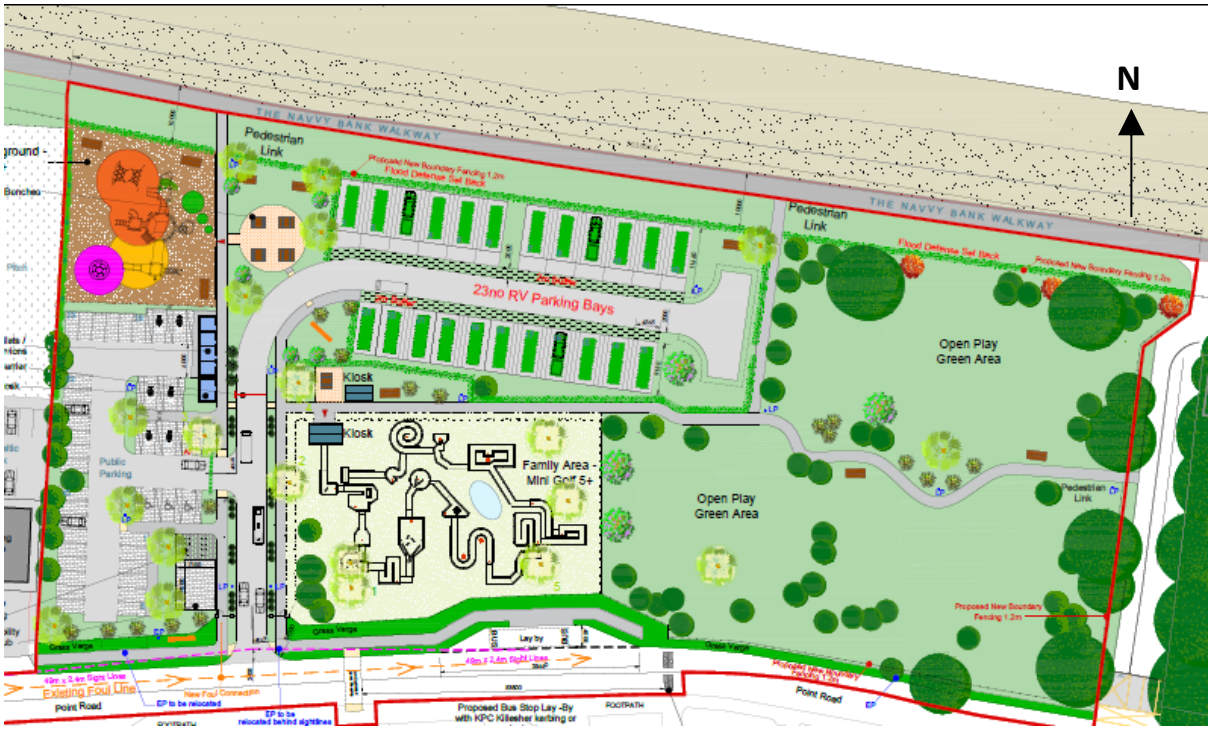


Fig.1.3 – Proposed Site Layout (Extract from Drg. No. LCC-NVY-DRG-3.0 (Rev.1)

2.0 INFILTRATION CHARACTERISTICS OF THE UNDERLYING SUB-SOIL

2.1 The infiltration characteristics of the underlying sub-soil at the site was determined by excavating a 1.8m deep trial hole within the site on 28/04/26 and carrying out an infiltration test in accordance with BRE 365. The location of the trial pit within the site is shown on Fig. 2.1

2.2 The subsoil was found to comprise of
0-0.3m Top Soil
0.3m -= 1.6m Stiff sand
1.6m – 1.8m - Loose sandy gravel

2.3 No rock was encountered within the 1.8m deep test hole. However, some infiltration of groundwater did occur at a depth of 1.6m.

2.4 The testing indicated that the underlying unsaturated layer of sub-soil has good infiltration characteristics with an estimated infiltration rate value of 3.28×10^{-5}m/s.

2.5 Full details, including calculations and photos, of the infiltration test are attached as Appendix 3.1

Fig. 3.1 – Trial Pit Location

3.5 It is proposed to apply a Factor of Safety = 1.5 to this calculated value in view of the uncertainty surrounding the determination of the infiltration co-efficient from a single test as recommended in the CIRIA SuDS Manual (Table 25.2)

3.6 The infiltration rate to be used in the design of all SUDS features is $3.28\ 10^{-5}/1.5 = 2.2 \times 10^{-5}$m/s or 80mm/hr

3.0 SURFACE WATER DRAINAGE DESIGN PROPOSAL - GENERAL OVERVIEW

3.1 It is proposed to avail of the favourable infiltration properties in the upper unsaturated layers of the sub-soil by applying a series of Nature Based Solution (NbS) that allows for surface water run-off generated within the development to discharge into the underlying sub-soil via infiltration devices as shown on Fig.3.1 and as follows:

(i) The provision of permeable surfaces to the maximum possible extent including:
- Permeable paving blocks within car park spaces
- Permeable paving (proprietary reinforced grass system) throughout the RV Parking Area
- Permeable surfacing within the play area
- Gravel surface to all walkways within the Open Play area

(ii) The provision of tree pits throughout the car park area

(iii) Creating cross falls within the carpark area to allow run-off from the circulating aisle to discharge by sheet flow across the surface into the permeable paved adjoining car park area

(iv) Provision of a shallow soakage trench to cater for run-off from the carriageway and footpaths along the main site access road

(v) Provision of a shallow detention pond within the open play / green area to cater for run-off from the mini-golf area

(vi) Collecting run-off from the roof of the toilet/services building in rain garden planter boxes

3.3 This suite of design measures represent a strong use of the upper tiers of the Hierarchy of Discharge – Nature Based Solutions (NbS) as follows:

Tier Level	***Nature Based Design Solution***	***Applied in Design***	***Design Feature***
1	Use surface water runoff as a resource	YES	Planter Boxes
2	Provide interception of rainfall	YES	Planter Boxes, Permeable paving, Tree Pits
3	infiltrate runoff to the ground	YES	Permeable paving, Tree Pits, Soakage trench Detention Basin
4	Controlled Discharge to an open surface water drainage system	NO	Not proposed
5	Controlled Discharge to a combined sewer	NO	Not proposed

3.4 Representative views of some of the recommended Nature Based Solutions are shown on Fig. 3.2 while details of the proposed cat park drainage arrangement are shown on Fig.3.3

3.4 Overall, the design proposal qualifies as an optimum 'Type A' Means of Discharge in which **all** generated surface water run-off infiltrates into the ground with no off-site discharge into a water course or piped drain/sewer.

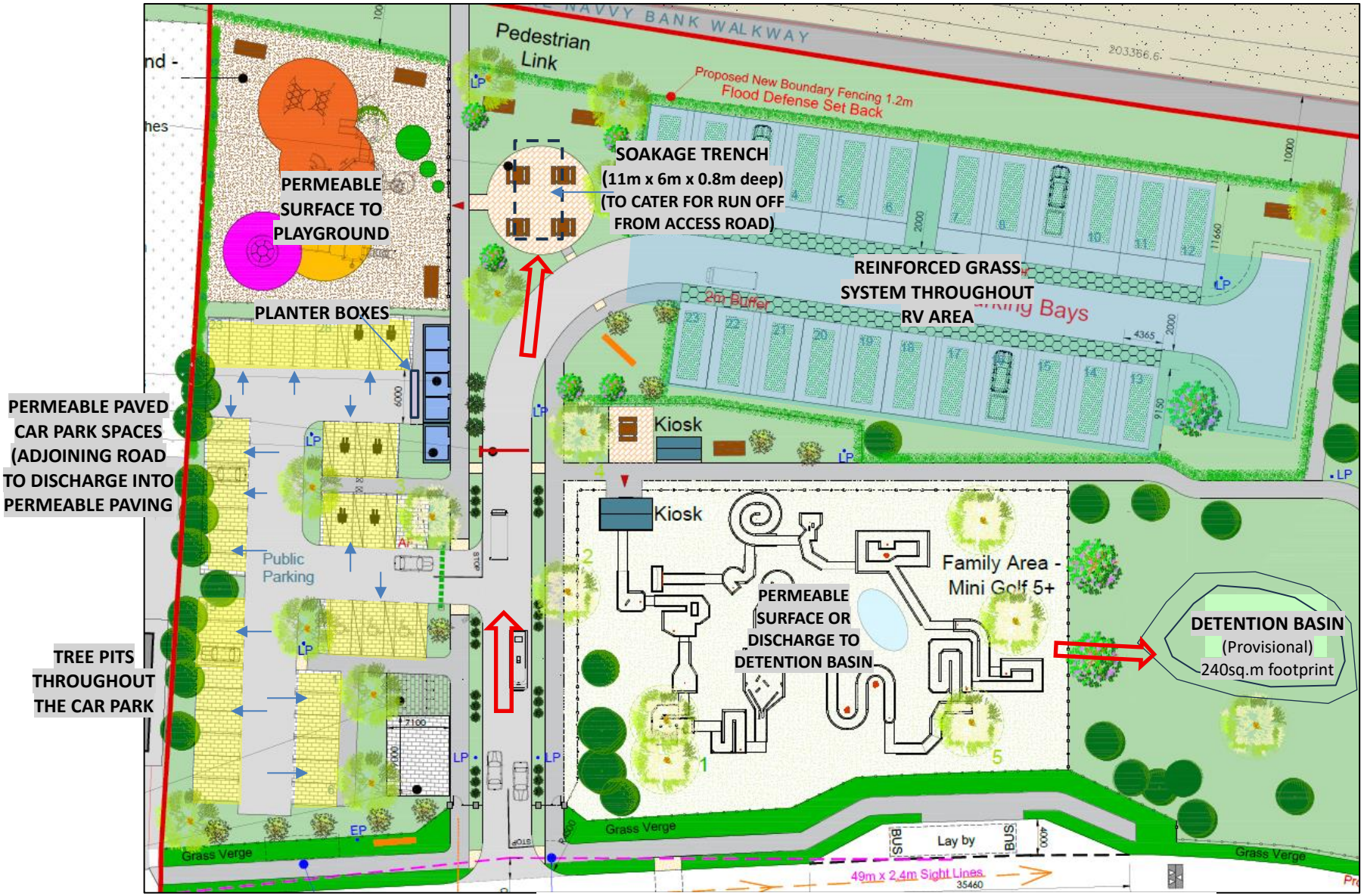


Fig.3.1 –Overview of Proposed Surface Water Drainage Design

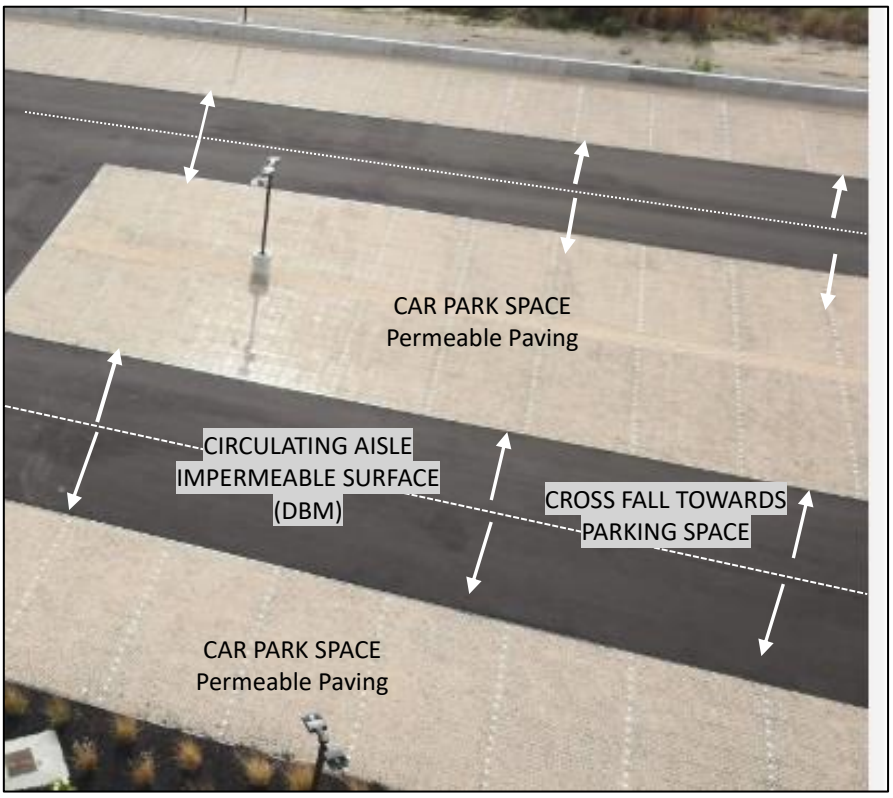
RAIN WATER PLANTER BOX
/– Toilet/Services Building

DETENTENTION BASIN
To be located in the Open Park Area for drainage of Mini-Golf Area

REINFORCED GRASS SYSTEM
RV Parking Area

TREE PIT
Car Park Area

Fig.3.2 – Representative Views of Proposed Design Features



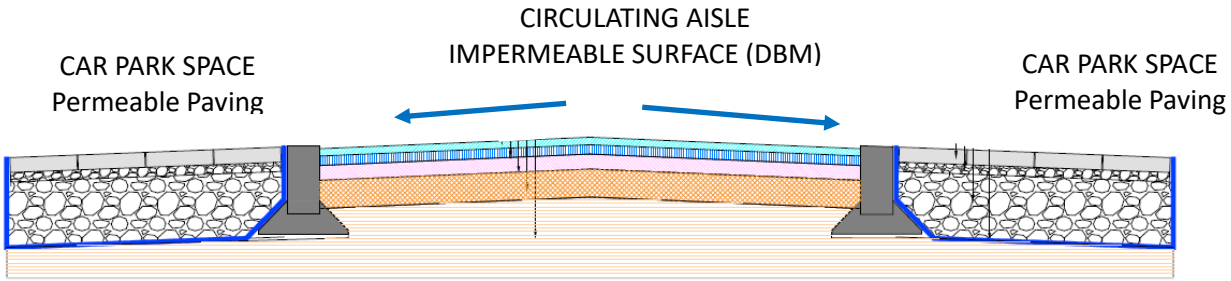


Fig.3.2 – Views of Proposed Car Park Drainage Configuration

4.0 WATER QUALITY

4.1 The CIRIA Simple Index Approach has been adopted to determine the pollution hazard level of the proposed development as 'low' with pollution loading indices of 0.6 (TSS), 0.4 (Metals) and 0.4 (hydrocarbons) as follows:

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hyrdocarbons
Residential Roofs	Very Low	0.2	0.2	0.2
Other roofs, typically commercial / industrial roofs	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (cul-de-sacs, homezones and general access roads) and non-residential car parking with infrequent change (schools, offices), < 300 traffic movements/day	Low	0.5	0.4	0.4

4.2 The proposed NbS features can offer the following mitigation indices:

NbS Feature	Mitigation Indices - Ref: CIRIA SuDs manual (C753)		
	TSS	Metals	Hydrocarbons
Tree Pits	0.8	0.8	0.8
Permeable Paving	0.7	0.6	0.7
Detention Basin	0.5	0.5	0.6

4.3 Overall, the total SuDs mitigation indices are higher than the pollution loading indices.

4.4 The preliminary design proposal can be deemed to adequately deal with pollution risk.

5.0 SOAKAGE TRENCH DESIGN – PRELIMINARY DESIGN

5.1 The use of permeable paving should be restricted to locations with a light traffic loading such as car park spaces due to the lower structural strength of this surface type. The circulating aisles within the car park and the main access road should have a standard asphaltic concrete surface (DBM)

5.2 The cross- fall profile within the car park should be designed to allow for run-off from adjoining impermeable road carriageway to also discharge into the porous paved area as shown on Fig.3.2. The resulting ratio of impermeable surface area to permeable surface area (0.6) is significantly below the accepted ratio of between 1 and 2.

5.3 It is proposed to drain the access road and footpaths using a standard SW pipe network with road gullies. It is proposed that the collected run-off discharges into a soakage trench located within the picnic area in the north-east corner of the site. The soakage trench has been designed as a shallow type (0.8m deep) to ensure that its base remains above the ground water table level (1.6m bgl)
Design Note: While the option of providing a linear bio-retention area within the grass verge being provided along each side of the Site Access Road was considered it has been ruled out at this preliminary design stage given the relatively short length of the Access Road and the high installation / maintenance costs of this system. The proposal to discharge the run-off into a shallow soakage trench is a more straightforward and acceptable solution. The options for dealing with run-off from the Access Road could be re-examined during the detailed design stage.

5.4 The communal Soakage Trench is designed based on the hydraulic design methodology set out in BRE 365. The design calculations are based on storm return periods of 1 in 100 years and include a 20% provision for the increased rainfall expected over the coming decades because of climate change. Site specific rainfall data for Dundalk has been used in the calculations. A copy of the rainfall dataset as supplied by Met Eireann is attached as Appendix 2

5.5 It is proposed to construct the Soakage Trench using a proprietary crate system (Aquacell Core Units as manufactured by Wavin Ltd or similar approved) to avail of their high void ratio (95%), high strength and simple installation. The Aquacell units shall be wrapped in a non-woven permeable geotextile designed for treatment of hydrocarbon pollution (Perafilter Geotextile PV23002 as manufactured by Polypipe or similar approved).

5.6 An inlet manhole shall be provided at the inlet of the soakage to allow access for maintenance and to provide additional storage. This manhole shall be constructed as a silt trap type to minimise the quantity of suspended solids entering the system.

5.7 The total impermeable area to be drained is 750sq.m comprising of the access road and adjoining footpaths. Provision has also been made for run-off from the roof of toilet block kiosk buildings also discharging into the SW Network

5.8 The design calculations for the communal soakage trench are summarised in Table 5.1
Full design calculations are provided in Appendix 3. It is calculated that a 11m x 6.0m x 0.8m 1.2m deep soakage trench, constructed using 252no. AquaCell Core units wrapped in a non-woven hydrocarbon treating geotextile. A schematic sketch of the proposed soakage trench is shown on Fig. 651

Parameter	*Details*
Contributing Area (sq.m)	750
Dimensions of Soakage Trench	11m x 6mx 0.8m deep
Soakage Trench Construction	264no. AquaCell Eco Units wrapped in a permeable geotextile (95% voids)
1 in 100 year storm	
Critical Storm Duration (hrs)	18
Storage Required (cu.m)	48.2
Storage Provided (cu.m)	51.9
Max. depth of stored water (m)	0.74
Time to empty 50% (hrs)	22.38

Table 5.1 -Summary of Design Calculations for the Communal Soakage Trench

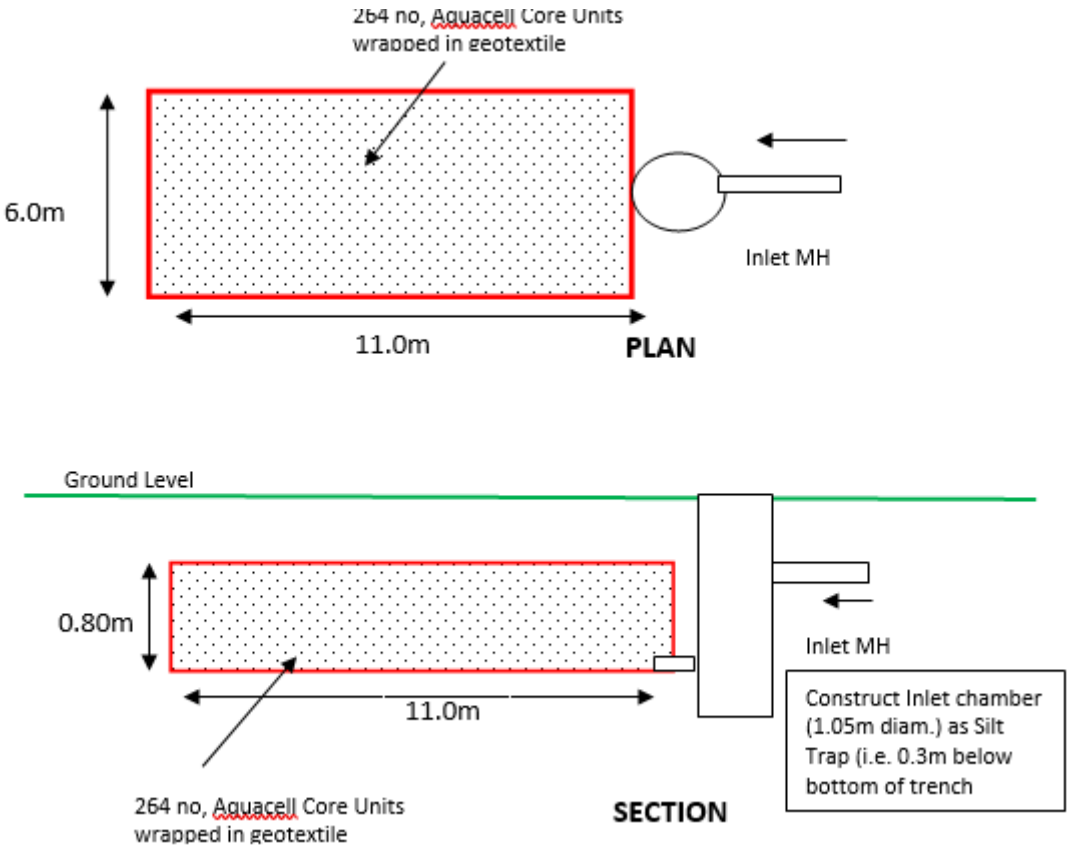


Fig. 5.1 -Proposed Soakage Trench – Schematic Sketch Only

6.0 PERMEABLE PAVING DESIGN – PRELIMINARY DESIGN

6.1 It is proposed to construct the car parking spaces and all non-trafficked surfaces using concrete block permeable paving (CBPP) to allow direct infiltration of rain falling on this spaces into the underlying sub-soil.

6.2 It is also proposed to allow run-off from the adjoing circulating aisle to discharge onto the permeable paving

Structural Design

6.3 The structural design of the permeable paving is based on the methodology set out in Section 8.0 of 'Design & Construction of Concrete Block Permeable Paving' (Interpave). The key design issues are the strength of the sub-grade (CBR value) and the traffic loading to be placed on the surface

6.4 *Sub-Grade Strength* - The trial holes excavated within the site for the soil infiltration test identified the subsoil as a 'stiff sand' or a SW classification as per the descriptors used in the table below. SW classified soils have a CBR value in the 10% - 40% range. It is considered that selection of a CBR of 5% for the sub-soil material at the site is a robust design decision.

USCS – Soil Classification	Shearing strength when compacted	Compress-ibility	Typical CBR range
GW-well graded gravels	Excellent	Negligible	30 to 80
GP-poorly graded gravels	Good	Negligible	20 to 60
GM-silty gravels	Good	Negligible	20 to 60
GC-clayey gravels	Good to fair	Very low	20 to 40
SW-well graded sands	Excellent	Negligible	10 to 40
SP-poorly graded sands	Good	Very low	10 to 40
SM-silty sands	Good	Low	10 to 40
SC-clayey sands	Good to fair	Low	5 to 20
ML-inorganic silts of low plasticity	Fair	Medium	2 to 15
CL-inorganic clays of low plasticity	Fair	Medium	2 to 5
OL-organic silts of low plasticity	Poor	Medium	2 to 5
MH-inorganic silts of high plasticity	Fair to poor	High	2 to 10
CH-inorganic clays of high plasticity	Poor	High	2 to 5

6.5 *Traffic Loading* - A Traffic Loading Category of 5 ('car park receiving occasional commercial vehicles) can be adopted for the car park space areas as per Table 4 of the Interpave design guide.

Traffic category	Standard axles per day	msa	NRSWA[1] Road Type	Typical application
11	Areas with axle loads greater than permitted by the Construction and Use Regulations are not included in this document.			
10	≤8 000	≤60	0	Adopted highways and commercial/ industrial developments used by a high number of commercial vehicles
9	≤4 000	≤30	1	
8	≤1 500	≤10	2	Ports and airport landside
7	≤350	≤2.5	3	Bus stops and bus lanes
6	≤70	≤0.5	4	Adopted highways and other roads used by a moderate number of commercial vehicles Pedestrian areas subjected to regular overrun of commercial vehicles. Industrial premises Petrol station forecourts
5	≤7	≤0.05		Pedestrian areas subjected to occasional overrun of commercial vehicles Car parks receiving occasional commercial vehicular traffic Railway platforms excluding edge
4	1	N/A		Urban footways with no planned vehicular overrun Pedestrian areas used by light commercial vehicles, emergency vehicles and maintenance vehicles
3	0			Small car parks subject to car, light van and motorcycle access
2	0			Pedestrian and cycle areas, domestic driveways
1	0			Pedestrian-only areas, including domestic applications
0	0			No requirement (decoration)

Notes:

Traffic Loading Categories – Table 4 of the 'Interpave' Design Guide

6.6 The appropriate permeable paving design of the l car park spaces from a structural perspective given the combination of a minimum CBR of 5.0 and a Traffic Loading of 5 as per Table 4 of the Interpave Design Guide is as follows:

- 80mm permeable block paving , complying with BS EN1338:2003, on
- 50mm laying course (6.3mm – 2.0mm grit) complying with BS EN 13242 on
- 70mm HRA 32 (with 50mm perforations at 300mm centres) on
- 150mm Coarse Granular Aggregate (4/20mm) complying with BS EN 13242 , on
- Non-woven permeable geotextile (Permafilter Geotextile (PV23002 as manufactured by Polypipe or similar approved non-woven geotextile designed for hydrocarbon pollution)

Traffic category	Concrete paving units – minimum thickness	Laying course – nominal thickness	Base – HBCGA or AC	Sub-base – CGA or Type 3	Design basis
11		Areas with axle loads greater than permitted by the Road Vehicles (Construction and Use) Regulations (1986) as amended are not included in this document			
10		Site specific using Interpave guide for heavy duty pavements (Knapton, 2008)			Knapton (2008)
9		Site specific using Interpave guide for heavy duty pavements (Knapton, 2008)			Knapton (2008)
8	80 mm	50 mm	300 mm HBCGA or 220 mm AC32	150 mm	ICPI Permeable Design Pro
7	80 mm	50 mm	200 mm HBCGA or 130 mm AC32	150 mm	
6	80 mm	50 mm	125 mm HBCGA or 90 mm AC32	150 mm	
5	80 mm	50 mm	100 mm HBCGA or 70 mm AC32	150 mm	
4	80 mm	50 mm	--	300 mm	Knapton et al (2012) and ICPI Permeable Design Pro
3	60 mm	50 mm	--	225 mm	
2	60 mm	50 mm	--	150 mm	
1	60 mm	50 mm	--	100 mm	
0	60 mm	50 mm		Sufficient to provide suitable construction base	

Car Park Spaces

Table 5: Typical construction thickness over subgrade with 5% CBR or greater.

Hydraulic Design of the Permeable Paved Areas.

6.7 It is necessary to determine whether the depth of storage available within the 150mm deep layer of coarse granular aggregate is sufficient from a hydraulic design perspective.

6.8 Each car park spaces (12.5sq.m) shall also cater for run-off from an area of the adjoining road carriageway (7.5sq.m). On this basis each 12.5sq,m of permeable paving caters for run-off from 20sq.m.

6.9 It has been determined that the sub-soil has a design infiltration rate of 2.2×10^{-5}m/s. On this basis run-off shall infiltrate through the base of each car park space at a rate of $0.99m^3$/hr (2.2×10^{-5} m/s x 3600 x $12.5m^2$)

6.10 Run-off shall discharge immediately through the base of the permeable paved areas once the discharge rate is less than $0.99m^3$/hr. Run-off shall be stored within the 35% voids provided within the coarse aggregate in cases where the quantum of run-off exceeds the discharge rate of $0.99m^3$/hr through the base of the driveway.

6.11 Calculations determining the storage required under a range of rainfall events based on a 1 in 100 year rainfall return period and a further 20% allowance for climate change would be as follows:

Storm Duration	***Rainfall 1 in 100 year[1] (mm)***	***Rainfall + 20%***	***Contrib. Area (sq.m)***	***Total Vol of Rainfall (cu.m)***	***Rate of Discharge into underlying sub-soil ($0.99 m^3$/hr)***	***Storage Required Cu.m***	***Depth of Stone to provide required storage (m)***
15 mins	20.3	24.4	20	0.49	0.25	0.24	0.05
30 mins	25.1	30.1	20	0.64	0.50	0.14	0.03
1 hour	31.0	37.2	20	0.74	0.99	-0.25	0.0
2 hour	38.3	46.0	20	0.92	1.98	-1.06	0.0
3 hour	43.4	52.1	20	1.04	2.97	-1.93	0.0
4 hour	47.4	56.9	20	1.14	3.96	-2.82	0.0

6.12 The calculations show that storage shall be required only during short rainfall events less than 30 minutes in duration with a maximum storage requirement of $0.24m^3$ during a 15 minute storm.
This equates to a stored water depth of 0.031m or 35mm as follows:
Depth of water stored (m) = $0.24m^3/(12.5m^2 \times 0.35)$ = 0.05m (50mm)

6.13 It is a standard design provision to have a 100mm fereboard above the TWL of stored water and the top of the sub-base. The required depth of sub-base from a hydraulic design perspective is therefore 50mm + 100mm = 150mm.

6.14 This depth equates to the 150mm depth of coarse aggregate sub-base required under the pavement strength design criterion. It is therefore <u>not necessary</u> to increase the depth of porous sub-base above 150mmmm to ensure sufficient attenuation storage is provided in the stone

6.15 The half empty time for the stored water shall be $(0.24m^3)(0.5)/(0.99m^2/hr)$ = 0.12hours. This is significantly less than the design theshold of 24 hours and therefore acceptable

6.16 The preliminary design construction details for the permeable car park spaces, that meets both structural and hydraulic criteriion, is as follows:

- 80mm permeable block paving , complying with BS EN1338:2003, on
- 50mm laying course (6.3mm – 2.0mm grit) complying with BS EN 13242 on
- 70mm HRA 32 (with 50mm perforations at 300mm centres) on
- 150mm Coarse Granular Aggregate (4/20mm) complying with BS EN 13242, on
- Non-woven permeable geotextile (Permafilter Geotextile (PV23002 as manufactured by Polypipe or similar approved non-woven geotextile designed for hydrocarbon pollution)

7.0 DETENTION BASIN – PRELIMINARY DESIGN

7.1 The optimum design solution would be to construct the Mini-Golf area (1,800sq.m) with a permeable surface type to allow direct infiltration of rain into the underlying sub-soil.

7.2 In the event that a permeable surface is not feasible then run-off from the Mini-Golf area should be collected within a SW Drainage network and discharged into a shallow detention basin constructed within the Open Play Area to the east of the Mini-Golf Area

7.3 It is considered that a shallow detention basin with a footprint of c. 240sq.m can be easily accommodated within the open space area of the site

7.4 It is proposed that the detention basin should be sized to be capable of dealing with 1 in 100 year rainfall events with a further 20% added to current rainfall data to allow for climate change.

7.5 The infiltration rate through the 240sq.m base of the detention basin shall, based on the design infiltration rate of 2.22×10^{-5}m/s, be 5.3×10^{-3} cu.m/s or 19.0 cu.m/hr

7.6 Calculations showing the volume of water to be storage and associated water depth for a range of storm durations is set out in Table 7.1. Calculations show that the critical storm duration is 1 hour during which storage of 48.0m^3 would be required within the detention basin equating to a water depth of 0.20m or 200mm given the 240m^2 plan area of the basin. Such a depth is considered acceptable and would not pose a health and safety threat especially as it occurs during a 1 in 100 year rainfall event with persons very unlikely to be accessing the open space area in such conditions.

7.7 It would take circa 2.53 hours (48.0m^3 /19.0 m^3/hr) for this amount of stored water to fully infiltrate into the ground following the end of the storm. This period is less that the allowed 24 hours to have empty a soak-pit under the BRE 365 design criteria

7.8 In summary, the volume of water retained shall therefore be small (max. depth of 200mm) and for a short period only (total duration of 2.53 hours). The selection of a base area of 240sq,m for the Detention Basin is an acceptable preliminary design

Rainfall Data for Point Road, Dundalk,Co. Louth			Impermeable Area	Flow In	Flow Out Based on infiltration rate of 19.0 cu.m/hr or 0.317cu.m/min	Storage Required	Depth of Stored Water Required (240sq.m)
	Rainfall (1 in 100 years)			Volume		m^3	m
Duration (D)	Current	With 20% for climate change (R)	A	(I = R x A/1000)	(O = D x 0.39)	(S= I - O)	H = S/80
	(mm)	(mm)	(m^2)	(m^3)	(m^3)	(m^3)	(m)
15 min	20.3	24.4	1800	43.9	4.7	39.2	0.16
30 min	25.1	30.1	1800	54.2	9.5	44.7	0.19
60 min	31.0	37.2	1800	67.0	19.0	48.0	0.20
120 min	38.3	46.0	1800	82.8	38.0	44.8	0.19
180 min	43.4	52.1	1800	93.8	57.0	36.8	0.15
240 min	47.4	56.9	1800	102.4	76.0	26.4	0.11
360 min	55.5	66.6	1800	119.9	114.0	5.9	0.02
540 min	60.8	73.0	1800	131.4	171.0	-39.6	-

Table 7.1 - Calculation of Storage Required in Detention Basin

8.0 SUMMARY

8.1 An infiltration test carried out at the site identifies the upper unsaturated layers (< 1.6m below ground level) of the underlying sub-soil as having a good design infiltration rate of 2.2×10^{-5} m/s.

8.2 It is proposed to avail of the favourable infiltration properties in the upper unsaturated layers of the sub-soil by applying a series of Nature Based Solution (NbS) that allows for surface water run-off generated within the development to discharge into the underlying sub-soil via infiltration devices as shown on Fig.3.1 and as follows:

(i) The provision of permeable surfaces to the maximum possible extent including:
- Permeable paving blocks within car park spaces
- Permeable paving (proprietary reinforced grass system) throughout the RV Parking Area
- Permeable surfacing within the play area
- Gravel surface to all walkways within the Open Play area

(ii) The provision of tree pits throughout the car park area

(iii) Creating cross falls within the carpark area to allow run-off from the circulating aisle to discharge by sheet flow across the surface into the permeable paved adjoining car park area

(iv) Provision of a shallow soakage trench to cater for run-off from the carriageway and footpaths along the main site access road

(v) Provision of a shallow detention pond within the open play / green area to cater for run-off from the mini-golf area

(vi) Collecting run-off from the roof of the toilet/services building in rain garden planter boxes

8.3 Preliminary design details for the key features being provided are as follows

Feature	***Function***	***Design Details***
Soakage Trench	Drainage of Access Road & Roof of Toilet Block/Kiosk building	Required Storage Capacity = 48cu.m Dimension: 11m x 6m x 0.8m Construction Detail: Aquacell Core Units (264no.) wrapped in a permeable geotextile
Permeable Paving	Drainage of Car Park area	80mm permeable block paving , on 50mm laying course on 70mm HRA 32 (perforated), on 150mm Sub-Base (CGA),on Non-woven permeable geotextile
Detention Basin	Drainage of Mini-Golf Facility	Required Storage Capacity = 48cu.m Footprint of Basin: 240sqm Max. Depth of Stored Water : 0.20m

8.4 This suite of design measures represents a strong use of the upper tiers of the Hierarchy of Discharge – Nature Based Solutions (NbS) as follows:

Tier Level	***Nature Based Design Solution***	***Applied in Design***	***Design Feature***
1	Use surface water runoff as a resource	YES	Planter Boxes
2	Provide interception of rainfall	YES	Planter Boxes, Permeable paving, Tree Pits
3	infiltrate runoff to the ground	YES	Permeable paving, Tree Pits Soakage trench Detention Basin
4	Controlled Discharge to an open surface water drainage system	NO	Not proposed
5	Controlled Discharge to a combined sewer	NO	Not proposed

8.5 The preliminary design proposal can be deemed to adequately deal with pollution risk as the total SuDs mitigation indices are higher than the pollution loading indices.

8.6 Overall, the preliminary design demonstrates the feasibility of providing a surface water drainage system for the development in which **all** generated surface water run-off is dealt with through a mix of source and site treatment measures without the need to progress to the less desirable 'down site' or 'regional treatment' stages of the SUDS Management Train

8.7. The preliminary design concepts and design calculations contained in this report can be developed and refined further during the detailed design stage.

Eamonn Mc Mahon

Eamonn Mc Mahon.
B.E., M.Eng Sc,
Chartered Engineer
10/05/26

APPENDIX 1 – INFILTRATION TEST DETAILS & RESULTS

BRE INFILTRATION TESTS AT POINT ROAD, DUNDALK, CO.LOUTH

Date: 28/04/26

Client: Louth Co Co

Test Carried Out by: P Herr & Associates

Test Hole Location: south west corner of Site - to east of Pitch & Putt Store

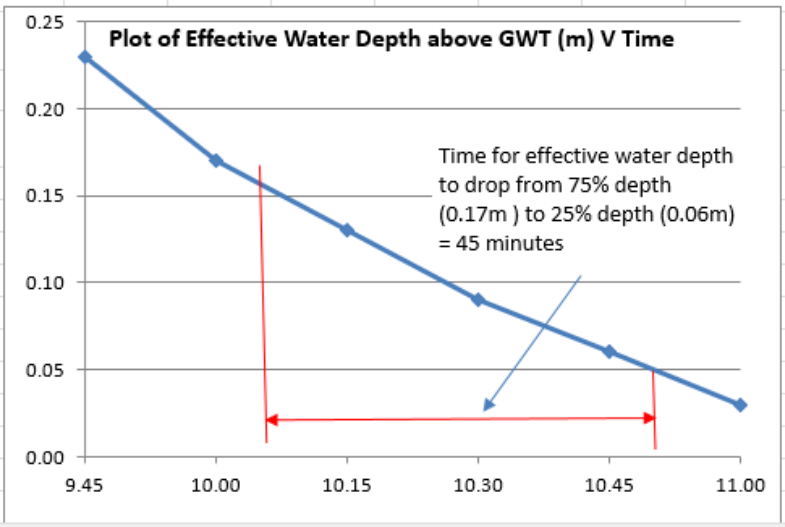
Dimensions of Test Hole: 2.3m x 1.2m x 1.8m deep

Description of sub-soil: stiff sand with loose snadt gravel below 1.6m

Depth to water Table: Infiltration of Goundwater at 1.6 depth (0.18 depth in test hole)

Depth to Rock: No rock encountered

Time	Effective Depth above GWT(m) Measured Depth minus 0.18m	Actual Depth of Water (m) as measured
9.45	0.23	0.41
10.00	0.17	0.35
10.15	0.13	0.31
10.30	0.09	0.27
10.45	0.06	0.24
11.00	0.03	0.21



	TEST HOLE *(Soakpit)*
Length of Test Hole (m)	2.3
Width of Test Hole (m)	1.15
100% depth water (m)	0.23
75% depth (m)	0.17
25% depth (m)	0.06
Time to drop 75% to 25% (mins)	45
Depth of water infiltrated during test period	0.115
Vol of water infiltrated during test period (m3)	0.304175
Surface Area through which water infiltrates during test period (m2)	3.4385
Soil Infiltration Rate (m/min)	0.00197
Soil Infiltration Rate (m/sec)	3.276E-05

INFILTRATION TEST - PHOTOS

APPENDIX 2 – SOAKAGE TRENCH – PRELIMINARY DESIGN CALCULATIONS

P. HERR & ASSOCIATES
CIVIL ENGINEERS & BUILDING SURVEYORS

Proposed Recreational/Amenity Facility at Point Road, Dundalk, Co.Louth
Louth Co. Co.

SOAKAGE TRENCH DESIGN

Design Proposal

Discharge all run-off from the Access Road, adjoing footpaths and roof of the Toiley Block and Kiosk Buildings into a soakagge trench located within the picnic area in the north west corner of the site.
Total contributing area = 800sq.m
Soakage trench to be designed so that requiredf storage 1 in 100 year rainfall events with 20% allowance for climate change
Soakage Trench to be > 5m from a building and 3m from a boundary

Calculations for Storms with a Return Period (Years) of 100 PLUS 20% to allow for climate change

The fundamental design formula used in BRE 365 is **S = I - O**, where

S = Storage required in soakaway
I = Inflow from impermeable area draining into soakaways during storm duration
O = Outflow infiltration from soakaway into soil during storm duration
$O = a_{as0} \times f \times D$, where
as50 = Internal surface area of soakaway to 50% effective depth (excluding base)
f = Soil infiltration rate
D = Storm duration

Details of Proposed Soakage Trench

Use 11.0m long x 6.0m wide x 0.80m deep soakage trench using Aquacell Corte Units wrapped in permeable geotextile

Trench Length =	11.00	(m)
Trench Width =	6.00	(m)
Trench Depth =	0.80	(m)

Contributing Impermeable Area (m^2)		
Roof Area (m^2)	Paved Area (m^2)	Total (m^2)
100	650	750

Volume of Trench =	52.8	(m^3)
Voids Ratio =	95%	(%)
Storage in Trench =	50.16	(m^3)
Diam. Inlet Chamber =	1.050	(m)
Depth Inlet Chamber	1.00	
Storage in Chamber=	0.87	(m^3)
No. of Chamber =	2	(m^3)
Total Storage in chambers =	1.73	
Total storage in Trench & Chan	51.89	(m^3)

Soil Infiltration Rates

An infiltration test carried out on 28/04/26 by P Herr & Associates. The test results determined that an infiltration rate of 3.28 x 10-5m/s applies. It is proposed to apply a 1.5 Factor of Safety to this value in line with good practice and to ensure a design i.e. a design infiltration rate of 2.2 x 10-5m/s. No rock was encountered in the 1.8m test hole. However groundwater was struck at 1.6m depth. The soakage trench shall be designed as a 'shallow' type (0.8m deep) to remain within the unsaturated layers of the subsoil
It is proposed to construct the soakage trench using a propieritary crate system (Aqua-cell Units or similar) to avail of the high void ration they provide (95%)

Depth to TWL of Water Table (m)	Infiltration Rate (f) mm/minute	Infiltration Rate (f) m/s
1.6	1.3200	0.000022

Internal Surface Area of each Soakaway Trench to 50% Effective Depth (Excluding Base) A_{sso}

A_{sso} per Trench (m^2)	No. of Soakage Trenches	Total Internal Surface Area (a_{sso}) (m^2)
13.60	1	13.60

A 1.05m diam. manhole shall be constructed at the inlet into the soakage trench as act as a silt trap, provide access/maintenance purposes and to provide additional storage.
The soakage trench shall be constructed using 264no. Aquacell Core units wrapped in permeable geotextile

Calculation of Storage Required in Soakage Trench

Met. Eireann Rainfall Data for Point Road, Dundalk, Co. Louth					Inflow	Outflow	Storage
Duration	Return Period (Years)	ADD 20% to Allow for Climate Change	Duration	Impermeable Area	Volume (I)	Volume (O) f x a_{sso} x D	Required (S = I - O)
	100						
minutes	rainfall-mm	rainfall-mm	(minutes)	(m^2)	(m^3)	(m^3)	(m^3)
30 min	25.1	30.12	30	750	22.59	0.54	22.05
60 min	31.0	37.2	60	750.0	27.90	1.08	26.82
2 hours	38.3	46.0	120	750.0	34.47	2.15	32.32
3 hours	43.4	52.1	180	750.0	39.06	3.23	35.83
4 hours	47.4	56.9	240	750.0	42.66	4.31	38.35
6 hours	53.7	64.4	360	750.0	48.33	6.46	41.87
9 hours	60.7	72.8	540	750.0	54.63	9.69	44.94
12 hours	66.3	79.6	720	750.0	59.67	12.93	46.74
18 hours	75.1	90.1	1080	750.0	67.59	19.39	48.20
24 hours	82.0	98.4	1440	750.0	73.80	25.85	47.95

Rainfall data attached as Appendix 2

Maximum Storage Required = 48.20 m^3 Duration = 18 hour

Minimum Spare Capaciy in Soakaway = 3.69 m^3 Duration = 18 hour

Maximum Storage required = 48.20 m^3
Spare Capacity in Trench = 3.69 m^3
Storage provided in Trench = 51.89 m^3

Time to empty 50% of max storage

t secs = $\frac{(s)(0.5)}{(a_{sso})(f)}$ = 80551.20

t hours = 22.38 **22.38 < 24 OK**

Will take 22.38 hours for soakage trench to empty by 50% after being filled to max. depth

APPENDIX 3 – RAINFALL DATA FOR POINT ROAD, DUNDALK, CO.LOUTH

Met Éireann

Return Period Rainfall Depths

Coordinates: 54.006925, -6.370300

Duration	0.5 yrs	1 yrs	2 yrs	3 yrs	4 yrs	5 yrs	10 yrs	20 yrs	30 yrs	50 yrs	75 yrs	100 yrs	120 yrs
15 mins	4.3	5.9	6.7	7.9	8.7	9.4	11.4	13.6	15.1	17.1	18.9	20.3	21.2
30 mins	5.7	7.7	8.7	10.2	11.2	12	14.4	17.1	18.9	21.3	23.4	25.1	26.2
1 hour	7.5	10	11.3	13.1	14.3	15.3	18.3	21.5	23.7	26.6	29.1	31	32.3
2 hours	9.9	13	14.6	16.9	18.4	19.5	23.2	27.1	29.6	33.1	36.1	38.3	39.8
3 hours	11.6	15.2	17	19.6	21.3	22.5	26.6	31	33.8	37.6	40.9	43.4	45.1
4 hours	13.1	17	18.9	21.7	23.6	25	29.4	34.1	37.1	41.2	44.7	47.4	49.2
6 hours	15.4	19.8	22	25.2	27.3	28.8	33.7	39	42.3	46.8	50.7	53.7	55.6
9 hours	18.1	23.2	25.7	29.2	31.5	33.3	38.7	44.6	48.3	53.2	57.5	60.7	62.9
12 hours	20.3	25.9	28.6	32.5	35	36.8	42.7	49	53	58.3	62.9	66.3	68.6
18 hours	24	30.2	33.3	37.6	40.4	42.5	49.1	56.1	60.4	66.3	71.3	75.1	77.6
24 hours	26.9	33.8	37.1	41.8	44.8	47.1	54.2	61.7	66.3	72.6	78	82	84.7
2 days	33.3	41.2	44.9	50.3	53.7	56.2	64.1	72.4	77.5	84.4	90.2	94.6	97.4

APPENDIX 4– AQUACELL CORE UNITS – DATA SHEET

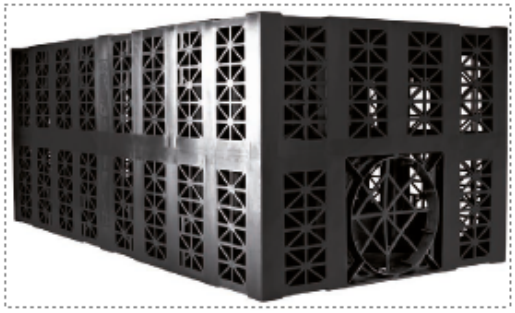
AquaCell Core-R

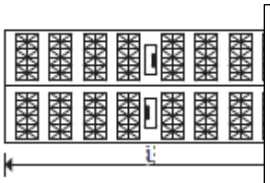
Application

AquaCell Core-R has been designed for use in deep applications, subject to regular and heavy traffic loadings, e.g. cars and HGV's. AquaCell Core-R can also be used for deep soakaways and landscaped applications.

Typically for use down to depths of 6.68m in landscaped areas (6.43m trafficked by cars) to the base of the units from ground level, in best soil conditions.

Trafficking by heavy construction plant on site, including mechanical equipment, must be avoided until the minimum cover depth of 1.11 metres is in place.





Nominal size (mm)	Part number
160	6LB150

Features and benefits

- Suitable for regular and heavy traffic loadings
- Proven vertical loading capacity of: 66.9 tonnes/m² (669 kN/m²)
- Proven lateral loading capacity of: 12.3 tonnes/m² (123kN/m²)
- BBA approved – Certificate No 03/4018
- Ideal for all types of shallow and deep projects including major attenuation and infiltration schemes

Typical minimum cover depths and maximum installation dept

Location type	Minimum cover depth	
	AquaCell Eco	AquaCell Core-R
Landscaped/non-trafficked areas[2]	0.30	0.30
Car parks, vehicle mass up to 9 tonnes[1]	n/a	0.60
HA/HGV loading up to 60 tonnes	n/a	1.11
	Maximum installation de	
Maximum depth to base of unit (Landscaped)	2.68	6.68
Maximum depth to base of unit – vehicle mass up to 9 tonnes	n/a	6.43

Maximum installation depths – to base of units (m)[1]

Typical soil type	Soil weight kN/m³	Angle of internal friction φ (degrees)[2,3]	Landscaped areas	Vehicle mass <9 tonnes[4,5]	Vehicle mass <44 tonnes
Over-consolidated stiff clay	20	24	3.85	3.61	3.36
Silty sandy clay	19	26	4.35	4.09	3.83
Loose sand and gravel	18	30	5.34	5.06	4.78
Medium dense sand and gravel	19	34	5.94	5.68	5.41
Dense sand and gravel	20	38	6.68	6.43	6.18

(1) Without groundwater present below base of units – AquaCell Core-R may be used where groundwater is present, contact Wavin for technical advice.
(2) Loosening of dense sand or softening of clay by water can occur during installation. The designer should allow for any such likely effects when choosing an appropriate value of φ.
(3) The design is very sensitive to small changes in the assumed value of φ, therefore, it should be confirmed by a chartered geotechnical engineer. In clay soils, it may be possible to utilise cohesion in some cases.
(4) Applicable for car parks or other areas trafficked only by cars or occasional refuse collection trucks or similar vehicles (typically one per week).
(5) This category should be used when considering landscaped areas that may be trafficked by ride on mowers.

Assumptions made:
- Ground surface is horizontal
- Shear planes or other weaknesses are not present within the structure of the soil

Source: BBA