



Permeable Paving Design

GARVOCK FILLING STATION

Location Address:	Garvock filling Station, 86 Halbeath Road Dunfermline
Designed:	Geoman Ltd.
Date:	14/06/2023
Design Reference Number/Version:	22-6083-F1
Type of Design:	Attenuation Permeable Paving Design
 Tobermore Sales Executive Contact:	Kevin MacPherson

Technical Support and Back Up

If you have any questions relating to this design, please contact the people listed below:

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1.0 Introduction

It is proposed to install Tobermore Hydropave permeable paving as the surfacing to a car parking area at the proposed Garvock filling station in Dunfermline as indicated on Geoman drawing number SK22-6083-F1-01.

The permeable sub-base of the Hydropave area will provide sufficient storage for rainfall events of up to 1 in 100-year storms plus an additional 40% allowance for climate change. The catchment is to include some surrounding hardstanding as indicated on SK22-6083-F1-01.

It is proposed to install an impermeable 2000 gauge membrane at formation level to discharge the sub-base drainage into the storm water system. All outlet details/ flow controls are to be confirmed/ designed by the Client's Consulting Engineer.

2.0 Scope

The scope of this element design includes the build-up of the Hydropave permeable paving system, from the formation level on the sub-base to the Hydropave surfacing blocks. This design is based on the following information as provided by the client;

- I. Traffic Loading for Hydropave Areas – For the Hydropave areas, it is assumed they will need to accommodate Loading Category 5 (Light vehicles and occasional commercial vehicular traffic only) as defined by the Interpave Guidelines Edition 7 -Dec 2018. Please advise if a more onerous loading is to be considered.
- II. Subgrade CBR – Assumed to be a minimum of 5%. Refer to Section 3.0.
- III. Design Hydropave area, catchment area and allowable outlet discharge rate – These values are reported in Section 5.1 .

Outlet details are to be confirmed by the Client's Consulting Engineer. The Client must review and advise if changes to the catchment and permeable paving areas are required.

Any solution outside this scope is not covered by this design and Geoman Ltd. should be informed so that a new design can be advised if necessary.

2.1 Permeable Paving Summary

Category Type:	Category 5 car parking aisle and access roads
Paving Block:	Tobermore Hydropave 240 (240x120x80mm deep)
Laying Course:	50mm thickness of 6.3-2mm grit to BS EN13242:2002
Asphalt Concrete:	Not required for loading category 5
Coarse Graded Aggregate:	Minimum 350mm thick
Strengthening Geogrid:	Geoman Strengthening Geogrid Type A
Impermeable membrane:	2000 gauge liner laid at formation.
Capping	See Section 3.0
Drawing Number(s):	SK22-6083-F1-01

2.2 Tobermore Hydropave Product to be used on Scheme

Product Name:	Tobermore Hydropave 240
Size:	240x120x80mm deep
Color:	TBC
Finish:	Standard
Strength:	> 3.6MPa or 250 N/m



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Manufactured to:	BS EN 1338:2003
Installed to:	BS EN 7533-3:2005
Laying pattern:	Herringbone

2.3 Information

This design is based on the following information provided by the Client;

Drawings:

- AMCA Drawing numbers:
 - 3891_PL_007_G_PROPOSED SITE PLAN
 - 3891_PL_012_D_PROPOSED SITE LEVELS
 - 3891_PL_030_D_PROPOSED SURFACING AREAS

Ground Information:

- No formal ground report has been provided. AMCA Architects have advised that the site consists of shallow depths of MADE GROUND overlying impermeable CLAY.

2.4 Responsible Parties

AMCA Architects is our Client and the Principal Designer

Tobermore is the block manufacturer.

The Principal Contractor should be confirmed in accordance with CDM 2015.

The above parties should all read and check this design document before proceeding. Please advise us before proceeding with construction if there are any errors in the scope.



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3.0 CBR for Pavement Design

Sub-grade preparation is to be carried out in accordance with the Specification for Highway Works Series 600. Remove all soft spots and fill with suitable replacement material before compaction.

No ground information or CBR testing at formation level has been provided. This design assumes a minimum 5% CBR value will be present at formation level of the Hydropave sub-base. Testing must be carried out to confirm this prior to construction and if the CBR is lower than 5% then Geoman should be contacted to revise the design.

To achieve the loading requirements Geoman strengthening geogrid Type A must be provided above the impermeable liner at formation to provide reinforcement of the sub-base. This design is not valid if this geogrid is not installed.

4.0 Site Levels

The paved Hydropave surface should have no slopes steeper than 1:20 to ensure that water can infiltrate through the joints. It is assumed that any fall greater than 1:20 will run off in to an area with a max 1:20 fall and infiltrate in to the permeable subbase.

The minimum sub-base depths specified in this design are the minimum depths required on the lowest part of the site for storage. The sub-base formation level must remain virtually flat (no steeper than 1V:100H) towards the outlet to ensure there is no loss of storage due to a sloping site.

5.0 Hydraulic Design

The thickness of a permeable pavement's coarse graded aggregate has to be calculated on the basis of the need to water storage and structural requirements. In this section, the thickness calculation based on the storage of water is set out. Data is taken from the Flood Estimation Handbook Web Service.

This preliminary design considers a 1 in 100-year storm, plus 40% to account for climate change.

Table 01: Rainfalls for 1 in 100 Year Storm

Return Period:	Storm Duration									
	Minutes					Hours				
100	5	10	15	30	60	2	4	6	10	24
Rainfall (mm)	7.56	11.17	13.72	18.52	25.02	32.51	42.53	48.46	56.79	75.10
x CC Factor	10.59	15.63	19.21	25.92	35.03	45.52	59.54	67.84	79.50	105.14



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5.1 Site Analysis

Hydraulic calculations have been carried out for the Hydropave area based on a minimum 350mm thick sub-base. A summary of the calculation inputs are listed below:

Total area of Tobermore Hydropave in the car park is approximately 805m².

Total Catchment Area approximately 873m² (includes Hydropave area and some surrounding hardstanding areas as indicated on SK22-6083-F1-01)

The proposed formation level CBR will be at least 5%. This should be confirmed via in-situ testing prior to construction. If lower values are recorded this design will need to be reviewed.

Allowable discharge rate from the permeable sub-base taken as 2.499l/s (as advised by AMCA Architects).

Please check these areas and the allowable discharge rate adopted are acceptable.

The following table indicates the Factors of Safety for the proposed Hydropave system for storm durations up to 24 hours. The void ratio of the coarse graded aggregate was assumed to be 0.32, with the minimum depth of the CGA for water storage to be 350mm under the Hydropave blocks and impermeable spaces.

Storm Duration	Depth of rainfall (mm) 100 year storm	Volume entering Hydropave (m ³)	Outflow to Storm Sewer (m ³)	Infiltration to Subgrade (m ³)	Storage Required (m ³)	Storage Capacity (m ³)	Factor of Safety
5 minutes	10.59	9.24	0.75	0.00	8.49	90.16	10.62
10 minutes	15.63	13.65	1.50	0.00	12.15	90.16	7.42
15 minutes	19.21	16.77	2.25	0.00	14.52	90.16	6.21
30 minutes	25.92	22.63	4.50	0.00	18.13	90.16	4.97
1 hour	35.03	30.58	9.00	0.00	21.58	90.16	4.18
2 hours	45.52	39.74	17.99	0.00	21.74	90.16	4.15
4 hours	59.54	51.98	35.99	0.00	16.00	90.16	5.64
6 hours	67.84	59.23	53.98	0.00	5.25	90.16	17.18
10 hours	79.50	69.41	89.96	0.00	-20.56	90.16	N/A
24 hours	105.14	91.78	215.91	0.00	-124.13	90.16	N/A

The critical storm duration therefore 2 hours.



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6.0 Structural Design & Summary

For the Hydropave areas, it is assumed they will need to accommodate loading as per Loading Category 5 (light vehicles and occasional commercial vehicular traffic only) as defined by the Interpave Guidelines Edition 7 - Dec 2018. Please advise if a more onerous loading is to be considered.

A layer of Geoman Strengthening Geogrid Type A must be laid on the impermeable liner at proposed subgrade level with a minimum CBR of 5%. If this is not installed this design is not valid. The actual subgrade CBR value must be confirmed via in-situ testing prior to construction. Should the ground conditions be more onerous than assumed for the purposes of this design, the design will need to be revised.

Kerb haunching must extend a minimum of 150mm below the base of the kerb to provide a firmly restrained pavement.

If any discrepancy is noted between the site conditions and the design assumptions (regarding CBRs, water levels, soil conditions, proposed loadings etc.), the Contractor/Engineer must contact Geoman Ltd. immediately to facilitate a review of the preliminary design.

This design and associated drawings have been produced using the methodology detailed above. However, it should be noted that the design proposal has been generated from information provided to Geoman Ltd, which has not been independently verified and may contain assumptions and inaccuracies regarding geotechnical, hydraulic and other parameters.

Geoman Ltd accordingly does not accept responsibility for the accuracy or completeness of information or assumptions from which the design proposal has been produced.

Geoman Ltd did not undertake to supervise the construction of this structure, and therefore cannot comment on the standard of workmanship.

The design proposal remains the copyright and property of Geoman Ltd and is not to be copied or disclosed to any person other than the person to whom it is originally intended.

The material supplier can provide typical health & safety hazards to consider when approaching this work.

6.1 Construction Considerations

Sub-base material (coarse graded aggregate) should be placed in layers not exceeding 150mm in thickness or twice the nominal maximum aggregate size. Unlike traditional pavement construction, the open-graded materials should not be fully compacted to eliminate any voids, as this will compromise the performance of the system.

It is likely that excessive compaction will result in the displacement of the open graded aggregate by the compaction equipment. The open-graded material should be compacted such that its maximum density is achieved for the particular aggregate type and grading without compromising the final void percentage offered by the material.

Each layer should be suitably compacted before the next layer is placed to prevent any potential settlement of the pavement after completion.

Due to the nature of both the sub-layers and the block paving, care should be taken during the construction process to prevent dirt or detritus contaminating the sub-base and compromising the permeability of the system. For example, the trafficking of the sub-base as a site access route should not be undertaken. Should



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other construction or maintenance work take place close to the pavement which may affect the infiltration of the pavement, suitable protective measures should be implemented.

Edge restraints should be sufficiently robust to resist the lateral displacement from imposed loadings placed upon the pavement. The edge restraint may take the form of associated fittings, walls or buildings or be formed from precast concrete, clay or natural stone kerb systems, either existing or newly constructed features. The restraint must provide a consistent vertical face to a level below the laying course material.

7.0 CDM Regulations

Geoman is not the Principal Designer, but has considered the risks associated with this element of the works that affect or are affected by the design.

“Designers” are responsible for fulfilling their obligations as defined in the Construction (Design & Management) Regulations 2015.

Geoman Ltd, as designers, understands that under the Regulations its duties are generally to;

- Ensure that the client for the project is aware of the duties and responsibilities that they have.
- So far as is reasonably practicable, taking due account of other relevant design considerations, avoid foreseeable risks to the health and safety of any persons carrying out, liable to be affected by such or maintaining the permanent fixtures and fittings of construction work.

In discharging this duty, the designer shall:

- Eliminate hazards that may give rise to risks
- Reduce risks from any remaining hazards and in doing so give collective measures priority over individual measures.

The designer shall also:

- Take all reasonable steps to provide with the design sufficient information about aspects of the design of the structure or its construction or maintenance as will adequately assist clients, other designers and contractors to comply with their duties under the Regulations.

In respect of this particular project, Geoman hereby draws to the attention of the Principal Designer and the Principal Contractor that they have specific duties under CDM 2015.

The Principal Contractor must be responsible for and fulfill all the contractor’s obligations.

However, since the Principal Designer has designated the chosen location and dimensions of the structure on this site, the Principal Designer has, in this respect, acted as a ‘designer’ under CDM 2015. The Principal Designer is therefore responsible for fulfilling all the obligations that this entails.

The scope of Geoman Ltd., as element ‘designer’, to minimise design risks is therefore limited by those elements of the design pre-determined by the Principal Designer. The following significant design risks remain and must therefore be addressed by the Principal Designer and Principal Contractor.

SIGNIFICANT DESIGN RISKS REMAINING:

1. RISK: INCORRECT USE OF AGGREGATES AFFECTING PERFORMANCE
A permeable paving design relies heavily on using the correct aggregates. Prior to installation, we would ask you to test both the 4/20mm coarse graded aggregate and also the 6.3-2mm bedding and



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jointing grit as per the relevant British Standard specification (BS EN7533-13:2009). In particular, the material should be categorised as LA30, FI20 and MDE20 according to Table A.3, within this standard. The grit should be insoluble in dilute hydrochloric acid and should be naturally occurring material. In our experience, incorrect use of aggregates is one of the most common reasons for failure of a permeable paving design.

2. RISK: NOT CORRECTLY FILLING AND TOPPING UP PAVING JOINTS.

All joints must be filled to the top with 6.3-2mm grit. Joints which are not fully filled can lead to possible movement of the blocks after use. We recommend that after a few weeks use that any joints, which have settled and are not full, are topped up with grit. Joints should be kept filled at all times. You need approximately 1 ton of grit for every 100m² of 80mm paving.

3. RISK: JOINTS BECOMING BLOCKED DURING CONSTRUCTION

Care should be taken that the permeable joints do not become contaminated as work on the scheme is completed. Special care needs to be taken when soft landscaping is carried out so that soil does not enter the joints.

4. RISK: CONSTRUCTION OF PERMEABLE PAVING ON WEAK SUBGRADE

For the basis of the design, a minimum CBR value of 5% has been assumed. The actual subgrade CBR value must be confirmed via in-situ testing prior to construction. Should the ground conditions be more onerous than assumed for the purposes of this design, the design will need to be revised. Sub-grade preparation is to be carried out in accordance with the Specification for Highway Works. Remove all soft spots and fill with suitable replacement material before compaction. The sub-grade design CBR has been taken as greater than or equal to 5%, and confirmation of this on site is the responsibility of the Principal Contractor.

5. RISK: STORAGE AREAS AND CATCHMENT AREAS DIFFERENT TO WHAT HAS BEEN ASSUMED

Details of the proposed storage and catchment areas assumed for this design are detailed in Section 5.1. These should be checked by the Client's Consulting Engineer prior to construction. If these assumptions are not correct this design is not valid and will need to be revised.



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Appendix A – Aggregates

Please Refer to BS7533-13 2009 Guide for the design of permeable pavements constructed with concrete paving blocks and flags, natural stone slabs and setts and clay pavers.

Laying Course and jointing material

Laying course requires 6.3-2mm sized grit to BSEN 13242:2002. In particular, the material should be categorised as LA20 according to Table 9, SZ18 according to Table 10 and MDE15 according to Table 11 within this standard. The grit should be insoluble in dilute hydrochloric acid and should be naturally occurring material. In our experience, incorrect use of aggregates is one of the most common reasons for failure of a permeable paving design.

Course Graded Aggregate (CGA)

Requires 32% of voids spacing for the storage of water. CGA should comply with the requirements of BSEN 13242:2002. The material should be designated Type 4/20 (4mm minimum and 20mm maximum particle size). In our experience, incorrect use of aggregates is one of the most common reasons for failure of a permeable paving design.

Capping

Capping material is included in order to achieve a firm-working platform so that the overlying layers can be correctly installed. The permeable paving designs are normally designed for 5% CBR, If not then the appropriate increase in capping material should be used. All capping materials should meet the requirements of either 6F1 or 6F2 of Table 6.1 of Highways Agency's 'Specification for Highway Works-Series 600-Earthworks'

Please note: If you obtain the appropriate technical information for the aggregates which you plan to use on a permeable paving scheme please send them to us so we can give feedback on if they meet BS 7533-13:2009 and BSEN 13242:2002 requirements. Depending on the project size we would strongly advise customers that aggregates used in the construction of a permeable paving system should be tested to ensure conformity during the construction of the project.

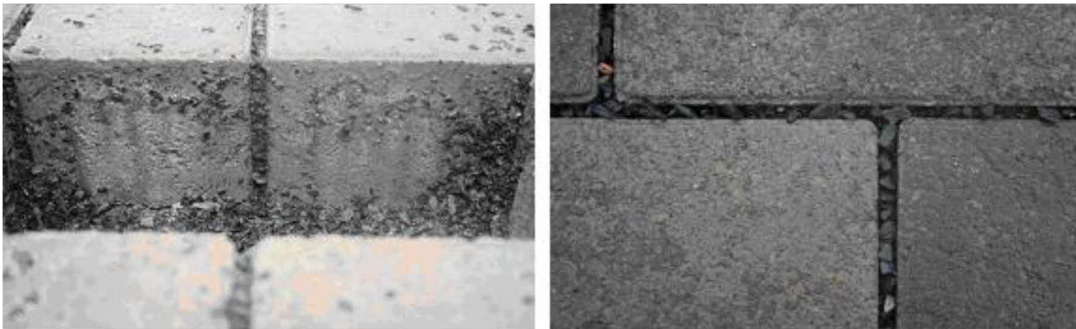


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Appendix B – Installation

Paving should be installed to BS7533-3:2005.

- i. A permeable paving design relies heavily on using the correct aggregates. Prior to installation, we would ask you to test both the 4/20mm coarse graded aggregate and also the 6.3-2mm bedding and jointing grit as per the relevant British Standard specification (BS EN 13242:2002). In particular, the material should be categorized as LA20 according to Table 9, SZ18 according to Table 10 and MDE15 according to Table 11 within this standard. The grit should be insoluble in dilute hydrochloric acid and should be naturally occurring material. In our experience, incorrect use of aggregates is one of the most common reasons for failure of a permeable paving design.
- ii. All joints must be filled to the top with 6.3-2mm grit. Joints which are not fully filled can lead to possible movement of the blocks after use. We recommend that after a few weeks use that any joints, which have settled and are not full, are topped up with grit. Joints should be kept filled at all times. You need approximately 1 ton of grit for every 100m² of 80mm paving.
- iii. Care should be taken that the permeable joints do not become contaminated as work on the scheme is completed. Special care needs to be taken when soft landscaping is carried out so that soil does not enter the joints.



All joints must be filled to the top with 6.3-2mm grit.



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Appendix C – Geoman Services

Geoman Ltd offers design services in relation to permeable paving products in general accordance with the Interpave design guide:

Where certain information is not provided assumptions will be made in order to produce an answer. The project team should check any assumptions in a site investigation or using tests at the construction stage.

Often the project team will update and make changes to our proposal based on their detailed knowledge of the scheme and its requirements.

Our deliverable documents include a design signed off by a chartered engineer recording all the information provided. The project team should check that all the information used is current. The Project Consulting Engineer still has a duty to check the design provided.

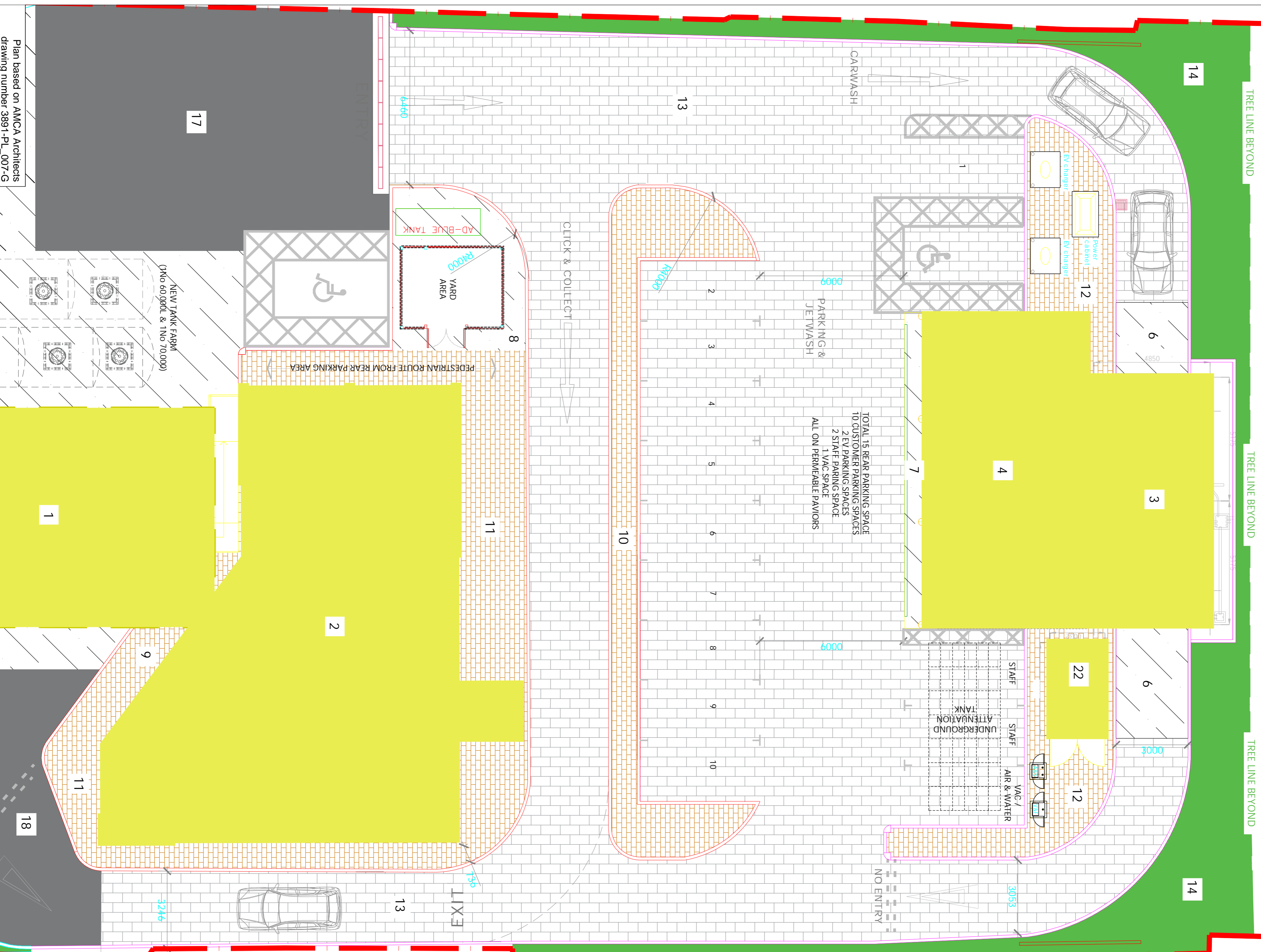
This service excludes supervision of the works. Responsibility for supervision of the works remains with the Resident Engineer, usually a representative of the Project Consulting Engineer. If this supervisory service is required, Geoman should be given a brief and asked to formally quote for it by the project team. Invoices will be made direct to the project team or client for this supervisory service.

Occasionally some projects have the specialized aspects of the works billed as contractor design or a form of warranty may be required. Geoman Ltd can offer an indemnified design as above and in addition will make visits as we see fit in order to check that the works are being undertaken correctly. Often this service will consist of one or two visits, occasionally we are requested to supervise full time. Good liaison is required with the Principal Contractor and if defects are not correct we reserve the right to report any concerns direct to the project team.

The Principal Contractor still has a duty to install the system correctly and make any changes advised.

Any site supervisory staff still has a duty to record and notify Geoman of any activities that give rise to concern in our absence. If this supervisory service is required, Geoman should be given a brief and asked to formally quote for it by the project team. Invoices will be made direct to the project team, Principal Contractor or client for this supervisory service.

INDICATIVE LOCATION OF PROPOSED PERMEABLE PAVING
 1:100
 All geometry, setting out and required offsets to be confirmed by the Principal Geomani Contractor and/or Principal Consulting Engineer. All proposed locations of all services prior to construction and ensure that none will be affected by the Permeable Paving and its installation.



KEY:

- Hydropave area. Design for Loading Category 5 (Occasional Commercial Vehicular traffic only) - Area = 6003m²
- Paved areas contributing to the Hydropave Catchment

INSTALLATION METHODOLOGY

GENERAL
 WORKS TO BE CARRIED OUT IN ACCORDANCE WITH BS 7533-13:2009, BS 7533-14:2009, BS 7533-15:2009, BS 7533-16:2009, BS 7533-17:2009, BS 7533-18:2009, BS 7533-19:2009, BS 7533-20:2009, BS 7533-21:2009, BS 7533-22:2009, BS 7533-23:2009, BS 7533-24:2009, BS 7533-25:2009, BS 7533-26:2009, BS 7533-27:2009, BS 7533-28:2009, BS 7533-29:2009, BS 7533-30:2009, BS 7533-31:2009, BS 7533-32:2009, BS 7533-33:2009, BS 7533-34:2009, BS 7533-35:2009, BS 7533-36:2009, BS 7533-37:2009, BS 7533-38:2009, BS 7533-39:2009, BS 7533-40:2009, BS 7533-41:2009, BS 7533-42:2009, BS 7533-43:2009, BS 7533-44:2009, BS 7533-45:2009, BS 7533-46:2009, BS 7533-47:2009, BS 7533-48:2009, BS 7533-49:2009, BS 7533-50:2009, BS 7533-51:2009, BS 7533-52:2009, BS 7533-53:2009, BS 7533-54:2009, BS 7533-55:2009, BS 7533-56:2009, BS 7533-57:2009, BS 7533-58:2009, BS 7533-59:2009, BS 7533-60:2009, BS 7533-61:2009, BS 7533-62:2009, BS 7533-63:2009, BS 7533-64:2009, BS 7533-65:2009, BS 7533-66:2009, BS 7533-67:2009, BS 7533-68:2009, BS 7533-69:2009, BS 7533-70:2009, BS 7533-71:2009, BS 7533-72:2009, BS 7533-73:2009, BS 7533-74:2009, BS 7533-75:2009, BS 7533-76:2009, BS 7533-77:2009, BS 7533-78:2009, BS 7533-79:2009, BS 7533-80:2009, BS 7533-81:2009, BS 7533-82:2009, BS 7533-83:2009, BS 7533-84:2009, BS 7533-85:2009, BS 7533-86:2009, BS 7533-87:2009, BS 7533-88:2009, BS 7533-89:2009, BS 7533-90:2009, BS 7533-91:2009, BS 7533-92:2009, BS 7533-93:2009, BS 7533-94:2009, BS 7533-95:2009, BS 7533-96:2009, BS 7533-97:2009, BS 7533-98:2009, BS 7533-99:2009, BS 7533-100:2009.

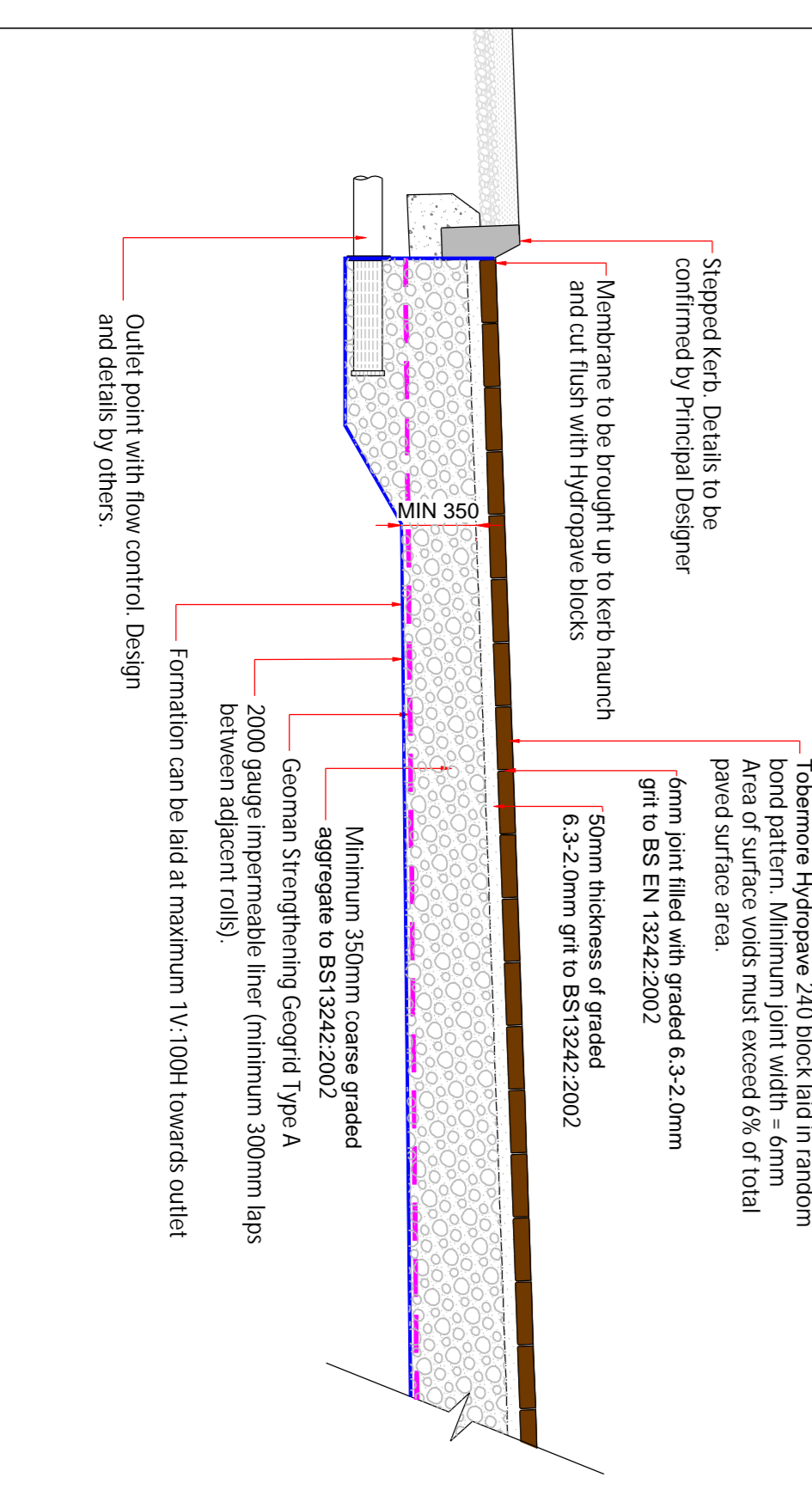
SUB-BASE GRADING - TABLE 1

SIEVE SIZE	PERCENTAGE PASSING
80	100
40	100
20	100
10	100
6.3	95-100
4	90-99
2	80-89
1	60-69
0.75	50-59
0.5	40-49
0.25	30-39

LAYING COURSE GRADING - TABLE 2

SIEVE SIZE	PERCENTAGE PASSING
80	100
40	100
20	100
10	100
6.3	95-100
4	90-99
2	80-89
1	60-69
0.75	50-59
0.5	40-49
0.25	30-39

SECTION 1-1
 Permeable paving build-up
 (Loading Category 5)
 1:25



NOTES

1. PERMEABLE PAVING DESIGN REQUIRES HEAVY LIFTING USING THE CRANE. THE DESIGNER SHALL BE RESPONSIBLE FOR THE DESIGN AND WORKS TO BE CARRIED OUT IN ACCORDANCE WITH BS 7533-13:2009, BS 7533-14:2009, BS 7533-15:2009, BS 7533-16:2009, BS 7533-17:2009, BS 7533-18:2009, BS 7533-19:2009, BS 7533-20:2009, BS 7533-21:2009, BS 7533-22:2009, BS 7533-23:2009, BS 7533-24:2009, BS 7533-25:2009, BS 7533-26:2009, BS 7533-27:2009, BS 7533-28:2009, BS 7533-29:2009, BS 7533-30:2009, BS 7533-31:2009, BS 7533-32:2009, BS 7533-33:2009, BS 7533-34:2009, BS 7533-35:2009, BS 7533-36:2009, BS 7533-37:2009, BS 7533-38:2009, BS 7533-39:2009, BS 7533-40:2009, BS 7533-41:2009, BS 7533-42:2009, BS 7533-43:2009, BS 7533-44:2009, BS 7533-45:2009, BS 7533-46:2009, BS 7533-47:2009, BS 7533-48:2009, BS 7533-49:2009, BS 7533-50:2009, BS 7533-51:2009, BS 7533-52:2009, BS 7533-53:2009, BS 7533-54:2009, BS 7533-55:2009, BS 7533-56:2009, BS 7533-57:2009, BS 7533-58:2009, BS 7533-59:2009, BS 7533-60:2009, BS 7533-61:2009, BS 7533-62:2009, BS 7533-63:2009, BS 7533-64:2009, BS 7533-65:2009, BS 7533-66:2009, BS 7533-67:2009, BS 7533-68:2009, BS 7533-69:2009, BS 7533-70:2009, BS 7533-71:2009, BS 7533-72:2009, BS 7533-73:2009, BS 7533-74:2009, BS 7533-75:2009, BS 7533-76:2009, BS 7533-77:2009, BS 7533-78:2009, BS 7533-79:2009, BS 7533-80:2009, BS 7533-81:2009, BS 7533-82:2009, BS 7533-83:2009, BS 7533-84:2009, BS 7533-85:2009, BS 7533-86:2009, BS 7533-87:2009, BS 7533-88:2009, BS 7533-89:2009, BS 7533-90:2009, BS 7533-91:2009, BS 7533-92:2009, BS 7533-93:2009, BS 7533-94:2009, BS 7533-95:2009, BS 7533-96:2009, BS 7533-97:2009, BS 7533-98:2009, BS 7533-99:2009, BS 7533-100:2009.
2. ALL JOINTS MUST BE FILLED TO THE TOP WITH 6.3:2.0mm GRIT. JOINTS WHICH ARE NOT FULLY FILLED CAN LEAD TO POSSIBLE MOVEMENT OF THE BLOCKS AFTER USE. WE RECOMMEND THAT SETTING JOINTS WITH SAND OR OTHER MATERIALS WHICH HAVE A LOWER STRENGTH THAN THE PERMEABLE PAVING IS NOT ACCEPTABLE. JOINTS SHOULD BE KEPT FILLED AT ALL TIMES YOU NEED APPROXIMATELY 1 TON OF GRIT FOR EVERY 100m² OF 60mm PAVING.
3. CARE SHOULD BE TAKEN THAT THE PERMEABLE JOINTS DO NOT BECOME CONTAMINATED AS WORK ON THE SCHEDULE IS CARRIED OUT. THE JOINTS SHOULD BE KEPT FILLED WITH 6.3:2.0mm GRIT AT ALL TIMES YOU NEED APPROXIMATELY 1 TON OF GRIT FOR EVERY 100m² OF 60mm PAVING.
4. ALL DIMENSIONS IN DIMS UNLESS OTHERWISE SPECIFIED.
5. ALL PAVING SHOULD BE INSTALLED IN ACCORDANCE WITH BS 7533-3:2009 BY A COMPETENT EXPERIENCED PAVING CONTRACTOR.
6. ALL AGGREGATES SHOULD BE INSTALLED IN ACCORDANCE WITH THE MATERIAL SPECIFICATION TABLE.
7. BASE OF SUB-BASE TO BE CONSTRUCTED TO COMPETENT HORIZONTAL WITH A CAR VALUE IN EXCESS OF 8%. THIS MUST BE CONFIRMED VIA IN-SITU TESTING PRIOR TO CONSTRUCTION.
8. AN ALLOWABLE DISCHARGE RATE OF 2.49% HAS BEEN ADOPTED FOR THE DESIGN AS ADVISED BY AMCA ARCHITECTS. OUTLET DETAILS AND FLOW CONTROL DESIGN IS TO BE CONFIRMED BY THE CLIENT'S CONSULTING ENGINEER.
9. THE MAXIMUM STORM RETURN PERIOD ASSUMED IN THE PRELIMINARY ANALYSIS WAS 1 IN 100 YEARS. PLUS AND MINUS AN ADDITIONAL 4% TO COVER FOR CLIMATE CHANGE.
10. THIS DRAWING MUST BE USED IN CONJUNCTION WITH GEOMAN LTD DESIGN DOCUMENT Z2-6083-F1-01.

FOR APPROVAL

GEOMAN
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 Belfast
 BT9 6AZ
 Tel: 02890 664941
 Fax: 02890 662007
 geomani@geomani.co.uk

AMCA ARCHITECTS

**GARVOCK FILLING STATION,
 DUNFERMLINE**

**PROPOSED PERMEABLE
 PAVING DETAILS**

Designed: AMCK
 Drawn: AMCK
 Approved: AMCK
 Date: 14.06.23
 Project No: 22-6083-F1
 Scale: As Shown
 Drawing No: SK22-6083-F1-01
 Revision: 0



DESIGN WARRANTY

This agreement is made the (DATE) between (Element Designer) Geoman Ltd whose address is 44 Elmwood Avenue, Belfast BT9 6AZ and (Client)... whose address is on behalf of (Principal Designer)..... whose address is

Copyright in Our Design

This design has been produced for the site stated in the design document only. All advise is specific to this development. The completed design, including all calculations, drawings, specifications and any advice produced on behalf of Geoman is subject to the law of copyright. Geoman will retain exclusive retain copyright and other intellectual property rights. This design and advise is not to be used for any other project with prior written consent from Geoman. For these purposes "Design" means the design attached to these conditions. This includes any design included in the specification and/ or any other design or technical advice provided by Geoman in connection with the Project, including any revisions, amendments and updates made by Geoman to these design and/or design advice. "Development" means the client's specified project location (where "client" include any contractor, architect, specifier or agent who is identified as the client) in connection with which the design is supplied.

Now it is hereby agreed in consideration of the payment of excluding VAT by to Geoman Ltd, receipt of which Geoman Ltd hereby acknowledges:

1. Geoman Ltd (The Element Designer) warrants that it has exercised reasonable care and diligence in the performance of its services to (The Client) under the appointment.
2. In the event of any breach of this agreement:
 - a. Subject to sub-clauses (b) and (c), The element designer shall be liable for the reasonable costs of repair, renewal and/or reinstatement of any part or parts of the development to the extent that the purchaser reasonably incurs such costs and the purchaser becomes liable or by way of financial contribution for such costs. The element designer shall not be liable for other losses incurred by the purchaser.
 - b. Without prejudice to any other exclusion or limitation of liability, damages, loss, expense or costs the element designer's liability for such costs of the repair, renewal or reinstatement in question shall be further limited to that proportion thereof as it would be just and equitable to require the element designer to pay having regard to the extent of the element designer's responsibility for the same and on the assumptions that:
 - i. all other element designers, consultants and advisors, contractors and subcontractors involved in the development have provided contractual undertakings on terms no less onerous than those set out in clause 1 to the purchaser in respect of the carrying out of their obligations in connection with the development and;
 - ii. that there are no exclusions of or limitations of liability nor joint insurance or co-insurance provisions between the purchaser and any other party referred to in this clause 2 and any such party who is responsible to any extent for such costs is contractually liable to the purchaser for the same and
 - iii. all the parties referred to in this clause 2 have paid to the purchaser such proportion of such costs that it would be just and equitable for them to pay having regard to their responsibilities for the same.
 - c. The element designer shall be entitled in any actions or proceedings by the purchaser to rely in any limitation or exclusion in the appointment and to raise the equivalent rights in defence of liability as it would have against the client under appointment.
 - d. The obligations of the element designer under or pursuant to this agreement shall not be released or diminished by the appointment of any person by the purchaser to carry out any independent enquiry into any relevant matter.
3. The element designer has exercised reasonable skill and care to see that, unless authorised by the client in writing, or where such authorisation is given orally, confirmed by the element Designer to the client in writing, materials specified by it for use in the development are in accordance with the guidelines contained in the edition of the publication 'Good Practice in Selection of Construction Materials' (Ove Arup & Partners) current at the date of its specification.
4. The purchaser shall have no authority to issue any direct or instruction to the element designer in relation to the appointment.
5. The element designer shall not be liable for any use by the purchaser, the client, the principal designer or its appointee of any of the documents for any purpose other than that for which the same were prepared by or on behalf of the element designer.
6. This design and advise provided to the principal engineer by the element designer is specific to the development stated in this design document. The client acknowledge that to complete this design, the element designer have relied upon the information, supplied by the client and any professional advisors working on this development. Geoman (the element designer) can take no responsibility for any failure or defect arising for incomplete, inaccurate or misleading information we have received for you or arising from any other third party engaged in this development. This design and advise have been provided on the basis that the element designer approved products will be used in construction. If any other products other than the element designers approved products are used for construction, the element designer can no accept responsibility for the performance of those products. This design and/or advise will not be valid for the use of any other products other than the element designer's approved products.
7. The element designer shall maintain professional indemnity insurance in an amount each year of not less than (...) pounds in the aggregate for the period of insurance in respect of each and every occurrence or series of occurrences arising out of one event for a period of five years from the date of practical completion of the design under this agreement and provided that such insurance is available at commercially reasonable rates. The element designer shall inform the purchaser if such insurance ceases to be available at reasonable commercial rates in order that the element designer and purchaser can discuss the best means of protecting their respective positions. The element designer shall on reasonable request provide evidence that such insurance is being maintained.
8. The purchaser may assign by way of absolute legal assignment only the benefit of this agreement to a third party who also takes an assignment of the purchaser's interest in the premises (The 'first assignee'). The First Assignee may assign by way of absolute legal assignment only the benefit of this agreement to a third party who also takes an assignment of the First Assignee's interest in the premises. Any such assignment shall only be effective if written notice thereof is given to the element designer. No further or other assignment of this agreement shall be permitted.
9. Any notice to be given by the element designer shall be deemed to be duly given if it is delivered by hand or sent by recorded (signed for) or special delivery to the purchaser at the above mentioned address; and any notice given by the purchaser shall be deemed to be duly given if it is delivered by hand or sent by recorded (signed for) or special delivery to the element designer at the above address. Any such notices shall be deemed to have been received 48 hours after being posted (subject to proof to the contrary).
10. No action or proceedings for any breach of this agreement shall be commenced against the element designer after the expiry of five years from the date of practical completion of the relevant part of the premises or, in the event that practical completion is not achieved, the date that the element Designer finished its services under the appointment.
11. Nothing in this agreement confers or purports to confer on any third party any benefit or any right to enforce any term of this agreement pursuant to the Contracts (rights of third parties) Act 1999.
12. This agreement is subject to the law of England and Wales and the parties hereto subject to the jurisdiction of the courts of England and Wales.

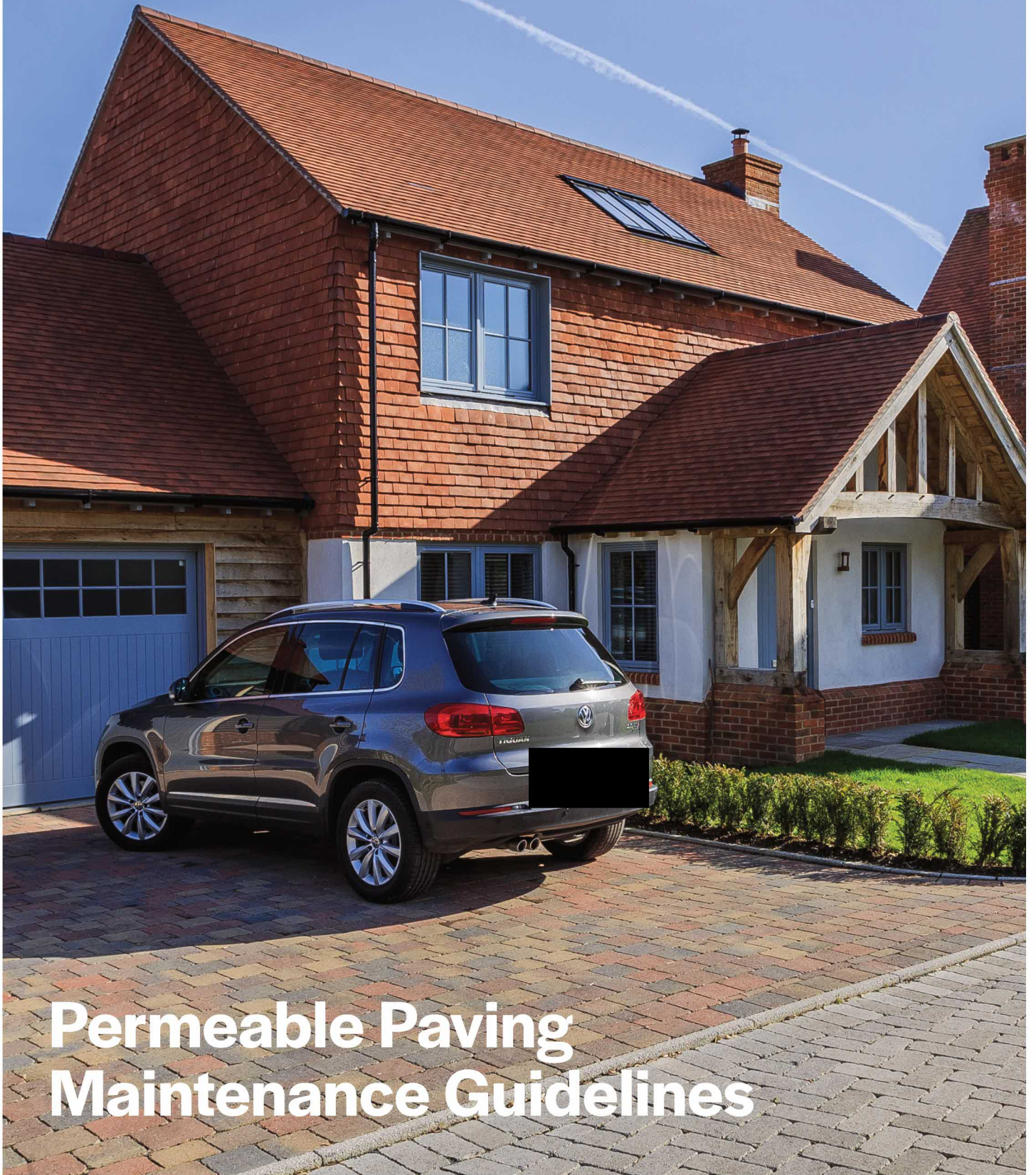
As witness the hands of the parties hereto:

Signed by or on behalf of the Element Designer

For and on behalf of Geoman Ltd

Signed by or on behalf of the Client

For and on behalf of ... Ltd



Permeable Paving Maintenance Guidelines

Guidelines for the maintenance of Tobermore Hydropave Permeable Paving

To ensure optimum performance of Hydropave permeable paving, Tobermore provide the following maintenance guidelines.

These guidelines are provided as a general maintenance regime but may be altered if necessary depending on the specific paved area or any factors which may impact the paving.

Hydropave permeable paving relies upon its ability to infiltrate surface water through its joints into a sub-base beneath. Hydropave Permeable Paving requires much less maintenance than is perceived by many however maintenance of the pavement should be carried out when necessary to ensure the infiltration of the paving is maintained and the paving is kept looking at its best.

During design, construction and after construction care should be taken to ensure that the paved area is protected and maintained to minimise clogging of the joints.

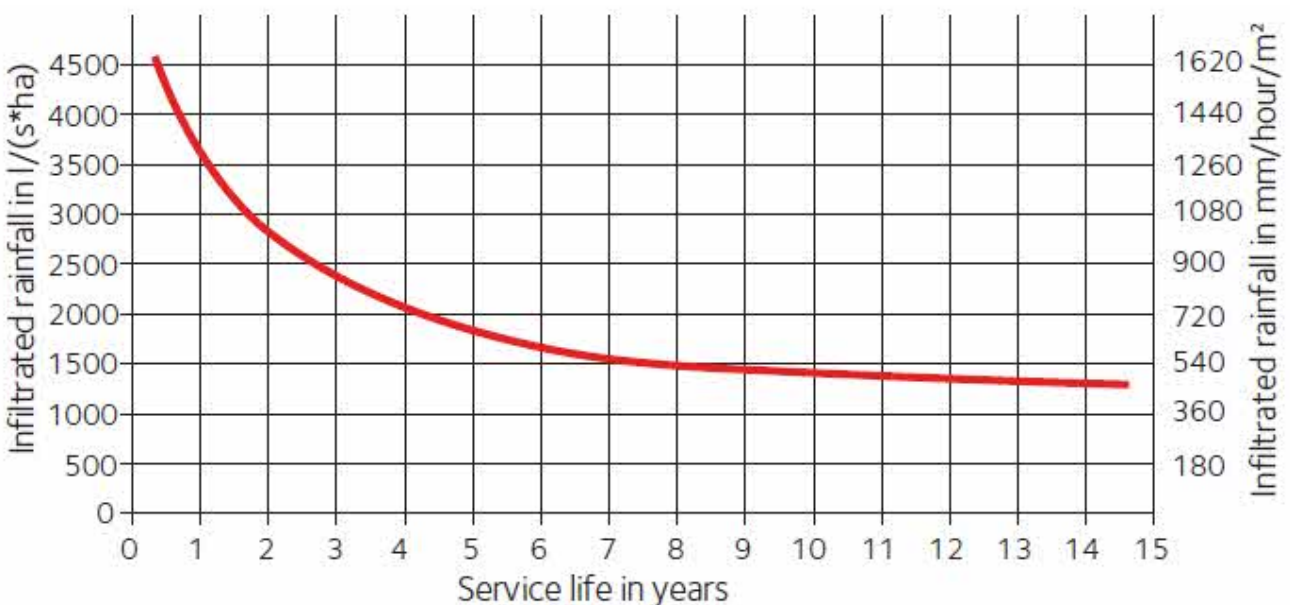
With age and use, detritus and silt collects in jointing material at the top of the joints. This forms a thin crust like layer over the joint however this does not severely impact the ability of the joints to infiltrate surface water. Research has demonstrated that whilst the infiltration rate of the joints does decrease over time it stabilises and still exceeds UK & Ireland hydrological requirements.

Rainfall experienced in the UK & Ireland is typically 20mm per hour with an extreme rainfall event being 75mm per hour. Research has concluded that the infiltration capacity of a newly installed Hydropave Concrete Block pavement is over 4,000mm per hour. The bedding course and sub-base aggregates will have even higher infiltration capacity.

The UK guidelines require the infiltration rate of the surface joints to be 400mm and hour which is only 10% of the actual rate of newly installed permeable paving. Even allowing for clogging over the long term there is a large factor of safety built in.

See Figure 1.

Figure 1.



General Maintenance Guidelines

Routine visual inspections.

A major benefit of permeable paving over traditional drainage systems is the ability to quickly and cost effectively assess that it is working correctly. This can be done by visually inspecting the paving during heavy rainfall or following heavy rainfall.

In general, routine visual inspections are all that is required to determine whether or not remedial maintenance is required. Any infiltration issues are shown up by water ponding on the surface of the paving. If ponding is not visible then remedial action is not required. If ponding is visible see section on Remedial Action for ponding.

In the unlikely event that individual blocks are damaged these should be removed and replaced. See section on structural maintenance.

Frequency: Once a year during or following heavy rainfall.

Remedial maintenance for ponding.

If surface water ponding is visible the joints should be brushed and vacuumed.

Brushing and vacuuming should be carried out in a manner which ensures that the paving blocks are not damaged and that jointing material is not removed from the joints. Any jointing material which is removed must be replaced. The size of sweeper used will be dependent on the overall size of the paved area. A range of large mechanical sweepers are now available as well as smaller lightweight equipment. These are available from specialist companies.

The structural integrity of Permeable paving will be compromised if the joints are not filled to the top with jointing aggregate.

It is good practice to complete a trial area first and then any adjustments to suction rates can be made if necessary.

The effectiveness of Hydropave Permeable Paving is not significantly compromised by moss, leaves or weeds on the surface as these are not impenetrable barriers.

Frequency: As and when required.

Maintenance for aesthetics of the joints.

To help maintain the overall appearance of the paving joints it is recommended that the surface of the paving including the joints is brushed and vacuumed at least once a year. Brushing the paving either mechanically or manually helps to agitate the jointing material and breaks up this thin layer of crust. Brushing also helps to prevent any vegetation growing in the joints.

Joints must be topped up with jointing material if any is removed during the brushing or vacuuming process.

Frequency: Recommended annually however maintenance for aesthetics of the joints can be carried out at the discretion of the developer/client.

Maintenance for aesthetics of the paving blocks.

Brushing with soapy water and a stiff brush will revive the colour of concrete block permeable paving.

For a deeper clean of the block surface a pressure washer can be used to maintain the appearance and colour of the paving blocks. A pressure washer set to a light / medium pressure should be all that is required to remove general dirt and grime. High pressure should not be used as this can damage the surface of the blocks.

Tips:

- Hold the lance of the pressure washer at a 30 to 45 degree angle to the paved surface to avoid removal of the jointing material.
- After cleaning is finished ensure that any jointing material which has been removed is top up with the correct material.

Maintenance during the winter months.

Hydropave Permeable Paving generally requires less de-icing than conventional concrete block paving.

The controlled use of conventional road de-icing techniques can be used without affecting the overall performance of the paving.

Some de-icing salts may leave temporary discoloration after the thaw. Normal weathering should soon remove this discoloration from the paving.

De-icing salts should be applied before snow or ice develops as this helps protect the concrete surface.

It is unlikely that the levels of chloride in the ground will increase significantly by employing conventional de-icing techniques.

Frequency: As required during winter.

Controlling weeds.

Weeds tend not to establish in areas which receive regular trafficking by vehicles. If weeds are an issue they can be dealt with by using a weed killer containing Glyphosate. The manufacturer's instructions should always be followed and adequate Health & Safety measures should also be put in place when handling chemicals.

Frequency: As required.



Structural Maintenance.

If a visual inspection has indicated that individual blocks have been damaged these blocks should be removed and replaced with new blocks.

If rutting of the surface has occurred the area needs to be lifted and reinstated immediately as it may be a hazard to users.

Any blocks which are removed need to be reinstated correctly ensuring that the correct sub-base, bedding and jointing aggregates are used. The installation method should be in accordance with BS 7533 Part 3. In particular, the joints should be filled to the top to ensure structural integrity. Any geotextiles or impermeable membranes which are damaged during the reinstating process should be replaced. If the blocks are not damaged they can be lifted, cleaned and re-used.

Frequency: As required

Guidelines to minimise maintenance and ensure the long-term performance of Hydropave Permeable Paving.

Pre- construction (Design stage)

- It is essential that the system is designed correctly by a qualified engineer. Refer to BS 7533 Part 13
- The design and detailing of the project should ensure that soil from soft landscaping is prevented from spilling onto the paving.

During construction.

- It is essential that the paving is installed by an experienced contractor who is familiar with installing permeable paving and its components. Refer to BS7533

Part 3

- Mud / soil and other contaminants should be prevented from entering the sub-base, bedding course and jointing aggregates.
- Do not allow muddy construction traffic to use the paved area once completed.
- Do not allow soft landscaping to spill onto the paving surface.

See Figure 2.

After construction.

- Do not store materials which may clog up the permeable joints such as soil and mulch on top of the paving.
- The joints between to permeable paving should be filled to the top with the correct aggregate.

Figure 2.



Maintenance overview

SCHEDULE	ACTION	FREQUENCY
Routine visual inspection	Visually inspect the paving for ponding during heavy rainfall or following heavy rainfall.	Once a year
Remedial maintenance for ponding	Brush / vacuum joints Replace any lost jointing material	As required
Structural Maintenance	Replace damaged blocks Repair any rutting	As required
Maintenance for aesthetics of the joints	Brush / vacuum joints as required Replace any lost jointing material	Recommended once a year
Maintenance for aesthetics of the paving blocks	Brush with soapy water Light pressure wash	As required
Weed control	Treat with weedkiller	As required
Maintenance during the winter months	De-icing salts	As required during winter
WARNING !	Do not replace the jointing grit with kiln dried sand as this will block the joints prevent infiltration. Do not store materials which may clog up the permeable joints such as soil and mulch on top of the paving.	