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Structural Engineering
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Traffic & Flood Risk Assessments
Water & Drainage Engineering
Technical Audits & Assessments

GOOSE FARM, MAYTON LANE, BROAD OAK, KENT

SURFACE WATER DRAINAGE REPORT

Issue: A

Date: 20th February 2017

Author: M Blenkharn

Job No 8441

BSI REGISTERED
UKAS QUALITY MANAGEMENT 003
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1.0 INTRODUCTION

Monson have been requested to provide a sustainable drainage design to ensure the run-off from the covered polytunnels does not result in increased surface water discharge than the existing green field situation. The scheme for installing the polytunnels has been approved but planning conditions have been imposed which require the surface water drainage issues to be resolved before the covers can be employed.

2.0 SITE DESCRIPTION

The site is located in the North Downs adjacent to Mayton Lane as indicated on the location plan in Appendix A. The ground is quite flat and is at an elevation ranging from approximately 50m ODN to 45 m ODN. There are six blocks of polytunnels approved which will be used for the growing of soft fruits, strawberries, which are grown on table tops in a growing medium.

A plan showing the contours indicates the ground is very flat for approximately half the polytunnel area but the ground from the centre does slope towards the northern corner. This plan is included in Appendix B.

There is a significant grassed verge running around the edge of the fields which are closest to the neighbouring houses but the general slope of the ground is away from these properties. The block plan showing the location of the polytunnels is included in Appendix C.

3.0 SURFACE WATER RUN-OFF: CURRENT SITUATION

During the periods when the polytunnels are uncovered, rainfall will simply fall onto the ground and infiltrate into the sub strata. The green field run-off for the fields in question has been determined using the Institute of Hydrology equation which is the standard formula for areas less than 50 hectares. The actual area under the polytunnels is 9.33 hectares and the green field run-off rates have been based on this area. The calculations are included in Appendix D and indicate the green field run-off rates would be 120.1 l/s for the 1 in 100 year event and 144.1 l/s for the 1 in 100 year event plus climate change. The climate change allowance for rainfall has been taken as 20% which is the revised upper limit for rainfall in England up to the year 2070. This is based on the current climate change guidance from the Environment Agency published in February 2016. The relevant extract from the guidance is included in Appendix E. The calculated green field run-of rates for varying return period events are shown in the table below:-

Site Name	Total Area (ha)	1 in 1 year run-off rate	1 in 2 year run-off rate	1 in 30 year run-off rate	1 in 100 year run-off rate	1 in 100 year plus CC run-off rate
Goose farm	9.33	32.0 l/s	37.7 l/s	86.6 l/s	120.2 l/s	144.1 l/s

The underlying strata is London Clay which is why the green field run-off rates are quite high for this area of land and this run-off would flow towards the northern most corner which is the lowest part of the field.

5.0 SURFACE WATER RUN-OFF: POLYUTUNNELS COVERED

The polytunnels are formed of 6 blocks which run south east to north west as indicated on the drawing included in Appendix F. Blocks 1, 2 3 and 4 run in the roughly the same direction as the slope of the ground which in our opinion could result in additional run-off from the site if no mitigation measures are taken. Blocks 5 and 6 are on the flattest part of the site and run-off from the polytunnels will simply flow across the land as it does at present and will not result in any additional surface water run-off. The construction details of the polytunnels for the 6 blocks are included in Appendix F.

5.1 Blocks 1 -4

The polytunnels will be constructed so they will run predominantly down the slope and any rainfall will fall in the narrow gap between each tunnel. The natural slope of the ground will tend to cause the run-off to flow directly down the slope and may not spread evenly over the whole ground as it would in the green field situation or if the polytunnels were constructed across the slope.

There will be some spread of the run-off as the slope is not just simply down the line of the polytunnels in a northwest direction but the land also falls in a more northerly direction as indicated by the contours, so some run-off will also flow under the polytunnels. The drawing showing the direction of the tunnels and the general slope of the ground is included in Appendix F.

Nevertheless, in an extreme intense rainfall event it is probable that more surface water run-off will be generated when the polytunnels are covered than in the uncovered green field situation. We would anticipate that intense storms up to 2 hours in duration would result in more surface water discharge, but storms over a longer period would not increase the level of run-off as water would be able to spread across all the land as it would in the uncovered situation. The strawberries will be grown on raised tables so there is no impediment to the run-off flowing across the ground under the polytunnels.

It is possible that up to 50% of the rainfall in an extreme event would run-off the site because it has not been able to spread across the land as it would in the natural green field situation. This additional run-off could cause a flood risk to the adjacent property immediately to the east of this field.

In order to prevent an increase in this flood risk we propose that a bund is constructed along the northern edge of the field as shown in the drawing which is also in Appendix F. The water will collect in the northern most corner and the bund will need to be highest at this point to prevent any surface water flowing off the site. We have proposed that the bund should be a minimum of 0.5 m high at the edges so that they can direct any run-off towards the lowest part of the field. The bund will generally be constructed along the 41 m contour and we propose that the bund should be a minimum of 1.5 m high (top level = 42.4 m ODN) constructed of compacted clay. A French Drain should also be constructed along the front edge to help water infiltrate into the ground once the storm event has passed in order to prevent long periods of waterlogging. The construction details of the bund are also included in the drawing in Appendix F.

The rainfall data, included in Appendix G, indicates the 1 in 100 year rainfall for the 2 hour event is 55.9 mm, and adding the climate change allowance of 20% increases this to 67.08 mm. The total covered area is 6.8 hectares so the total run-off would be 6.8 x10000 x 0.06708 cubic metres. This equals 4561 cubic metres and if we assume 50% will infiltrate into the ground, the required storage is approximately 2280 cubic metres.

The maximum storage depth is 1.5m and the length of bund is 200 metres whilst the distance from the bund to the point where the ground reaches 42.5 m ODN is approximately 20 metres. Therefore the storage is 200 x (1.5/2) x 20 = 3000 cubic metres. This exceeds the required storage and as this bund will actually prevent any surface water discharge it will also reduce the risk of surface water flooding to the adjacent land that exists in the green field situation.

6.0 POLLUTION

The reason for the planning condition relating to surface water is to prevent pollution in accordance with Policy C37 of the Canterbury District Local Plan 2006. Additional surface water run-off may be considered to be pollution but the mitigation measures proposed in section 5 will prevent any additional run-off and will in fact significantly reduce run-off from the site.

The pollution could also refer to additional pesticides or fertilisers which could be washed off the land. It is more likely that the use of pesticides and fertilisers will be sprayed more directly onto the plants than was the case when the fields were previously used as orchards so overall we would expect less pesticides and fertilisers to fall on the ground. The bund will now prevent any surface water discharge from the site so there will be a further reduction in the amount of pollutants that could leave the site via surface water run-off.

7.0 CONCLUSION

Planning approval has been granted for the use of polytunnels at Goose Farm for the growing of strawberries on raised tables. The introduction of the polytunnels will increase the harvest from these plants but the council requires a sustainable drainage design to ensure there is no increase in run-off that may affect neighbouring land and property.

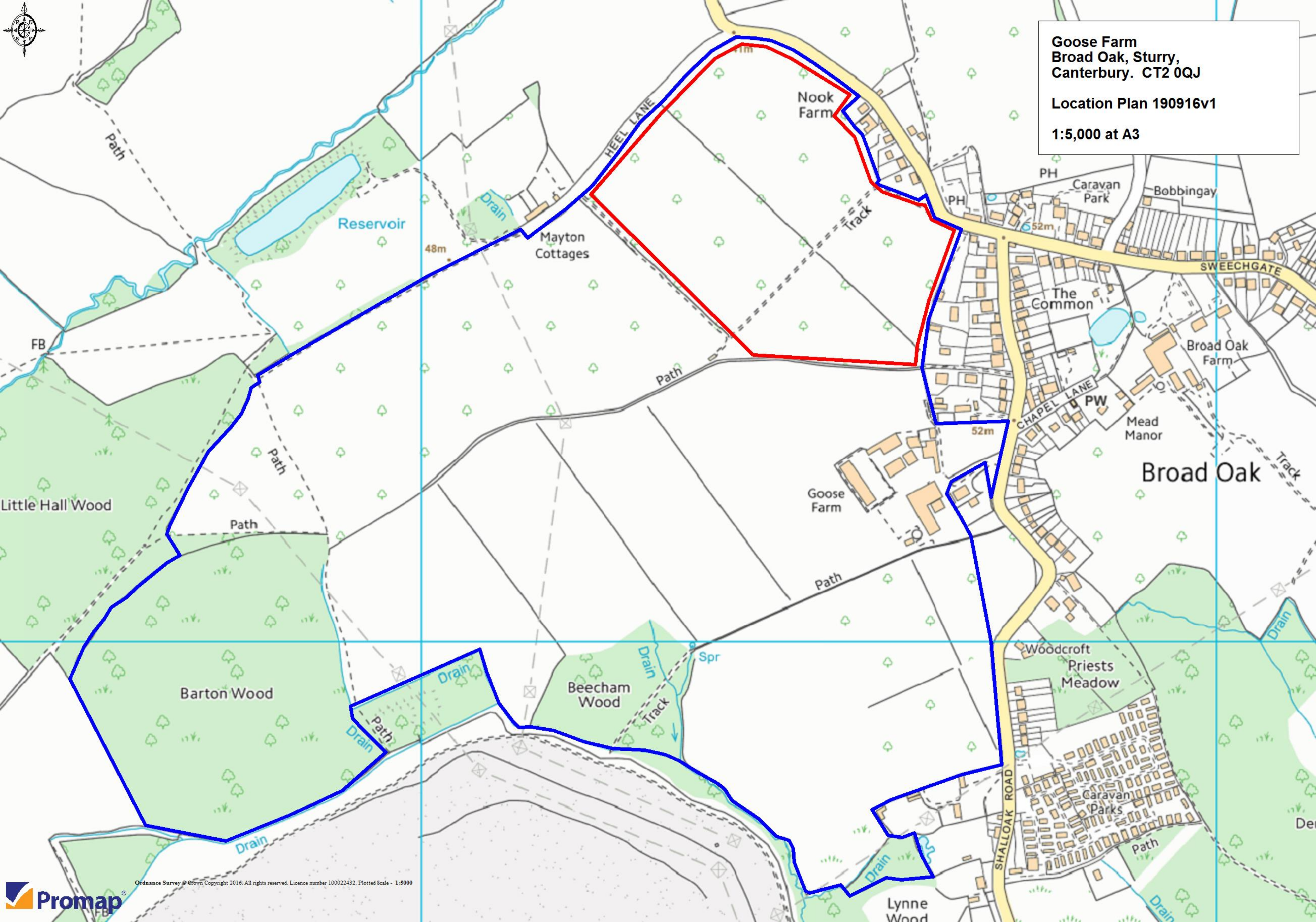
The approved polytunnels are made up of 6 blocks. Blocks 5 and 6 are on the flattest part of the site and run-off would be able to spread under the covers just as occurs in the current green field situation and will not therefore result in an increase in surface water discharge.

Blocks 1, 2, 3 and 4 do run down the slope and this could result in greater surface water discharges as the rainfall would not infiltrate over the whole field area. We have therefore proposed a bund should be constructed along the northern edge of the field as shown in the drawing in Appendix F which will store any additional run-off caused by the polytunnels. The storage provided is approximately 3000 cubic metres, whilst the required storage is approximately 2280 cubic metres. This bund will again reduce the risk of surface water flooding to the adjacent land as it will remove any surface water discharge altogether so will be an improvement on the greenfield situation.

The mitigation as proposed will ensure the drainage is managed in the most sustainable way without increasing the flood risk to neighbouring land and will also reduce the level of pollutants that would be washed off the site compared with the previous green field situation.

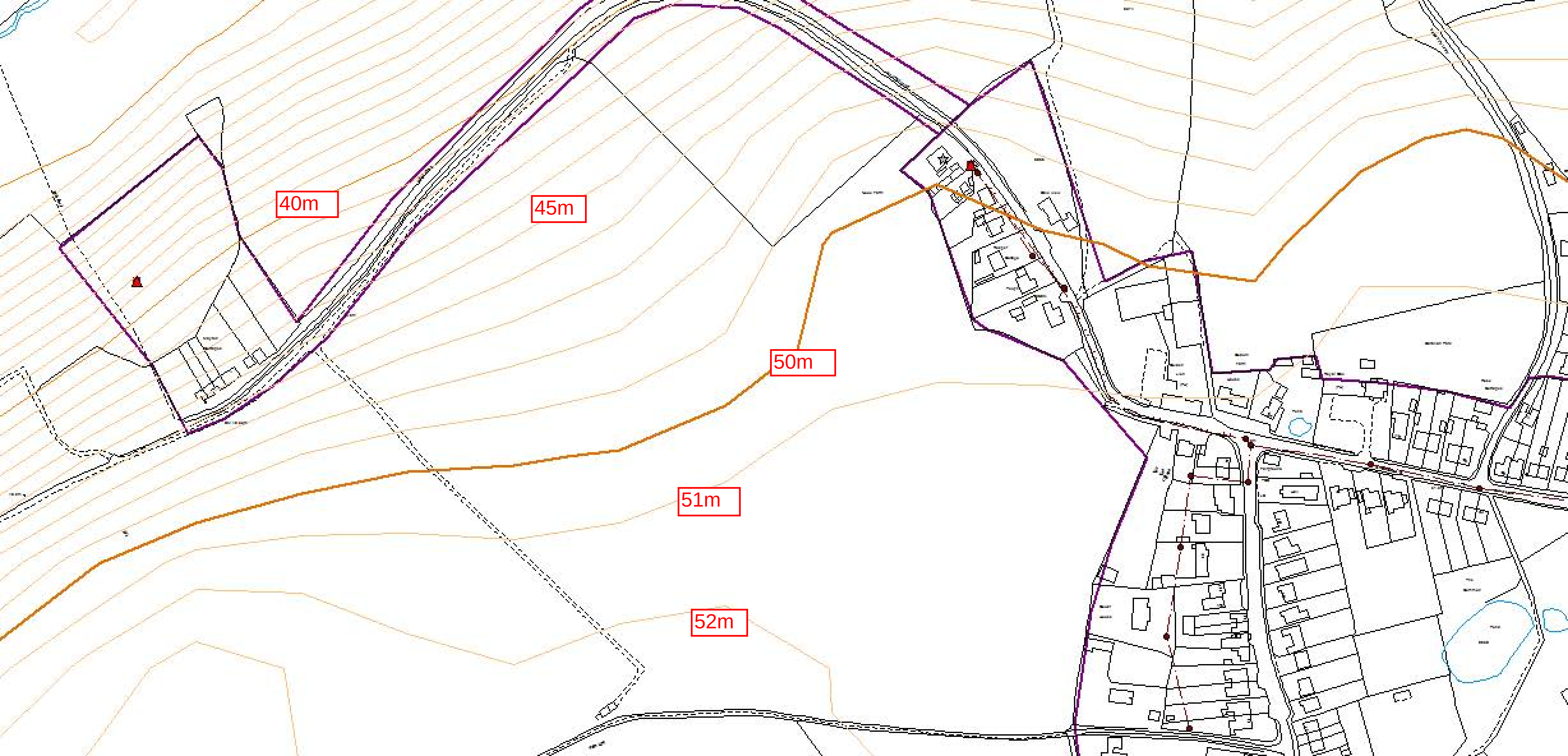
We therefore recommend that the mitigation measures proposed are adopted so that the planning condition can be met.

APPENDIX A - SITE LOCATION

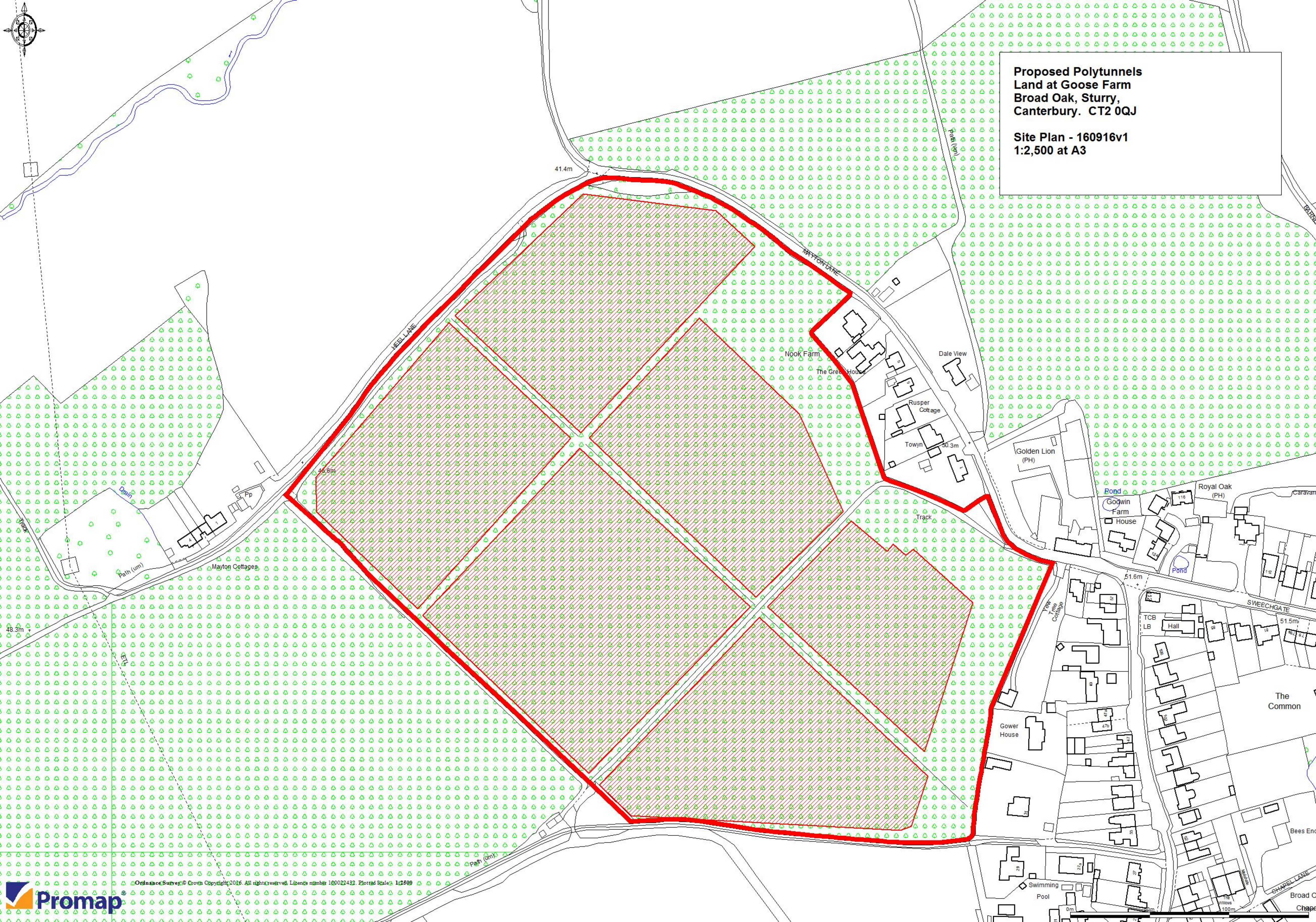


Goose Farm
Broad Oak, Sturry,
Canterbury. CT2 0QJ
Location Plan 190916v1
1:5,000 at A3
Nook Farm
HEEL LANE
Mayton Cottages
Reservoir
48m
Path
Track
PH
Caravan Park
Bobbingay
52m
SWEECHGATE
The Common
Broad Oak Farm
CHAPEL LANE
PW
Mead Manor
Broad Oak
Goose Farm
Little Hall Wood
FB
Barton Wood
Drain
Beecham Wood
Spr
Woodcroft
Priests Meadow
Caravan Parks
SHALLOAK ROAD
Lynne Wood
Ordnance Survey © Crown Copyright 2016. All rights reserved. Licence number 100022432. Plotted Scale - 1:5000
Promap

APPENDIX B – CONTOUR MAP


40m
45m
50m
51m
52m

APPENDIX C – BLOCK PLAN


Proposed Polytunnels
Land at Goose Farm
Broad Oak, Sturry,
Canterbury. CT2 0QJ
Site Plan - 160916v1
1:2,500 at A3
41.4m
MAYTON LANE
HEEL LANE
Nook Farm
The Green House
Dale View
Rusper Cottage
Towyn
50.3m
Golden Lion (PH)
Pond
Godwin Farm House
Royal Oak (PH)
Track
51.6m
SWEECHGATE
TCB
LB
Hall
51.5m
The Common
Gower House
Swimming Pool
Bees End
CHAPEL LANE
Mayton Cottages
Path (um)
Drain
Track
Pp
48.3m
Path (um)
Promap
Ordnance Survey © Crown Copyright 2016. All rights reserved. Licence number 100022432. Plotted Scale - 1:2500

APPENDIX D – GREEN FIELD RUN-OFF CALCULATIONS

Catchment Characteristics: Goose farm

616950	162300	TR,16950,62300
AREA	18.6	
FARL	1	
PROPWET	0.23	
ALTBAR	67	
ASPBAR	75	
ASPVAR	0.3	
BFIHOST	0.295	
DPLBAR	5.03	
DPSBAR	37.8	
LDP	12.22	
RMED-1H	12.2	
RMED-1D	31.5	
RMED-2D	41.1	
SAAR	651	
SAAR4170	637	
SPRHOST	45.2	
URBCONC	0.512	
URBEXT199	0.011	
URBLOC	1.125	
C	-0.022	
D1	0.311	
D2	0.372	
D3	0.261	
E	0.316	
F	2.513	
C(1km)	-0.021	
D1(1km)	0.312	
D2(1km)	0.357	
D3(1km)	0.26	
E(1km)	0.316	
F(1km)	2.501	

TABLE 6 The five WRAP classes against runoff potential

Class	Winter rainfall acceptance	Winter runoff potential	General description of soils
1	Very high	Very low (S_1)	i) Well drained permeable sandy or loamy soils and shallower analogues over highly permeable limestone, chalk, sandstone or related drifts. ii) Earthy peat soils drained by dykes and pumps. iii) Less permeable loamy over clayey soils on plateaux adjacent to very permeable soils in valleys.
2	High	Low (S_2)	i) Very permeable soils with shallow groundwater. ii) Permeable soils over rock or fragipan, commonly on slopes in western Britain associated with smaller areas of less permeable wet soils. iii) Moderately permeable soils, some with slowly permeable subsoils.
3	Moderate	Moderate (S_3)	i) Relatively impermeable soils in boulder and sedimentary clays, and in alluvium, especially in eastern England. ii) Permeable soils with shallow groundwater in low lying areas. iii) Mixed areas of permeable and impermeable soils, in approximately equal proportions.
4	Low	High (S_4)	Clayey, or loamy over clayey soils with an impermeable layer at shallow depth.
5	Very low	Very high (S_5)	Soils of the wet uplands i) with peaty or humose surface horizons and impermeable layers at shallow depth; ii) deep raw peat associated with gentle upland slopes or basin sites; iii) bare rock cliffs and screes; and iv) shallow, permeable rocky soils on steep slopes.

The Soil Survey allocated a soil profile to the five class WRAP system by weighting four main soil and site properties. These parameters were in order of priority -

1. Soil water regime
2. Depth to impermeable horizon
3. Permeability above the impermeable horizon
4. Slope (which accentuates the effect of the above three parameters).

e soil types within a catchment may be allocated to a WRAP class using the ur-way Table 7 which incorporates the above four parameters.

BLE 7 Allocation of soil sites to WRAP classes

ater egime lass	Depth to impermeable horizon (cm)	Slope classes <3.5% Rapid	<3.5% Medium	<3.5% Slow	3.5-14% Rapid	3.5-14% Medium	3.5-14% Slow	>14% Rapid	>14% Medium	>14% Slow
		Permeability class (above impermeable horizon)								
1	>80	1	1	2	1	1	2	1	2	3
	80-40	1	1	2	3	3	3	3	3	4
	<40	-	-	-	-	-	-	-	-	-
2	>80	2	2	3	3	3	4	-	4	4
	80-40	2	3	3	3	4	4	4	4	4
	<40	3	4	4	4	4	4	4	4	5
3	>80	4	4	5	5	5	5	-	5	5
	80-40	4	5	5	5	5	5	-	5	5
	<40	5	5	5	5	5	5	5	5	5

OTE: 1. Water Regime Class.

1. Rarely waterlogged within 60 cm at any time (well and moderately well drained)
2. Commonly waterlogged within 60 cm during winter (imperfect and poor)
3. Commonly waterlogged within 60 cm during winter and summer (very poorly drained)

2. A suggested modification to the derivation of the WRAP class is given in Section 3.4.3 where the effects of underdrainage on peak runoff are evaluated.

3. In some cases sandy or sandy loam soils may be inherently weak in structure and when uncropped will slake or cap readily. The winter runoff potential and WRAP class number could in this situation be much higher.

In the next stage of the analysis, for each catchment the fraction covered by each of the five WRAP classes was measured and referred to as S_1, S_2, S_3, S_4 and S_5. These fractions were then combined to give a weighted mean of the individual fractions for any catchment.
A suitable numerical index was found using multiple regression of the WRAP class fraction on indices of a catchment's flood potential and morphometric characteristics. The equation derived is given below -

$$S_m = \frac{(0.15\ S_1 + 0.30\ S_2 + 0.40\ S_3 + 0.45\ S_4 + 0.50\ S_5)}{(1 - S_u)} \quad \ldots\ldots \quad (12)$$

where S_m is the modifying soil factor;

S_1-S_5 are the fractions of the area covered by the appropriate WRAP class and S_u is the unclassified area of the catchment which is covered by water or a paved area. In cases where S_u is zero, the derived S_m index will then have a value in the range of 0.15 to 0.50.

The derived S_m index is then applied to the calculated peak runoff flow to indicate the effect on peak flow of soils other than the relatively impermeable clay deposits. The modified equation is:

$$Q_c = 2.78\ F_A\ A\ \frac{R_B}{T}\ M_F \text{ litre/s} \qquad \ldots\ldots (13)$$

$$\text{where } M_F = 4.938\ S_m^{\ 2.0} \qquad \ldots\ldots (14)$$

$$\text{or} \quad Q_c = 13.73\ S_m^{\ 2.0}\ F_A\ A\ \frac{R_B}{T} \text{ litre/s} \qquad \ldots\ldots (15)$$

The basic flood flow equation, number 10, was designed from wholly clay catchments whose WRAP class would be 4. The modifying soil index factor S_m would be 0.45 from equation (12) and the modifying factor

$$M_F = 4.938\ S_m^{\ 2.0} \longrightarrow 1.$$

The basic flood flow equation would then apply.

In catchments containing an appreciable amount of more permeable soils (WRAP classes 1 or 2), the S_m factor would be less than the 0.45 for a clay soil, and the modifying factor M_F would be less than unity. The derived flood flow would thus be reduced to take account of the area of the catchment covered by more permeable soils.

3.4.2 The effect of groundwater

In some catchments a complication which may affect the quantity of water leaving the catchment and entering a pipe ditch scheme is from a groundwater source. For example, in glaciated lowlands adjacent to an area of uplands, confined groundwater can migrate quickly from one catchment to another through a continuous aquifer of pervious rocks.

Where it is considered likely that groundwater might have an appreciable affect on peak runoff an allowance should be built into the design rate based on available information.

3.4.3 The effect of field drainage

The method presented here for the derivation of a peak flow runoff was determined for natural catchments with no appreciable paved areas and with no underdrainage. A modifying factor has been suggested in the derivation for small paved areas, see Section 3.4.1. Similarly a modification could be incorporated for the presence of an underdrainage system where it is likely to exert an appreciable retarding action on the surface runoff from the catchment. Field drainage may have a modifying influence on the runoff by virtue of improving the Winter Rainfall Acceptance through enhanced storage in the profile over the moisture range of field capacity to saturation (Bailey and Bree 1980). Where the field drainage is known to

Site at Goose Farm, Broad Oak
Green field Run-Off Rates

IoH
Q bar
$0.00108\ Area^{0.89} x SAAR^{1.17} \times SOIL^{2.17}$

Area	0.5		
$Area^{0.89}$	0.539614		
SAAR	651		
$SAAR^{1.17}$	1958.347		
SOIL	0.45	Soil Type 4: slope >3.5%<14 and water regime class 2: depth to impermeable strata <40 cm.	
$SOIL^{2.17}$	0.176795		
Actual site area		9.33	hectares
Qbar	0.201775	m3/s	for 50 hectare site
Qbar site	0.037651	m3/s	

For sites less than 50 hectares, use 50 hectares and calculate rate per hectare and then muliply by actual size of site (comes from SUDS manual)

growth factors from FSH for south east (region 7) are:-

1 year =	0.85
30 year =	2.3
100 year =	3.19

green field run -off rates for site

1 year =	0.032004	32.00358	l/s
2 year =	0.037651	37.65127	l/s
30 year =	0.086598	86.59792	l/s
100 year =	0.120108	120.1075	l/s
100year plus cc =	0.144129	144.1291	l/s

APPENDIX E – EXTRACTS FROM GUIDANCE ON CLIMATE CHANGE RAINFALL INCREASES

range of allowances
- less vulnerable – use the central and higher central to assess a range of allowances
- water compatible – use the central allowance

In flood zone 3b

- essential infrastructure – use the upper end allowance
- highly vulnerable – development should not be permitted
- more vulnerable – development should not be permitted
- less vulnerable – development should not be permitted
- water compatible – use the central allowance

If (exceptionally) development is considered appropriate when not in accordance with flood zone vulnerability categories, then it would be appropriate to use the upper end allowance.

Peak rainfall intensity allowance

Increased rainfall affects river levels and land and urban drainage systems.

When to use the peak rainfall intensity allowance

Table 2 shows anticipated changes in extreme rainfall intensity in small and urban catchments.

For flood risk assessments and strategic flood risk assessments, assess both the central and upper end allowances to understand the range of impact.

Table 2 peak rainfall intensity allowance in small and urban catchments (use 1961 to 1990 baseline)

Applies across all of	Total potential change anticipated for	Total potential change anticipated for	Total potential change anticipated for

England	the '2020s' (2015 to 2039)	the '2050s' (2040 to 2069)	the '2080s' (2070 to 2115)
Upper end	10%	20%	40%
Central	5%	10%	20%

Sea level allowances

There is a single regional allowance for each epoch or time frame for sea level rise in table 3.

EA expect sea level rise to increase the rate of coastal erosion. Use the coastal erosion risk maps to plan for any changes in the position of the coastline. The maps are based on the best available data. They show the shoreline management plan policy for each stretch of coast and erosion predictions where there is no policy to maintain defences.

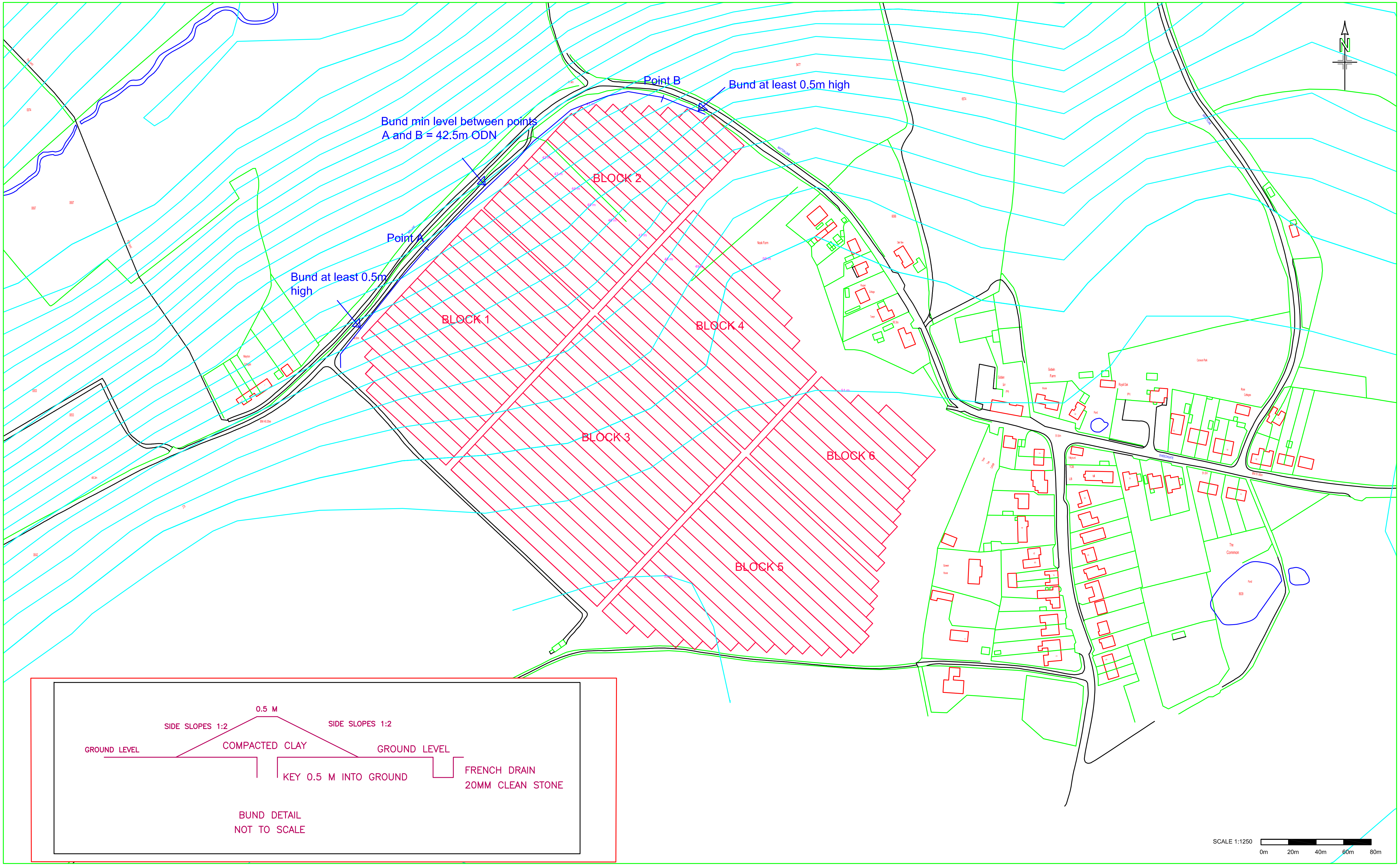
EA will want to see if you have considered if it is appropriate to apply high++ allowances for your flood risk assessment or strategic flood risk assessment.

Table 3 sea level allowance for each epoch in millimetres (mm) per year with cumulative sea level rise for each epoch in brackets (use 1990 baseline)

Area of England	1990 to 2025	2026 to 2055	2056 to 2085	2086 to 2115	Cumulative rise 1990 to 2115 / metres (m)
East, east midlands, London, south east	4 (140 mm)	8.5 (255 mm)	12 (360 mm)	15 (450 mm)	1.21 m

APPENDIX F – LAYOUT OF POLYTUNNELS AND RUN-OFF ROUTES

CONSTRUCTION DETAILS OF POLYTUNNELS



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3. ALL DIMENSIONS IN MILLIMETRES, ALL LEVELS IN METRES.

Issue	By	Date	Amendments
A	initial	../../..	Original issue

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71 High Street, Wallingford Oxfordshire OX10 0BX
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Project:
Goose Farm
Broad Oak
New Polytunnels

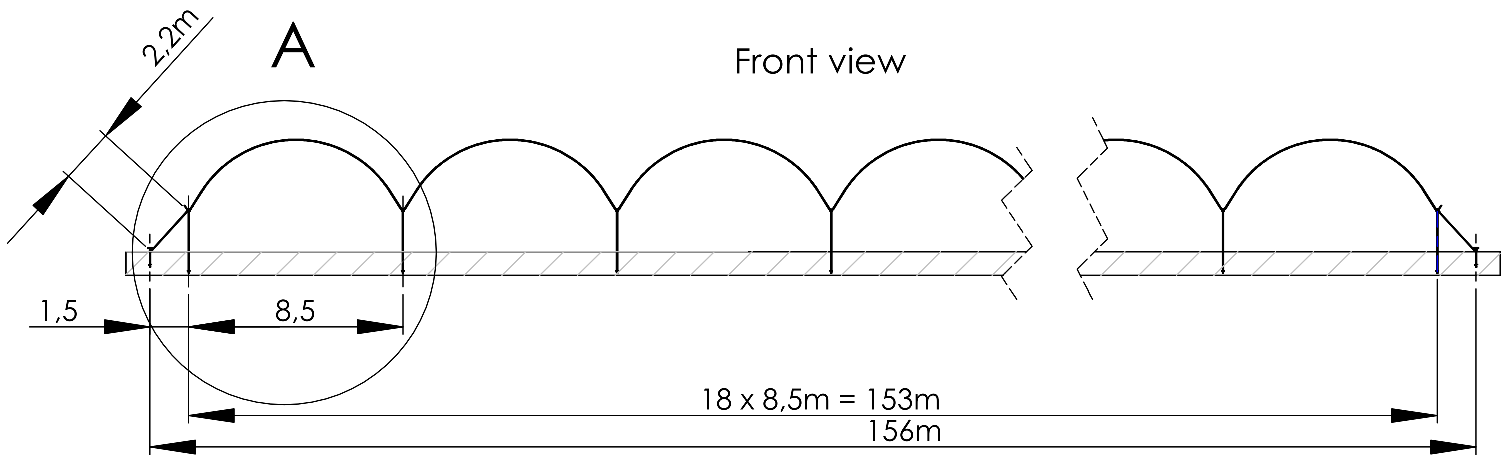
Description:
Polytunnel Directions
Slope of Ground
and Surface Water Mitigation
Measures

Original Drawing: Prepared -MB Approved ---
Origin: Crowborough Size A1
Current Issue: Approved --- Date 20/02/2017
Drawing Status: PRELIMINARY

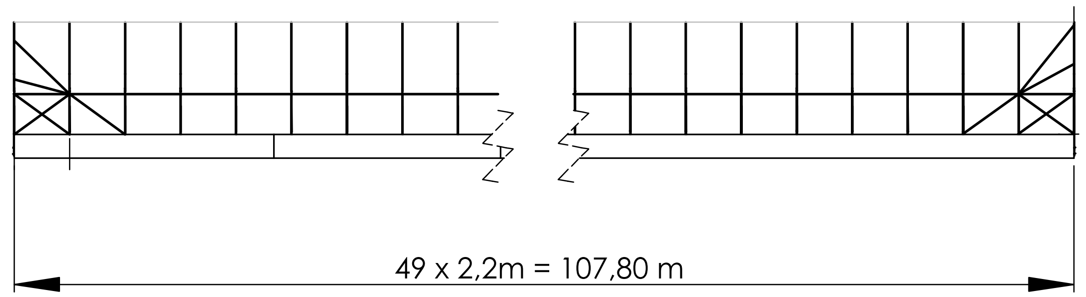
Scale: 1:1250
Dwg No: 8441/01
Issue: A

All dimensions ±5%
All dimensions in meters

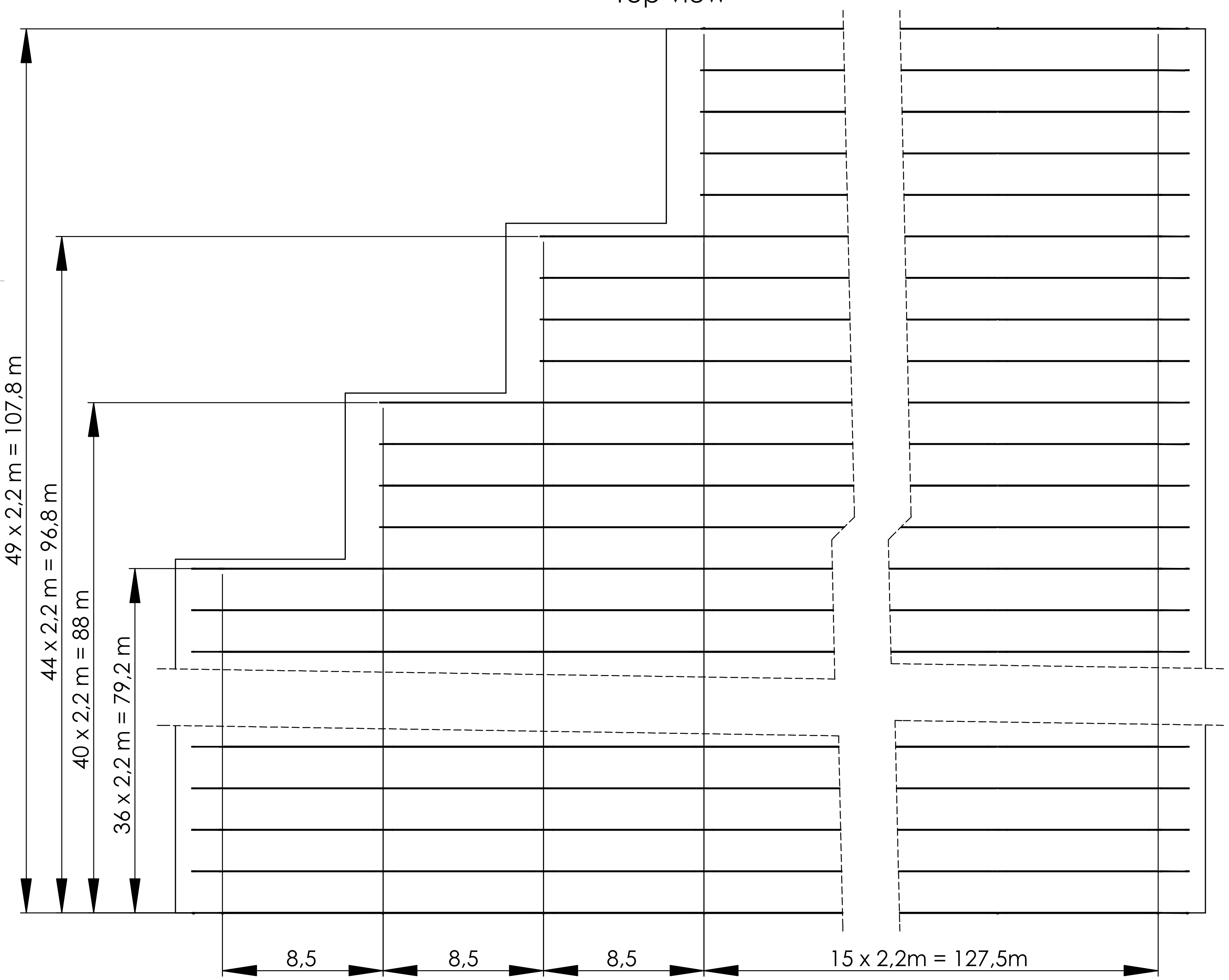
Front view



Side view



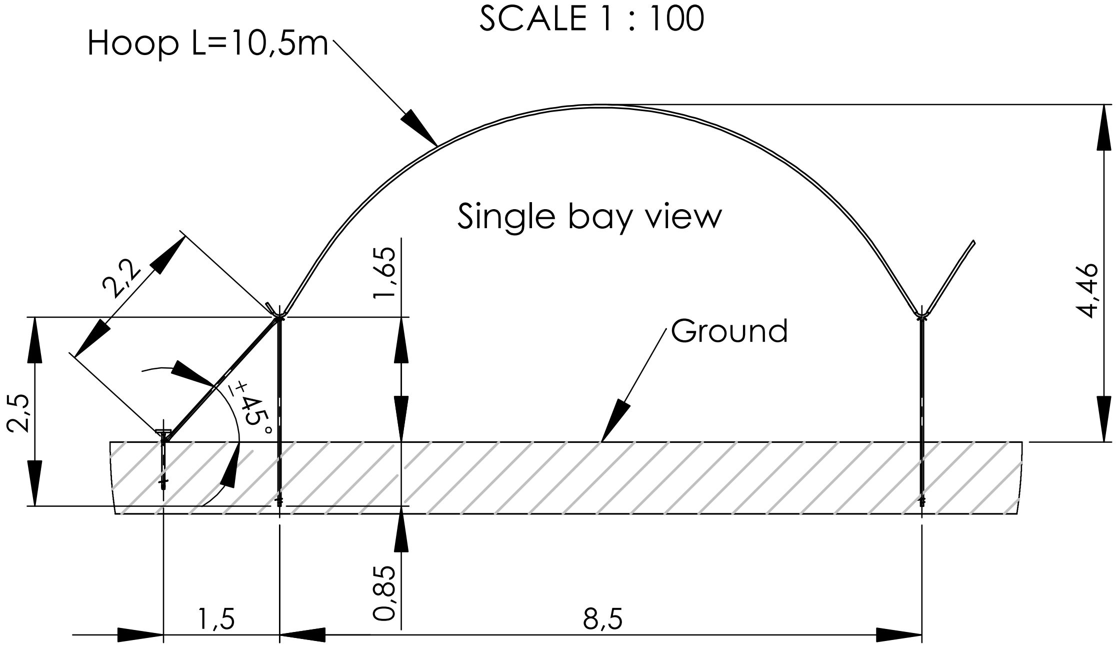
Top view



SCALE 1: 300

0 5 10m

Detail A
SCALE 1 : 100



SCALE 1 : 100

0 2 4 6 8 10m

IF IN DOUBT ASK	**DEBUR AND BREAK SHARP EDGES / WSZYSTKIE OSTRE KRAWĘDZIE STĘPIĆ**				
Masz wątpliwości pytaj	ALL DIMENSIONS IN MM UNLESS STATED DO NOT SCALE DRAWING Wszystkie wymiary w milimetrach jeśli nie zaznaczono inaczej	Material/Materiał:			
		Weight/Ciężar:			
Drawn/Rys.	Date/Data	Checked/Spr.	Date/Data	Approved/Zatw.	Date/Data
gleszczynski	2011-09-26				F

Haygrove

Haygrove Ltd
Redbank, Ledbury
Herefordshire U.K.
Tel: 44 (0)1531 635041
Info@haygrove.co.uk

TITLE:
OPIS: Man-1-ne-16 – Big Block 1

18 tunnels at 8.5m wide with 3 staggers

DWG NO:
NR RYS.: TA01913

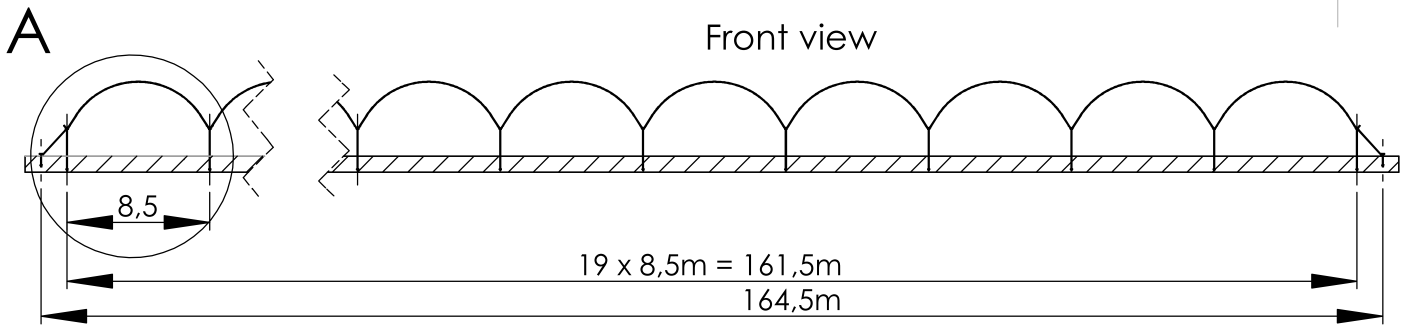
HG No:

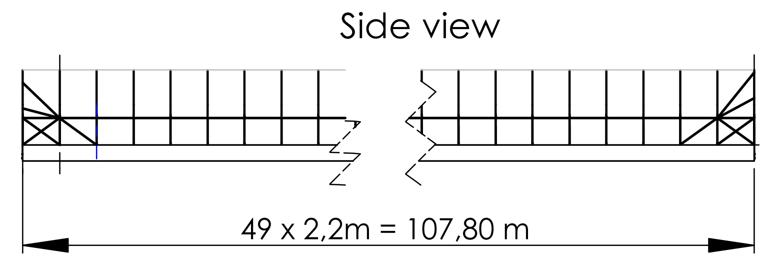
SCALE:
SKALA: 1:300

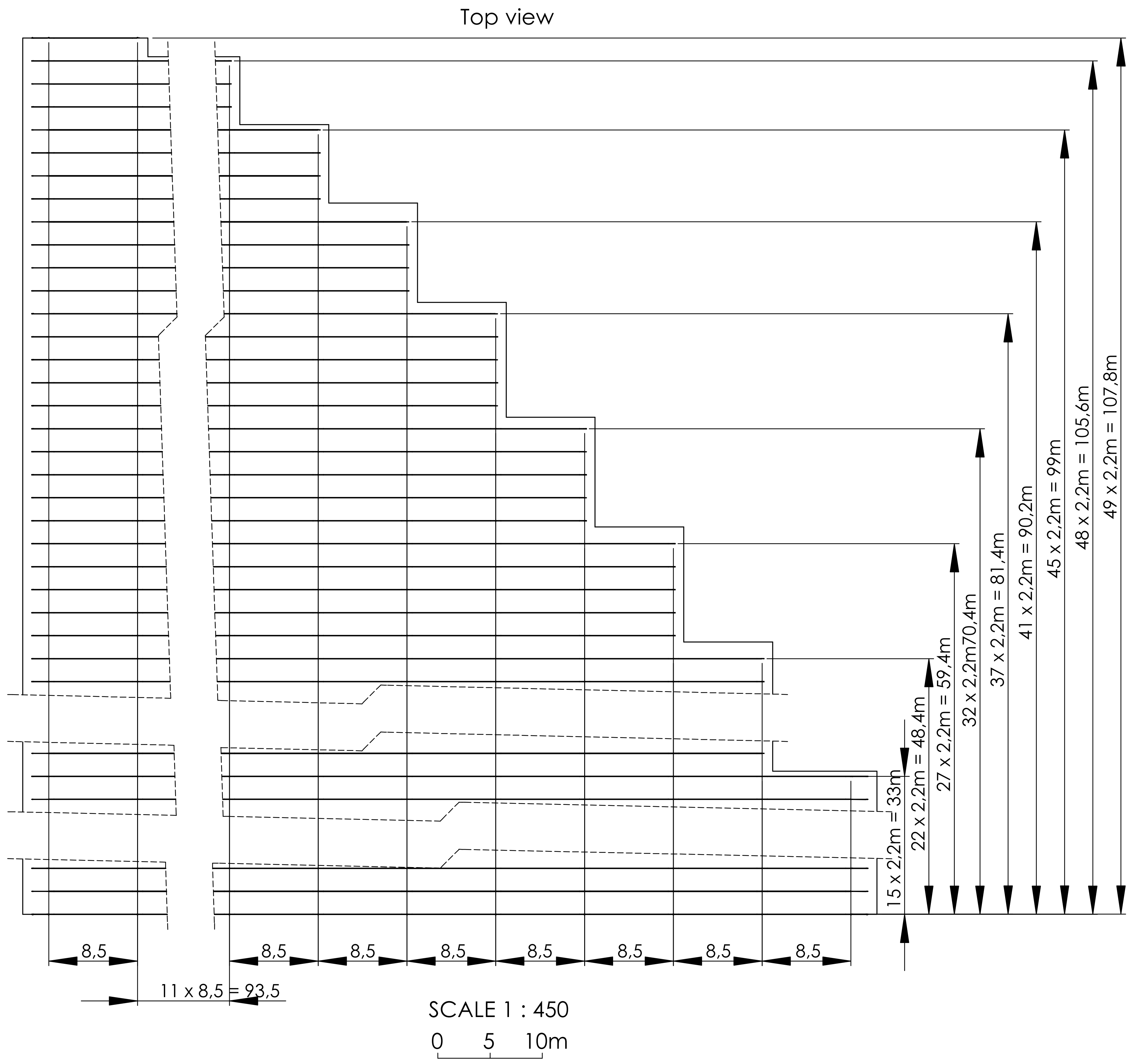
SHEET:
ARKUSZ: 1 of 1

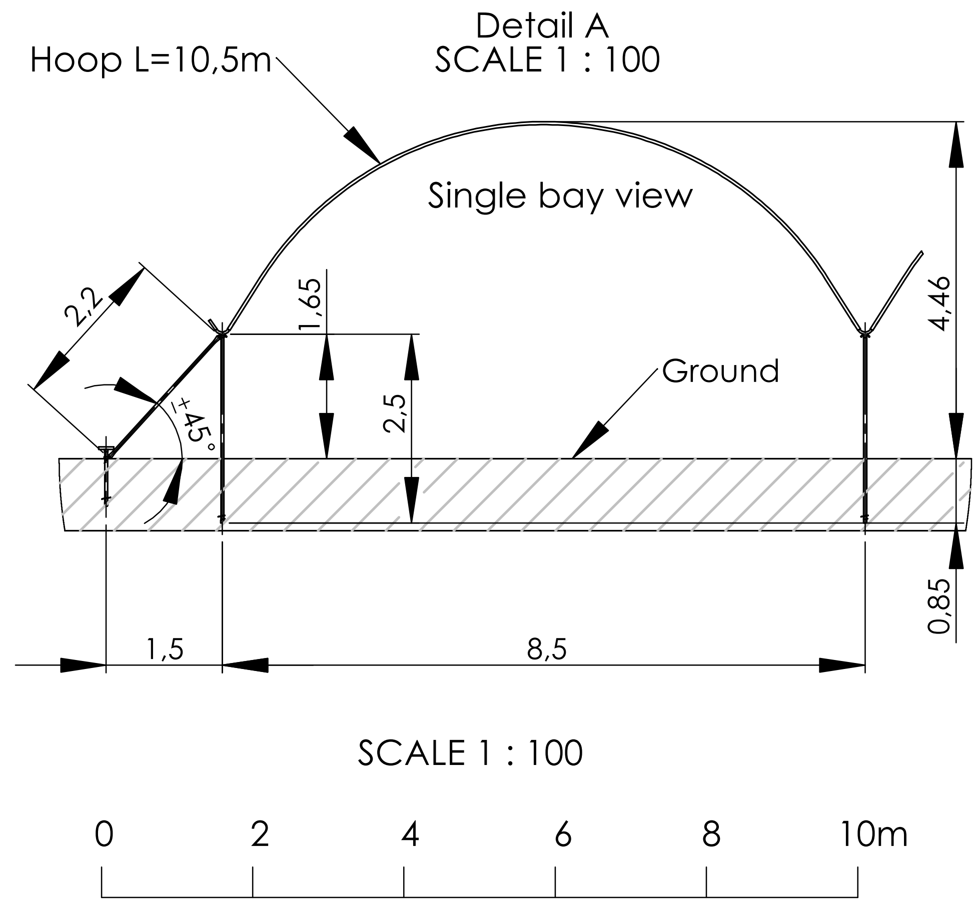
REVISION:
REWIZJA: 1

A3









All dimensions ±5%
All dimensions in meters

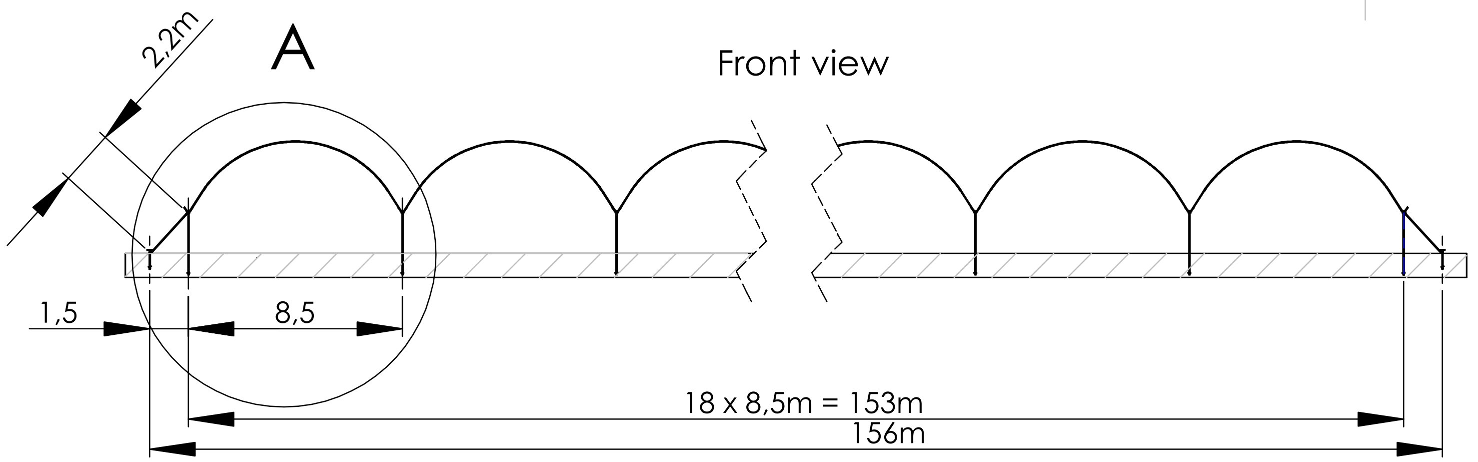
IF IN DOUBT ASK	**DEBUR AND BREAK SHARP EDGES / WSZYSTKIE OSTRE KRAWĘDZIE STĘPIĆ**					
Masz wątpliwości pytaj	ALL DIMENSIONS IN MM UNLESS STATED DO NOT SCALE DRAWING Wszystkie wymiary w milimetrach jeśli nie zaznaczono inaczej	Material/Materiał:				
		Weight/Ciężar:				
		Drawn/Rys.	Date/Data	Checked/Spr.	Date/Data	Approved/Zatw. Date/Data
		gleszczynski	2011-09-26			F
		TITLE: OPIS:	Man-2-ne-16 – Big Block 2			
	Haygrove Ltd Redbank, Ledbury Herefordshire U.K. Tel: 44 (0)1531 635041 info@haygrove.co.uk		19 tunnels at 8.5m wide with 6 staggers			
		DWG NO: NR RYS.:	TA01914	HG No:		
		SCALE: SKALA:	1:450	SHEET: ARKUSZ: 1 of 1	REVISION: REWIZJA: 1	A3

Haygrove

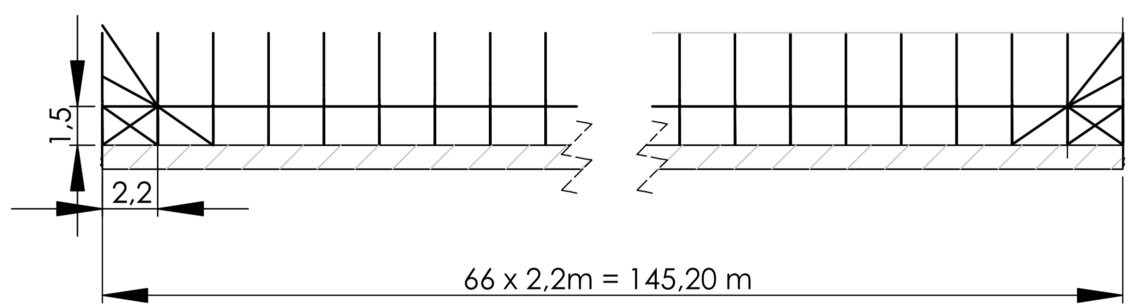
All dimensions ±5%
All dimensions in meters

A

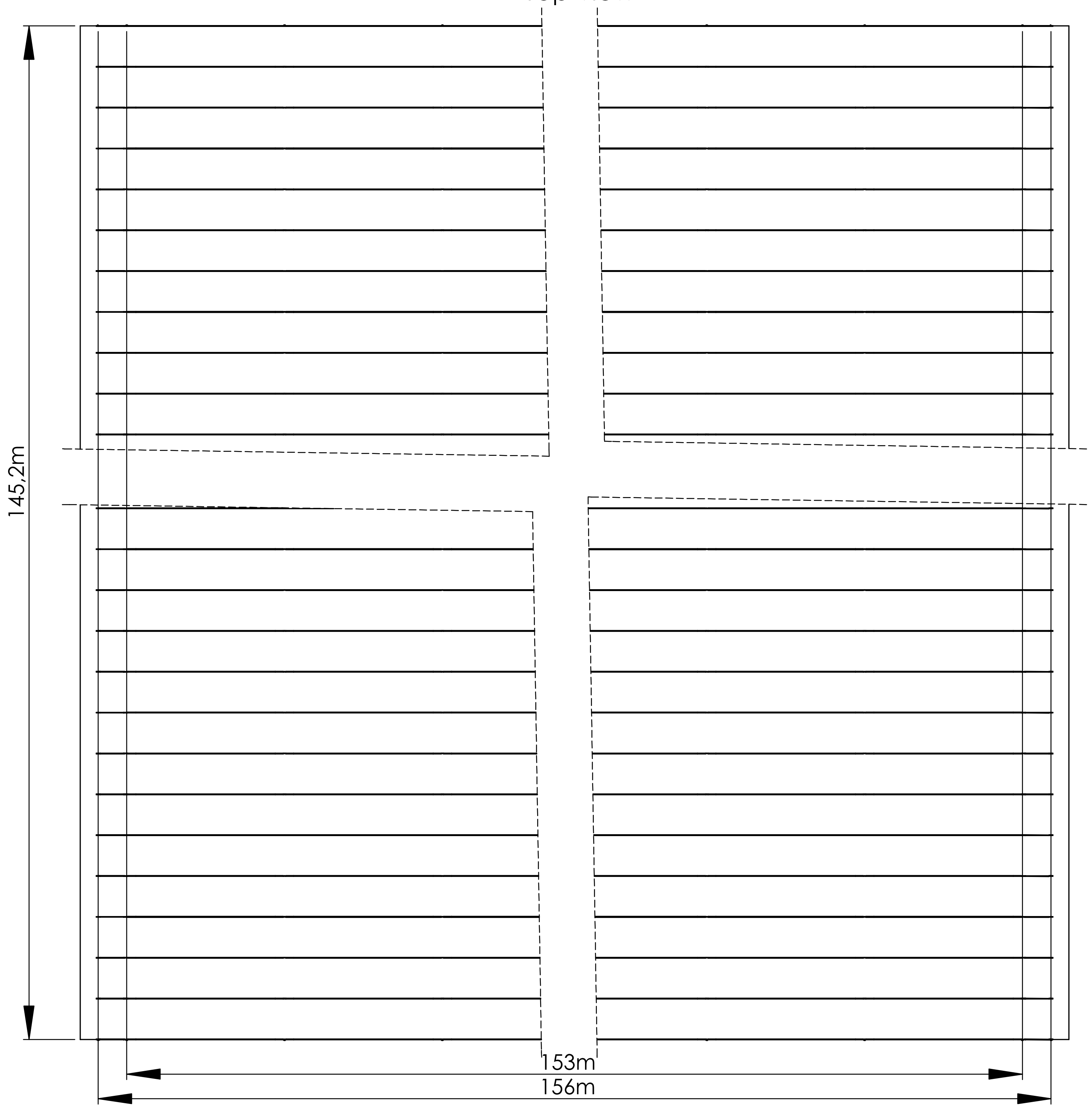
Front view



Side view

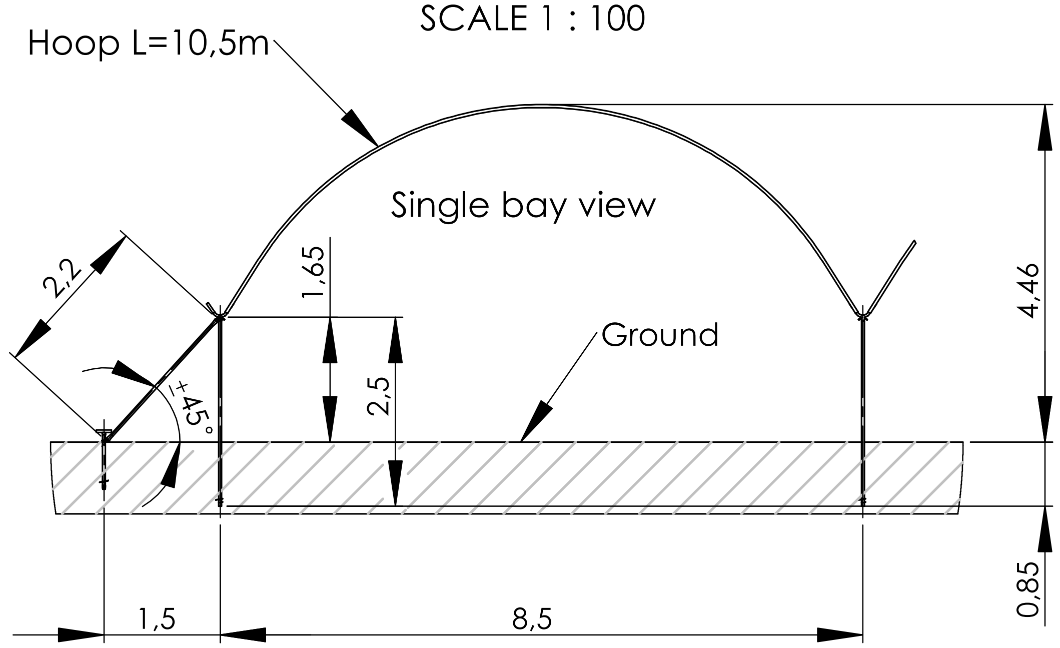


Top view



SCALE 1:300

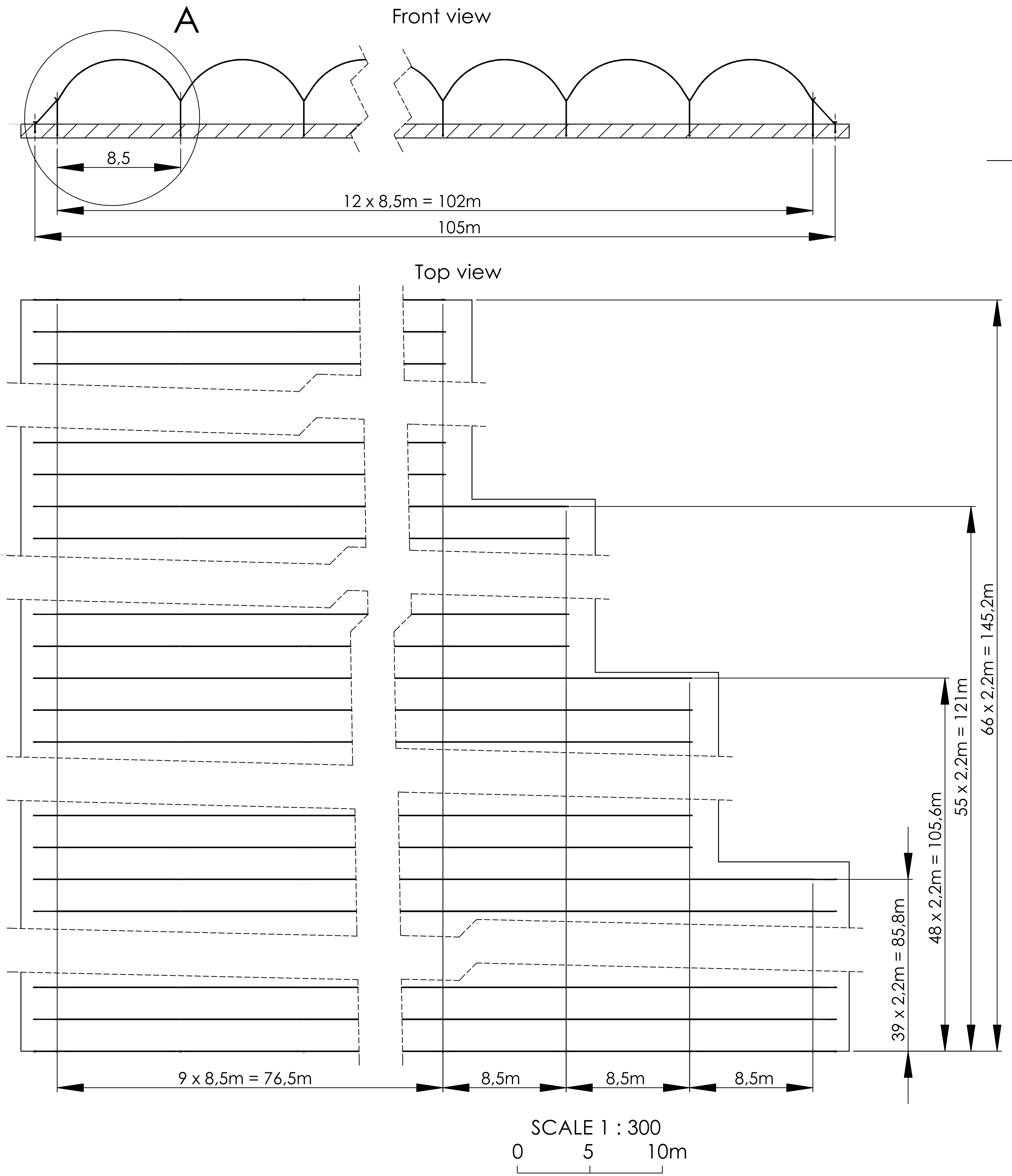
Detail A
SCALE 1 : 100

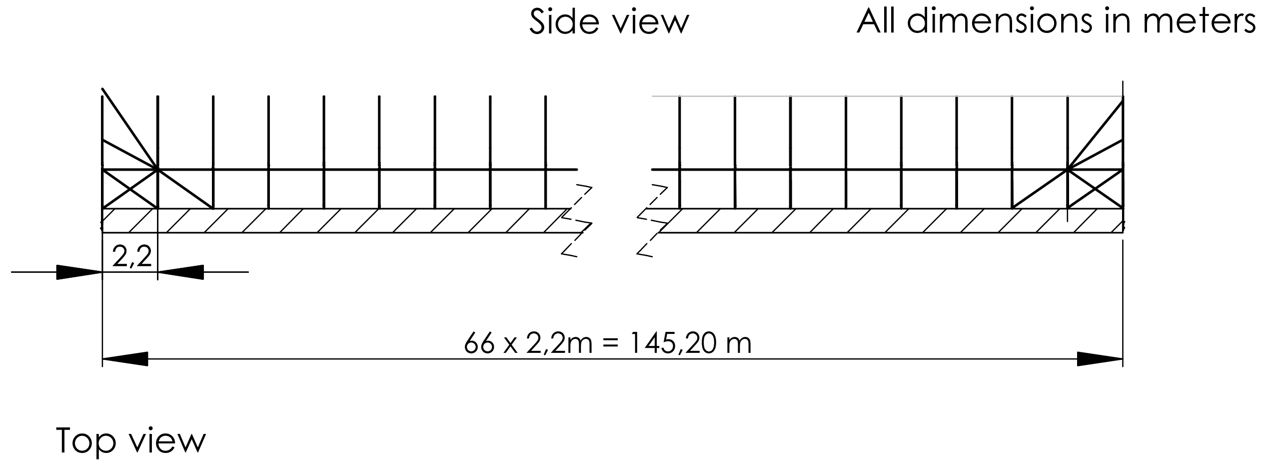


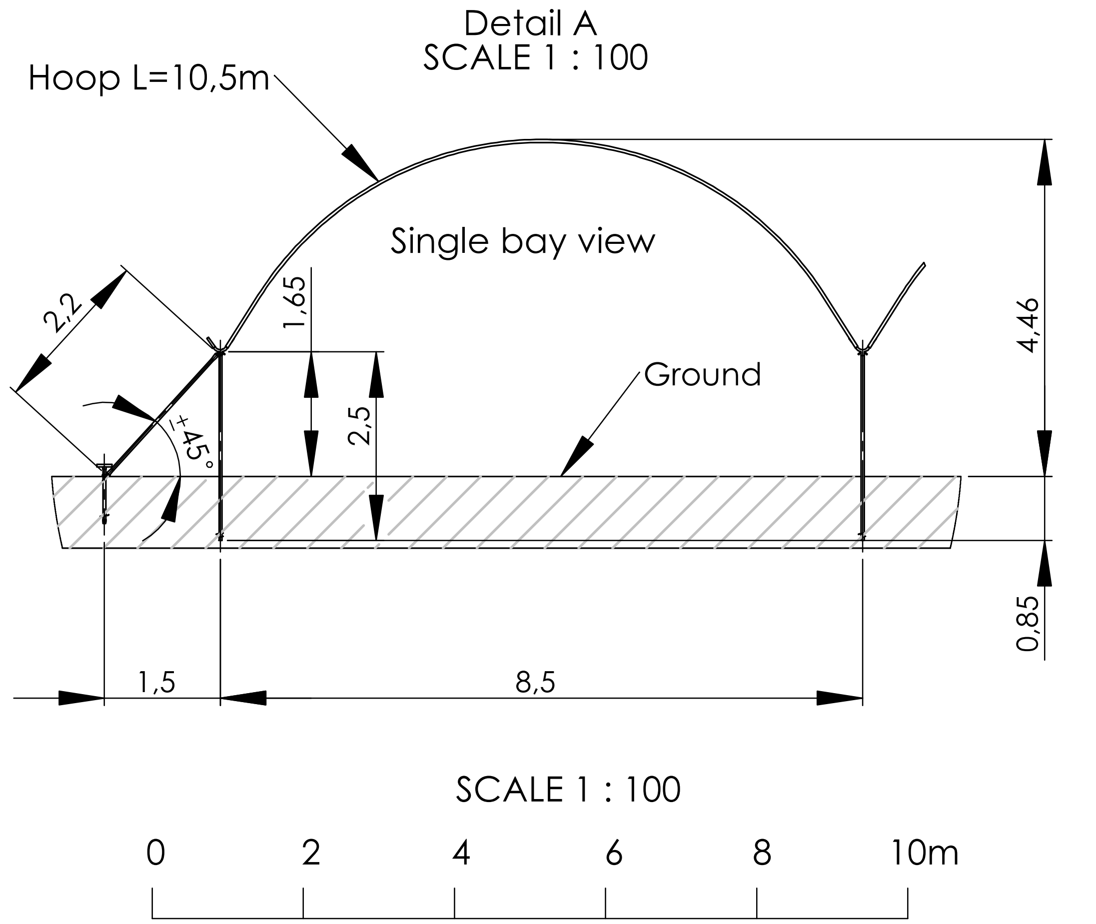
SCALE 1 : 100

IF IN DOUBT ASK	DEBUR AND BREAK SHARP EDGES / WSZYSTKIE OSTRE KRAWĘDZIE STĘPIĆ					
Masz wątpliwości pytaj	ALL DIMENSIONS IN MM UNLESS STATED DO NOT SCALE DRAWING Wszystkie wymiary w milimetrach jeśli nie zaznaczono inaczej	Material/Materiał:				
This document is confidential and the document and the copyright therein are the property of Haygrove Ltd. The document and any information therein may not beused, copied or disclosed to any third party without theprior written authorisation of Haygrove Ltd. Ten dokument jest własnością firmy Haygrove Ltd.. Wykorzystanie lub kopiowanie elementów lub rysunku bez zgody firmy Haygrove Ltd. jest zabronione.		Weight/Ciężar:				
		Drawn/Rys.	Date/Data	Checked/Spr.	Date/Data	Approved/Zatw. Date/Data
		gleszczynski	2011-09-26			F
		TITLE: OPIS:	Man-3-ne-16 – Big Block 3			
Haygrove	Haygrove Ltd Redbank, Ledbury Herefordshire U.K. Tel: 44 (0)1531 635041 info@haygrove.co.uk		18 tunnels at 8.5m wide and 145m long (No staggers)			
		DWG NO: NR RYS.:	TA01915	HG No:		
		SCALE: SKALA: 1:300	SHEET: ARKUSZ: 1 of 1	REVISION: REWIZJA: 1		A3

All dimensions ±5%
All dimensions in meters







IF IN DOUBT ASK **DEBUR AND BREAK SHARP EDGES / WSZYSTKIE OSTRE KRAWĘDZIE STĘPIĆ**

Masz wątpliwości pytaj

ALL DIMENSIONS IN MM UNLESS STATED
DO NOT SCALE DRAWING
Wszystkie wymiary w milimetrach jeśli nie zaznaczono inaczej

Material/Materiał:

Weight/Ciężar:

Drawn/Rys.	Date/Data	Checked/Spr.	Date/Data	Approved/Zatw.	Date/Data
gleszczynski	2011-09-26				F

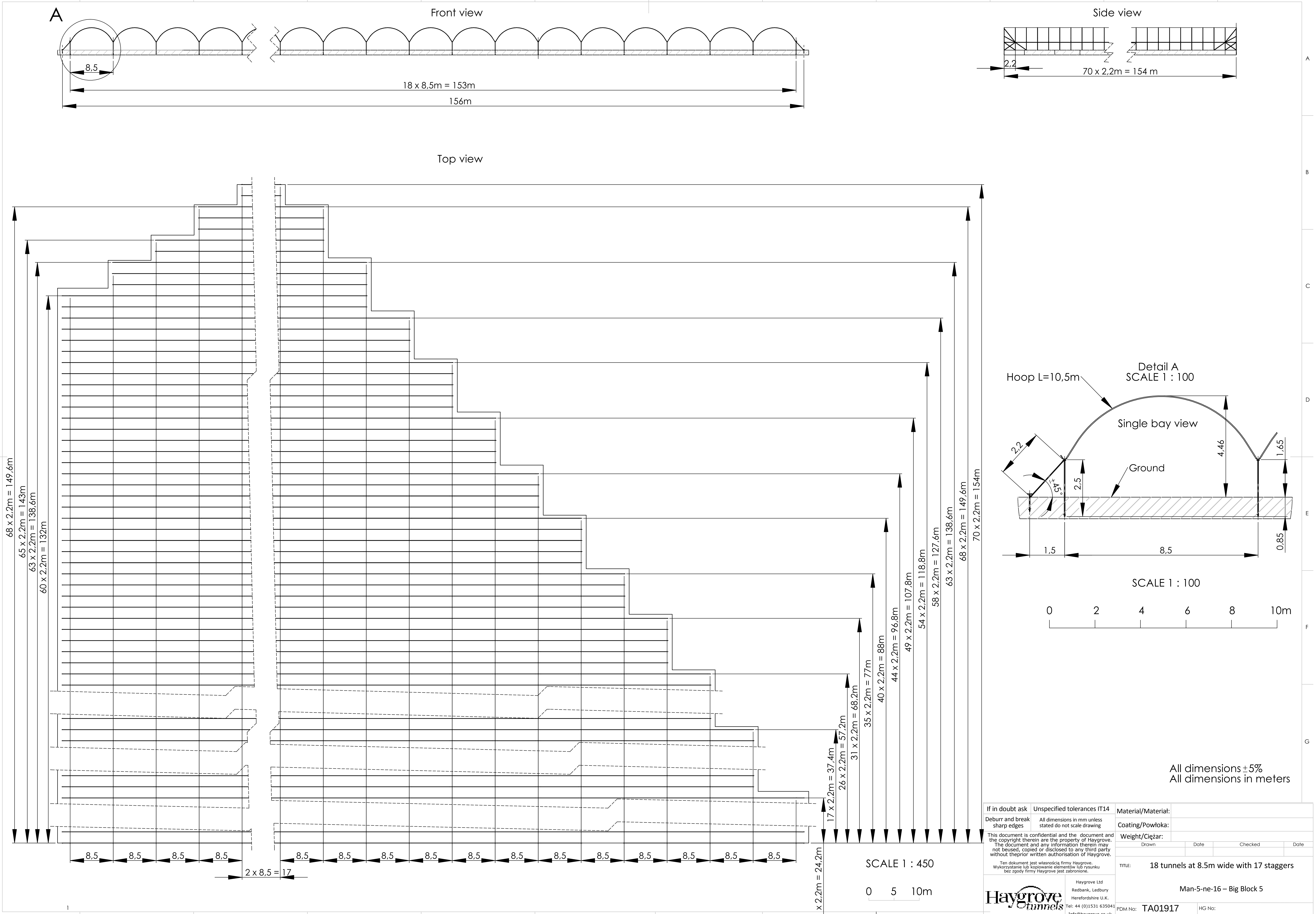
Haygrove
Haygrove Ltd
Redbank, Ledbury
Herefordshire U.K.
Tel: 44 (0)1531 635041
info@haygrove.co.uk

TITLE: OPIS: Man-4-ne-16 – Big Block 4

12 tunnels at 8.5m wide with 3 staggers

DWG NO: NR RYS.: TA01916 HG No:

SCALE: SKALA: 1:300 SHEET: ARKUSZ: 1 of 1 REVISION: REWIZJA: 1 A3



All dimensions ±5%
All dimensions in meters

If in doubt ask	Unspecified tolerances IT14	Material/Materiał:	
Deburr and break sharp edges	All dimensions in mm unless stated do not scale drawing	Coating/Powłoka:	
		Weight/Ciężar:	

Drawn	Date	Checked	Date

TITLE: 18 tunnels at 8.5m wide with 17 staggers

Man-5-ne-16 – Big Block 5

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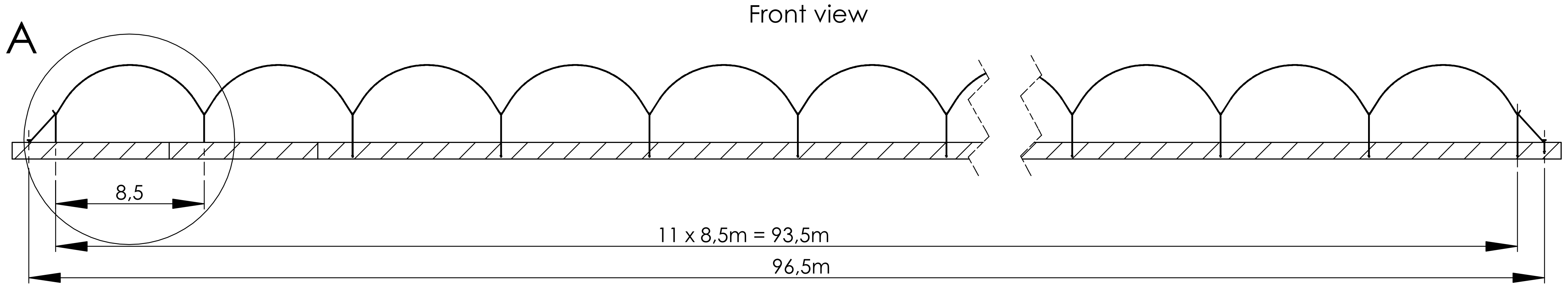
Herefordshire U.K.
Tel: 44 (0)1531 635041
Info@haygrove.co.uk

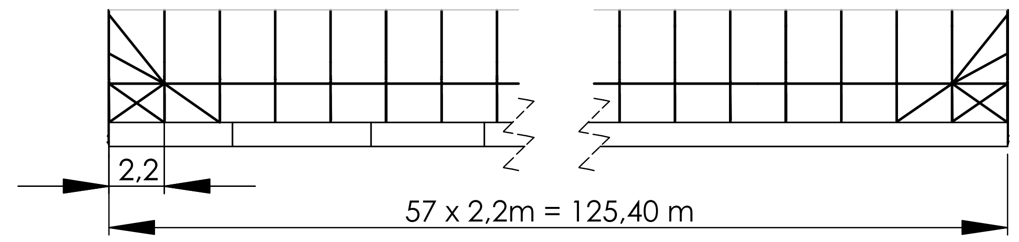
PDM No: TA01917 | HG No:

SCALE: 1:450 | SHEET: 1 of 1 | REVISION: 1 | A2

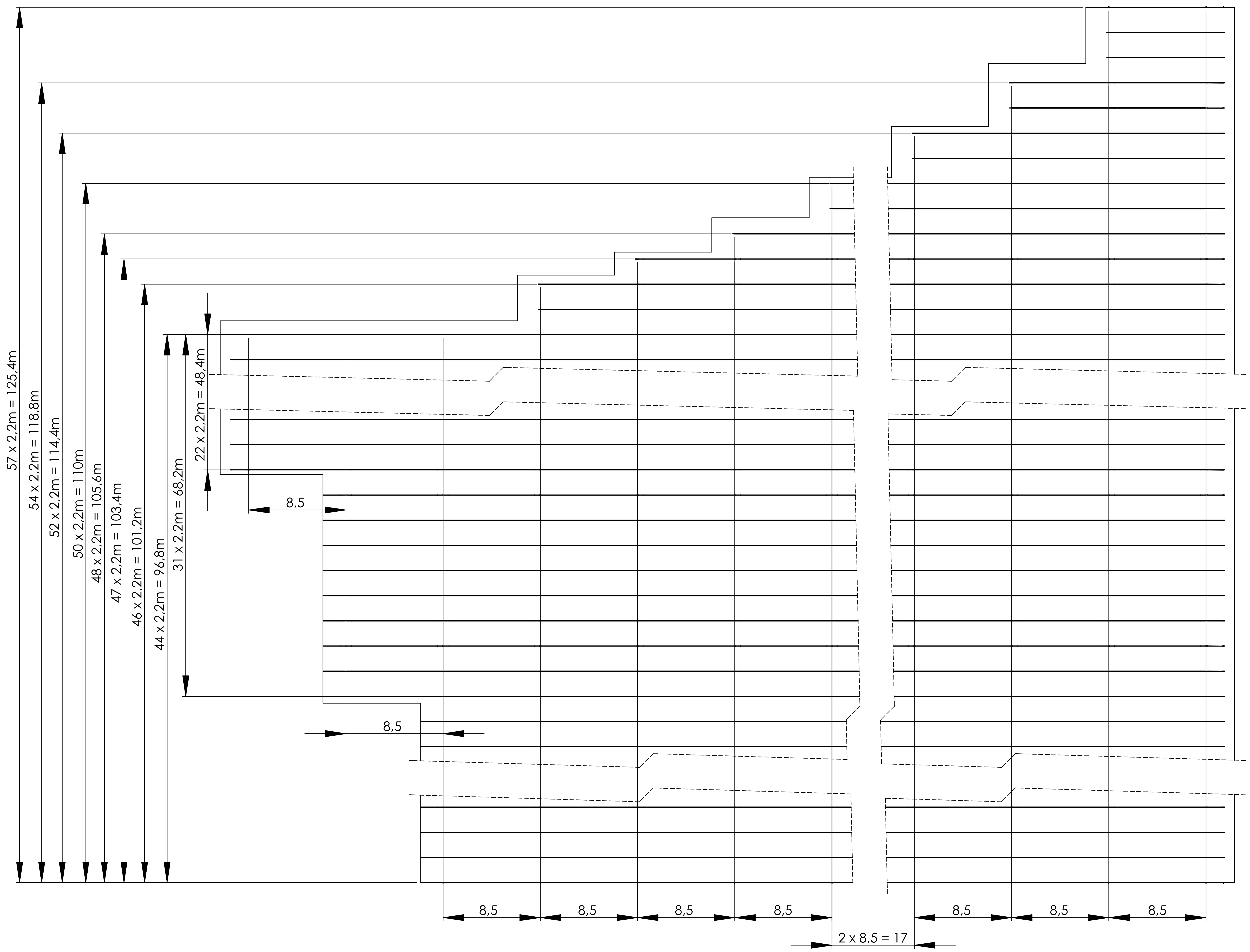
Front view



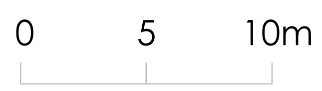
Side view



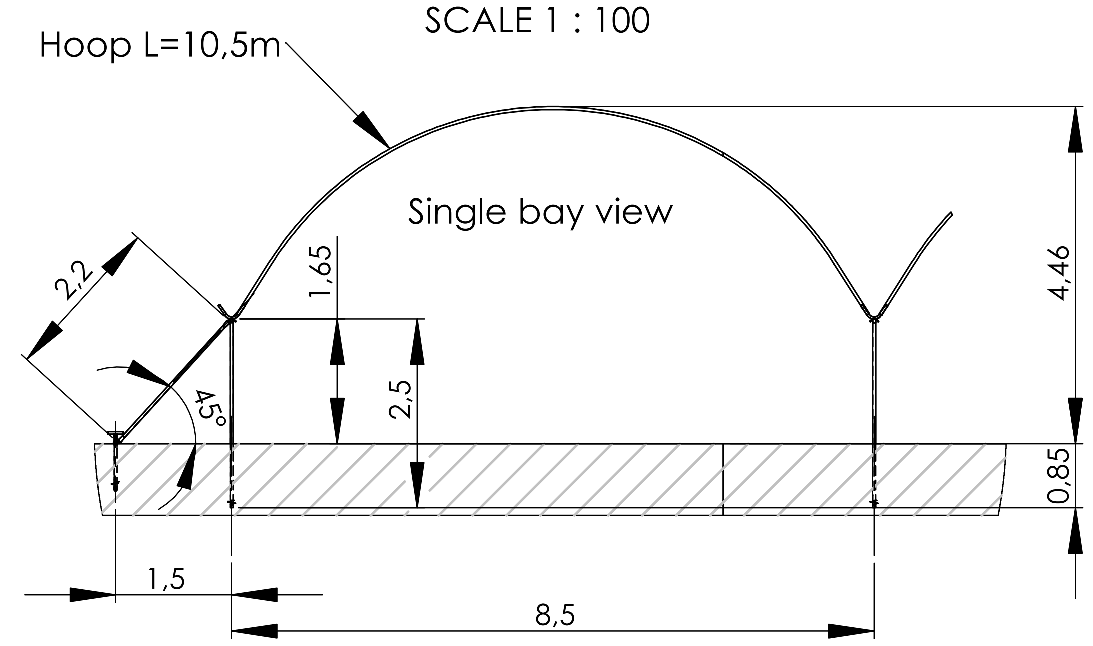
Top view



SCALE 1 : 300



Detail A
SCALE 1 : 100



SCALE 1 : 100

All dimensions ±5%
All dimensions in meters

IF IN DOUBT ASK	**DEBUR AND BREAK SHARP EDGES / WSZYSTKIE OSTRE KRAWĘDZIE STĘPIĆ**				
Masz wątpliwości pytaj	ALL DIMENSIONS IN MM UNLESS STATED DO NOT SCALE DRAWING Wszystkie wymiary w milimetrach jeśli nie zaznaczono inaczej	Material/Materiał:			
		Weight/Ciężar:			
		Drawn/Rys.	Date/Data	Checked/Spr.	Date/Data
		Approved/Zatw.	Date/Data		

Haygrove tunnels

Haygrove Ltd
Redbank, Ledbury
Herefordshire U.K.
Tel: 44 (0)1531 635041
Info@haygrove.co.uk

TITLE:
OPIS: Man-6-ne-16 – Big Block 6

11 tunnels at 8.5m wide with 5 staggers and sloping headlands

DWG No:
NR RYS.: TA01918 HG No:

SCALE:
SKALA: 1:300 SHEET:
ARKUSZ: 1 of 1 REVISION:
REWIZJA: 1 A2

APPENDIX G – RAINFALL DATA AT GOOSE FARM

Rainfall Data: Goose farm

Parameters

Calculation type=Design rainfall

Calculation mode=Typical point in catchment

Catchment area=	18.598		km**2			
Duration=	1	1	(hour)			
Fixed duration=	0					
Return period=	100	1	(years)			
Annual maximum=	0					
c	d1	d2	d3	e	f	
-0.022	0.311	0.372	0.261	0.316	2.513	

An areal reduction factor of 0.889 has been applied to a point rainfall of 52.8 mm .

to yield a catchment design rainfall of 47.0 mm

No warning(s) or advisory(ies) is present for this calculation.

The data in the following table have been computed using sliding durations

Duration minutes	Duration hours	Duration days	10 year rainfall mm	20 year rainfall mm	50 year rainfall mm	100 year rainfall mm	200 year rainfall mm	500 year rainfall mm
15	0.25	0.010417	14.16	18.18	25.1	31.97	40.69	55.92
30	0.5	0.020833	17.92	22.75	30.97	39.03	49.14	66.6
60	1	0.041667	22.34	28.05	37.66	46.95	58.5	78.18
120	2	0.083333	27.57	34.24	45.31	55.9	68.91	90.82
240	4	0.166667	33.78	41.48	54.13	66.07	80.58	104.72
360	6	0.25	37.93	46.29	59.9	72.66	88.07	113.52
600	10	0.416667	43.81	53.03	67.91	81.73	98.3	125.4
720	12	0.5	46.1	55.64	70.98	85.19	102.18	129.87
1440	24	1	58.25	69.54	87.46	103.85	123.24	154.47
2880	48	2	73.41	86.68	107.48	126.28	148.28	183.27