Keystone
Design Associates Ltd.

DRAINAGE STRATEGY

LAND OFF HILL HOUSE INDUSTRIAL ESTATE, THORNTON-CLEVELEYS

October 2023

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DOCUMENT ISSUE RECORD

Revision	Date	Details
Full	October 2023	Issued for action

LAND OFF HILL HOUSE INDUSTRIAL ESTATE, THORNTON-CLEVELEYS

Report Approved by D.W.Hadwin B.Eng(Hons) C.Eng MICE
For Keystone Design Associates

Signature...............................

Date.......19th October 2023...............

CONTENTS

1.0 INTRODUCTION

1.01 It is proposed to develop the existing site to accommodate an industrial unit on the site at land off Hill House Industrial Estate, Thornton-Cleveleys.

1.02 The works for the development would comprise the building of the industrial unit and installation of the new infrastructure, of which the drainage would be material. This report discusses the proposed strategy for the disposal of both foul and surface water.

1.03 This report is intended to provide supporting information for the consent of planning permission.

2.0 DESCRIPTION OF DEVELOPMENT

2.01 The development site is currently a brownfield site adjacent to Hill House Industrial Estate, Thornton-Cleveleys. The site is surrounded by land to the north and east, commercial/industrial buildings to the south and a residential development to the west.

2.02 The proposal is for the development of the site to accommodate an industrial unit.

2.03 The necessary infrastructure to cater for the industrial unit will need to be installed, this being drainage.

2.04 The drawing attached to appendix C as supplied by this office illustrates the proposed scheme.

3.0 LOCATION OF SITE

3.01 The site is located adjacent to Hill House Industrial Estate, Thornton-Cleveleys. The site is identified on the location plan at as appendix A.

3.02 The proposed site is surrounded by land to the north and east, commercial/industrial buildings to the south and a residential development to the west. The site is situated in Thornton-Cleveleys, in the borough of Wyre, approximately 4 miles north of Blackpool and 2 miles south of Fleetwood.

3.03 The site is located in a flood zone 2/3.

3.04 The ordnance survey grid reference is SD N444150, E334107.

3.05 The site is 0.42Ha area.

4.0 EXISTING DRAINAGE

4.01 No drainage was found on site. There is a dyke located to the east of the site. For the purpose of surface water drainage calculations the site will be treated as greenfield.

4.02 It is proposed to connect to a water treatment plant and dyke as shown on the drawing attached to appendix C.

5.0 SURFACE WATER DRAINAGE STRATEGY

5.01 The primary flood risk generated by a development is the surface water runoff. The proposed development will increase the amount of surface water discharge; to comply with the planning condition the surface water will be attenuated within the site boundary.

5.02 The surface water drainage for any development site should be designed so that the volumes and peak flow rates of surface water leaving the site are limited to the original greenfield rates.

5.03 In order to comply with not increasing volume of discharge as a consequence of the development it will be necessary to provide surface water storage and/or infiltration to limit and reduce both the peak rate of discharge from the site.

5.04 The Environment Agency require that, for the range of annual flow rate probabilities, up to and including the 1% annual probability (1 in 100 year event) the developed rate of run-off into a watercourse should be no greater than the undeveloped rate of run-off for the same event. Water Authorities take a similar approach to that of the Environment Agency, however they ask that flows be restricted to include up to the 3.33% annual probability (1 in 30 year event), whilst demonstrating that the 1 in 100 year event does not pose a threat to the locality (known as designing for exceedance).

5.05 Climate change (CC) will be taken into account by increasing the rainfall intensity by 40% in compliance with DEFRA technical standards.

6.0 SUSTAINABLE DRAINAGE

6.01 The Technical Guidance for the National Planning Policy Framework requires that a development exceeding 0.4Ha or more than 4 dwellings requires that the management of the surface water runoff utilises Sustainable Urban Drainage (SUDS) and considers the hierarchy of provision which are as follows

- Infiltration to ground - soakaways and permeable surfacing.
- Discharge to local watercourse.
- Discharge to public sewer.
- Discharge to adjacent land drains and ponds.

6.02 The first option to be considered for surface water disposal for all proposed development must be infiltration into the ground. Even when there are alternative sewer connections or watercourses available infiltration must still be utilised unless it is proved unfeasible. The suitability for infiltration is determined by a percolation test. Where the underlying soil conditions are relatively impermeable, or the water table is high the site would not be suitable for ground infiltration and discharge to a water course or sewer may be considered.

6.03 The sub soil in this area is firm to stiff clay close to the surface. The water table is also close to the ground surface. These ground conditions are not suitable for ground infiltration.

6.04 As discharge to the ground is not appropriate, the next level of of SuDs is to be considered. The dyke to the east of the site is a watercourse as defined in the SuDs Manual 2015. It is proposed to discharge surface water to the watercourse.

6.05 In order to prevent an increase in flood risk to adjacent land and downstream of the site it will be necessary to restrict the surface water discharge from the development to the equivalent QBAR greenfield run-off rate from the site (mean annual greenfield peak flow). The SuDS Manual recommends the use of Report No.124 ‘Flood estimation for small catchments’, Institute of Hydrology for catchments smaller than 50 hectares. The total site area of the development site 0.42 ha.

6.06 The Environment Agency standard advice is to calculate the existing greenfield run-off from the entire developable site. The calculated QBAR rate is 1.05 l/s, which is the maximum final discharge rate that should not be exceeded.

6.07 When calculating the final allowable discharge rate only the impermeable areas are considered. The other areas of the site which include landscaping and porous pavement will not contribute to the surface water run-off. The total area of impermeable surfacing is the whole site. Existing greenfield run-off rates are calculated at 0.92l/s and the 1 in 30 year event at 1.79l/s and the 1 in 100 year event at 2.19l/s.

6.08 Surface water flows from the site are to be restricted to the equivalent QBAR rate of 5.0l/s. This is greater than the calculated 1.05l/s as a practicable minimum limit on the discharge rate from a flow attenuation device is often a compromise between attenuating to a satisfactorily low flow rate while keeping the risk of blockage to an acceptable level. This limit is therefore set at 5 litres per second.

6.09 The Draft National Standards for Sustainable drainage systems covers the whole range of sustainable approaches to surface water drainage management including:

- source control measures including rainwater recycling and drainage.
- infiltration devices to allow water to soak into ground, that can include individual soakaways and communal facilities.
- filter strips and swales, which are vegetated features that hold and drain water downhill mimicking natural drainage patterns.
- filter drains and porous pavements to allow rainwater and run-off to infiltrate into permeable material below ground and provide storage if needed.
- basins and ponds to hold excess water after rain and allow controlled discharge that avoids flooding, and
- Underground storage to hold excess water after rain and allow controlled discharge that avoids flooding.

6.10 These SuDS solutions are considered below with reference to their suitability for the proposed development.

SuDS Group	Technique	Likely to be suitable?	Notes
Source Control	Rainwater Harvesting	Yes	Would not feasibly accommodate the full increase of volume of runoff created by the proposed development but would work alongside any attenuated system Rainwater butts can also be used to reduce run-off and water use.
Infiltration Devices	Permeable Paving	No	The ground sub striate is not suitable for infiltration
	Infiltration trenches and basins	No	Could be used to slow the movement of water down, but not as an effective means of dealing with run-off and The ground sub striate is not suitable for infiltration
Filtration	Soakaways	No	Ground is not suitable for surface water disposal
	Open Swales	No	Use for attenuation, evaporation, water quality and slowing water movement down and will fit with nature of site. Insufficient space to accommodate pond Hazardous to site users
	Filter Strips	No	Could be used to slow the movement of water down, but not as an effective means of directly dealing with run-off
Retention/ Detention	Basin / Ponds	No	Suitable for controlling discharge to watercourse via a piped outfall, evaporation and treatment of run-off. Insufficient space to accommodate pond
Underground Storage	Culverts / Tanks / Oversized Pipes	Yes	Suitable for controlling discharge to watercourse or sewer via a piped outfall No land take required to accommodate

7.0 PROPOSED DRAINAGE STRATEGY - SURFACE WATER

7.01 It is proposed that surface water drainage from the proposed development will be discharged into the water course located to the east of the site via the new proposed manholes.

7.02 It is important when designing drainage systems for new developments that a scheme be considered to deal with the first 5mm of rainfall to hit the site. Around 50% of rainfall events are less than 5mm and cause no measurable runoff from greenfield areas into receiving waters. In contrast, runoff from a development takes place for virtually every rainfall event. This difference means that watercourses receive frequent discharges with polluted washoff from urban surfaces (hydrocarbons, suspended solids, metals etc). Replication of the greenfield runoff from small events will result in many fewer polluted discharges so limiting the potentially damaging impact on the receiving environment. This concept is known as interception and the volume of rainfall required to replicate the event known as Interception Storage.

7.03 The concept of Interception storage to prevent any runoff from rainfall depths up to 5mm, should therefore be provided. Certain SuDS features such as Swales and Pervious Pavements provide runoff characteristics that reflect this behaviour depending on their design. These will be considered and designed in to the proposed layout at detailed design stage once final volumes are calculated. An estimation of the interception storage requirements for the proposal is included within the calculations below.

7.04 Above and beyond the Interception Storage requirements there are the more intense storms to consider. Attenuation will be required within the system to accommodate the volume of surface water created by restricting the outfall rates to the existing 5.0l/s equivalent.

7.05 There are a number of options available for attenuating the proposed flows from the development, however it is considered that the storage would be to utilise storm water crates. This solution allows for large quantities of storage at relatively shallow depths.

7.06 In calculating the surface water run off the following assumptions have been made:-

- **No infiltration –** Due to the ground conditions no infiltration is assumed, however if any could be achieved the volume discharged would be reduced.
- **No Rainwater Harvesting / Water Butts –** Suitably designed rainwater harvesting tanks can significantly reduce the volume of run-off and form an integral part of the attenuated system. United Utilities usually accept that such techniques are suitable for collecting water up to and including the 1 in 1 year event.
- **No storage within swales –** Swales have a combined advantage of providing a volume of storage, slowing the rate at which water enters the downstream system and providing a certain amount of infiltration into the ground.
- Within the analysis it has also been assumed that 100% of the rainwater falling on the proposed impermeable areas enters the system. It is therefore considered that the analysis undertaken is robust.

7.07 In order to comply with Environment Agency peak rates of run-off will be restricted to the existing greenfield run-off rate and storage will be provided up to and including the 1 in 100yr storm event plus an allowance of 40% increase for climatic change. This is above and beyond the requirements of a United Utilities adopted drainage system which requires storage up to and including the 1 in 30yr storm event. Flows would be restricted which will limit discharge to 5.0l/s.

7.08 Causeway Flow program has been used to calculate the storage volume required for the development attached as appendix D. The storage volume is calculated at 240m^3. Proposed Run-off Rates include an increase of 40% climatic change allowance.

7.09 It is generally accepted that surface water systems are designed to accommodate the 1 in 30yr plus climatic change event and anything above and beyond that could be allowed to flood the system. This is known as designing for exceedance. It is not achievable to accommodate exceedance due to the topography therefore the system has been designed to full accommodate the full exceedance within the drainage network.

7.10 It is also important to note that this system takes no account of the peripheral storage that will be available within the remainder of the proposed drainage network and therefore, notwithstanding the techniques outlined in para 6.9, the storage attenuation requirements will be less.

MAINTENANCE OF PROPOSED SUDS SYSTEMS.

7.11 It is important during any development process to consider the long term maintenance of the proposed drainage system. The more traditional non-SuDS route would be to have the system offered up for adoption though United Utilities, where they would take on responsibility for the maintenance of the drainage network. However, this is not the case with SuDS.

7.12 With the emerging Flood and Water Management Act 2010 (although it is noted that Schedule 3 relating to SuDS has not yet come into force), the SuDS Approving Body (SAB), would be obliged to adopt sustainable drainage solutions which comply with National Standards. Consequently, the system would have to be reviewed and approved by the SAB to ensure it meets these relevant standards.

7.13 Until such a time as Schedule 3 of the Act comes into force, the SuDS system (although approved by both the LPA and the SAB) would remain private and be maintained and managed by a private management company. This maintenance would be secured through ownership of the property. The system has been designed to require minimum maintenance and, the inspection and upkeep of the drainage system can be maintained in perpetuity.

8.0 PROPOSED DRAINAGE STRATEGY – FOUL WATER

8.01 No foul sewers are recorded on site. It is proposed to connect to a water Sewage Treatment Plant which will then discharge into the watercourse located to the east of the site via new manholes that are to be installed.

8.02 The proposed development is to accommodate one industrial unit. The calculated foul discharge from the site in compliance with Approved Document part H of the Building Regulations Table A1 would be 5.4l/s.

9.0 CONCLUSIONS

9.01 The developer is committed to delivering a sustainable development and the drainage proposals will be designed in accordance with the techniques set out within the SuDS Manual. Future maintenance of the system will be secured in perpetuity, through the use of a planning condition.

9.02 Foul drainage will be discharged to the watercourse via a Sewage Treatment Plant.

9.03 Surface water drainage will be discharged to a watercourse.

9.04 The strategy outlined above shows a viable sustainable drainage solution is achievable within the constraints of the site. The delivery of a SuDS surface water system together with an appropriately designed foul network and connection can be secured through planning condition.

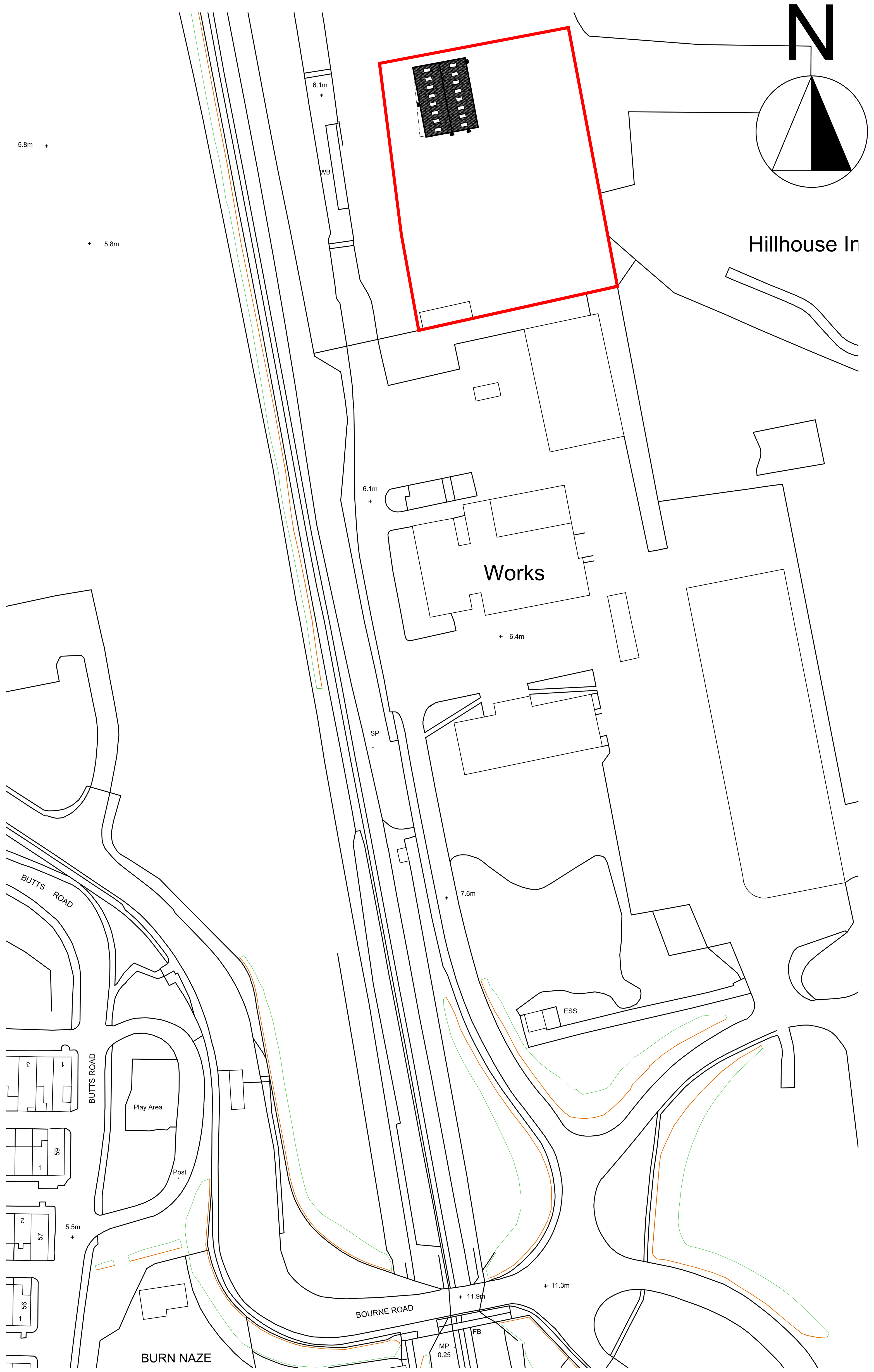
10.0 APPENCIES

Appendix A	Location plan
Appendix B	Environment Agency Flood Map
Appendix C	Proposed Scheme Drawing
Appendix D	Drainage Calculations

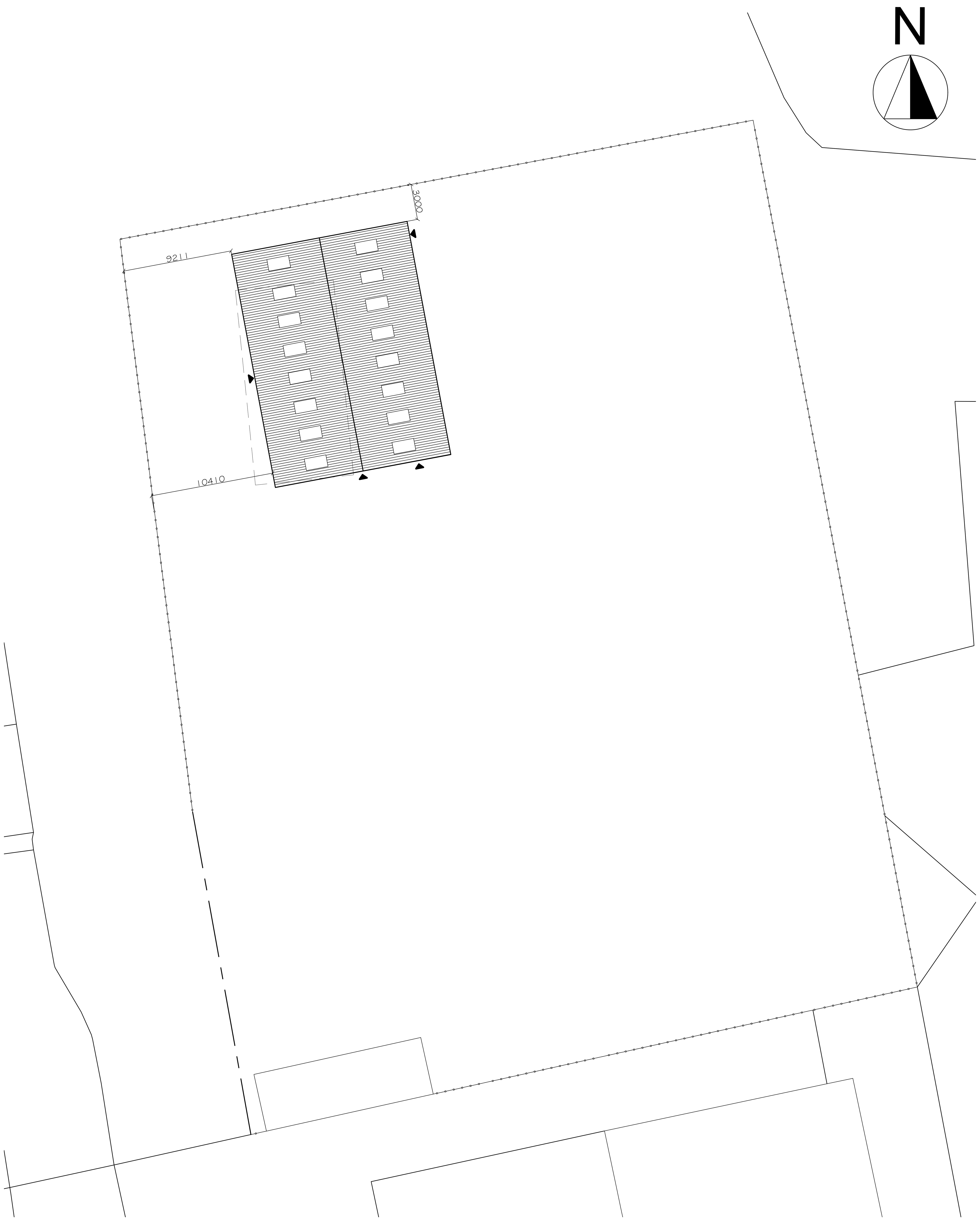
Appendix A
Location plan

Revision -

DRAWING No. A023/236/P/101



SITE LOCATION PLAN
SCALE 1:1000



SITE PLAN
SCALE 1:200

NOTES

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2. DO NOT SCALE FROM THIS DRAWING.
3. THIS DRAWINGS IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELATED DRAWINGS & DOCUMENTS. THE USER SHOULD CONSULT THE DRAWING ISSUE REGISTER FOR DETAILS.
4. THE CONTRACTOR IS TO CHECK AND VERIFY ALL DIMENSIONS ON SITE PRIOR TO COMMENCEMENT OF CONSTRUCTION WORKS.
5. THE ENGINEER/ARCHITECT SHOULD BE CONTACTED IMMEDIATELY IF THE ASSUMPTIONS USED IN THE DESIGN DIFFER TO THAT FOUND ON SITE.

Rev.	Amendments	Date	By

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PROJECT ADDRESS
LAND OFF HILL HOUSE INDUSTRIAL ESTATE, THORNTON-CLEVELEYS, FY5 4QD

PROJECT TITLE
NEW INDUSTRIAL BUILDING

DRAWING TITLE
PROPOSED SITE GA (OPTION 2)

Client: MRS J HILL		Scales @A1 1:1000/200
Drawn By. JG	Checked By. DWH	Date 03/10/23
DRAWING No. A023/236/P/101		Revision -

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Appendix B
Environment Agency Flood Map

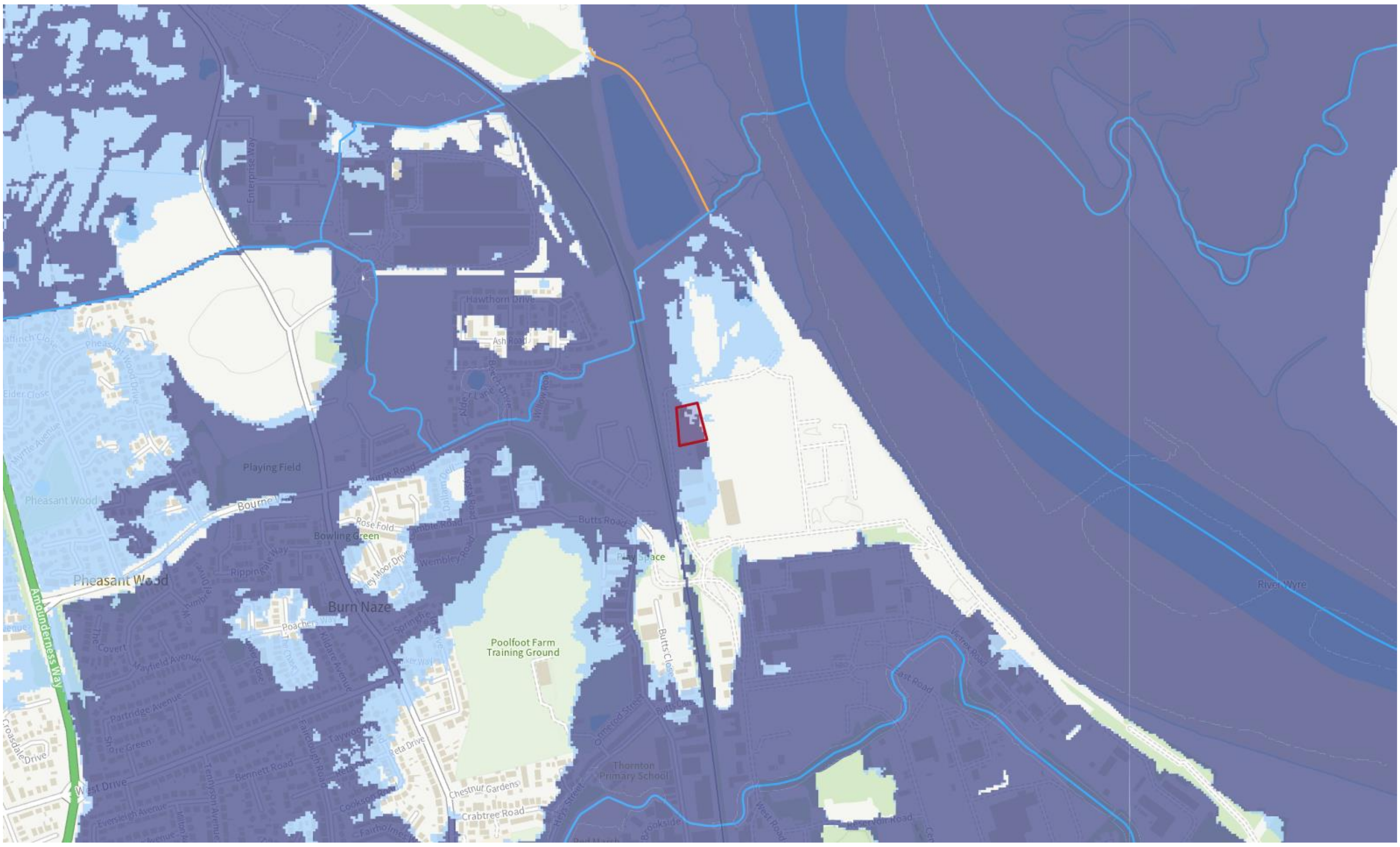
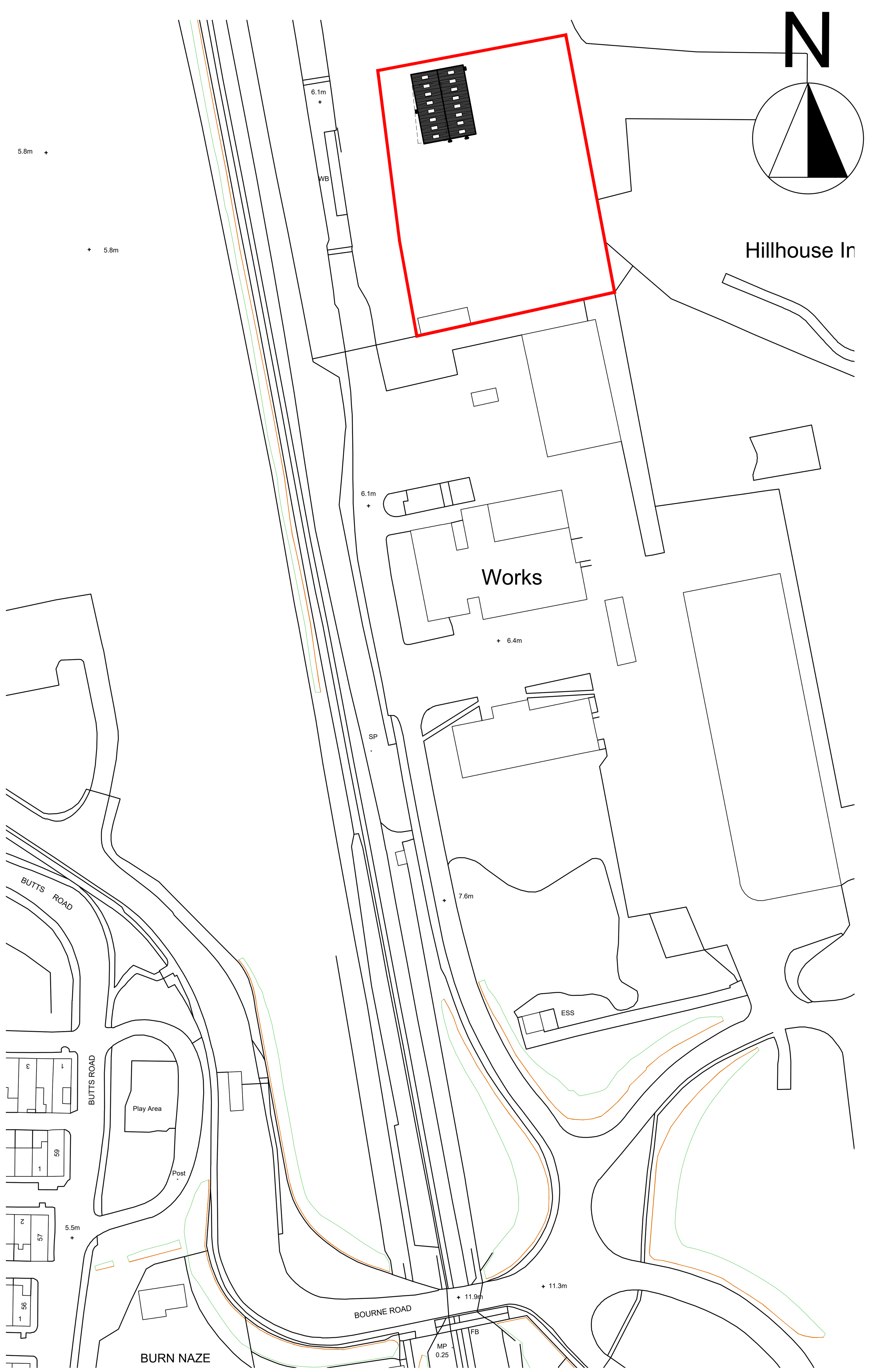


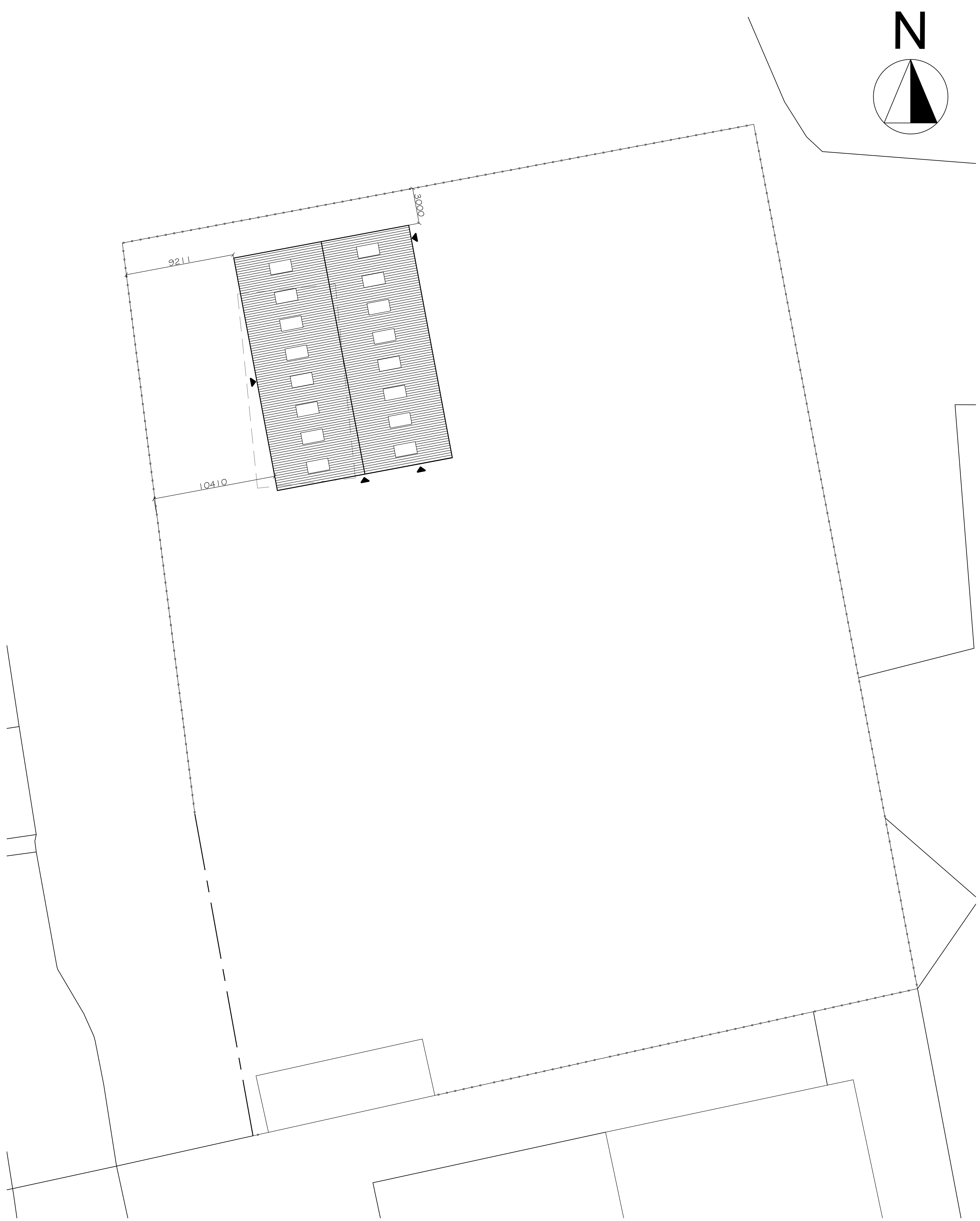
Fig 1 Extract from Environment Agency Flood Map

Appendix C
Proposed Scheme Drawing

DRAWING No. A023/236/P/101 Revision -



SITE LOCATION PLAN
SCALE 1:1000



SITE PLAN
SCALE 1:200

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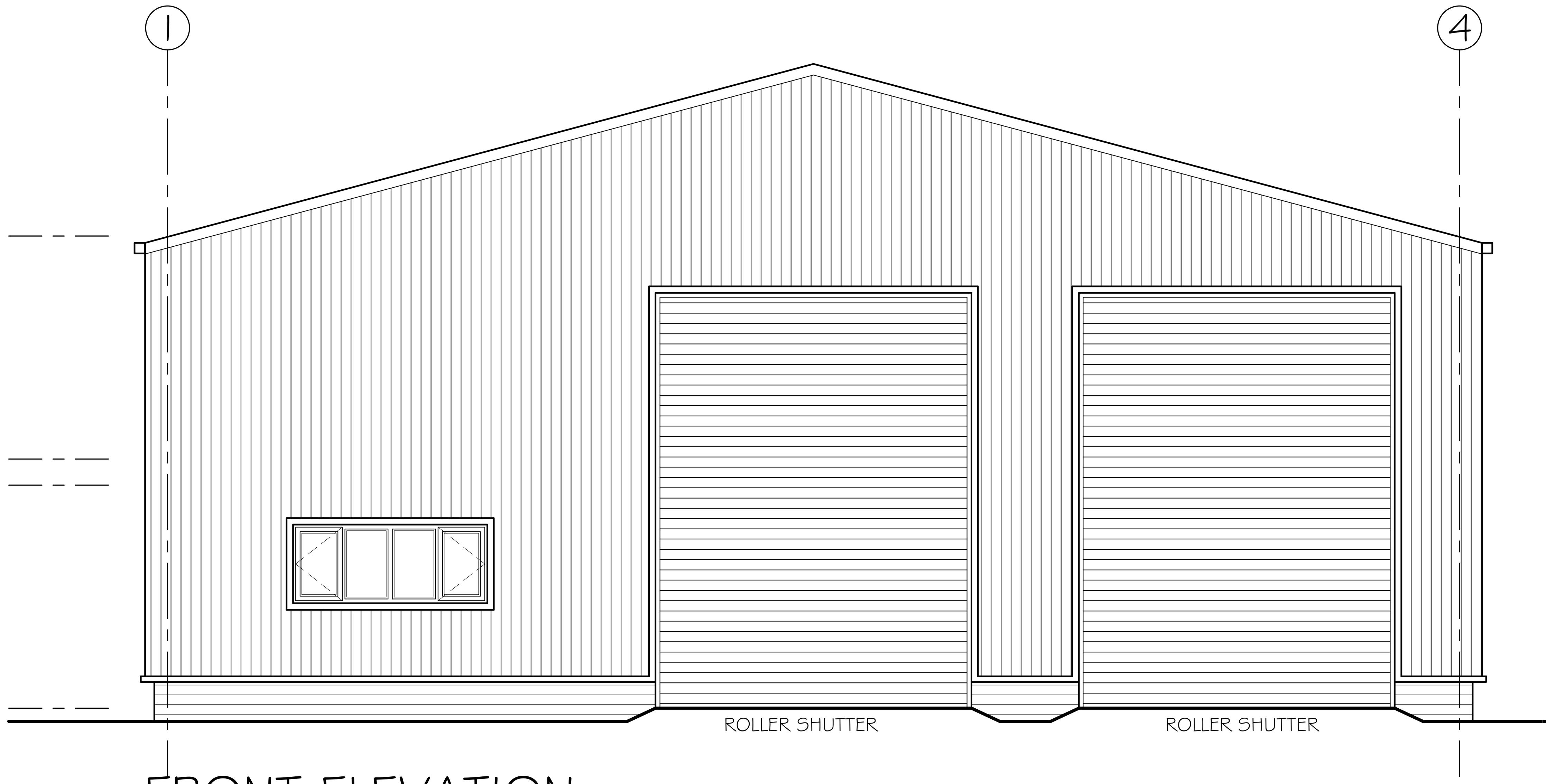
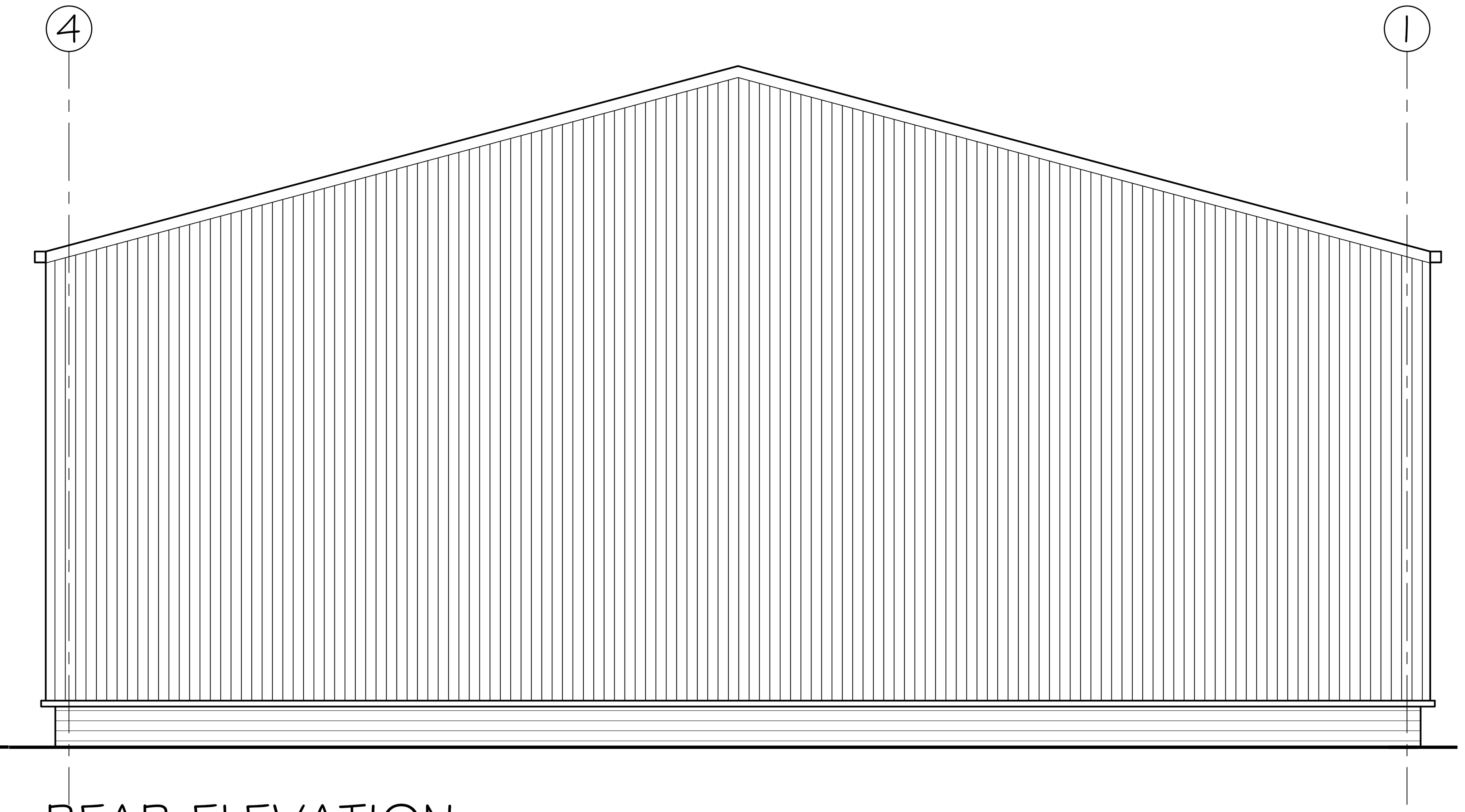
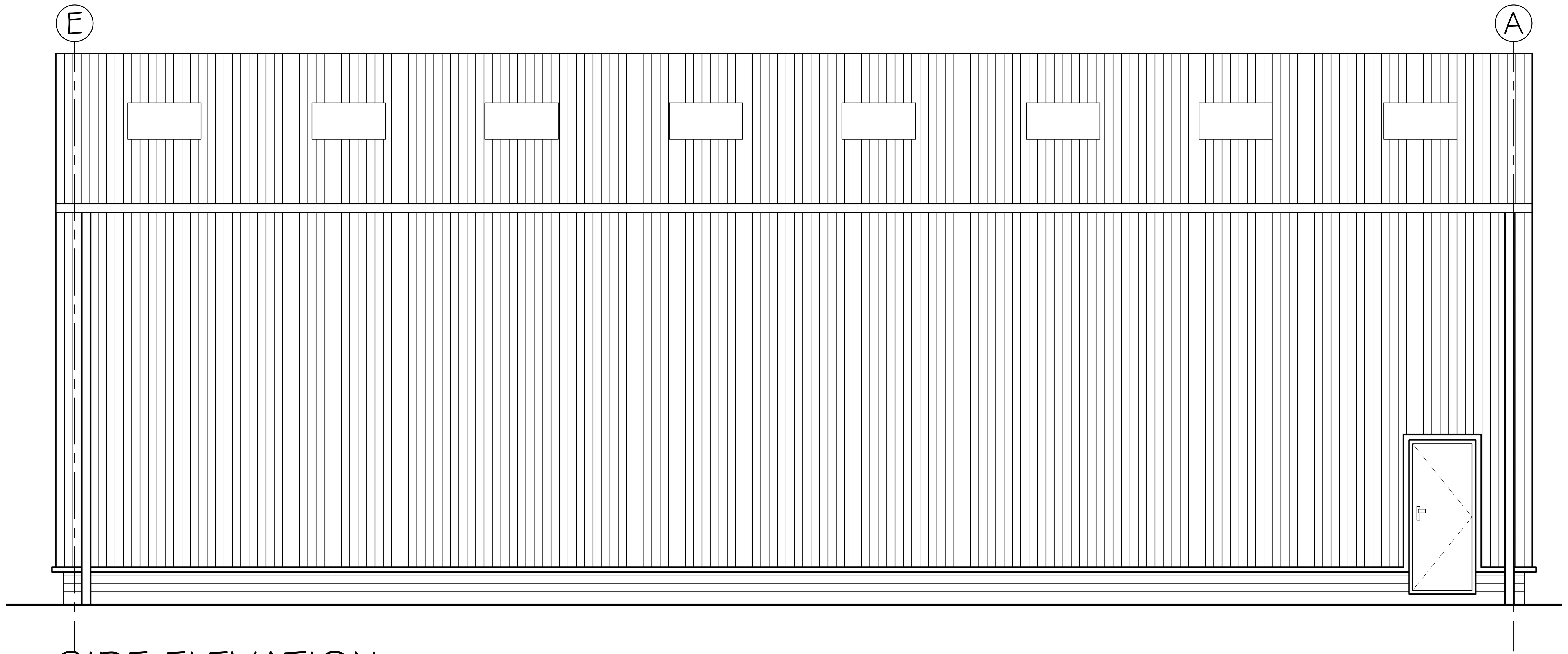
Revision -



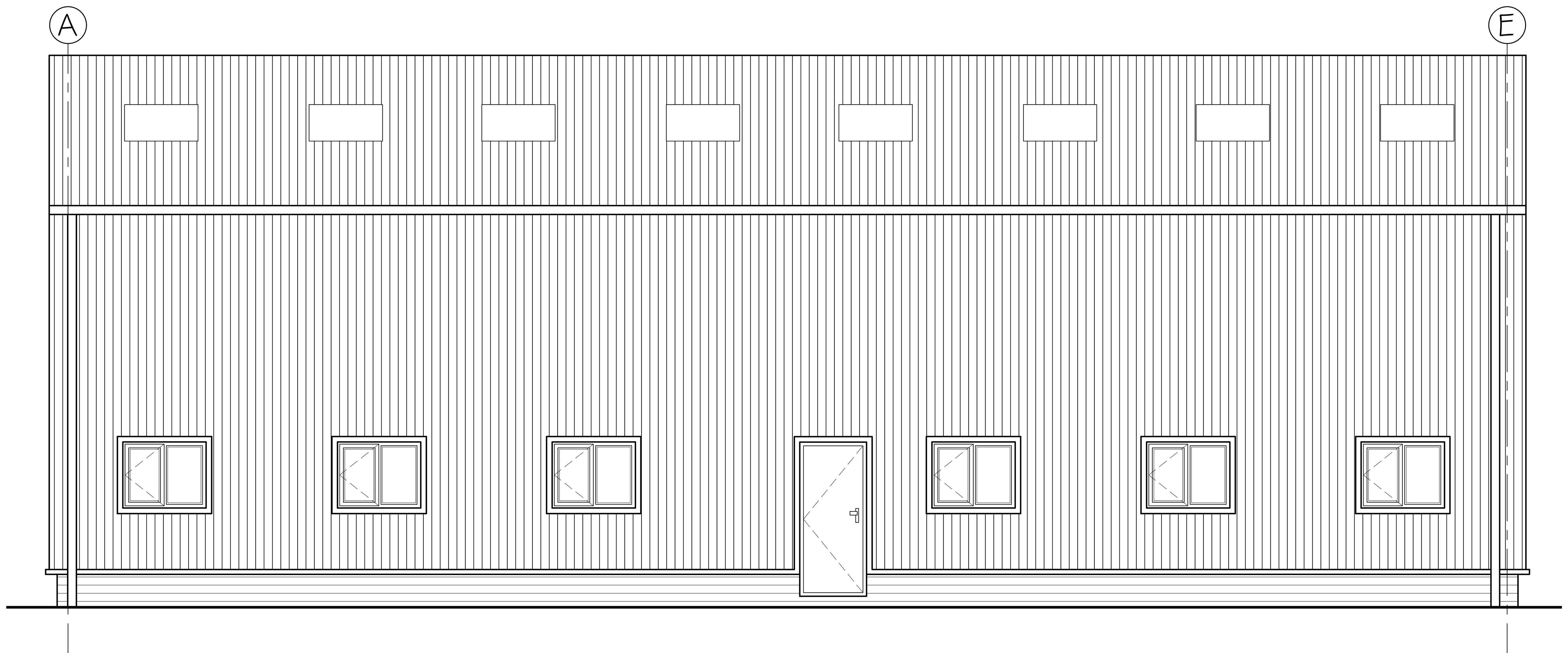
FRONT ELEVATION



REAR ELEVATION



SIDE ELEVATION



SIDE ELEVATION

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MATERIAL SPECIFICATION
ROOF CLADDING KINGSPAN INSULATED PANELS - COLOUR GOOSEWING GREY
EXTERNAL WALLS ROUGH FACED RED BRICK KINGSPAN INSULATED PANELS - COLOUR ANTHRACITE GREY
GLAZING ANTHRACITE GREY UPVC DOORS ANTHRACITE GREY UPVC
RAINWATER GOODS BLACK ALUMINIUM GUTTERING BLACK ALUMINIUM DOWNPIPES

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DRAWING TITLE
PROPOSED ELEVATIONS (OPTION 2)

Client: MRS J HILL		Scales @A1 1:50
Drawn By. JG	Checked By. DWH	Date 03/10/23
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Revision -

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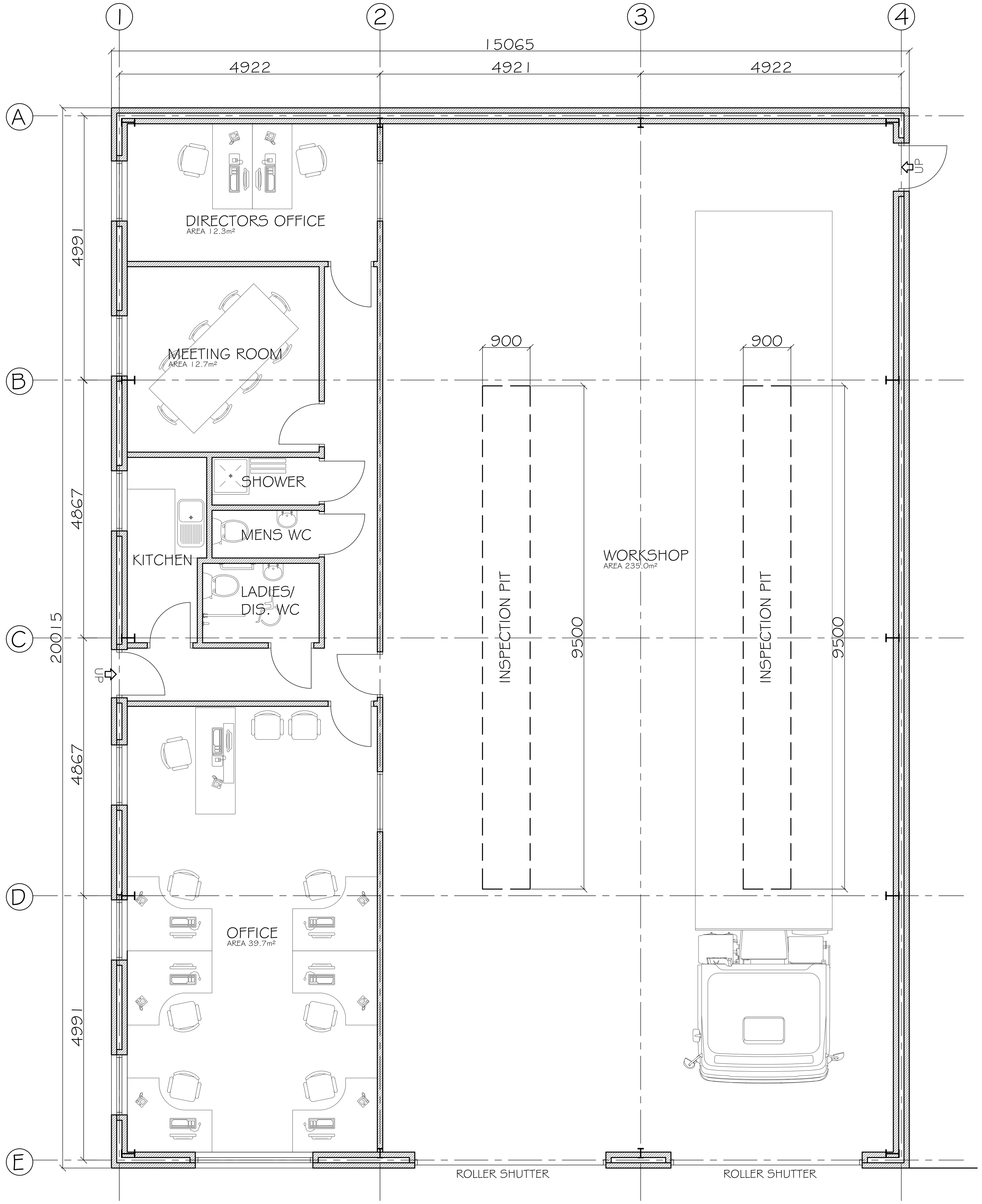

GROUND FLOOR

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CONFIGURATION

GROUND FLOOR TOTAL AREA: 280m²

TOTAL SITE AREA: 4254m²

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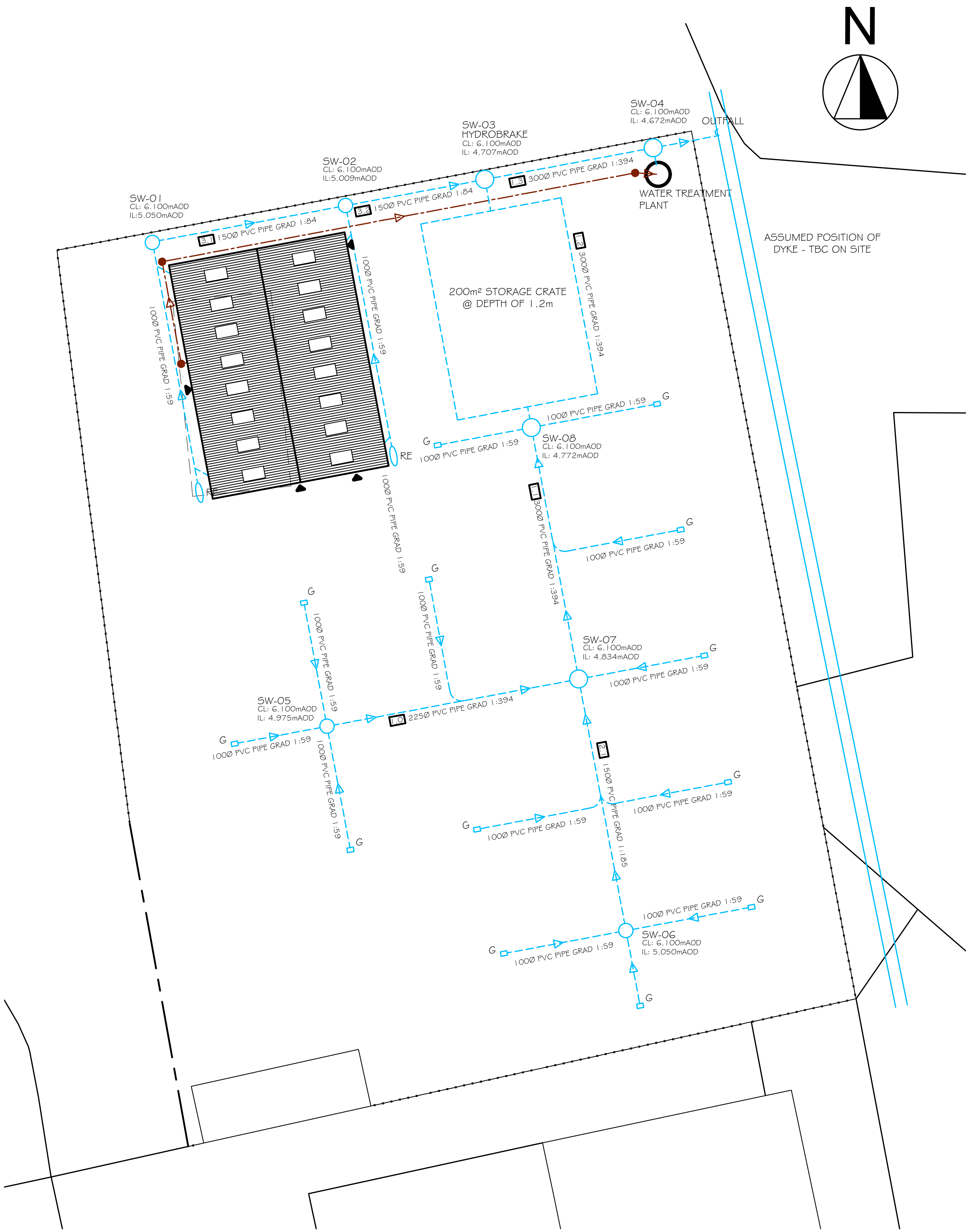

SURFACE WATER MANHOLE SCHEDULE											
M.H REF	CHAMBER TYPE	INTERNAL DIM	COVER GRADE	COVER LEVEL	INVERT LEVEL	DEPTH	PIPE	MATERIAL	DIAMETER	CHAMBER LAYOUT	NOTES
SW-01	TYPE 1	1200	STEEL	6.100	5.050	1.050	A B	PVC PVC	100 150	B A	
SW-02	TYPE 1	1500	STEEL	6.100	5.009	1.091	A B C	PVC PVC PVC	150 100 150	C A B	
SW-03	TYPE 1	1500	STEEL	6.100	4.707	1.393	A B C	PVC PVC PVC	150 300 300	C A B	HYDROBRAKE INSTALLED
SW-04	TYPE 1	1500	PVC	6.100	4.672	1.428	A B C	PVC PVC PVC	300 100 300	C A B	
SW-05	TYPE 1	1800	PVC	6.100	4.975	1.125	A B C D	PVC PVC PVC PVC	100 100 100 225	C D B A	
SW-06	TYPE 1	1200	STEEL	6.100	5.050	1.050	A B C D	PVC PVC PVC PVC	150 100 100 100	D C B A	
SW-07	TYPE 1	1200	STEEL	6.100	4.834	1.266	A B C D	PVC PVC PVC PVC	300 225 100 150	D C B A	
SW-08	TYPE 1	1200	PVC	6.100	4.772	1.328	A B C D	PVC PVC PVC PVC	300 100 100 300	D C B A	

NOTES:
CHANNEL FITTINGS ARE TO BE USED IN ALL MANHOLES UPTO AND INCLUDING 300MM
ALL LEVELS RELATE TO ORDINANCE DATUM
ALL LATERAL PIPE CONNECTIONS TO BE MADE AT SOFFIT LEVEL WITH MAIN DRAIN
* = EXISTING PIPE

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DRAWING KEY

............DENOTES COMBINED DRAIN
............DENOTES SURFACE WATER SEWER
............DENOTES FOUL SEWER
............DENOTES SW MANHOLE
............DENOTES FOUL MANHOLE
............DENOTES COMBINED MANHOLE
............DENOTES STORM WATER STORAGE CRATE
IC ....DENOTES INSPECTION CHAMBER
RE ....DENOTES RODDING EYE
RWP ....DENOTES RAINWATER PIPE CONNECTION
SVP ....DENOTES SOIL VENT PIPE CONNECTION
BIG ....DENOTES BACK INLET GULLY
G ....DENOTES ROAD GULLEY
............DENOTES CHANNEL
+0.000 ....DENOTES LEVEL
0.0 ....DENOTES LINK REFERENCE

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A	Calculations Added	03/11/23	LM

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Revision A
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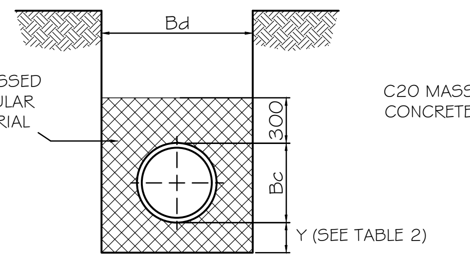
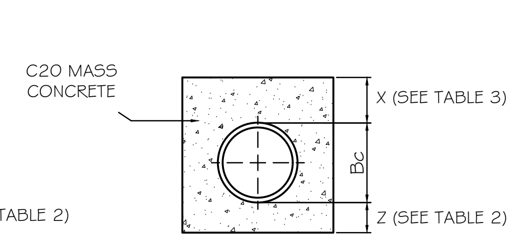
TABLE 2
EMBEDMENT DIMENSIONS FOR RIGID PIPES

NOMINAL INT PIPE DIA	DIMENSION Y1 EVEN TRENCH BOTTOM (MIN)	DIMENSION Y2 ROCK OR UNEVEN TRENCH BOTTOM (MIN)	PROCESSED GRANULAR MATERIAL	DIMENSION Z (MIN)	PERMITTED TRENCH WIDTH (MAX)
150	100	200	10mm SINGLE SIZED OR 14mm TO 5mm GRADED	100	750
225	100	200		100	825
300	100	200		100	925
375	100	200	14mm SINGLE SIZED OR 14mm TO 5mm GRADED	100	1050
450	150	200		150	1150
525	150	250		150	1200
600	150	250	20mm SINGLE SIZED OR 20mm TO 5mm GRADED	150	1350
675	150	250		225	1450
750	225	300		225	1500
825	225	300		225	1600
900	225	300		225	1900
975	225	300		300	2000
1050	225	300		300	2100
1125	225	300		300	2200
1200	250	350		300	2300
1350	375	450		375	2500
1500	375	450		375	2700
1650	375	450		450	2800
1800	375	500	40mm SINGLE SIZED OR 40mm TO 5mm GRADED	450	3100
1950	400	500		525	3200
2100	425	650		525	3400
2400	450	675		600	3700

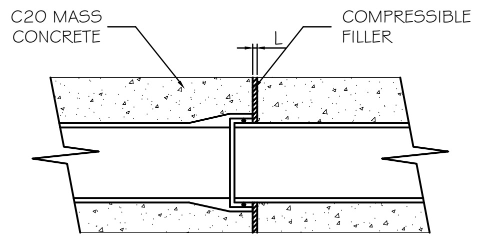
NOTE:
Bc = OUTSIDE DIAMETER OF PIPE
Bd = EFFECTIVE TRENCH WIDTH MEASURED 300mm ABOVE CROWN OF PIPE



TYPE 7
EMBEDMENT CLASS S



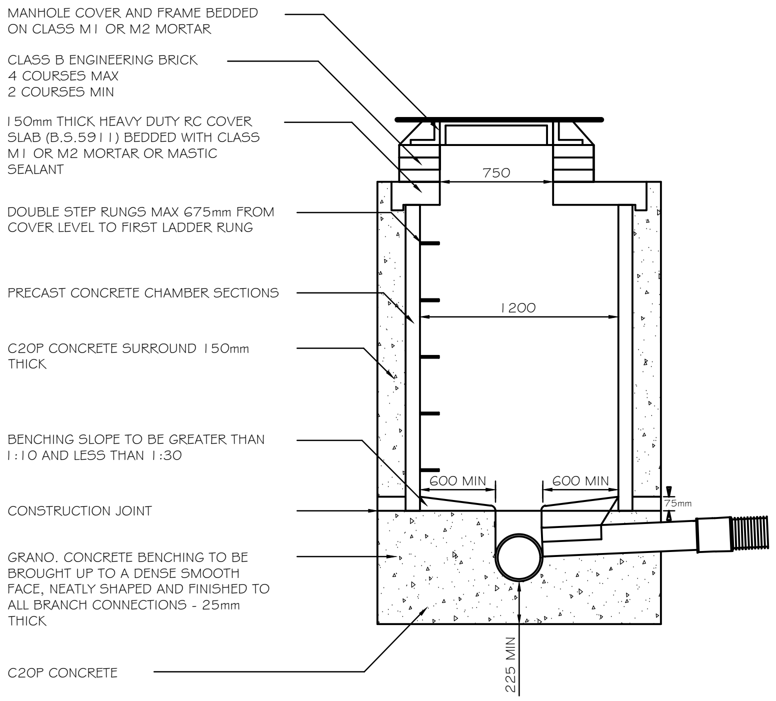
CONCRETE SURROUND
EMBEDMENT CLASS S



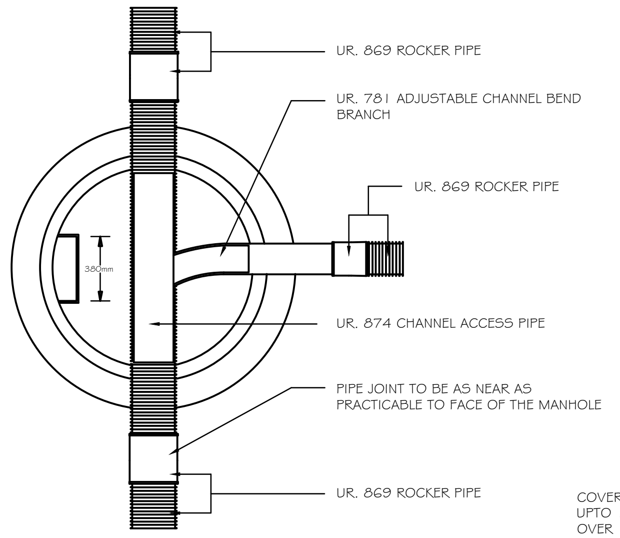
FLEXIBLE JOINT DETAILS FOR CONCRETE BED & SURROUND SPIGOT & SOCKET PIPES

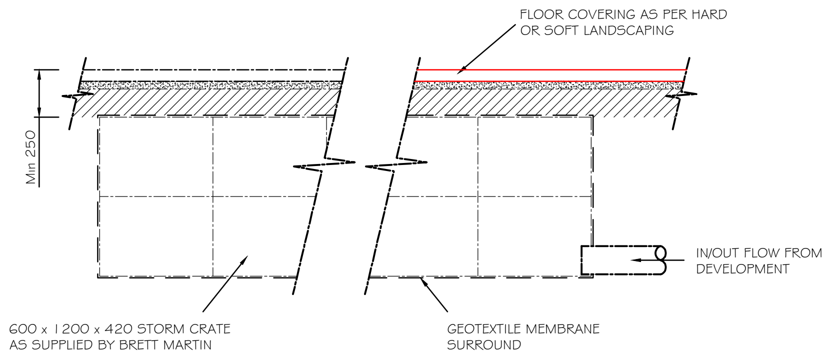
TABLE 3
THICKNESS OF COMPRESSIBLE FILL (L)

NOMINAL INT PIPE DIA	DIMENSION Xmm	COMPRESSIBLE FILLER Lmm
<400	160	18
400-700	200	36
725-1200	300	36
>1200	300	54

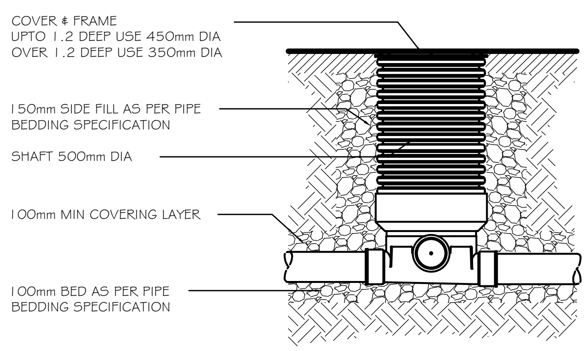


TYPICAL MANHOLE DETAIL TYPE 1
DEPTH FROM COVER LEVEL TO PIPE SOFFIT 1.35m TO 3m
SCALE 1:20

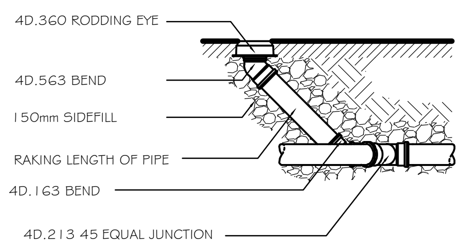




STORM WATER STORAGE DETAIL
(SCALE 1:20)



TYPICAL MANHOLE DETAIL TYPE 3
UNIVERSAL INSP CHAMBER DETAIL
SCALE 1:20



TYPICAL RODDING EYE DETAIL
SCALE 1:20

NOTES

1. ALL DIMENSION ARE IN MILLIMETERS.
2. DO NOT SCALE FROM THIS DRAWING.
3. THIS DRAWINGS IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELATED DRAWINGS & DOCUMENTS. THE USER SHOULD CONSULT THE DRAWING ISSUE REGISTER FOR DETAILS.
4. THE CONTRACTOR IS TO CHECK AND VERIFY ALL DIMENSIONS ON SITE PRIOR TO COMMENCEMENT OF CONSTRUCTION WORKS.
5. THE ENGINEER/ARCHITECT SHOULD BE CONTACTED IMMEDIATELY IF THE ASSUMPTIONS USED IN THE DESIGN DIFFER TO THAT FOUND ON SITE.

Rev.	Amendments	Date	By

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PROJECT ADDRESS
LAND OFF HILL HOUSE INDUSTRIAL ESTATE, THORNTON-CLEVELEYS, FY5 4QD

PROJECT TITLE
NEW INDUSTRIAL BUILDING

DRAWING TITLE
DRAINAGE DETAILS 01

Client: MRS J HILL
Scales @A1: 1:20
Drawn By. LM
Checked By. DWH
Date 03/11/23
DRAWING No. A023/236/P/105
Revision -

H:\documents\Drawings\2023\Hill House Industrial Estate

Revision -
DRAWING No. A023/236/P/105

NOTES

1. ALL DIMENSION ARE IN MILLIMETERS.
2. DO NOT SCALE FROM THIS DRAWING.
3. THIS DRAWINGS IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELATED DRAWINGS & DOCUMENTS. THE USER SHOULD CONSULT THE DRAWING ISSUE REGISTER FOR DETAILS.
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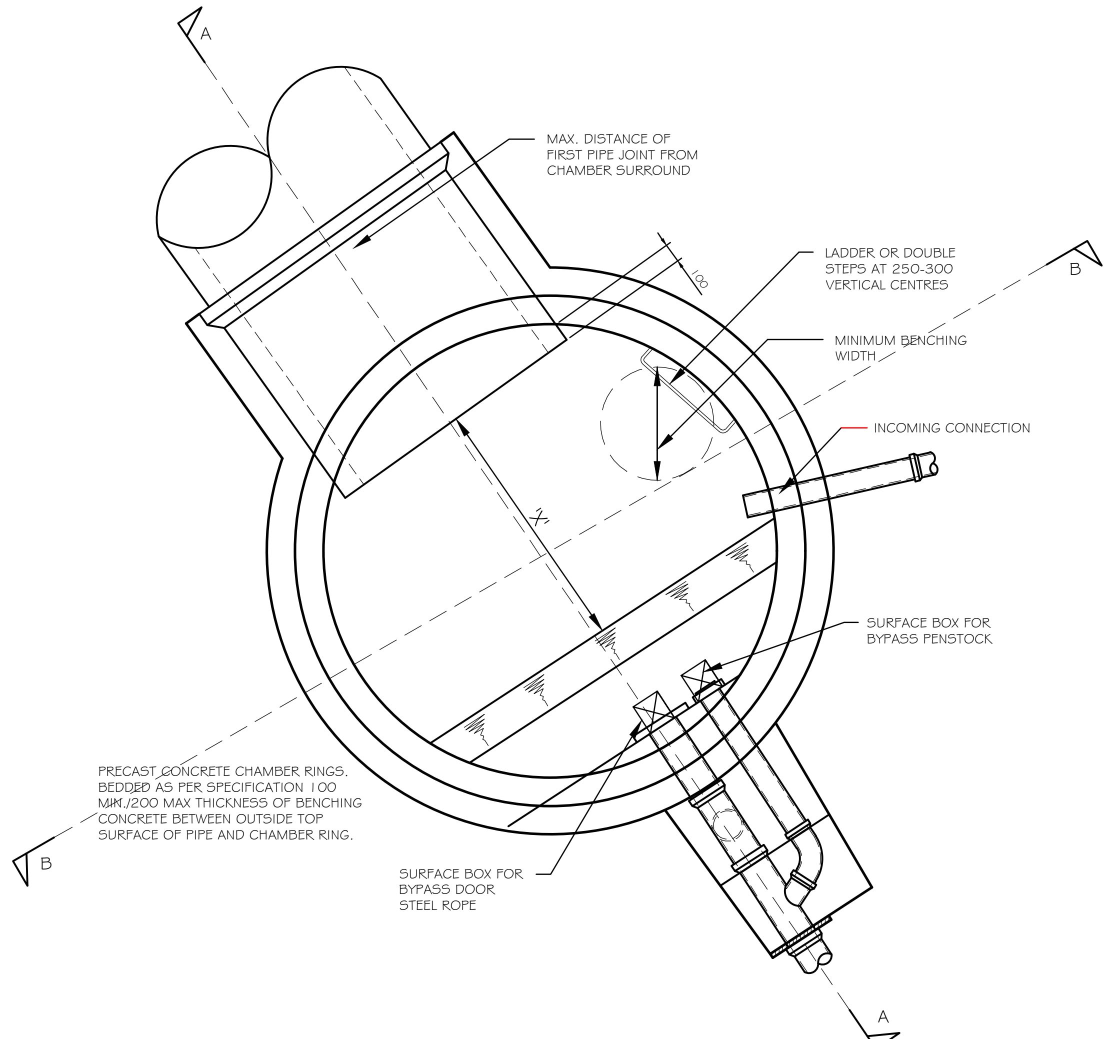
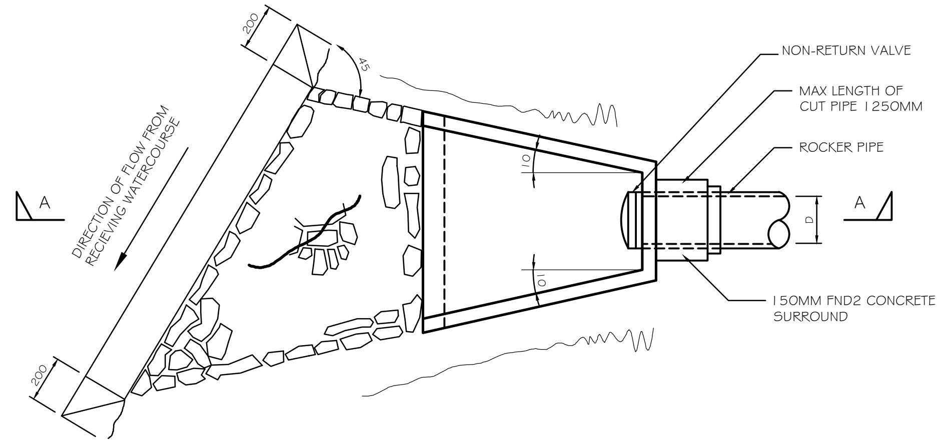
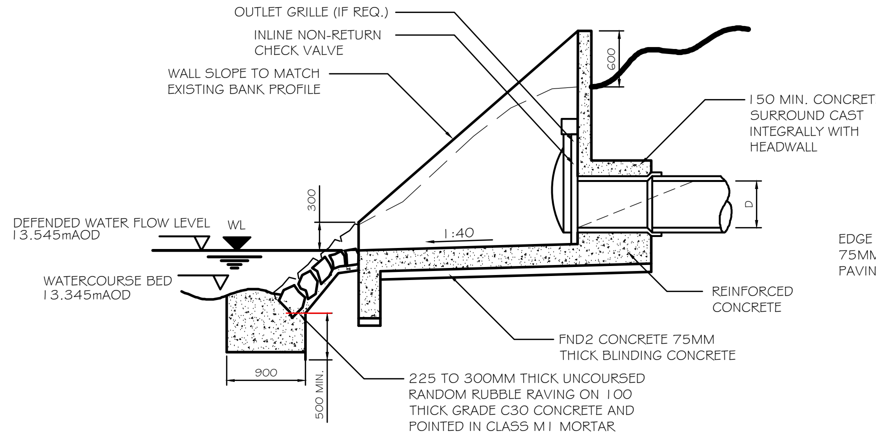


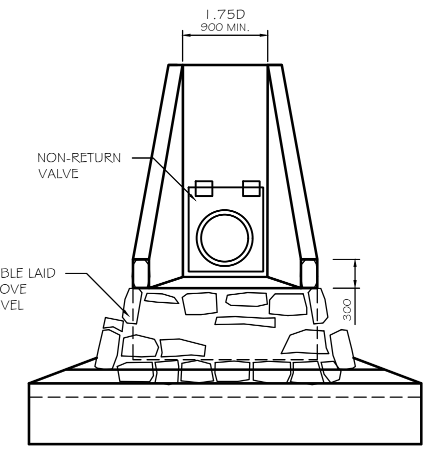
PLAN VIEW



PLAN VIEW

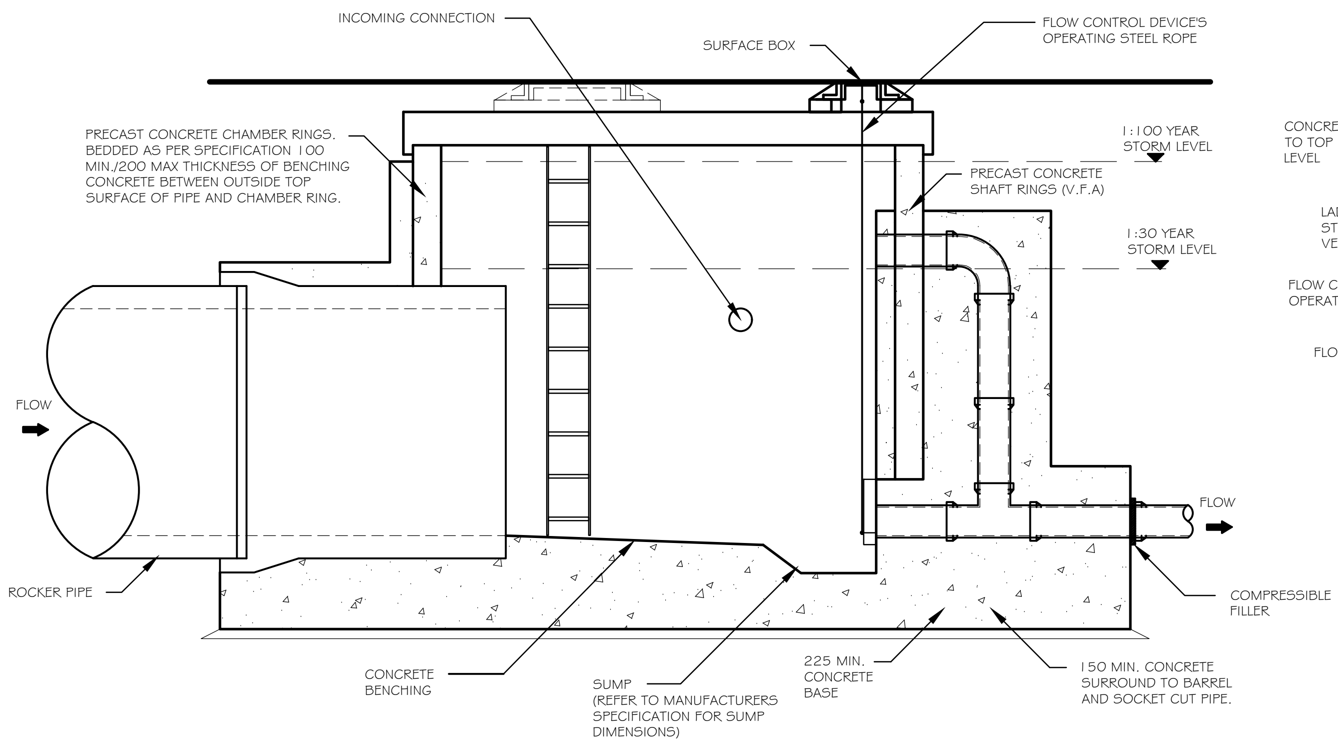


SECTION ON A-A

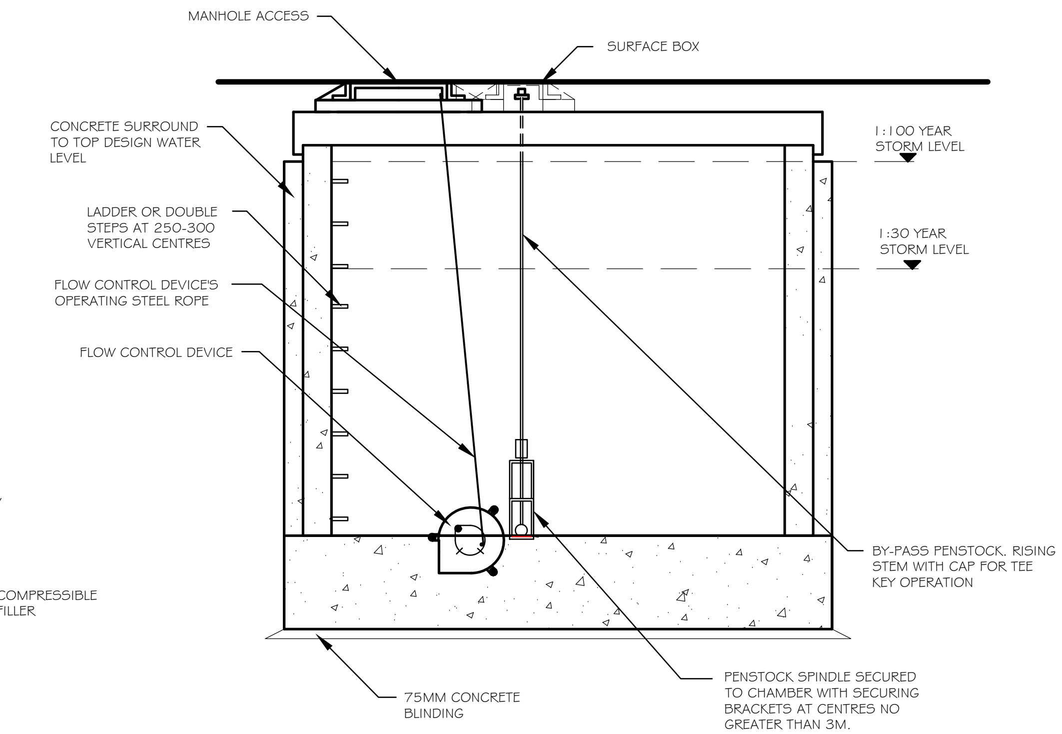


ELEVATION VIEW

TYPICAL OUTFALL DETAIL TYPE 1
N.T.S



SECTION ON A-A



SECTION ON B-B

FLOW CONTROL MANHOLE DETAIL
SCALE 1:20

Rev.	Amendments	Date	By

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PROJECT ADDRESS: LAND OFF HILL HOUSE INDUSTRIAL ESTATE, THORNTON-CLEVELEYS, FY5 4QD

PROJECT TITLE: NEW INDUSTRIAL BUILDING

DRAWING TITLE: DRAINAGE DETAILS 02

Client: MRS J HILL		Scales @A1: 1:20
Drawn By. LM	Checked By. DWH	Date 03/11/23
DRAWING No. A023/236/P/106		Revision -

H:\documents\Drawings\2023\Hill House Industrial Estate

Revision -
DRAWING No. A023/236/P/106

Appendix D
Drainage Calculations

Design Settings

Rainfall Methodology	FSR
Return Period (years)	1
Additional Flow (%)	0
FSR Region	England and Wales
M5-60 (mm)	17.000
Ratio-R	0.400
CV	0.750
Time of Entry (mins)	4.00
Maximum Time of Concentration (mins)	30.00
Maximum Rainfall (mm/hr)	50.0
Minimum Velocity (m/s)	1.00
Connection Type	Level Soffits
Minimum Backdrop Height (m)	0.200
Preferred Cover Depth (m)	0.900
Include Intermediate Ground	✓
Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
sw01	0.054	4.00	6.100	1200	12.500	76.000	1.050
sw02	0.030	4.00	6.100	1200	28.600	76.000	1.091
sw03	0.036	4.00	6.100	1500	41.200	78.000	1.393
sw04	0.000		6.100	1500	55.200	78.000	1.428
sw05	0.072	4.00	6.100	1200	18.000	28.600	1.125
sw06	0.070	4.00	6.100	1200	41.600	16.000	1.050
sw07	0.070	4.00	6.100	1500	44.000	28.000	1.266
sw08	0.056	4.00	6.100	1500	42.000	52.400	1.328
outfall	0.000		6.100	1200	61.000	78.000	1.443

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1	sw05	sw07	26.007	0.600	4.975	4.909	0.066	394.0	225	4.66	48.1
1.1	sw07	sw08	24.482	0.600	4.834	4.772	0.062	394.9	300	5.18	45.9
1.2	sw08	sw03	25.612	0.600	4.772	4.707	0.065	394.0	300	5.73	43.9
1.3	sw03	sw04	14.000	0.600	4.707	4.672	0.035	400.0	300	6.03	42.9
1.4	sw04	outfall	5.800	0.600	4.672	4.657	0.015	386.7	300	6.15	42.5
2.1	sw06	sw07	12.238	0.600	5.050	4.984	0.066	185.4	150	4.28	49.8
3.1	sw01	sw02	16.100	0.600	5.050	5.009	0.041	392.7	150	4.54	48.6
3.2	sw02	sw03	12.758	0.600	5.009	4.857	0.152	83.9	150	4.73	47.8

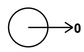
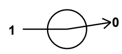
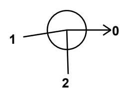
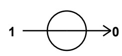
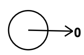
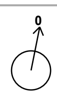
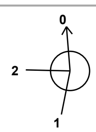
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1	0.652	25.9	9.4	0.900	0.966	0.072	0.0	94	0.601
1.1	0.785	55.5	26.4	0.966	1.028	0.212	0.0	146	0.775
1.2	0.786	55.5	31.9	1.028	1.093	0.268	0.0	163	0.812
1.3	0.780	55.1	45.1	1.093	1.128	0.388	0.0	207	0.867
1.4	0.793	56.1	44.7	1.128	1.143	0.388	0.0	203	0.878
2.1	0.735	13.0	9.5	0.900	0.966	0.070	0.0	95	0.801
3.1	0.501	8.9	7.1	0.900	0.941	0.054	0.0	102	0.557
3.2	1.098	19.4	10.9	0.941	1.093	0.084	0.0	81	1.130

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1	26.007	394.0	225	Circular	6.100	4.975	0.900	6.100	4.909	0.966
1.1	24.482	394.9	300	Circular	6.100	4.834	0.966	6.100	4.772	1.028
1.2	25.612	394.0	300	Circular	6.100	4.772	1.028	6.100	4.707	1.093
1.3	14.000	400.0	300	Circular	6.100	4.707	1.093	6.100	4.672	1.128
1.4	5.800	386.7	300	Circular	6.100	4.672	1.128	6.100	4.657	1.143
2.1	12.238	185.4	150	Circular	6.100	5.050	0.900	6.100	4.984	0.966
3.1	16.100	392.7	150	Circular	6.100	5.050	0.900	6.100	5.009	0.941
3.2	12.758	83.9	150	Circular	6.100	5.009	0.941	6.100	4.857	1.093

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1	sw05	1200	Manhole	Adoptable	sw07	1500	Manhole	Adoptable
1.1	sw07	1500	Manhole	Adoptable	sw08	1500	Manhole	Adoptable
1.2	sw08	1500	Manhole	Adoptable	sw03	1500	Manhole	Adoptable
1.3	sw03	1500	Manhole	Adoptable	sw04	1500	Manhole	Adoptable
1.4	sw04	1500	Manhole	Adoptable	outfall	1200	Manhole	Adoptable
2.1	sw06	1200	Manhole	Adoptable	sw07	1500	Manhole	Adoptable
3.1	sw01	1200	Manhole	Adoptable	sw02	1200	Manhole	Adoptable
3.2	sw02	1200	Manhole	Adoptable	sw03	1500	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
sw01	12.500	76.000	6.100	1.050	1200		0	3.1	5.050	150
sw02	28.600	76.000	6.100	1.091	1200		1	3.1	5.009	150
							0	3.2	5.009	150
sw03	41.200	78.000	6.100	1.393	1500		1	3.2	4.857	150
							2	1.2	4.707	300
							0	1.3	4.707	300
sw04	55.200	78.000	6.100	1.428	1500		1	1.3	4.672	300
							0	1.4	4.672	300
sw05	18.000	28.600	6.100	1.125	1200		0	1	4.975	225
sw06	41.600	16.000	6.100	1.050	1200		0	2.1	5.050	150
sw07	44.000	28.000	6.100	1.266	1500		1	2.1	4.984	150
							2	1	4.909	225
							0	1.1	4.834	300

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
sw08	42.000	52.400	6.100	1.328	1500	1	1.1	4.772	300
						0	1.2	4.772	300
outfall	61.000	78.000	6.100	1.443	1200	1	1.4	4.657	300

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	17.000	Drain Down Time (mins)	240
Ratio-R	0.400	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
2	0	0	0
30	0	0	0
100	40	0	0

Node sw03 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	4.707	Product Number	CTL-SHE-0103-5000-1200-5000
Design Depth (m)	1.200	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	5.0	Min Node Diameter (mm)	1200

Node sw08 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	4.772	Slope (1:X)	1.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)		Depth (m)	0.100
Safety Factor	2.0	Width (m)	32.000	Inf Depth (m)	
Porosity	1.00	Length (m)	52.000		

Node sw03 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	4.707
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	200.0	0.0	1.200	200.0	0.0	1.201	0.0	0.0