

**REMOVAL OF
DRILLING FLUIDS,
ENGINEERING
WORKS AND
EXTENDED WELL
TEST**

**DESIGN
PHILOSOPHY
STATEMENT FOR
FULLY ENGINEERED
IMPERMEABLE
SUBBASE**

**ANGUS ENERGY WEALD
BASIN No.3 LIMITED**



17TH JUNE 2020

REVISION NUMBER: R0

**BALCOMBE WELLSITE
LOWER STUMBLE EXPLORATION SITE
LONDON ROAD, BALCOMBE,
WEST SUSSEX, RH17 6JH**



APPROVALS

	Name	Title	Company	Signature
Prepared By	Mat Martin	Construction Manger	Zetland Group Limited	
Reviewed By	Jonathan Foster	Managing Director	Zetland Group Limited	
Approved By	Freddie Holt	Geoscientist	Angus Energy Weald Basin No.3 Limited	

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1. INTRODUCTION

Angus Energy Weald Basin No.3 Limited (“Angus Energy”) is submitting a planning application to West Sussex County Council (“WSCC”) under the Town and Country Planning Act 1990, seeking consent to undertake development at the Lower Stumble Exploration Site, London Road, Balcombe, West Sussex, RH17 6JH (“Balcombe Wellsite”). The development for which consent is being sought is:

‘Temporary permission for exploration and appraisal comprising the removal of drilling fluids and subsequent engineering works with an extended well test for hydrocarbons along with site security fencing and site restoration.’

Angus Energy is proposing a phased approach to the development. Phase 1 provides for well clean-up and establishing hydrocarbon flow. Contingent upon the success of Phase 1, Phase 2 provides for the installation of a fully engineered impermeable subbase across the wellsite platform, in preparation for Phase 3, Extended Well Test (EWT). Contingent upon the results of the EWT, Phase 4 provides for well decommissioning and site restoration.

A planning application (Planning Ref: WSCC/071/19) had previously been submitted to WSCC for this development but was subsequently withdrawn in April 2020.

A new planning application for this development is now being submitted to WSCC, which is to be supported by a Design Philosophy Statement (this document).

Zetland Group has been commissioned by Angus Energy to prepare a Design Philosophy Statement (this document), setting out the basis for the design of a fully engineered impermeable subbase system, what will inform the design and how quality assurance will be achieved during its construction (“CQA”).

For clarity, the installation of a fully engineered impermeable subbase is contingent upon the success of Phase 1 of the development and will be subject to a detailed civil and structural design and CQA.

2. SCOPE

This Design Philosophy Statement is applicable to the Balcombe wellsite and can be used in support of applications to WSCC and the Environment Agency, where there is a requirement to provide details of the proposed fully engineered impermeable subbase, for example when preparing an updated Hydrogeological Risk Assessment (HRA).

Should planning permission or environmental permits be granted, this Design Philosophy Statement will be superseded by a civil and structural design statement.

3. DEFINITIONS

BGA:	British Geomembrane Association
CBR:	California Bearing Ratio
CPT:	Cone Penetrating Test
CSM:	Conceptual Site Model
EPR2016:	Environmental Permitting (England and Wales) Regulations 2016
EWT:	Extended Well Test
HDPE:	High Density Polyethylene
HRA:	Hydrogeological Risk Assessment
KN:	Kilonewton
KN/m ² :	Kilonewton per metre squared
LFE:	Landfill Engineering
m:	Metre

mm:	Millimetre
OMC:	Optimum Moisture Content
PSD:	Particle Size Distribution
T:	Metric Tonne
SPZ:	Source Protection Zone
TRL:	Transport Research Laboratory
TWI:	Thermal Welding Institute
UKAS:	United Kingdom Accreditation Service

4. PRE-CONSTRUCTION SURVEYS & ASSESSMENTS

To inform both the design philosophy and subsequent detailed civil and structural design, a number of pre-construction surveys are required. The following section sets out what surveys and assessments are required and when.

4.1 Topographic Survey

To inform the basis of design (design philosophy), a topographic survey of the site and associated access track was acquired in November 2019 (*Evolution Surveys: Drawing Number: J207-TS-01 Rev: A*). The Zetland Group Construction Manager attended site to coordinate the survey team and make an assessment of the site's 'as-built' condition, including photographic record.

The topographic survey was then overlaid on Ordnance Survey MasterMap Topography Layer to create an existing wellsite platform layout plan (Drawing Ref: ZG-AE-BAL-DPS-HDPE-01). A copy of the plan, together with proposed platform construction details (Drawing Ref: ZG-AE-BAL-DPS-HDPE-02) and associated section details (Drawing Ref: ZG-AE-BAL-DPS-HDPE-03 & ZG-AE-BAL-DPS-HDPE-04) are provided as Appendix 2 within this Design Philosophy Statement.

4.2 Basis of Design

Using the existing layout plan, Zetland Group drafted the position of a fully engineered impermeable subbase, to be retrospectively installed, contingent upon the success of Phase 1 of the development. For clarity, the fully engineered impermeable subbase consists of the following:

- Removal of the existing 300mm granular platform surface material, existing polypropylene geo-grid and existing geotextile;
- If required, screen existing granular material, removing large cobbles in excess of 50mm;
- A 'V-Type' perimeter containment ditch and HDPE impermeable membrane anchor berm surrounding the active area of the wellsite;
- A fully welded 2mm thick HDPE impermeable membrane laid across the active area of the wellsite and perimeter containment ditch;
- Protective geotextiles laid below and above the HDPE impermeable membrane;
- Batten fixing the HDPE impermeable membrane to existing concrete pad, which surrounds the Balcombe-2z drilling cellar;
- Twin-wall perforated pipe and rodding/jetting points laid within the perimeter containment ditch, above the HDPE impermeable membrane and protective geotextiles, back filled to finished platform level using 40mm single size granular material;
- A connection from the twin-wall perforated pipe system to the existing interceptor and installation of isolation valves (up and down stream of interceptor) and a sampling point downstream of the interceptor;
- A layer of extruded polypropylene geo-grid across the active area of the wellsite, above the HDPE impermeable membrane and protective geotextiles, for additional structural support; and

- A 300mm thick layer of compacted granular material above the protective geotextile and geo-grid, providing the finished wellsite platform with nominal fall toward the perimeter containment ditch.

The objective of the fully engineered impermeable subbase is to provide full hydraulic containment of the wellsite platform, preventing contaminated surface water and/or pollutants from entering the ground. Subject to obtaining the relevant surface water discharge permits from the Environment Agency, it also provides the ability to discharge 'clean' run-off water, although, for the purpose of EWT, it is proposed that the interceptor is isolated and all surface water removed from site via road tanker to an Environment Agency permitted water treatment works. For clarity, the pipework connecting the perimeter containment ditch to the interceptor needs to be included in the fully engineered impermeable subbase, thus future proofing the containment system, negating the need to modify the system at a later date (if the site continues to operate, subject to future consents).

4.2.1 Anticipated Loading Requirements

The finished wellsite platform shall be designed to accommodate a worst case anticipated loadings, which will be based on expected worst case crane loading supplied by the crane supplier. For typical anticipated loading requirements, refer to Table 4.1 below.

Load Type	Pressure	Application Area
68.4 T Outrigger Load	141.4 KN/m ²	2.2m x 2.2m
68.4 T Outrigger Load	200.0 KN/m ²	1.8m x 1.8m
16.2T Axle Load/80KN Tyre Load	404.0 KN/m ²	0.445m x 0.445m

Table 4.1: Worst Case Anticipated Loadings

The make-up of the wellsite platform shall be sufficient to ensure that the HDPE impermeable membrane is not subject to mechanical stress and subject to cylinder testing, as set out in Section 5.3 below.

4.2.2 Proposed Containment Area

Table 4.2 below sets out the proposed containment areas and their respective thicknesses, from which surface water attenuation can be derived.

Containment Area	Area/Length	Material Depth/Volume
Overall Containment Area to Anchor Trench	4,141m ²	Various Depths and Materials
Wellsite Platform (Excluding Perimeter Containment Ditch, Concrete Pad and Concrete Access Area)	3,199m ²	300mm Granular Material (50mm to Dust)
Concrete Pad	200m ²	250mm Concrete
Concrete Access Area	51m ²	250mm Concrete
Perimeter Containment Ditch	242m (Mean Length)	1.5m ³ x 242m = 363m ³ Granular Material (40mm Single Size)

Table 4.2: Proposed Containment Areas for Surface Water Attenuation

4.3 Civil & Structural Design

To inform a detailed civil and structural design for the retrospective installation of a fully engineered impermeable subbase, a number of additional surveys and assessments will be undertaken, as set out below.

4.3.1 Existing Geotechnical Information

A geotechnical investigation of the site was acquired in 2010, in advance of remedial construction works in preparation for the drilling of the Balcombe 2 well (drilled in 2013). A review of the 2010 geotechnical investigation indicates that sixteen (16) cone penetrating tests (CPTs) were carried out across the site, from surface to a depth of approximately

10m. The geology encountered during the tests confirmed the subgrade to be a silty/gravelly sand above firm to very hard clay, with silty sand at depth.

Whilst the geotechnical investigation was deemed sufficient for establishing ground bearing pressure upon which remedial construction works would take place in preparation for drilling the Balcombe 2 well, no soil sampling or testing of the soils was carried out, therefore, there is no interpretative report from which Zetland Group and the civil and structural designers can base any future design, in particular, one which fully considers the underlying geology and its potential to compromise the integrity of an impermeable subbase, should it be installed.

4.3.2 Further Evaluations and Interpretive Report Requirement

Given the limited geotechnical information available for the site, Zetland Group advised [and Angus Energy agreed] that a detailed scheme of site investigation should be carried out. The scheme, which, consists of the following two (2) phases, was carried out in December 2019:

Phase 1 - Desktop Study and Report

- A review of mining, historical, geological, hydrological, hydrogeological, and environmental and geotechnical third party data;
- Preliminary Conceptual Site Model (CSM), geotechnical and environmental risk assessments;
- A site walkover survey; and
- Phase 1 report.

Phase 2 - Intrusive Works

- A series of ground investigation holes (mechanical trial pits), with in-situ ground strength testing where appropriate;
- In-situ California Bearing Ratio (CBR) tests using Transport Research Laboratory (TRL) probe;
- Supervision and logging in accordance with BS 5930 *Codes of practice for site investigations* and EN 1997 – 1 EuroCode 7: *Geotechnical design*;
- Selected soil sampling for chemical and geotechnical laboratory analysis;
- Selected sampling of existing granular platform material for Particle Size Distribution (PSD) and Optimum Moisture Content (OMC) analysis; and
- Phase 2 interpretive report and laboratory analysis.

5. CIVIL AND STRUCTURAL ENGINEERING AND DESIGN

Contingent upon the success of Phase 1 of the development, a detailed civil and structural design will be prepared, informed by this Design Philosophy Statement, the geotechnical evaluation, chemical analysis and interpretive reporting.

In formulating a design, the following key criteria will be considered:

- Environmental condition;
- Geotechnical condition;
- Drainage requirements, including falls to encourage surface run-off;
- Vehicle movements;
- Lifting/loading requirements;
- Health and safety; and
- Design life.

5.1 Standards and Codes

The design of the fully engineered impermeable subbase will comply with British Standards, Codes of Practice or Eurocodes and relevant National annexes.

Environment Agency guidance relevant to the installation of fully engineered impermeable subbases is as follows:

- Onshore oil and gas sector guidance;
- LFE2 *Cylinder testing geomembranes and their protective materials*;
- LFE4 *Earthworks in Landfill Engineering*;
- LFE5 *Using geomembranes in landfill engineering*; and
- LFE7 *Using non-woven protector geotextiles in landfill engineering*.

5.2 Consultation with Manufacturer

The civil and structural design process includes consultation with the HDPE impermeable membrane and protective geotextile manufacturer, who will be issued with a copy of the geotechnical interpretive report and lifting/loading requirements. The manufacturer will then issue a recommendation to the civil and structural design team, setting out the platform design thickness and protective geotextiles specification. For clarity, a 300mm granular cover is generally acceptable, with only the thickness of the protective geotextiles or introduction of additional geo-grids varying, depending on the specifics of the subgrade or lifting/loading requirements.

5.3 Cylinder Testing

The proposed platform construction, consisting of [from below to above] a layer of geotextile, the HDPE impermeable membrane, a layer of geotextile, a layer of extruded polypropylene geo-grid and a 300mm thick layer of granular material, will be subject to cylinder testing, in accordance with the Environment Agency guidance LFE2 *Cylinder testing geomembranes and their protective materials* and carried out by a United Kingdom Accreditation Service (UKAS) accredited laboratory. The results of the laboratory testing will be fed back to the HDPE impermeable membrane and protective geotextile manufacturer and further advice obtained if required.

The purpose of the cylinder test is to confirm the effectiveness of the protective geotextiles, in protecting the HDPE impermeable membrane against long term mechanical effects of static point loading and the trafficking of vehicle movements.

6. CONSTRUCTION QUALITY ASSURANCE

In accordance with Chapter 6 of the Environment Agency guidance LFE4 *Earthworks in Landfill Engineering*, a CQA plan will be prepared for the retrospective installation of a fully engineered impermeable subbase (Phase 2 of the development). The CQA plan will be developed in conjunction with the specialist installation requirements of the HDPE impermeable membrane manufacturer and construction contractor. A British Geomembrane Association (BGA) specialist sub-contract installer with the relevant Thermal Welding Institute (TWI) experience and qualifications shall be appointed to install the HDPE impermeable membrane.

As a minimum, the CQA plan will contain the following:

- Installation of the lower geotextile;
 - Delivery, unloading and storage;
 - Conformance Testing;
 - Subgrade preparation,
 - Geotextile placement; and
 - Protection.
- Installation of the HDPE impermeable membrane;
 - Delivery, unloading and storage;
 - Conformance Testing;
 - HDPE placement;
 - Trial seams;
 - Seam and weld testing;
 - Non-destructive testing (air testing of the liner welds, spark test over panel before covering);
 - Quantitate destruction testing; and
 - Liner panel layout plan, showing joint locations, roll number, repairs and penetrations etc.

- Installation of the upper geotextile;
 - Delivery, unloading and storage;
 - Conformance Testing;
 - Subgrade preparation,
 - Geotextile placement; and
 - Protection.
- Air testing of drainage ditch to interceptor and discharge;
- Replacement of granular material;
- In-situ plate bearing tests on prepared subgrade and platform following pre/post installation; and
- As-built topographic survey on completion of the installation works.

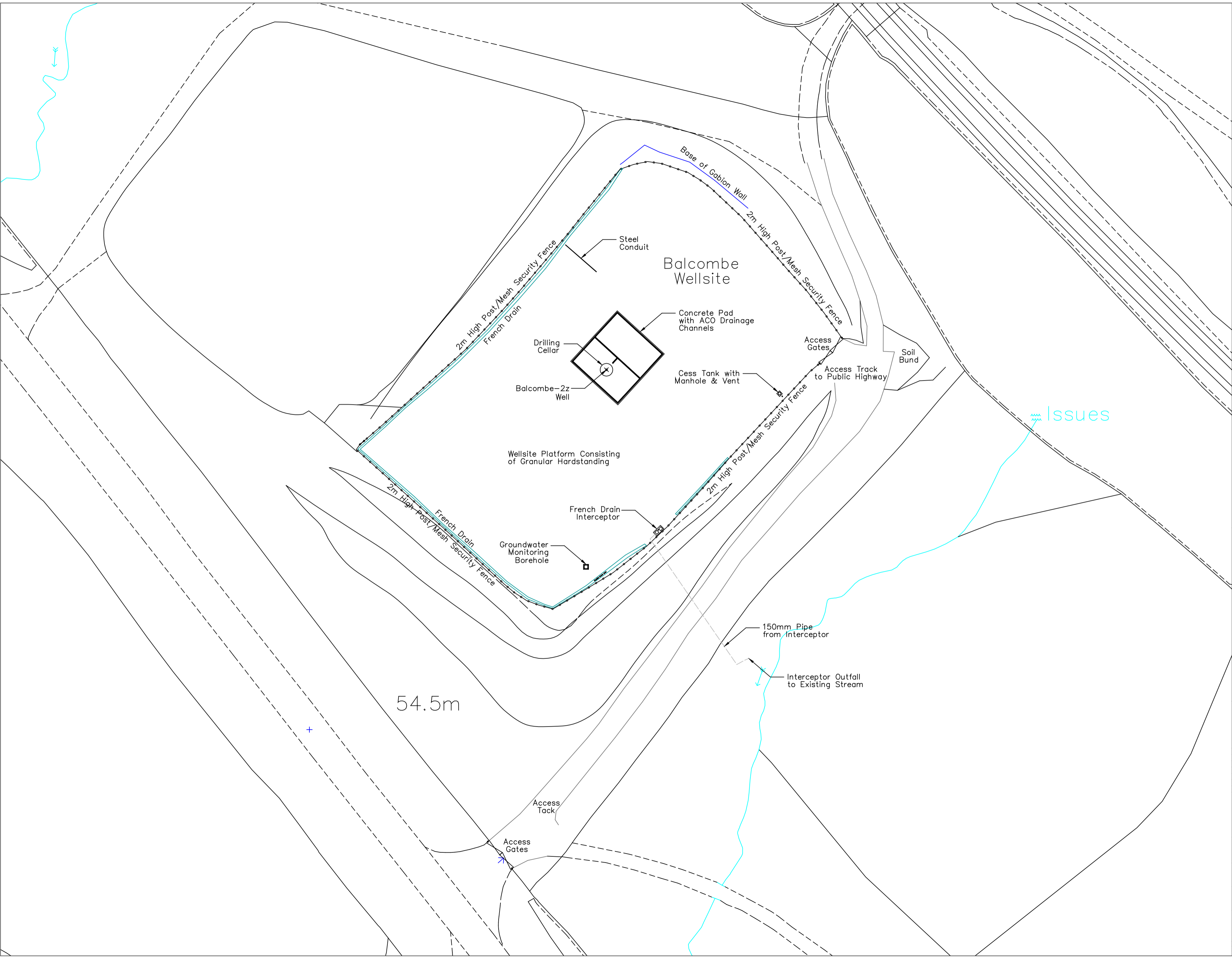
The Balcombe Wellsite is subject to environmental permitting under EPR 2016. A mining waste activity permit (Permit Ref: EPR/GB3609KQ) was issued by the Environment Agency to Angus Energy on 29th August 2018, following Angus Energy's acquisition of the asset.

Article 11 of the Mining Waste Directive requires the competent authority (in this case the Environment Agency) to satisfy itself that, in constructing a new waste facility or modifying an existing waste facility, the operator ensures that the facility shall be suitably constructed, managed and maintained to ensure its physical stability and prevent pollution and contamination. To aid the Environment Agency in fulfilling its duties imposed by Article 11 of the Mining Waste Directive, Angus Energy will consult the Environment Agency and seeks its approval of the CQA plan.



APPENDIX 1 – DESIGN PHILOSOPHY PLANS

KEY:



NOTES

APPLICANT:



REVISION HISTORY				
REV	DATE	BY	DETAILS	
0	DEC19	JF	ORIGINAL FOR ISSUE	JF



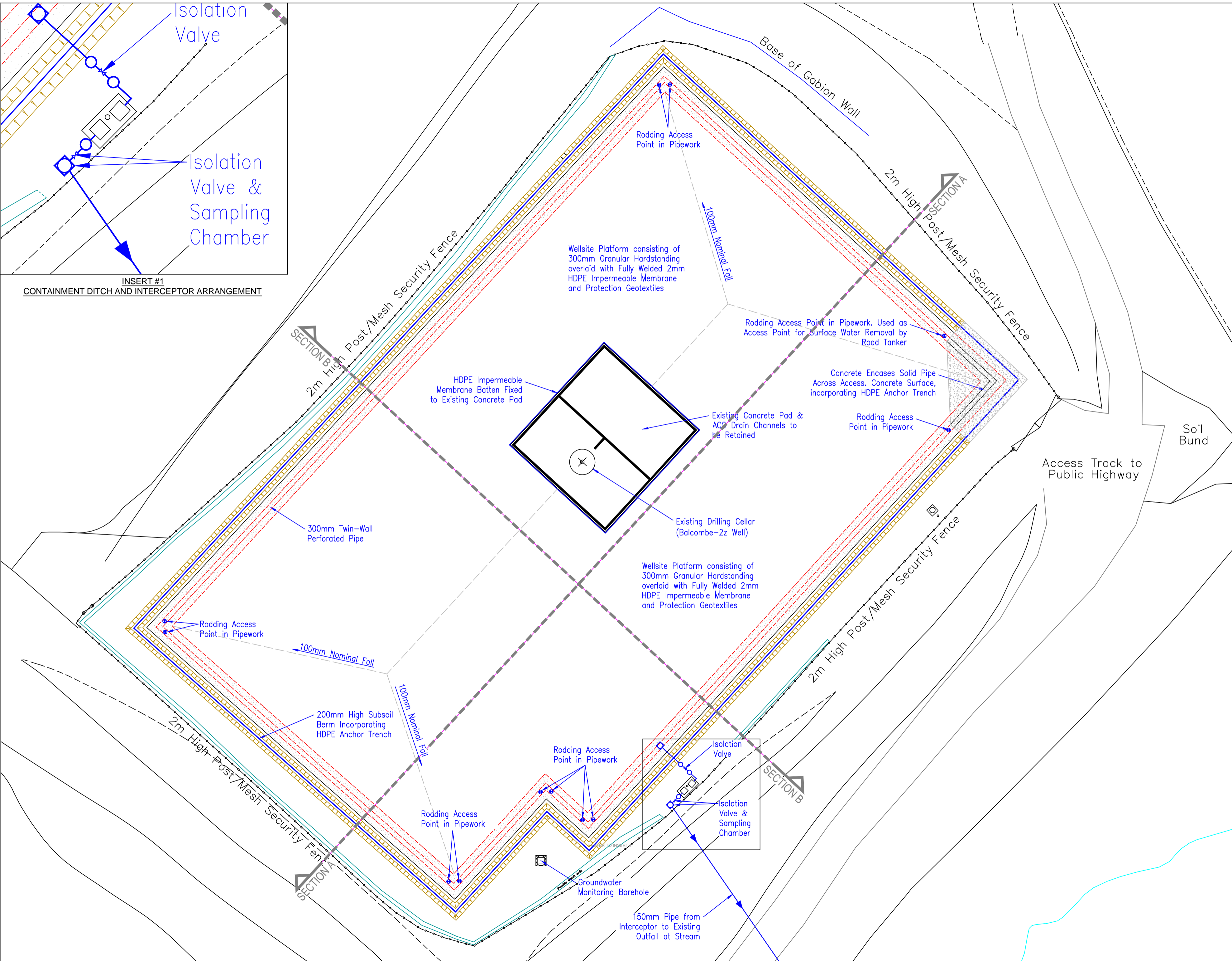
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SITE: BALCOMBE WELLSITE
OFF LONDON ROAD, BALCOMBE,
HAYWARDS HEATH, RH17 6JH

PROJECT: DESIGN PHILOSOPHY FOR
FULLY ENGINEERED
IMPERMEABLE SUBBASE

TITLE: EXISTING WELLSITE PLATFORM
LAYOUT

KEY:



INSERT #1
CONTAINMENT DITCH AND INTERCEPTOR ARRANGEMENT

- NOTES
1. PRE-CONSTRUCTION DESIGN WORKS TO INCLUDE DETAILED CIVIL & STRUCTURAL DESIGN, INFORMED BY GEOTECHNICAL EVALUATION (AND INTERPRETIVE REPORT) AND CONSULTATION WITH HDPE IMPERMEABLE MEMBRANE MANUFACTURER.
 2. HDPE IMPERMEABLE MEMBRANE AND PROTECTIVE GEOTEXTILES TO BE CYLINDER TESTED, IN ACCORDANCE WITH ENVIRONMENT AGENCY 'LEZ' CYLINDER TESTING GEOMEMBRANES AND THEIR PROTECTIVE MATERIALS.
 3. INSTALLATION OF THE HDPE IMPERMEABLE MEMBRANE TO BE UNDERTAKEN IN STRICT ACCORDANCE WITH A CONSTRUCTION QUALITY ASSURANCE PLAN, AGREED IN ADVANCE WITH THE ENVIRONMENT AGENCY.

APPLICANT:

REVISION HISTORY				
REV	DATE	BY	DETAILS	APR
0	DEC19	JF	ORIGINAL FOR ISSUE	JF

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FROM CONCEPTION TO COMPLETION

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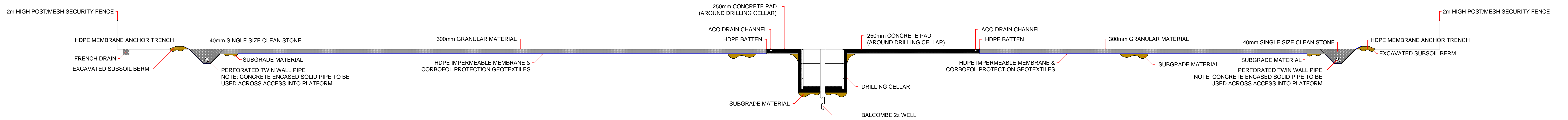
SITE: BALCOMBE WELLSITE
OFF LONDON ROAD, BALCOMBE,
HAYWARDS HEATH, RH17 6JH

PROJECT: DESIGN PHILOSOPHY FOR
FULLY ENGINEERED
IMPERMEABLE SUBBASE

TITLE: PROPOSED WELLSITE
PLATFORM CONSTRUCTION
DETAILS

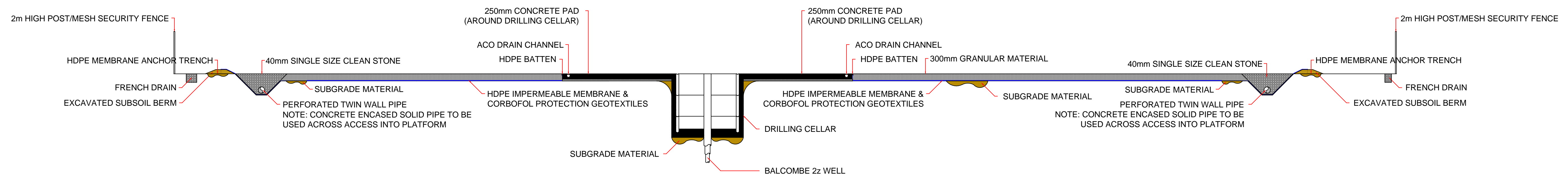
Section A-A Through Proposed Wellsite Platform

Scale 1:100



Section B-B Through Proposed Wellsite Platform

Scale 1:100



NOTES

1. THE CONSTRUCTION DESIGN WORDS TO INCLUDE DETAILS OF ALL STRUCTURAL DESIGN INFORMED BY GEOTECHNICAL CONSULTATIONS AND THE RELEVANT CONSTRUCTION WORKS TO BE PERFORMED BY THE CONTRACTOR. ANY NECESSARY MEMBRANE ANCHOR TRENCHES AND PERFORATED TWIN WALL PIPES SHOULD BE CONSIDERED WITH ENVIRONMENTAL IMPACTS OF THE NEW BARRIERED MEMBRANE TO BE INSTALLED AND THE PROTECTIVE MEMBRANE TO BE INSTALLED IN STRICT ACCORDANCE WITH THE DESIGN AND CONSTRUCTION QUALITY ASSISTANCE PLAN ISSUED IN ADVANCE WITH THE ENVIRONMENTAL REPORT.

APPLICANT:

NO.	REVISION	DATE
1	REVISED	2024-08-20
2	REVISED	2024-08-20
3	REVISED	2024-08-20
4	REVISED	2024-08-20
5	REVISED	2024-08-20
6	REVISED	2024-08-20
7	REVISED	2024-08-20
8	REVISED	2024-08-20
9	REVISED	2024-08-20
10	REVISED	2024-08-20

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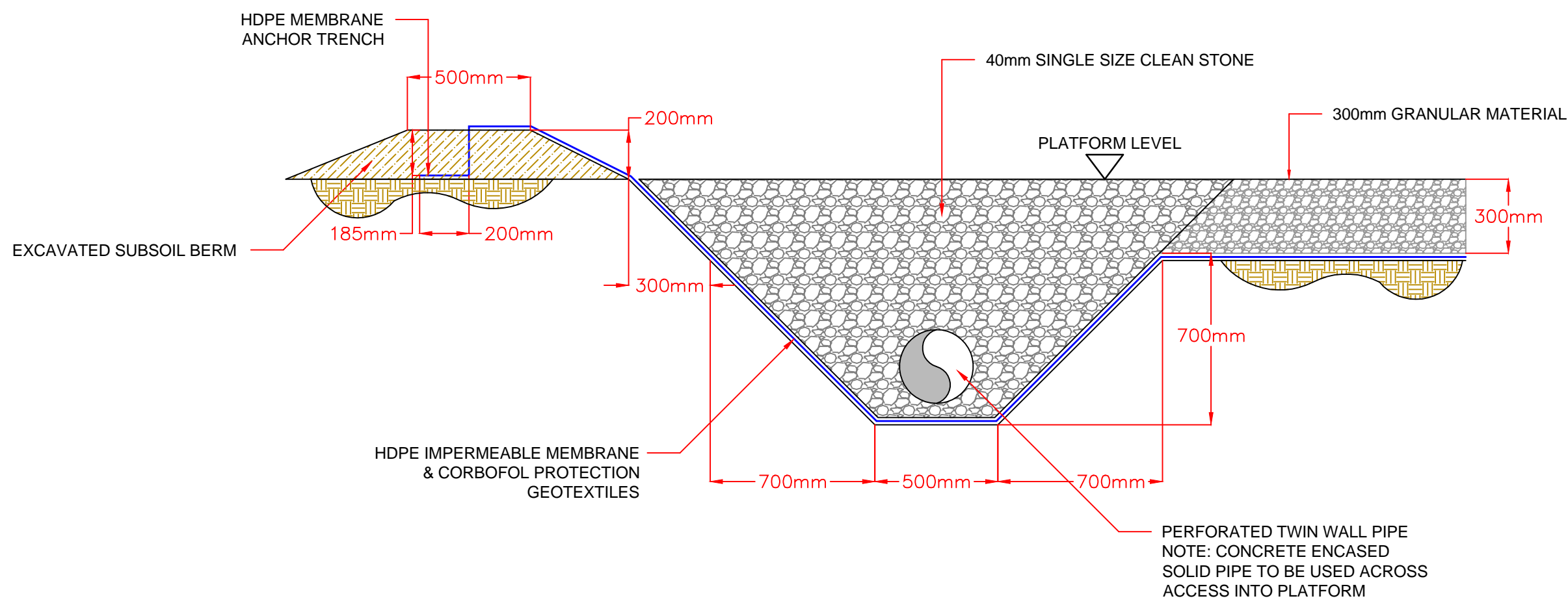
PROJECT: DESIGN THE GEOGRAPH FOR FULLY ENGINEERED IMPERMEABLE SUBBASE

TITLE: SECTIONS THROUGH PROPOSED WELLSITE PLATFORM

SCALE: 1:100 **DATE:** 22 AUG 2024 **DESIGNER:** JHS/CS

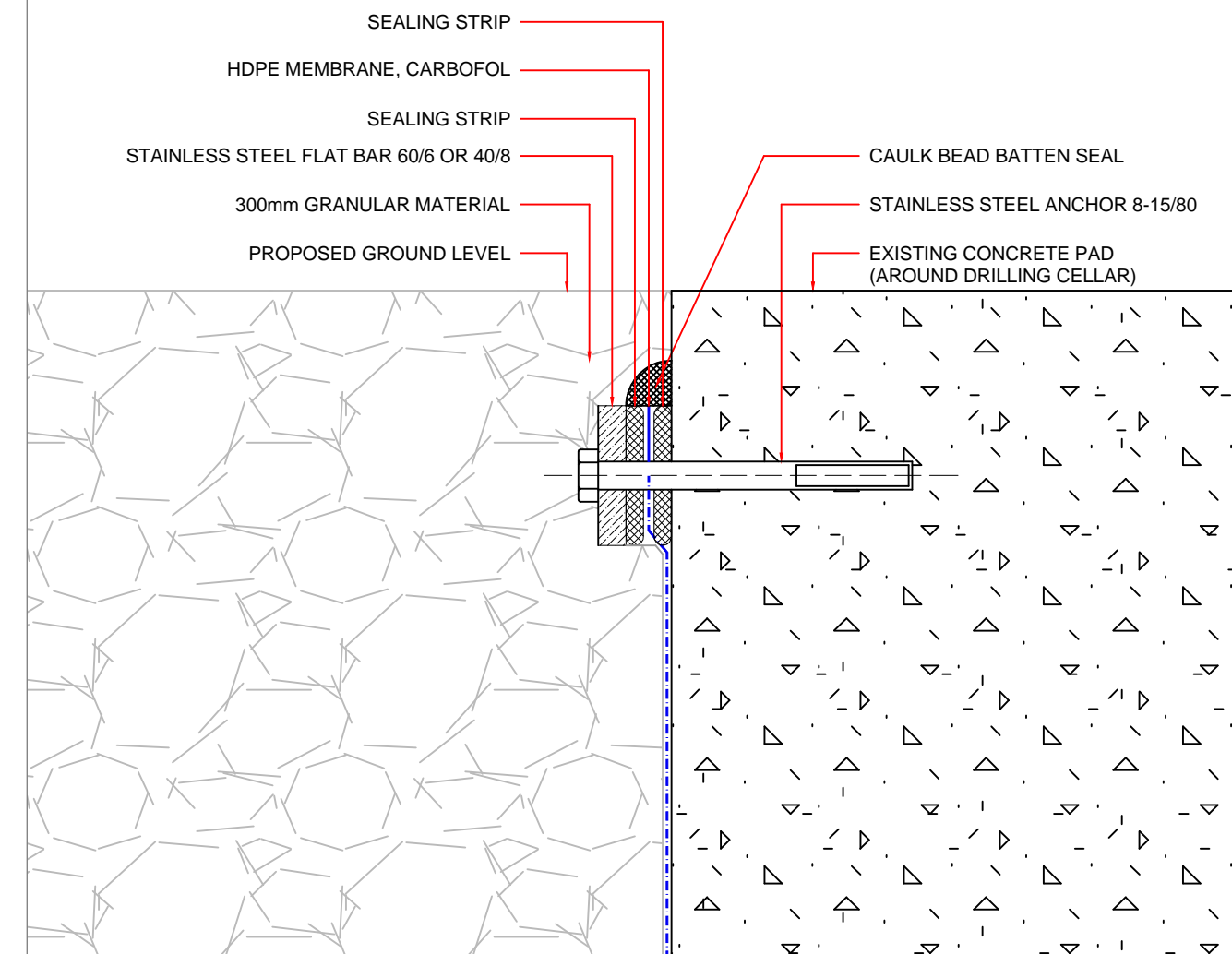
Containment Ditch Detail

Scale 1:20



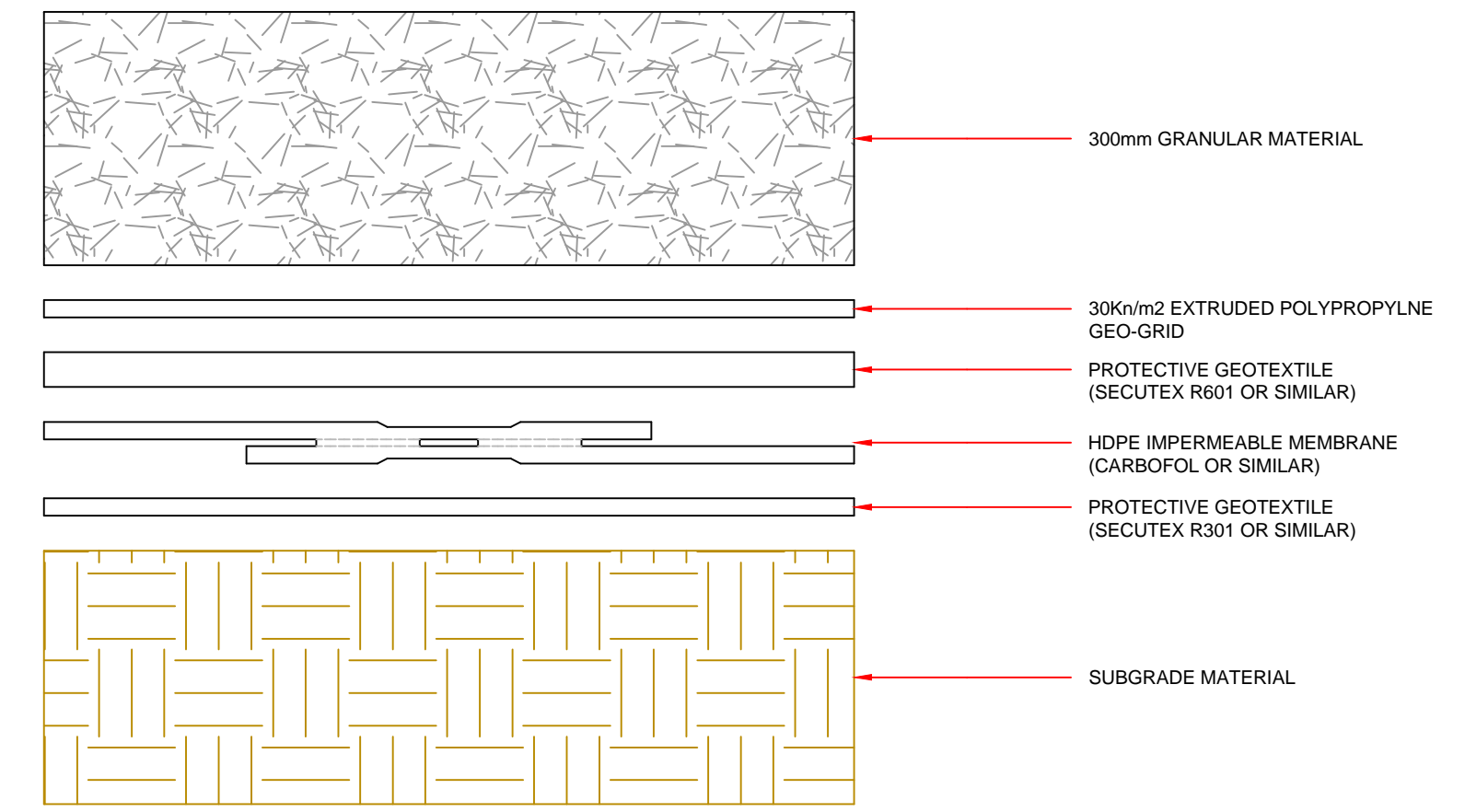
HDPE Batten Detail

Scale 1:2



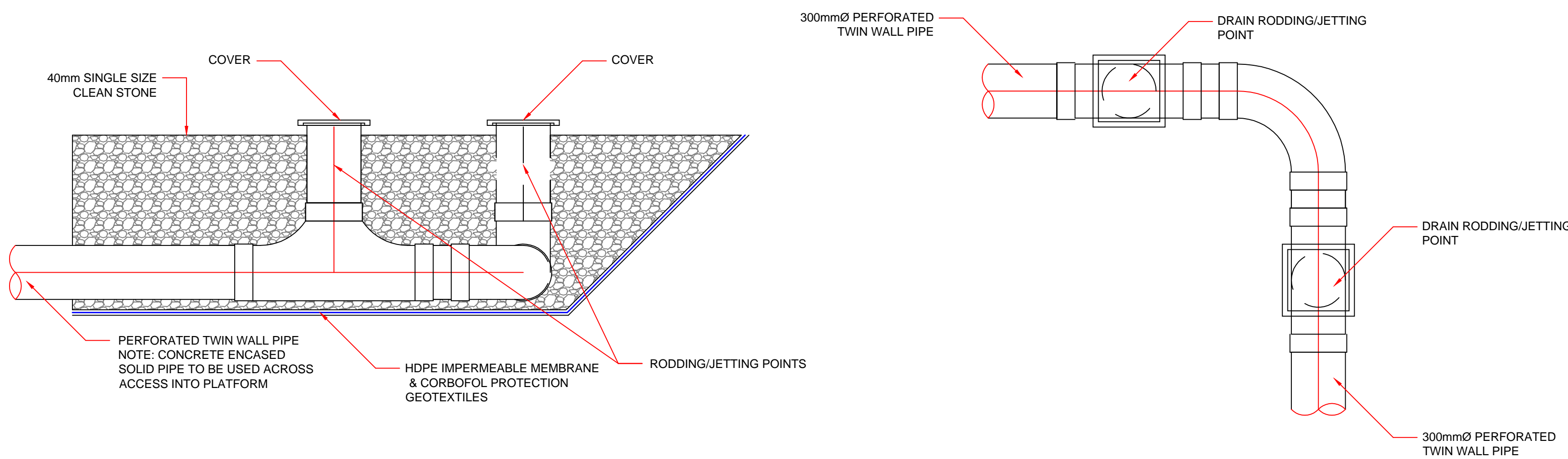
Wellsite Platform Build-Up Detail

Scale Indicative



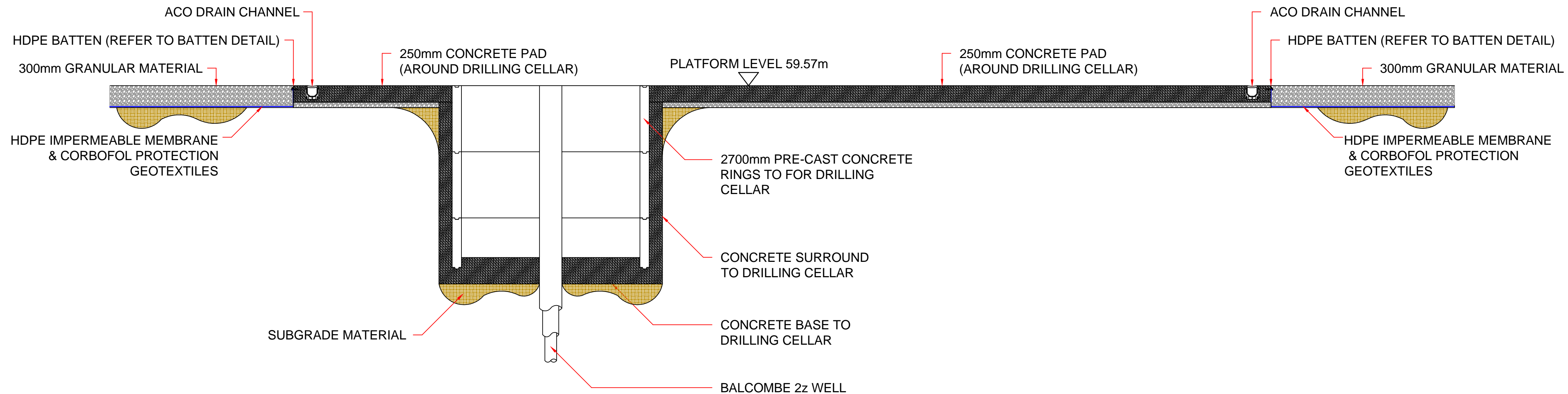
Rodding Access Point Detail

Scale 1:20



Drilling Cellar and Concrete Pad Detail

Scale 1:50



KEY:

NOTES:

1. PRE CONSTRUCTION DESIGN WORKS TO INCLUDE DETAILED CIVIL & STRUCTURAL DESIGN INFORMED BY GEOTECHNICAL EVALUATION (AND INTERPRETIVE REPORT) AND CONSULTATION WITH HDPE IMPERMEABLE MEMBRANE MANUFACTURER.
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HAYWARDS HEATH, RH17 6JH

PROJECT: DESIGN PHILOSOPHY FOR
FULLY ENGINEERED
IMPERMEABLE SUBBASE

TITLE: PROPOSED SECTION DETAILS

Scale: AS INDICATED DWG No: ZG-AE-BAL-EWT-HDPE-04