Horse Hill Developments Ltd

Title: Site Condition Report

Document Number: HHDL-EPR-HHP-SCR-006

Revision: 7

Rev.	Status	Reason for Issue	Revision Date	Written by	Reviewed by	Approved by
7	Final	Revised for Permit Variation	01/10/20	ZG-SS	ZG-TF	TH
6	Final	New application	02/05/19	ZG-SS	ZG-TF	TH
5	Final	Final amended	31/01/17	XXX	XXX	XXX
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2	Review	For review	24/10/16	XXX	XXX	
1	Review	For review	23/10/16	XXX	XXX	
0	Draft	New application	29/09/16	XXX	XXX	

Revision History

REVISION DESCRIPTION SHEET

Details to include revision number, a description of the revision indicating paragraphs and pages that have been revised, together with the date and approved signature.

Revision	Description	Date	Approved by
0	New Environment Agency application	29/09/16	
1	For review	23/10/16	
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4	Final issue	09/11/16	XXX
5	Final Issue, amended for EA's Schedule 5	31/01/17	XXX
6	Reviewed prior to Environmental Permit Variation	02/05/19	TH
7	Considers alteration to the Development and Schedule 5 Notice	01/10/20	TH

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1. INTRODUCTION

Horse Hill Developments LTD (HHDL) is a Limited Company that was formed to manage the exploration and production activities at the Horse Hill Well Site. HHDL is a consortium of natural resource companies and owns a 65% interest and operatorship of Petroleum Exploration and Development Licence (PEDL) 137 within which the Horse Hill Well Site is located.

HHDL is the holder of a number of Environmental Permits issued by the Environment Agency in accordance with the Environmental Permitting (England and Wales) Regulations 2016. The current permitted activities at the Horse Hill Well Site allow the undertaking of the following activities:

EPR/BB3300XG - A mining waste operation for the management of extractive waste from prospecting mineral resources, not involving a mining waste facility.

A mining waste operation for the management of non-hazardous extractive liquid waste and gas, from prospecting for mineral resources not including a waste facility resulting from well testing operation. No more than 10 tonnes of natural gas may be flared each day.

EPR/BB3691NN - The discharge of clean surface water off-site during periods of non-operational activity. Discharges to surface water may not take place during drilling, flow testing or well testing.

EPR/SP3339YS - The loading, unloading, handling or storage of, or physical, chemical or thermal treatment of crude oil with a capacity of no more than 500 tonnes.

EPR/AB3498DZ - SR 2014 No4 Permit () for the Accumulation and Disposal of radioactive waste from the NORM Industrial Activity of the production of oil and gas.

As the development continues to progress, additional permitted activities have been identified as being necessary. As a result, HHDL have prepared an application to vary the environmental permits with the purpose of gaining permission to undertake the following activities:

- Construct up to four (4) new additional boreholes (HH-3/HH-4/HH-5/HH-6) in addition to the current two (2) boreholes (HH-1/HH-2) already constructed at the Horse Hill Well Site **(EPR/BB3300XG)**;
- Harness at least one (1) of the six (6) boreholes as a reinjection well for the purpose of providing production support **(EPR/BB3691NN)**;
- Undertake well treatments such as an acid wash and solvent treatments **(EPR/BB3300XG)**;
- Undertake a 90 day well test for each of the additional wells (HH-3/HH-4/HH-5/HH-6) before later being added to the portfolio of production wells at the site or being abandoned **(EPR/BB3300XG)**;
- Undertake an injectivity test within HH-2 (HH-2z) and any other wells as dictated by HHDL **(EPR/BB3691NN)**;
- Incinerate natural gas at a rate not exceeding 10 tonnes per day during production operations, until such a time that it can be demonstrated that the incineration of natural gas is no longer considered Best Available Technique through a cost benefit analysis **(EPR/BB3300XG)**;

HHDL will continue to undertake the following activities at the site in accordance with the current permissions presented within the permit:

- Store and handle crude oil up to a capacity of 500 tonnes within the existing infrastructure and within the current permitted boundary. Permit **EPR/SP3339YS** will not be the subject of a permit variation.

2. SCOPE

This Site Condition Report is applicable to the Horse Hill Well Site and all operations conducted therein. It has been produced to provide a report on the current condition of the land and nearby surrounding area in advance of an application to the Environment Agency for an environmental permit.

It is applicable to HHDL, its contractor and subcontractors and can be used in support of an application to the Environment Agency under the Environmental Permitting (England and Wales) Regulations 2016 (EPR2016), where there is a requirement to provide a Site Condition Report. This Site Condition Report has been produced in accordance with the Environment Agency Horizontal Guidance Note H5 – Site Condition Report (Guidance and Templates) v3.0 April 2013.

3. DEFINITIONS

AOD	Above Ordnance Datum
AQMA	Air Quality Management Area
CQA	Construction Quality Assurance
EPR2016	Environmental Permitting (England and Wales) Regulations 2016
ERA	Environmental Risk Assessment
FRA	Flood Risk Assessment
g/m2	Grams per metres square
HDPE	High Density Polyethylene
HHDL	Horse Hill Developments LTD
km	Kilometre
LNR	Local Nature Reserve
m	Metre
MAGIC	Multi-Agency Geographic Information for the Countryside
mm	Millimetre
NPPF	National Planning Policy Framework
NPPG	National Planning Practice Guidance
PEDL	Petroleum Exploration and Development License
SAC	Special Area of Conservation

Table 3.1: Definitions

4. DEVELOPMENT AREA AND SITE DETAILS

The Horse Hill Well Site is shown in Figures 4.1. It is located in Surrey, approximately 3.5km north-west of Horley and approximately 3km north of Gatwick Airport.

The site is situated on the south side of Horse Hill, which is a north-east to south-west ridge of agricultural land.

The site address is:

Land off Horse Hill
Hookwood,
Horley,
Surrey
RH6 0RB

Nation Grid Reference: TQ 25297 43588

A Site Location Plan has been provided within Site Plans Document (HHDL-EPR-HHP-SP-004).

Figure 4.1: Horse Hill Wellsite (Image sourced from Google Earth 29/09/2020)

5. SITE CONDITION PRIOR TO PERMIT ISSUE

The following section provides a detailed account on the current site condition of the well site location at the point of application submission.

5.1 Sources of Information

This Site Condition Report has been compiled using a range of information sources, including:

- Multi-Agency Geographic Information for the Countryside (MAGIC);
- The Environment Agency;
- British Geological Survey;
- Hydrogeological and Flood Risk Assessment; and
- Air Quality Assessment.

5.2 Environmental Setting

The well site is located on agricultural land around 300m east of Horse Hill, a minor road running north off the A217 from Hookwood. It is bound by agricultural land and woodland on all sides.

The site is at around 65m (AOD), with ground levels rising to the north and falling to the south towards Spencer's Gill, a watercourse approximately 600m to the south of the site.

A desktop study was undertaken to identify any designated sites which may be affected by the proposal. The results of the desktop survey using the Multi-Agency Geographic Information for the Countryside (MAGIC) interactive mapping tool have been provided within Table 5.1 below.

Designated Site	Search Radius[1]	Name	Location from Site[2]
RAMSAR	10km	-	-
Special Area of Conservation	10km	Mole Gap to Reigate Escarpment	8.00km North
Special Protection Areas	10km	-	-
Marine Protection Areas	10km	-	-
Sites of Special Scientific Interest	2km	-	-
Schedule Ancient Monuments	2km	-	-
National Nature Reserve	2km	-	-
Local Nature Reserve	2km	Edolphs Copse	1.69 Southwest
Local Wildlife Site	2km	-	-

Table 5.1: MAGIC Desktop Study Results

The designated sites identified above have been considered potential receptors within the Environmental Risk Assessment (ERA) (HHDL-EPR-HH-ERA-007). The ERA concludes that, the implementation of mitigation measures as described within ERA, the environmental risks of the proposed development are negligible.

5.2.1 Geological Setting

The Site is located within the 'Low Weald': an area of low-lying terrain defined broadly by the outcrop of the Lower Cretaceous Weald Clay Formation which is encircled by a ridge of more resistant Lower Greensand Group rocks. The Site is within the northern part of the Weald Basin, a Permian to Cretaceous extensional sedimentary basin containing organic rich and hydrocarbon bearing rocks. The basin has been folded into an east-west trending anticlinal fold known as the Weald Anticline. The oldest rocks outcropping in the region, of the Cretaceous Purbeck Group, occur in the denuded core of the anticline in the eastern part of the Weald.

Cretaceous rocks outcrop at surface throughout the Weald; these are underlain by a thick succession of Jurassic and older strata. The Jurassic strata are concealed except at a few small outcrops in the Heathfield area where the Limestones of the Purbeck Group (Late Jurassic/ Early Cretaceous) are present. In the north of the Reigate district the Cretaceous Chalk Group is unconformably overlain by Palaeogene strata.

[1] Search Radius derived from Environment Agency Guidance: Annex A – Opra Scheme for Installations.
[2] Location from new site boundary.

The regional stratigraphy is summarised within the Hydrogeological Risk Assessment presented within the Surface Water Management Plan (HHDL-EPR-HHP-SWMP-013). The wells at the Site will target hydrocarbon bearing formations within the Jurassic sequence and therefore no information is presented with respect to the older strata below the Jurassic sequence.

The region is dominated structurally by the Weald Anticline, a regional fold structure formed during the Alpine orogeny of the late Oligocene to middle Miocene epochs. The fold trends roughly west-east through the region and plunges gently to the west. Numerous subsidiary and parallel anticlinal and synclinal folds also affect the region. Generally, strata dip gently away from the anticlinal axis. Fault trends within the basin are generally east-west.

Further information on the geological setting can be found within the Hydrogeological Risk Assessment presented within the Surface Water Management Plan (HHDL-EPR-HHP-SWMP-013).

The encountered geology of the HH-1 well has been presented in Table 5.2:

Unit Name and Age			Top of Formation (Measured Depth)	Unit Thickness (Metres)
Lower Cretaceous (Wealden Beds)		Weald Clay	7.6	150
	Hastings Beds	Upper Tunbridge Wells Sand	158	54
		Grinstead Clay	212	23
		Lower Tunbridge Wells Sand	235	10
		Wadhurst Clay	245	53
		Ashdown Beds	298	99
Upper Jurassic		Purbeck Durlston Beds	397	68
		Purbeck Carbonates	465	140
		Purbeck Main Anhydrite	605	17
		Portland Sandstone	622	86
		Lower Portland Sandstone	708	48
		Kimmeridge Clay	756	95
		Kimmeridgian Limestone 4	851	89
		Kimmeridgian Limestone 3	940	419
		Top Corallian	1,359	165
		Corallian Limestone	1,524	15
		Oxford Clay	1,539	127
Middle Jurassic		Kellaways Beds	1,666	16
		Cornbrash	1,682	1
		Main Great Oolite	1,683	50
		Fullers Earth	1,733	35
		Inferior Oolite	1,768	174
Lower Jurassic		Upper Lias	1,942	106
		Middle Lias	2,048	110
		Lower Lias	2,158	312
Triassic		Rhaetic	2,470	59
		Mercia Mudstone	2,529	53
		Dolomitic Conglomerate	2,582	11
-		Palaeozoic	2,593	-

Table 5.2: HH-1 Penetrated Sequence of Rocks

5.2.2 Hydrogeology Setting

The hydrogeology at the Horse Hill well site is dominated by surface water and shallow groundwater within low permeability weathered bedrock. The shallow groundwater system historically provided small amounts of water for local water supplies. Approximately 150m of the low permeability Weald Clay Formation is present directly beneath the site, which separates the shallow groundwater system from deeper water bearing formations. The Weald Clay may contain some thin sandstone and limestone layers but with limited potential to contain useful groundwater.

The Tunbridge Wells Sands Formation and Ashdown Formation is present beneath the Weald Clay Formation and whilst not exploited locally, these formations have the potential to contain useful groundwater for industrial or other

uses. The top of the Purbeck Group comprises approximately 70m of unproductive argillaceous bedrock that provides a hydraulic break between potentially useful groundwater and formation water in the Purbeck Group and deeper Jurassic strata with limited or no resource value. Water within these units is likely to old recharge water with elevated salinity. Geological faults are unlikely to connect the principal water bearing units due to the argillaceous nature of the intervening formations.

5.3 Pollution History

5.3.1 Pollution Incidents Affecting the Land

The development has been specifically and carefully designed to ensure that all processes with the potential to lead to contamination are contained within areas which are separated from the underlying strata, ground and surface waters. All well site operations which have the potential to lead to contamination of the surrounding environment will take place within the compound and the plant to be installed has been designed to minimise the risk of contamination.

Site activities will be regulated by an environmental permit issued by the Environment Agency. The permit will formalise operations at the site to ensure that they are undertaken with a view to minimising the risk of potential contamination.

5.3.2 Historical Land Use and Associated Contamination

The well site sits upon land which has consistently been used for agricultural purposes. Historical Maps Indicate that in 1874 “The Park Brick and Tile Works” were present and this could have led to potentially contaminative industrial use, however this is east of the proposed boundary.

Two (2) Pollution incidents to controlled waters were recorded within 1,000m of the proposed well site boundary these are located northeast of the proposed boundary and north of the proposed boundary. Both were classified as a minor incident by the Environment Agency.

5.3.3 Visual and Olfactory Evidence or Historic Contamination

There is no visual or Olfactory evidence to suggest existing or historic contamination at the well site location.

5.3.4 Evidence of Damage to Pollution Prevention Measures

No evidence of damage to any pollution prevention measures have been identified at the time of this report being produced.

6. WELL SITE CONSTRUCTION

6.1 Current Well Site Structure

The Horse Hill Well Site is designed, following standard industry practices, as a stable, level working platform to support a drilling rig and all associated equipment. The surface has been formed with a minimum of 300mm of granular material, compacted in accordance with the Specification for Highway Works on top of an appropriate geogrid for added strength.

The site is fully lined underneath the stone with a 1mm thick impermeable membrane made from Junifol High Density Polyethylene (HDPE) material, which is continuous through to a perimeter interceptor ditch. This impermeable membrane protects the surface water and groundwater from any site leakages, or potential spills. The membrane is further protected above and below using a 300g/m^2 non-woven geotextile. The use of crushed stone on top of an impermeable geomembrane layer is a standard and accepted method of site construction for onshore exploration well sites. The site was built by a competent contractor to industry standards, which included regular QA/QC checks on the site construction, as well as on the impermeable membrane, as outlined below.

All membranes delivered to site were accompanied by manufacturer's test data. The rolls of membrane were attached to a roll out frame, which in turn was attached to an excavator, the excavator tracked along unrolling the membrane, the membrane unrolled to the correct length, and once the correct length reached, the membrane was cut from the roll. The excavator then tracked adjacent to the panel of membrane laid and unrolled a further panel so that it overlapped the previous panel. This operation continued until the area was covered.

The membrane was placed with seam overlaps and prior to forming the joints, these overlaps were checked to ensure the weld area was clean, dry and free from imperfections. Welding (either hot wedge or extrusion welding) was carried out by certified welding technicians. When extrusion-welding methods were to be employed, the surface oxidation was removed from the membrane by sanding. Prior to commencing welding, a test weld was completed using off cuts of membrane and tested to destruction using field clamps in both the peel and shear modes. Failure must occur in the parent material and not enter the seam. The installation supervisor recorded all materials placed, roll numbers, panel numbers, seams welded and tested, and weather conditions.

All welds were tested as follows: site fusion welds were tested using air; twin fusion welds (hot wedge) were tested by sealing the ends of the air channel then inducing air pressure into the channel; extrusion welds were tested using spark testing methods. Welds which failed to conform to these non-destructive tests were repaired.

Vacuum testing employed purpose made equipment, which produced a vacuum over the tested area. A detergent/water solution was applied to the full test area prior to application of the test equipment, which will display any leaks by bubbling of the solution. Any leaks identified were subject to repair and retest.

The installation of membranes is sensitive to ambient temperature, moisture and high winds and no material installation or seam welding took place while adverse weather conditions exist. A concrete slab on site is formed around the well cellar. The cellar is sealed and the slab is set on top of the impermeable membrane layer, which is also sealed to the cellar so it is part of the overall larger impermeable site area. The surface water directed into the cellar can be disposed of off-site via a suction tanker to an authorised waste disposal facility.

The sealing of the cellar was tested by carrying out a 24-hour hydrotest: the cellar is filled with water and checks are made that this volume is retained over the 24-hour period. This was again verified on 10 October 2016. Both sets of results confirmed no leaks.

The approximate location of the impermeable membrane, covering all the internal well site area, is shown by the blue line in Appendix 1. This includes the interceptor ditch encircling the site and where the lining extends up, and on to, the bund beyond the ditch. At the entrance to the site the lining will be raised to the overall compound level (with the surface ramped up to this point on both sides to provide containment whilst allowing traffic to practically enter or leave the site). A cross sectional view across the well site showing the impermeable membrane and interceptor ditch is shown in Appendix 1.

The interceptor ditch serves the purpose of collecting all surface drainage from the lined well site footprint. An earth bund has been constructed on the outside of the ditch. The ditch design is shown in plan and in cross-section in

Appendix 1. It has a cross-sectional area of around 1.7m^2 and a length of approximately 290m, which gives a volume of around 500m^3 (500,000 litres) of fluid.

Rainfall onto the compound and bund area, as well as any potential contaminants such as diesel fuel and oil and chemicals used in operating the site, are directed into the interceptor ditch and then under gravity, via an outfall pipe and Class 1 SPEL oil bypass separator, into a 150mm pipe buried in a gravel swale beyond the lined bunded compound area, as shown in Appendix 1.

Isolation valves are installed both upstream and downstream of the separator (to allow full isolation of the site as well as isolation of the separator for maintenance works should they be required). The system is designed and operated to separate oil and water and fully conforms to both the Environment Agency PPG3 guidelines and European Standard BSEN-858-1-2 (less than 5mg of hydrocarbons/litre of water). The use of the separator has previous been approved by the Environment Agency and is in use when the site has no well operations being carried out.

When any workover or drilling rig is on site, the separator isolation valves remain closed. After operations have been completed, the excess water is released to the environment, pending the testing of the ditch fluid and the results being sent to the Environment Agency as per the Water Discharge Permit, EPR/BB3691NN. Any oil contamination from the test equipment or site traffic will be retained in the separator and removed by road tanker off site at the end of the well work.

The separator is designed to address the risk of infrequent light contamination and small-scale spills and is sized as appropriate for the size of the site. It is not designed to manage a major spill of hazardous materials (considered extremely unlikely). In such circumstances, emergency procedures will define that the discharge valve on the separator remains closed and all contaminated water trucked off site for disposal at an approved facility.

The construction design and method was previously approved by the Environment Agency following previous environmental permit applications for the site.

Within the centre of the site are two well cellars housing within them the two wells. The drilling of the original Horse Hill 1 (HH-1) well was drilled in 2014 to a depth of 2,717m (8,915ft) MD / 2,421m (7,942ft) TVDSS into the Triassic. The HH-1 well discovered oil within both the Portland Sandstones and the Kimmeridge Limestones. The well was re-entered in 2016 and a series of short tests confirmed the oil potential of the Portland Sandstone and the Kimmeridge Limestones at KL#4 and KL#3 levels. In 2018 the well was re-entered again for an Extended Well Test which was successful in flowing significant amounts of oil from all three target levels.

HHDL currently have the necessary environmental permits in place to undertake the HH-1z sidetrack. However, this has yet to be drilled. The permission to drill the HH-1z well shall be retained within this application.

The HH-2 well was subsequently drilled 4th quarter of 2019 and was drilled to a depth of 708m (2,322ft) MD / 627m (2,056ft) TVDSS and terminated in the Portland Mudstone. From the HH-2 well a sidetrack well known as HH-2z was drilled, kicking off from a depth of 397m (1,301ft) MD / 324m (1,062ft) TVDSS and entered the Portland Mudstone 720m (2,362ft) MD / 620m (2,035ft) TVDSS and reached a total depth of 1,245m (4,086ft) MD / 589m (1,934ft) TVDSS. The HH-2 well (HH-2 and HH-2z) is currently suspended pending well testing.

The existing well site has been constructed to a standard capable of accommodating exploratory operations and any subsequent production activity. The well site comprises a stable and flat surface of crushed and compacted stone overlaying a high-density polyethylene (HDPE) impermeable membrane and protective geotextile layers allowing for tertiary containment and controlled drainage. Construction within the existing well site will comprise the installation of four (4) new concrete chambers to act as drilling cellars housing the new wells.

A surface conductor, which is a large diameter pipe, will be installed to provide a stable structural foundation for the subsequent drilling of each well. A conductor setting rig will be mobilised to Site with a mast of up to 15m in height to drill and set the conductor casing to a pre-determined depth, isolating the shallow water systems underlying the Site from deeper strata, a further form of tertiary containment.

6.2 Additional Drilling Cellars

The installation of each additional drilling cellar will commence with the excavation of the site surface stone aggregate, geotextile membrane and the HDPE impermeable liner. The geotextile and HDPE liner will be cut at a specific length so as to provide enough material to ensure it can be appropriately joined to the well cellar. The well cellar forms part of the containment from which the borehole can be drilled, whilst also housing the wellhead.

The subsoil will be excavated to a depth sufficient to construct the well cellar, anticipated to be circa 3m.

A short section of steel casing (large enough to allow the first drilling bit to drill through) will be installed approximately 1m below the bottom of the cellar before a concrete chamber is sunk into the ground acting as a well cellar. A 400mm thick reinforced concrete base will be set in the bottom of the excavation. A Precast Cast Concrete (PCC) ring will then be set into the concrete base, providing a slight overlap of the concrete above the base of the PCC ring. Additional PCC rings are added to line the well cellar wall back to surface. Each PCC ring is sealed together using Tockstrip concrete joint sealant and all PCC lifting points will be suitably plugged and sealed. Once installed, the PCC rings are then encased in a 200mm thick concrete jacket surround, set to a depth immediately below the surface construction detail of the site. Subsurface soils will be reinstated once the concrete jacket has been installed. The HDPE liner and geotextile membrane will be folded upward along the external wall of the well cellar and banded to the cellar to ensure well site integrity.

At surface, a 200mm thick reinforced concrete slab will be set around the well cellar to provide additional load bearing capacity for the proposed drilling rig. When cast, the concrete slab will also provide additional protection to the HDPE sealing the wall of the well cellar.

6.2.1 Installation of Surface Conductor

Upon completion of the cellar construction, a vertical hole will be drilled and a conductor casing will be run and cemented in the top section of the wellbore. The top section will be drilled with a conventional waterwell drilling rig. This initial section will be drilled with air and/or water/bentonite.

Once the hole has been drilled a conductor casing will be run and cemented to surface. The primary purpose of this conductor is to create a stable foundation for the main drilling rig. The waterwell rig will be demobilised once this hole section has been completed.

In the event that a mousehole is required, it may be installed by the construction contractor or alternatively may be installed by the drilling contractor, prior to commencement of the main drilling operation. Depending on the drilling rig selected, it may be drilled vertically or at a slight inclination.

The mousehole will be drilled using fresh water either whilst drilling the conductor hole or prior to drilling the main hole. Once drilled to the required depth, circa 6m below ground level, a steel casing will be installed and cemented back to the base of the cellar, flush with the concrete pad. This method of construction will ensure that the mousehole has environmental integrity, preventing any ingress of drilling fluid or well fluid through the cellar construction.

6.2.2 Rat Hole and Mouse Hole

A rat hole and/or mouse hole may need to be drilled to accommodate the drilling rig and associated equipment during any drilling phase. The exact location of the mouse hole and/or rat hole cannot be confirmed until the drilling contractor, and associated drilling rig, has been selected. Once each hole has been drilled a casing will be run to the base of the hole and the annulus cemented back to surface. For clarity, the casing installed will be a closed ended steel casing ensuring that residual fluids i.e. drilling fluids cannot migrate down the casing into the subsurface due to being “capped”.

In the event the hole(s) are drilled through the bottom of the well cellar it may be necessary to remove the reinforced concrete. The hole will be drilled to the necessary depth through base of the well cellar and cemented back to surface (i.e. the base of the cellar). The ‘capped’ casing will be run to the base of the hole and will protrude out of the base of the well cellar to the drill floor. The casing will be grouted to the cellar floor.

Should the hole(s) be drilled outside of the well cellar, a small excavation (up to 1m x 1m) will be constructed on the concrete pad. The cement cuttings and hardcore will be excavated and the liner, once encountered, will be cut and folded back. A ‘top hat’ shall be formed with the liner being resealed around a steel/concrete box within the cut out

and cemented back to the concrete pad (surface). The hole(s) will then be drilled using the appointed drilling rig and a casing (capped at the base) installed and cemented back to surface.

Following the installation of the hole(s) within the cellar an integrity test will be carried out using water to measure whether any losses are incurred over a period of 24 hours. Should losses be encountered the mouse and rat hole installation will be remediated to ensure any pathways to the underlying subsoils are prevented.

6.2.3 Cellar Integrity Test

Once the well cellar has been constructed, or following any subsequent construction works such as mouse or rat hole installation, an integrity test will be carried out to confirm that it provides suitable and effective containment.

The test consists of filling the cellar with water and monitoring water loss over a period of 24 hours. The water level is marked on the side wall of the cellar using marker dye to provide a reference point. The cellar is then covered to avoid both water fill (precipitation) and water loss through evaporation. If no water loss within the drilling cellar is observed the test is determined as being successful. Should, however, the test identify that the cellar does not have integrity, the leak point shall be identified, repaired and the integrity test repeated. Immediately following installation of the surface conductor casing, the cellar integrity test will be repeated. A bucket may also be filled to calculate the evaporation rate of water if required.

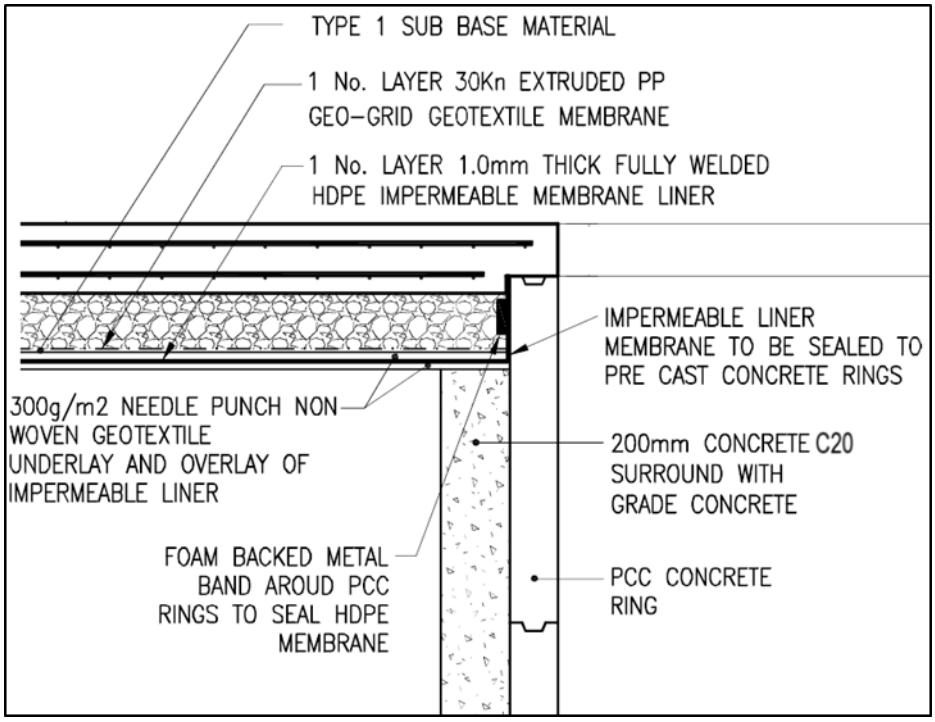

Figure 6.1:Indicative HDPE Geomembrane being installed around the Well Cellar PCC Rings

7. DEVELOPMENT ACTIVITIES

7.1 Permitted Activities

The Horse Hill Well Site currently holds the following environmental permits:

- Mining Waste Permit (EPR/BB3300XG) for the management of extractive waste not involving a mining waste facility including the drilling of a borehole and sidetrack, workovers and well testing involving the incineration of natural gas not exceeding 10 tonnes per day;
- Water Discharge Activity Permit (EPR/BB3691NN) for the discharge of surface run-off water from the well site via an oil-water separator;
- SR 2014 No4 Permit (EPR/AB3498DZ) for the Accumulation and Disposal of radioactive waste from the NORM Industrial Activity of the production of oil and gas; and
- SR 2014 No2 Permit (EPR/SP3339YS) for the loading, unloading, handling or storage of crude oil.

Following this application to the EA the following activities will also be undertaken:

- Construction of up to four (4) new additional boreholes (HH-3/HH-4/HH-5/HH-6) in addition to the current two (2) boreholes (HH-1/HH-2) already constructed at the Horse Hill Well Site **(EPR/BB3300XG)**;
- Harnessing at least one (1) of the six (6) boreholes as a reinjection well for the purpose of providing production support, this is considered a groundwater activity. **(EPR/BB3691NN)**;
- Undertaking well treatments such as an acid wash and solvent treatments **(EPR/BB3300XG)**;
- Undertaking a 90 day well test for each of the additional wells (HH-3/HH-4/HH-5/HH-6) before later being added to the portfolio of production wells at the site or being abandoned **(EPR/BB3300XG)**;
- Undertaking an injectivity test within HH-2 (HH-2z) and any other wells as dictated by HHDL **(EPR/BB3691NN)**;
- Incineration of natural gas at a rate not exceeding 10 tonnes per day during production operations, until such a time that it can be demonstrated that the incineration of natural gas is no longer considered Best Available Technique through a cost benefit analysis **(EPR/BB3300XG)**;

7.2 Additional Activities

Additional activities proposed to be undertaken at the well site which do not fall within the regulatory regime of EPR2016 will include:

- Car parking for staff vehicles;
- Provision of welfare facilities for site staff;
- Well maintenance; and
- Storage and disposal of non-hazardous and hazardous waste not directly associated with the permitted activities.

7.3 Environmental Risk Assessment

An Environmental Risk Assessment has been submitted to the Environment Agency as part of an application for a variation to the existing Horse Hill environmental permits.

8. ENVIRONMENTAL CONSIDERATIONS

A number of supporting documents have been prepared by HHDL and their subcontractors to inform both the planning application and permit variation on the impacts the proposed development will have of the environment.

8.1 Air Quality Impact

As part of the planning and permitting process it is necessary to assess the dispersion of releases to atmosphere associated with the proposed operations to determine their impact on ambient concentrations of important pollutants around the local area. In particular, impact at locations of permanent human habitation and sensitive nature conservation sites in the context of attainment of applicable environmental standards requires assessment.

The main sources of pollutant releases during site operations will be from the use of diesel fuel in on-site stationary engines and construction and transport vehicles and from the combustion of produced natural gas to generate electricity. Releases of nitrogen oxides, carbon monoxide, volatile organic compounds, sulphur dioxide and particulate matter were considered.

The drilling phase of the project is highly energy intensive and is the activity with the greatest pollutant release. Maximum pollutant process contributions occur during the drilling phase of the project. This phase, while being of around 15 months in duration is relatively short in comparison to the overall project duration of around 21 years, during most of which air quality impact is insignificant.

Maximum pollutant process contributions from the site operations are localised and occur within the well site boundary. Beyond the location of the maximum process contributions reduce significantly with distance. Process contributions at the site boundary are relatively high, in particular for the drilling phase of the project and generally well above the Environment Agency's screening criteria and in some cases above air quality standards. It is not considered that statutory air quality standards would be applicable in these areas due to the infrequency of human exposure.

Along the public footpaths, some of which approach the well site boundary, it might be expected that short term environmental standards would apply in view of the potential frequent, but short term, human exposure. All short term process contributions at the nearest footpaths are considered insignificant based on Environment Agency assessment criteria with the exception of nitrogen dioxide. While the process contribution of nitrogen dioxide cannot be screened out it is not anticipated that this additional contribution will pose any threat to continued attainment of the applicable ambient air directive limit.

At the neighbouring residential locations, where frequent and long term human exposure might be expected, all pollutant process contributions were considered insignificant based on Environment Agency assessment criteria and unlikely to threaten ambient air quality standard attainment.

At the sites sensitive to nitrogen and acid deposition (Edolph's Copse LNR and Mole Gap to Reigate Escarpment SAC) maximum process contributions are considered to be insignificant based on Environment Agency assessment criteria and considered unlikely to pose any threat to, or have any substantial influence on, the attainment of critical levels and critical loads.

At the nearest AQMA located in Horley the annual mean process contribution of nitrogen dioxide has the potential to slightly exceed the screening criteria during the drilling phase of the project. It is considered unlikely to have any meaningful influence on attainment of the ambient air directive limit in the AQMA. Process contributions at the AQMA in all other phases of the project are insignificant.

While the drilling phase of the project generates process contributions which may exceed Environment Agency screening criteria, it is not considered that these will compromise continued attainment of environmental standards in the areas where these are applicable. For the phases of the project which do not include drilling, equivalent to around 95% of the project duration, process contributions are considered insignificant and unlikely to have any meaningful influence on environmental standard attainment.

Necessary assumptions made to undertake the modelling are considered to have the effect of substantially overestimating the process contribution to ambient concentrations. It is considered that the predicted process impact reported herein is a conservative assessment and the conclusions reached therefore incorporate a reasonable margin of comfort in spite of the inevitable uncertainty of such modelling studies.

A copy of the Air Quality Impact Assessment has been provided within Waste Gas Management Plan.

8.2 Hydrogeological Impact

A hydrogeological conceptual model has been developed based on a detailed review of background information including the Site setting, local hydrology (surface water systems), geology and hydrogeology.

Using the conceptual model, a hydrogeological risk assessment (HRA) has been carried out in accordance with the Environment Agency's technical guidance which examines the risk to a wide range of receptors. The risk assessment shows that with the embedded and additional mitigation measures in place, the residual risk for all the identified hazards reduces to either 'very low' or 'none'.

The findings of the HRA are a result of the very high level of embedded mitigation within the proposed design and construction of the new well site compound and the wells, combined with additional mitigation that will be provided through the implementation of robust environmental management systems.

The effectiveness of the mitigation measures will be demonstrated through an appropriate scheme of surface water and groundwater monitoring that will be defined through the Environment Agency's environmental permitting process.

8.3 Surface Water Impact

A flood risk assessment (FRA) has been carried out in accordance with the National Planning Policy Framework (NPPF) and the accompanying online resource, National Planning Practice Guidance (NPPG): Flood Risk and Coastal Change 2014. The FRA demonstrates that the Proposed Development will not have a detrimental impact on drainage and flooding at or from the Site providing that surface water is managed appropriately.

The aim of the drainage scheme is to attenuate and control rainfall-runoff. The existing well site compound area is lined with a continuous High Density Polyethylene (HDPE) very low permeability membrane and 300g/m^2 non-woven fleece layers over which porous granular sub base material is laid to a depth of 300mm. The impermeable lining includes an open containment ditch encircling the Site which extends up and on to a containment bund beyond. An interceptor ditch serves the purpose of collecting all surface drainage from the lined well site footprint. The drainage system will be retained in this state and therefore the existing well site is a 'hydrologically contained area'.

An Outline Scheme of Monitoring has also been prepared for the proposed operations with respect to groundwater. This has been provided within the Surface Water Management Plan (HHDL-EPR-HHP-SWMP-013).

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APPENDIX 1 – CROSS SECTION DRAWING AND OVERHEAD VIEW

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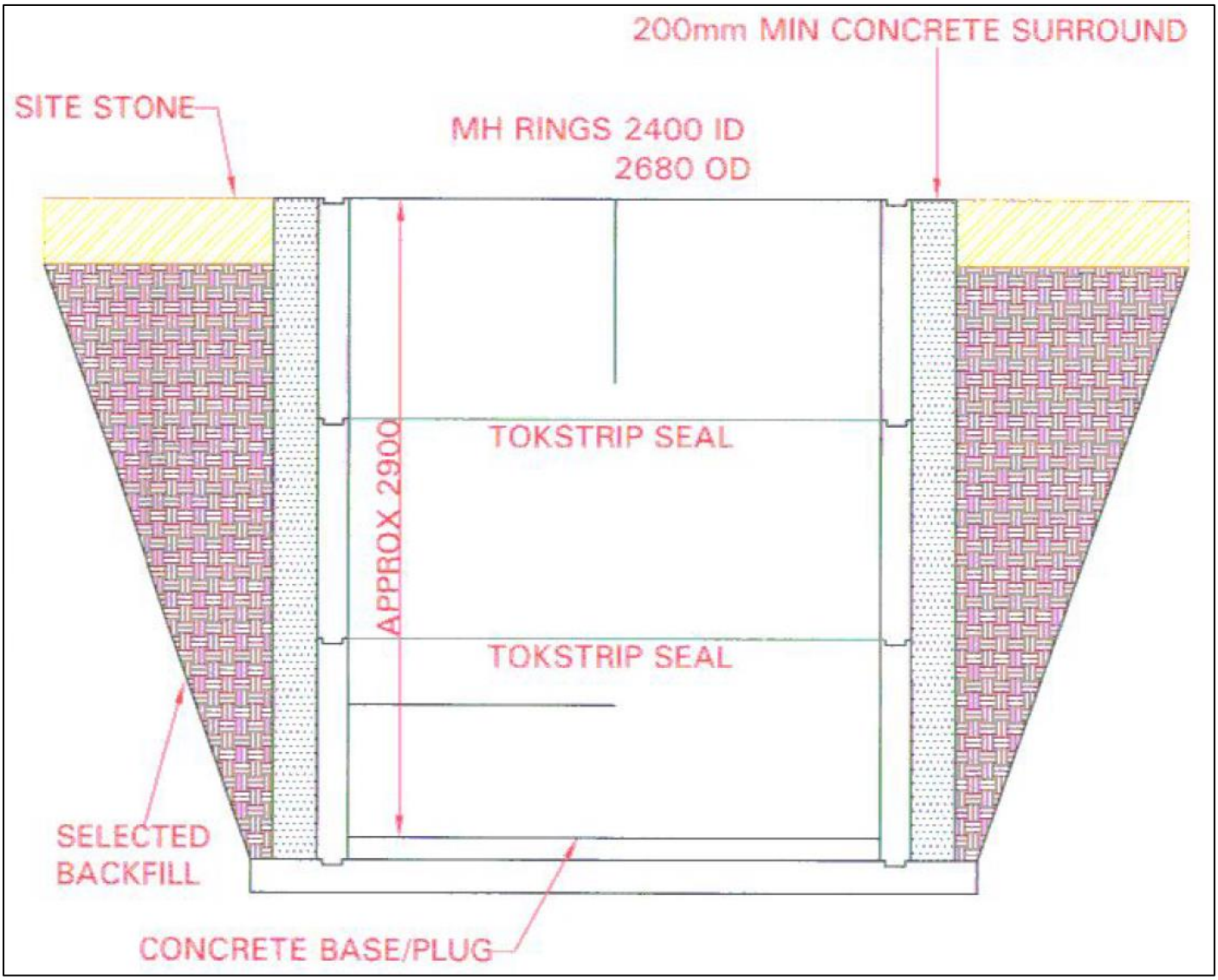
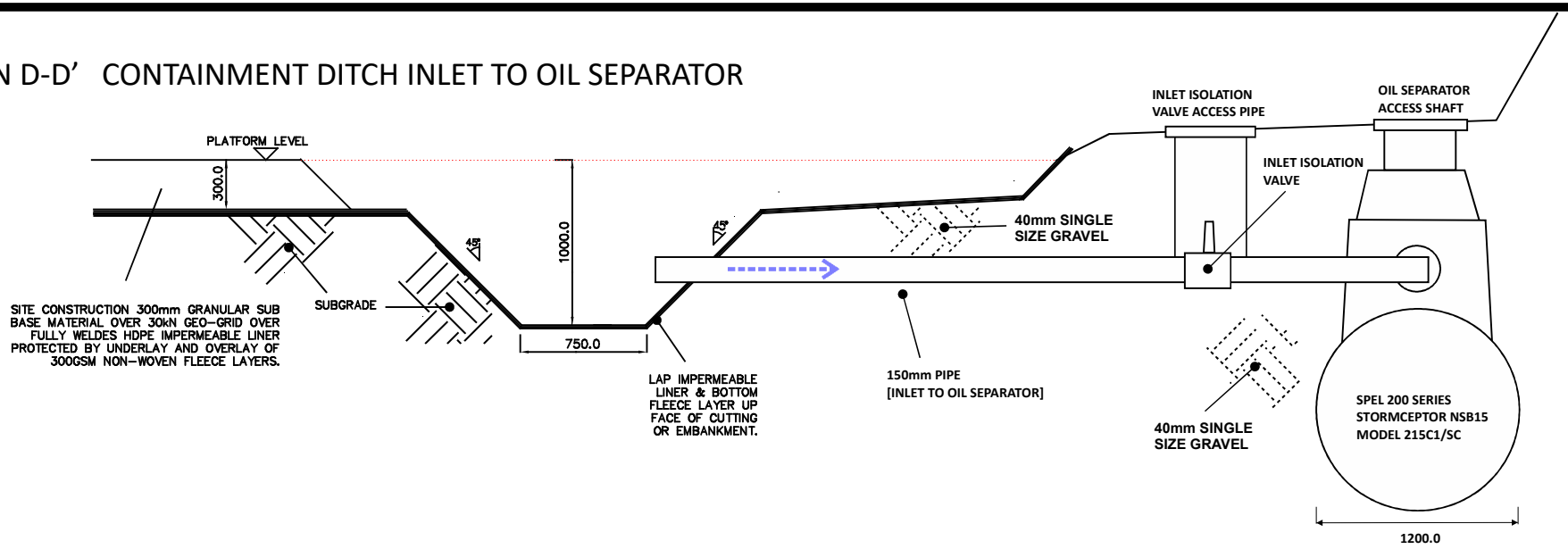


As Built Cellar Design (Not to Scale)

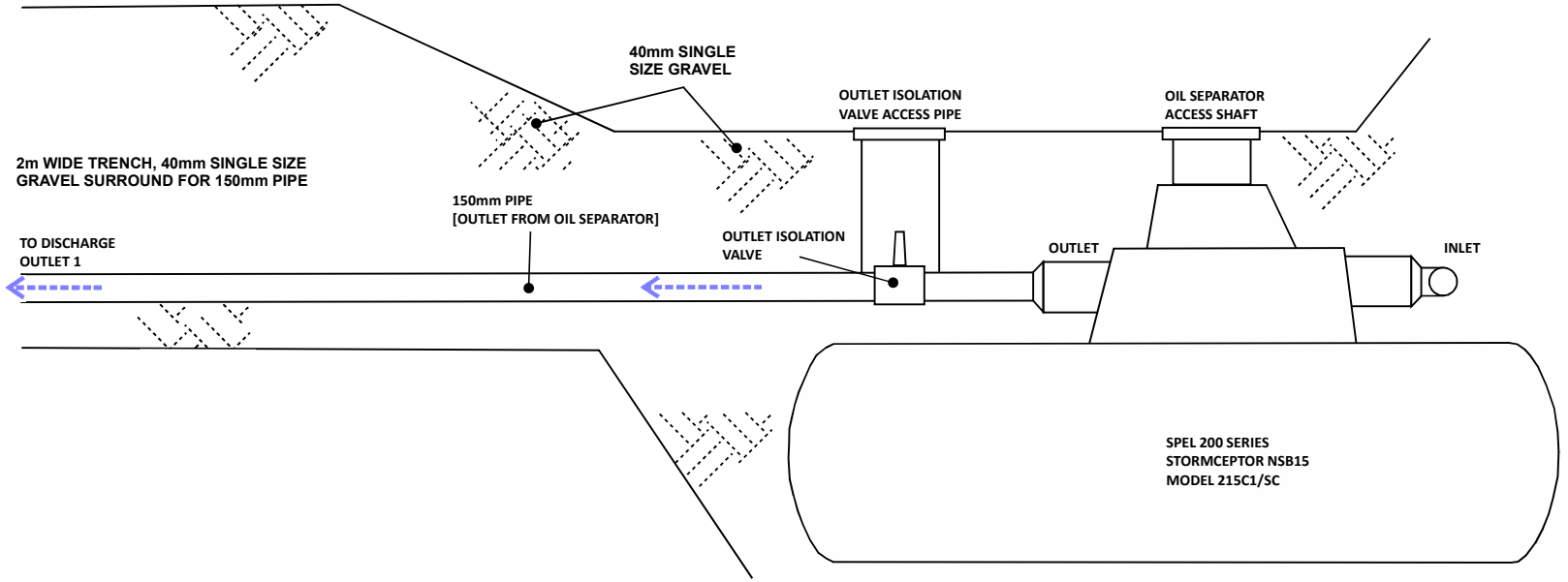
SECTION D-D' CONTAINMENT DITCH INLET TO OIL SEPARATOR

1:40



SECTION E-E' OIL SEPARATOR OUTLET TO DISCHARGE OUTLET

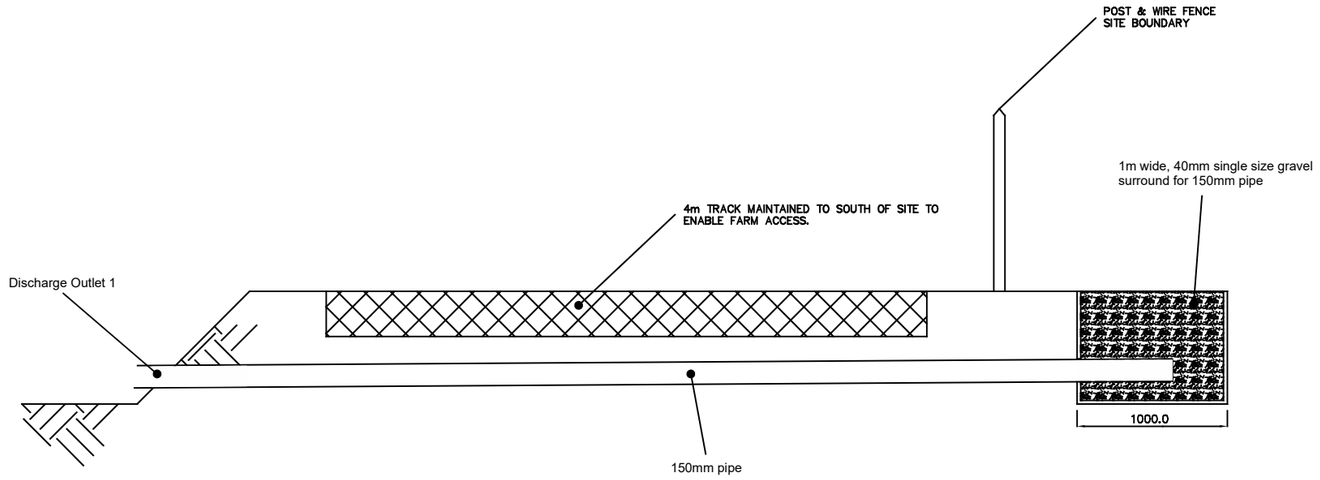
1:40



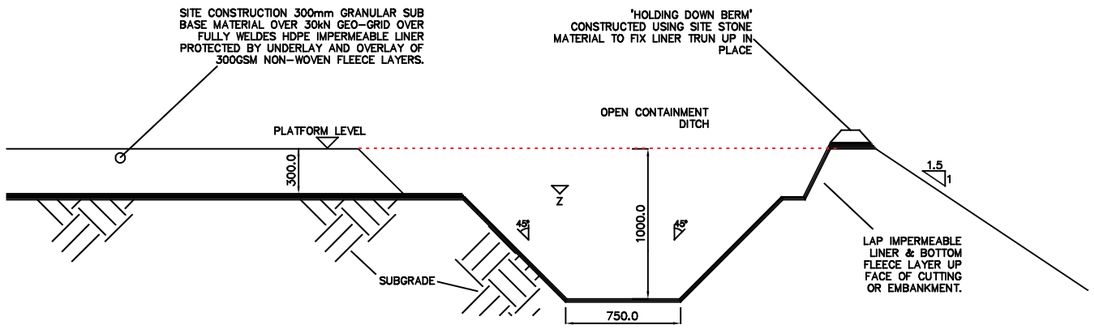
envireau WATER

Ref: P:\UKOG Horse Hill (2165)\40 - Reporting\Appendices Date: 13/02/2018	**Horse Hill Well Site**
Appendix A	Sections D-D' and E-E'

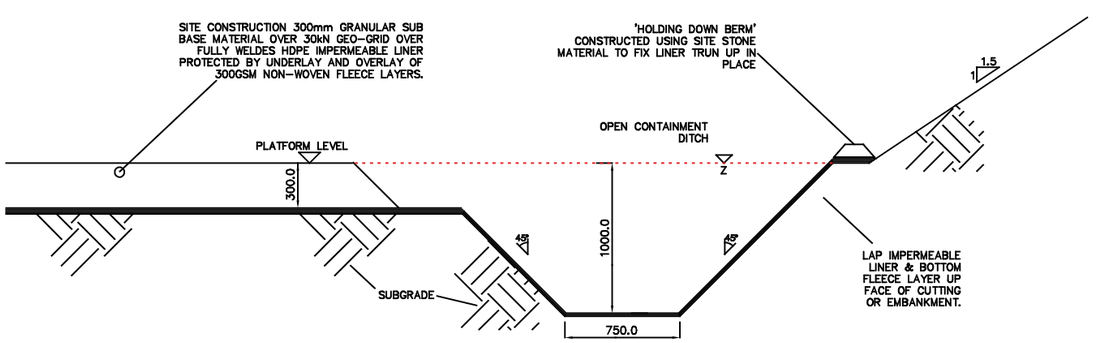
SECTION A–A' SOUTHERN BOUNDARY
1:40



SECTION B–B' EASTERN BOUNDARY
1:40



SECTION C–C' NORTHERN BOUNDARY
1:40



KEY:

NOTES:

FOR LOCATION OF CROSS-SECTIONS, REFER TO DRAWING NO. ZG-HHD-HH-PA-01

REVISION HISTORY				
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0	NOV17	JF	ORIGINAL FOR ISSUE	JF
REV	DATE	BY	DETAILS	APR

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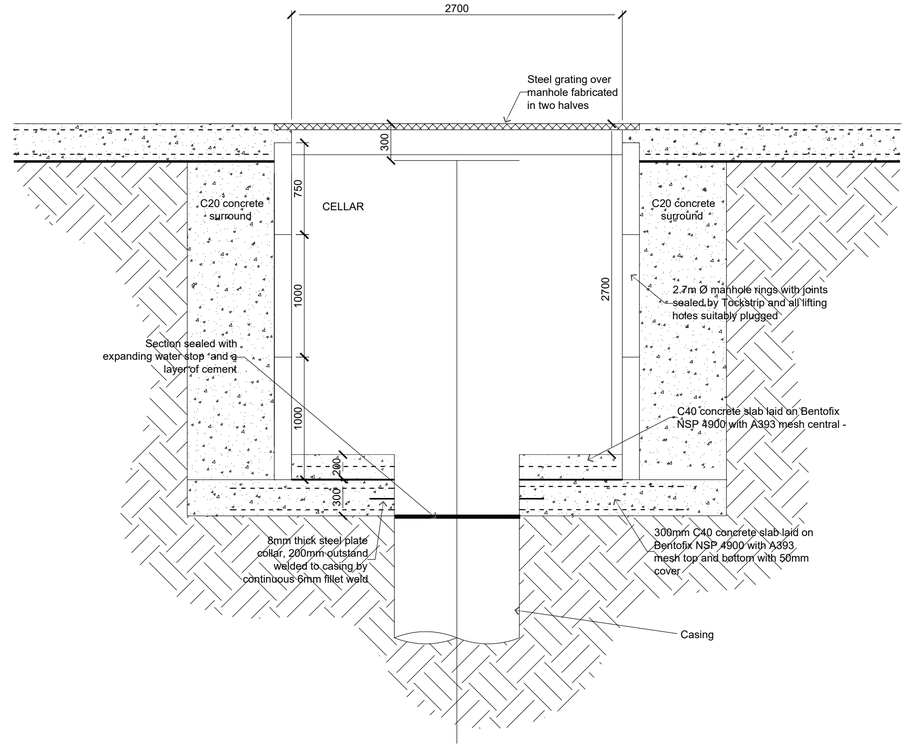
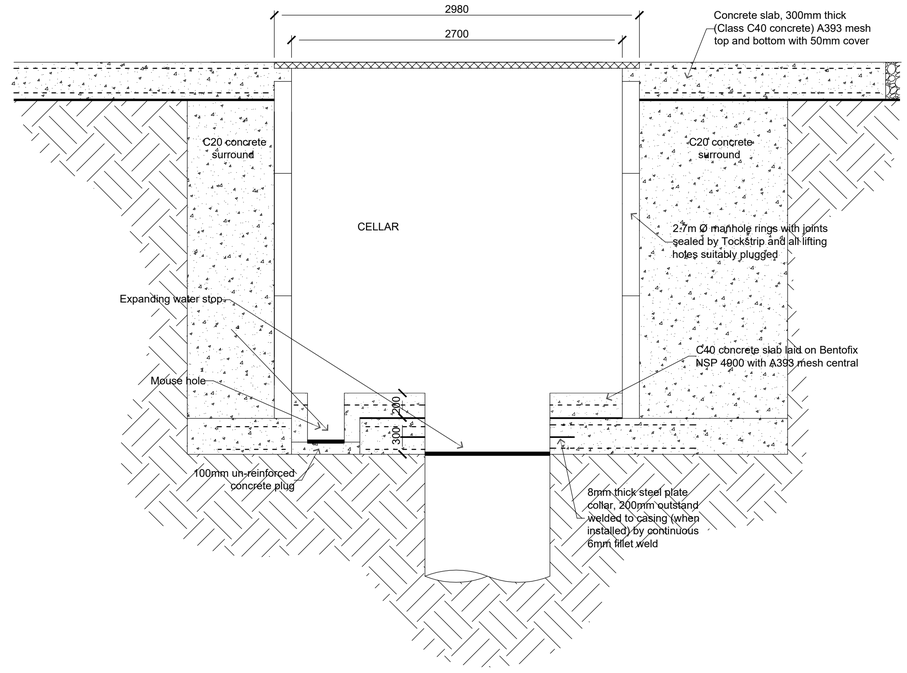
SITE:	HORSE HILL WELLSITE, SURREY
PROJECT:	
TITLE:	AS-BUILT SITE DESIGN CONTAINMENT DITCH DETAIL SECTIONS
CLIENT:	HORSE HILL DEVELOPMENTS

Scale:	1:40	DWG. No: ZG-HHD-HH-PA-02
Size:	A3	
Sheet:	2 of 2	

Site: Horse Hill
Drawing Number: HH-2 CELLAR
Scale 1:25
Drawn: DAW
Date 20/06/18



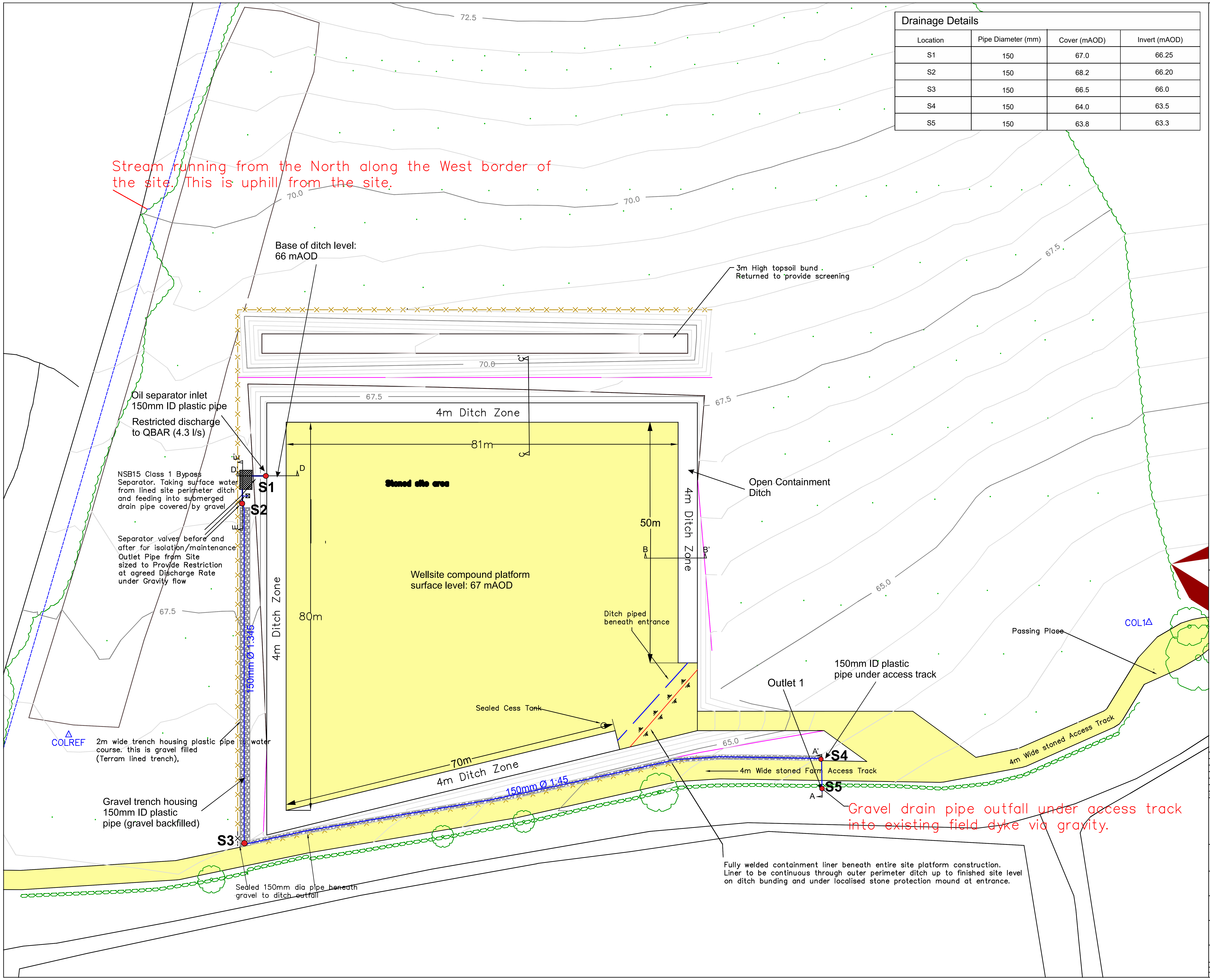
Detail
Scale 1:25



Detail
Scale 1:25

Drainage Details

Location	Pipe Diameter (mm)	Cover (mAOD)	Invert (mAOD)
S1	150	67.0	66.25
S2	150	68.2	66.20
S3	150	66.5	66.0
S4	150	64.0	63.5
S5	150	63.8	63.3



Stream running from the North along the West border of the site. This is uphill from the site.
72.5
70.0
67.5
65.0
Base of ditch level: 66 mAOD
3m High topsoil bund Returned to provide screening
Oil separator inlet 150mm ID plastic pipe
Restricted discharge to QBAR (4.3 l/s)
NSB15 Class 1 Bypass Separator. Taking surface water from lined site perimeter ditch and feeding into submerged drain pipe covered by gravel
Separator valves before and after for isolation/maintenance
Outlet Pipe from Site sized to Provide Restriction at agreed Discharge Rate under Gravity flow
S1
S2
S3
S4
S5
4m Ditch Zone
81m
50m
80m
70m
Stoned site area
Wellsite compound platform surface level: 67 mAOD
Open Containment Ditch
Ditch piped beneath entrance
Sealed Cess Tank
150mm Ø 1:345
150mm Ø 1:45
Passing Place
COL1
COLREF
150mm ID plastic pipe under access track
Outlet 1
4m Wide stoned Farm Access Track
4m Wide stoned Access Track
2m wide trench housing plastic pipe in water course. this is gravel filled (Terram lined trench),
Gravel trench housing 150mm ID plastic pipe (gravel backfilled)
Sealed 150mm dia pipe beneath gravel to ditch outfall
Fully welded containment liner beneath entire site platform construction. Liner to be continuous through outer perimeter ditch up to finished site level on ditch bunding and under localised stone protection mound at entrance.
Gravel drain pipe outfall under access track into existing field dyke via gravity.

KEY:

NOTES:

REVISION HISTORY

REV	DATE	BY	DETAILS	APR
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SITE: HORSE HILL WELLSITE, SURREY

PROJECT:

TITLE: AS-BUILT SITE DESIGN & SCHEMATIC LAYOUT

CLIENT: HORSE HILL DEVELOPMENTS

Scale:	1:500	DWG. No: ZG-HHD-HH-PA-01
Size:	A2	
Sheet:	1 of 2	