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West Burton C (Gas Fired Generating Station)

The West Burton C (Generating Station) Order

Land to the north of the West Burton B Power Station, Nottinghamshire

Outline Drainage Strategy

Applicant: EDF Energy (Thermal Generation) Limited
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GLOSSARY OF ABBREVIATIONS AND DEFINITIONS

ABBREVIATION	DESCRIPTION
FBA	Furnace Bottom Ash – by-product of a coal power station.
GI	Geotechnical Investigation – a study conducted to understand the physical properties of the soil and foundations for proposed areas of construction.
GRP	Glass-reinforced plastic material.
GT	Gas Turbine - air is drawn into the compressor of the gas turbine and is compressed. the fuel is then injected into the combustion chamber. the mixture of fuel and compressed air is ignited, producing gases at high temperatures. as the gas expands, it rotates the turbine to produce electricity.
HDPE	High-density polyethylene material.
NFPA	National Fire Protection Association – the requirements for the sprinkler systems, foam system and fire water discharge rate are set by the NFPA.
NGTS	National Grid Technical Specification – provided requirements for the drainage of oily water through NGTS (reference 1).
PFA	Pulverised Fuel Ash – by-product of a coal power station.
WBA	West Burton A - the existing coal fired power station within the west burton power station site, owned and operated by EDF Energy (Thermal Generation) Limited.
WBB	West Burton B - the existing gas fired power station, using combined cycle gas turbine (CCGT) technology, owned and operated by edf energy (thermal generation) limited.
WBC	West Burton C Power Station.

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Executive Summary

EDF Energy (Thermal Generation) Limited is proposing to develop a gas-fired peaking plant to be known as West Burton C (WBC). The Proposed Development Site is located within the existing West Burton Power Station site, near Gainsborough, Nottinghamshire.

The document aims to provide details on the drainage requirements, specification and arrangement for the Proposed Development. The WBC configuration is yet to be confirmed at the time of writing, therefore runoff requirements from two options (i.e. a single gas turbine or up to five turbines) have been compared in the course of this outline drainage strategy. The up to five smaller gas turbines layout is considered as the worst-case scenario for drainage out of the two layout options and, therefore, is the basis for all assumptions and statements in this strategy.

For the design of drainage for oily water, the National Grid Technical Specification (NGTS) (Reference 1) requirements were followed. The gas turbines, fuel delivery area and transformer compound would require oily water drainage. The assumption for the transformers is a single, shared remote underground oil containment tank made of glass-reinforced plastic (GRP) or direct to a full retention oily water separator. The report details alternatives for the tank once the detailed strategy is developed.

On the WBC site there are various pieces of high risk equipment that require fire protection. The National Fire Protection Association (NFPA) requirements are followed to ensure fire protection for WBC.

In designing the storm water drainage, the severity of the storm was developed in accordance with the Wallingford Method (Reference 3) and the UK Environment Agency (Reference 4). Three routing options have been considered based on three connection options (Options ‘A’, ‘B’ and ‘C’). Design calculations and layouts were created for two of three routes due to complications with one of the routes. Consideration for the runoff of storm water was also considered. In accordance with the procedure in the Institute of Hydrology Report 124 (Reference 5) it is assumed the runoff would go to ‘greenfield’ and the flow rate would be controlled.

The connection options highlighted in the storm water drainage investigation are developed further to show how WBC drainage may be connected to the existing site infrastructure. Each of the three connections methodologies are detailed in **Section 5**, with further information indicated in **Appendices D4, D6, E1 and E2**.

A risk assessment has been created to look at the design, construction and operation for Drainage Option ‘B’ (**Appendix F**). A possible high risk is the settlement of coal ash deposits. The causes of this build up are detailed along with possible mitigations, including local excavations and the use of impermeable membranes.

From the information detailed throughout this strategy, the conclusion provides a list of recommended actions that should be undertaken before detailed drainage system design is started.

1. Introduction

1.1.1 This strategy provides information on the outline drainage requirements, specification and possible arrangement for use by EDF Energy (Thermal Generation) Limited (Applicant) for the following purposes:

- approximate quantification of flows to assist with Drainage Discharge permit variations;
- identify approximate runoff attenuation area requirements;
- provide sufficient information to develop detailed drainage design specification;
- assist with identification of hazards and risks associated with drainage construction;
- provide suitable information to develop outline costings for final drainage construction

1.1.2 The WBC site layout is yet to be confirmed at the time of writing, therefore runoff requirements from two options have been compared in the course of this outline drainage strategy. These are up to five smaller gas turbines option (refer to **Appendix A1**) and a single large gas turbine option (refer to **Appendix A2**). Runoff calculations presented later in this report are based on the worst-case runoff from the two layout options, hence providing conservatism in design.

1.1.3 The individual WBC drainage components for water, fire water and storm water are detailed in the following sections, along with drainage outfall options and design risk assessment for drainage construction. Design calculations, drawings and selected example products specified in the outline design are included in the appendices.

1.1.4 References indicated in the report text are listed in **Section 9**.

1.1.5 This strategy assumes a finished WBC platform level of +12.85m AOD. The WBC platform level is yet to be confirmed.

2. Process Water Drainage

2.1 Design Philosophy

2.1.1 The proposed WBC site layouts incorporate up to five smaller gas turbines or a single open cycle gas turbine. The up to five smaller gas turbine layout is considered the most conservative case in terms of drainage and has been used as the basis for the design philosophy of this strategy. There is no specific process water demand for the gas turbine units, other than periodic wash-down.

2.1.2 Turbine compressor wash-down is likely to be via an automated system which will be operated periodically, typically 6 monthly.

2.1.3 Demineralised water and small quantities of detergent are used for wash-down. Depending on detergent type and concentration, wastewater from wash-down may require collection in closed drainage systems/sumps local to the turbines prior to removal by road tanker to an appropriate licensed waste handling facility.

2.1.4 There are no other plant items on the proposed WBC site that have been identified with water drainage requirements, albeit to be confirmed prior to detailed drainage design phase.

3. Oily Water Drainage

3.1 Design Philosophy

3.1.1 Design of oily water drainage has been carried out in accordance with requirements of National Grid Technical Specification 'Oil Containment' (Reference 1), hereafter referred to as NGTS 2.10.01.

3.1.2 At the time of writing we do not have detailed specifications for the plant items indicated on the proposed WBC layouts in **Appendix A**. However, for outline design purposes, we assume oily water drainage would be necessary to serve the gas turbines, fuel delivery area and transformer compound.

3.1.3 Turbine lube oil requirement would vary between specific turbine models. For outline drainage design we assume that any oil leakage would either drain to a local 'blind' bund (i.e. unconnected to site drainage network) for periodic removal or be connected to a suitably sized full containment oily water separator.

3.1.4 The fuel delivery area shall be provided with a 'forecourt' type oil separator to capture quantities of fuel oil in the event of accidental spillages. In the event of catastrophic failure of a single cell of a road tanker the drainage design should account that the spillage would be contained within the WBC footprint.

3.1.5 For outline design purposes it has been assumed that all transformers indicated on the current WBC Site Layout (refer to **Appendix A**) are oil-cooled and therefore require connection to the oily water system. This could be a blind bund or a pit or a full containment oily water separator.

3.1.6 The specification of transformers indicated in the current WBC Site Layout is unknown. For design purposes it has been conservatively assumed that the largest transformers each contain a maximum oil capacity of 100,000kg based on a typical 400kV transformer.

3.1.7 Outline design assumes that all other equipment indicated on the current WBC layout is either integrally bunded (e.g. containerised emergency diesel generator with double skin leak protection), or does not contain more than 200L of oil and hence does not require leak protection under current UK Oil Storage Regulations (**Reference 2**).

3.1.8 NGTS 2.10.01 requires that all equipment with oil capacity in excess of 200L is placed within above-ground oil retaining areas ('bunds'). Furthermore, some transformers and other large plant items require underground containment (storage) facilities. This latter underground storage may be achieved by either integral voided 'moat' foundations, or remote underground oil containment ('dump tanks').

3.1.9 The choice of moat foundation or dump tank is largely based on project economics. Dump tanks are likely to be more economic when they serve a number

of large oil-containing plant items. Moat foundations are likely to be more economic for individual, isolated, large oil-containing plant items.

3.1.10 Rainwater collected within above and below-ground oil containment facilities shall be removed using recognised control procedures that prevent rainwater containing any oils entering the drainage system.

3.1.11 Removed rainwater shall be collected and passed through an oily water separator prior to outfall to surface water drainage system. This is designed to ensure that oil concentrations of less than 5mg/L are discharged to the water environment.

3.1.12 Note that oil separators require periodic maintenance, including de-silting and emptying of collected oil, in order to function as intended. We recommend fitting of automated alarms and associated telemetry to identify when maintenance is required.

3.2 Outline Design Requirements

3.2.1 The 'forecourt separator' to the fuel delivery area is sized to capture accidental spillages from a road tanker delivery. A class 1 separator is required to enable discharge of storm water runoff from the fuel delivery area to the WBC surface water drainage network with concentrations of oil less than 5mg/L. Refer to **Appendix B2** for an example of a suitable oil separator.

3.2.2 The least cost oil containment option for the transformer compound, based on the above assumptions, is likely to involve connection of all transformer oil containment areas to a single, shared remote underground oil containment tank ('dump tank') or direct to a full retention oily water separator.

3.2.3 Following confirmation of transformer specifications, detailed design in accordance with NGTS 2.10.01 could prove that integral storage within voided 'moat' foundations below individual oil-containing transformers is more cost effective, or proves to be preferable from a construction perspective, than the alternative dump tank arrangement.

3.2.4 If utilised, the proposed WBC dump tank would be sized according to the largest single oil containment capacity of all connected plant in accordance with the recommendations of NGTS 2.10.01. The minimum required storage volume of the WBC dump tank is calculated as follows:

Minimum oil storage requirement = 1.10 V

Where, V = largest oil volume of any single connected item of plant

$V = W / \rho$

Where W = Weight of oil = 100,000kg

ρ = Density of oil = 870kg/m^3 (assumed)

V = 100,000kg / 870kg/m^3 = 115m^3 approx.

Therefore, in this example the minimum oil storage requirement = 1.10 x 115m^3 = 126.5m^3

3.2.5 For outline design purposes we propose to achieve the oil storage requirement with a single, double skinned GRP tank. Conder Environmental Solutions Ltd. offer a suitable 150,000L (150m^3) GRP tank with dimensions of 4.0m diameter by 12.590 m long (5.38 metric tonnes empty weight) (refer to **Appendix B1** for further details), and this product has been selected for inclusion in the current design. Detailed design may specify the use of alternative similar products as necessary.

3.2.6 The detailed design should consider optimisation of dump tank arrangement or direct to oily water separator based on ease of constructability and number of gas turbine (GT)'s included in the design. The potential for use of multiple smaller tanks in preference to a single large tank may yield benefits for handling and installation.

3.2.7 If utilised, de-silting of the dump tank by road tanker may also be necessary, depending on findings of periodic visual inspections.

3.2.8 If utilised, we recommend the dump tank is fitted with automated high level alarm in order to identify when it is approaching capacity. In this way it will become apparent if there is a build-up of rainwater within the dump tank, and hence assist in the prevention of a potential pollution incident when combined with the catastrophic failure of a connected item of oil-containing plant.

3.2.9 A class 1 oil separator with flow capacity of 4.0L/s (Conder CNS4s/11 (refer to **Appendix B2** for further details)) has been proposed to ensure it can accommodate removed rainwater from above and below-ground oil containment facilities. The final specification of the required oil separator shall be determined during detailed drainage design.

3.2.10 Refer to **Appendix C** for the proposed outline oily water drainage arrangement.

4. Fire Water Drainage

4.1 Design Philosophy

4.1.1 Fire protection shall be necessary for high risk WBC plant items. For the purpose of understanding any impact to the attenuation volume and discharge away from site, a high level evaluation has been carried out looking at firefighting philosophy for the main plant areas.

a. Step-up Transformer – Fire water sprinkler system in line with the National Fire Protection Association's (NFPA) requirements. Transformer to be located within a contained compound area with integral or external sumps with sufficient volume to capture spent fire-fighting water prior to removal to suitable waste water treatment facility offsite, via road tanker.

b. Gas Turbine Bearings and Under Turbine Pedestal – Fire water sprinkler system in line with NFPA requirements. Area below gas turbine bearings to be a contained area with sufficient volume to capture spent fire-fighting water prior to removal to suitable waste water treatment facility offsite, via road tanker.

c. Lube Oil and Hydraulic Station – Fire/foam fighting system in line with NFPA requirements. Oily storage areas to be within a contained area with sufficient volume to capture spent fire-fighting water prior to removal to suitable waste water treatment facility offsite via road tanker.

d. A site wide hydrant system would cover all other areas of the plant (non-oily areas), with a discharge rate in line with the NFPA's requirements (1,893 L/min for 2 hours). As the plant areas covered under the hydrant system would not contain oil, there is no need for containment and the spent fire water would drain into the plant wide drainage system. It is normal practice to assume 30% of fire water from a hydrant system is blown away or evaporated. As such, a maximum rate of 1,325 L/min for 2 hours would be assumed for fire water discharge into the drainage system.

4.1.2 The total fire water volume associated with item 4.1.1(d), assuming 30% water loss, is as follows: 1,325 L/min x 0.001 m^3/L x 120 mins = 159 m^3. This volume is significantly less than maximum storm water attenuation requirement (refer to **Section 5** for details).

4.1.3 For attenuation volume purposes we have assumed, given the low probability of simultaneous occurrence, that 1/100year design rainfall event and full fire water discharge are independent. However, freeboard allowances (refer to **Section 5**) would be sufficient to accommodate the entire 2-hour fire-fighting water volume without overtopping.

5. Storm Water Drainage

5.1 Design Philosophy

5.1.1 Drainage design considers 100-year storm return period with rainfall intensities determined in accordance with the Wallingford Method (Reference 3) and modified in accordance with Table 2 of the UK Environment Agency's publication 'Flood risk assessments: climate change allowances' (Reference 4).

5.2 Design of Below Ground Pipe Network

5.2.1 For outline design purposes a 1/100 year, 60-minute storm rainfall event has been used to size WBC storm water drainage. This ensures that ponding of the site due to exceedance of drainage network flow capacity is unlikely to occur during the design life of WBC.

5.2.2 The basic rainfall value has been factored by 120% to allow for the effects of climate change.

5.2.3 The resulting design rainfall intensity used for outline drainage design purposes is 44.3mm/hr.

5.2.4 WBC site runoff has been derived using a conservative lumped runoff coefficient and quantified using the 'Rational Method'. The calculated average impermeability of the WBC site is 84.2%.

5.2.5 The 2N^{o} proposed WBC layouts presented in **Appendix A** have been considered. The single, larger turbine option in **Appendix A2** has a smaller site and less runoff overall, therefore runoff calculations are only provided for the layout shown in **Appendix A1** as this is the more conservative case.

5.2.6 The design of WBC storm water drainage system is carried out using calculated runoff values, the Colebrook-White flow equation, an assumed fluid temperature of 10°C and a hydraulic roughness, k_s = 0.6mm as per industry practice.

5.2.7 For outline drainage design purposes only the main ('trunk') drains have been designed to an assumed layout, based on runoff from assumed catchment areas. Detailed design should also incorporate design of branch drains that will be required to serve particular downpipe locations, avoid other buried infrastructure, etc.

5.2.8 Alternative routing options 'A', 'B' and 'C' have been considered:

- Connection Option 'A': Southeast to West Burton B (WBB) GMX / purge line;

- Connection Option 'B': Northeast to purge line via ash road; and
- Connection Option 'C': Southwest to WBB GU drain.

5.2.9 Due to the technical difficulties and risks present with the connection option 'A' (Refer to Section 6.1), calculations and layouts have only been carried out for options 'B' and 'C'. Further details for all connection options is provided in Section 6.

5.2.10 Outline storm water drainage design calculations are presented for options 'B' and 'C' in **Appendices D1 and D5** respectively.

5.2.11 Outline arrangement layouts are presented for options 'B' and 'C' in **Appendices D4 and D6** respectively.

5.2.12 Note that twin-walled high-density polyethylene (HDPE) pipes have been specified for outline design purposes as they offer good chemical resistance and their light weight benefits handling compared with clay, concrete or ductile iron equivalents. Typical design life of HDPE twin-wall pipes is circa 60 years, and this is thought to be compatible with the anticipated design life of WBC. Alternative pipe materials may be specified during detailed drainage design as required.

5.3 Attenuation Requirements

5.3.1 For outline drainage design, it is assumed volumetric runoff discharge from a 1/100 year storm on the WBC site is to be limited to 'greenfield' equivalent in accordance with procedure in Institute of Hydrology Report 124 (Reference 5), scaled down from 50Ha minimum to actual site area.

5.3.2 The equivalent 'greenfield' runoff for the WBC site has been calculated as 5.01 L/sec.

5.3.3 We propose that flow from the WBC site would be limited to 5.0L/s using a flow control device fixed within a manhole near to the system outfall (i.e. pond outfall manhole S401 as shown in **Appendix D4**; a typical flow control device is presented in **Appendix D2**), or otherwise by controlled pumped discharge.

5.3.4 Maximum attenuation volumes have been calculated for a range of 1/100 year return storm durations. 1, 2, 6, 10, 24 and 48 hour storm durations have been considered. A climate change factor of 120% has been applied to rainfall depths in calculation of attenuation volumes.

5.3.5 Outline calculations apply a factor of 1.25 to maximum attenuation volume to account for lag between commencement of inflow to attenuation system and achievement of limiting 5.0L/s discharge under the required pressure head. It is noted that the 1.25 factor is in addition to the 120% climate change factor referenced in 5.3.4.

5.3.6 The maximum outline design attenuation volume is calculated as 1,456m^3. Refer to **Appendix D3** for calculation details. We recommend that detailed design should optimise attenuation volume requirements via software simulation, or similar.

5.3.7 An attenuation pond has been considered as an option to provide the required attenuation volumes. A pond has certain advantages over an equivalent buried tank (or oversized pipe systems) as it permits inspection of flows and maintenance without man entry to confined spaces, and may be of ecological/environmental benefit. However, an attenuation pond has drawbacks in terms of maintenance requirements (primarily control of vegetation and de-silting) and larger relative plan area requirements, plus the presence of fast-flowing or deep water may result in potential hazard to site maintenance staff that should be adequately identified and controlled.

5.3.8 Refer to **Appendix D4** for attenuation pond arrangement of Option 'B'. The attenuation pond shown in the **Appendix D4** has a storage capacity of circa 1,600m^3 at 1.5m deep, plus 150mm freeboard allowance.

5.3.9 Refer to **Appendix D6** for details of an alternative attenuation tank option and pumped discharge to WBB (Option 'C'). The attenuation tank plan dimensions of 20m wide by 40m long have been chosen based on available space requirements, maximum width for desilting with mechanical excavator and a desire to maximise remaining available space for future site developments. Tank depth of 2.0m (approx.) is chosen to accommodate the attenuation storage volume calculated in **Appendix D3** with suitable freeboard.

5.3.10 A sensitivity study was carried out using an alternative climate change factor of 130% for rainfall depth determination. Calculation procedure was otherwise the same as described above. The associated attenuation volume requirement using the 130% climate change factor is 1622m^3. This represents an increase of 11.4% from the 1,456m^3 calculated using the 120% factor. Depending on how much of a safety factor the Applicant requires, this may require attenuation storage capacity slightly more than the 1,600m^3 presented in **Appendix D4**.

6. Connection of WBC Drainage to Existing Site Infrastructure

6.1 Connection Option 'A': Southeast to WBB GMX/Purge Line

6.1.1 A potential outfall connection point for WBC drainage has been identified as one of four existing chambers along the purge lines that run approximately parallel with River Road from West Burton 'A' cooling towers to the purge line outfall at the sluice gate to the River Trent near the existing sewage treatment works in the northeast of the site.

6.1.2 A visual inspection of purge line chambers P3, P4, P7 and the GMX Pit was undertaken on 29th August 2017. In general, the inspection found the purge line chambers were in good condition, however there was suggestion that some of the connecting drains upstream of GMX, and between chambers P6 and P7 may be damaged.

6.1.3 The GMX Pit and Pit P7 are situated to the east of West Burton 'B' site. The existing WBB service plans provided by the Applicant indicate that, due to physical constraints of the steep embankment and fish ponds to the east of WBC, any drain passing from WBC would need to cross a major WBB service corridor containing drainage, electrical cables and a gas main supplying WBB. There are potential technical difficulties and significant risks associated with installing new drainage within this existing service corridor. Once the pre-detailed design activities (outlined in Section 8) have been undertaken, the route to the GMX Pit and Pit 7 will be reassessed to see if the identified technical difficulties and risks are still present.

6.2 Connection Option 'B': Northeast to purge line via ash road

6.2.1 This proposed discharge route is East via an attenuation pond outfall along the existing ash road towards River Road before turning towards, and connecting to, purge line chamber P3 as presented in **Appendix D4**. This is potentially a shorter route than Option 'A', and there are no known buried service obstructions.

6.2.2 Chamber P3 is located to the southeast of the existing sewage treatment works and southwest of the existing purge line sluice gate outfall to the River Trent. Currently access is difficult due to surrounding dense undergrowth and steep embankments to nearby site roads. It is envisaged that removal of vegetation and creation of a new access road stub to chamber P3 would be included in the WBC drainage works.

6.2.3 If connection to chamber P3 proves to be unfeasible or uneconomic due to access requirements, connection to chamber P4 could prove to be a convenient alternative due to its proximity to an existing access track to the northeast of the

site fish ponds. However, there may be technical and construction risks with connection of WBC drainage to P4 associated with high ground water and reversal of flow direction between WBC drainage and existing purge line drainage flows. Any new drain approaching P4 would flow southeast along the existing track before discharging into the purge line flowing in the opposite direction; the resulting abrupt change in flow velocities may exacerbate siltation within the drains.

Methodology of Connection

6.2.4 A proposed typical section for connection of new WBC drainage outfall to existing purge line chamber P3 is provided in **Appendix E1**.

6.2.5 An accompanying outline connection methodology is provided in **Appendix E2**. This methodology is provided for information only.

6.2.6 Final connection details and working methodology should be produced, reviewed and approved by suitably experienced and qualified personnel following full dimensional survey of existing purge line chamber P3 and prior to commencement of construction.

6.2.7 Potential risks associated with connection of new WBC drainage to existing West Burton A (WBA) purge line chamber P3 are highlighted in Section 7 and **Appendix F**.

6.3 Connection Option 'C': Southwest to WBB GU Drain

6.3.1 This option involves draining storm water from the WBC site by gravity to an open reinforced attenuation / holding tank to the south of the site close to the boundary with WBB. Refer to **Section 5** for methodology behind selection of attenuation tank dimensions.

6.3.2 The contents of the tank would subsequently be removed by fixed pump (either automated or manually controlled) or via gravity to the existing GU drain within the WBB site at times of low flow to ensure the receiving drains are not surcharged.

6.3.3 Due to minimum gradients and minimum cover to WBC branch drains, the proposed attenuation tank inlet is circa 2.7m below WBC finished platform level. When combined with the required tank depth and base thickness, the excavation for the tank is likely to be circa 5.0m deep and require perimeter piled retaining walls on the northern, western and southern sides to prevent instability of WBB and WBC platforms, plus proposed access road link between the two sites.

6.3.4 Suitable vehicular access is required to the attenuation tank for maintenance purposes such as de-silting, pump servicing and general inspection activities. Detailed design should make provision accordingly.

6.3.5 WBB manhole GU36 has been identified by EDF Energy (Thermal Generation) Limited as a potential outfall point for this option. Manhole GU36 will therefore

accept the 100mm diameter rising main (pressure pipe) from the outlet of the WBC attenuation tank.

6.3.6 Refer to **Appendix D6** for Option 'C' proposed arrangement.

6.3.7 Note that alternative options for the attenuation/holding tank structure exist (e.g. buried in-situ reinforced concrete tank, buried GRP tank arrays, open attenuation pond, etc.), and these should be appraised at detailed design stage to ensure optimum solution.

7. Design Risk Assessment

7.1 General

7.1.1 Refer to **Appendix F** for the Risk Assessments relating to the design, construction and operation of proposed WBC drainage Option 'B', and its relationship with ongoing site operations.

7.1.2 The above Design Risk Assessment is provided for information only. It is based upon assumptions and site information available at the time of writing and is intended for use in developing detailed designs and informed risk assessments that will be necessary for future site investigations and subsequent drainage construction.

7.1.3 Note that risks relating to construction connection of WBC drainage option 'C' to existing WBB GU drain are similar to those identified in **Appendix F** for connection of option 'B' drainage to the existing WBA purge line, although less significant due to improved construction access, shallower drains and lower potential existing flows. A specific risk assessment should be carried out for option 'C' drainage connection at detailed design phase if this is identified as a preferred solution.

7.2 Risk of Settlement Due to Coal Ash Deposits

7.2.1 The design risk assessment identifies potential issues with significant local ground settlement due to presence of loosely compacted coal ash (likely to be a mix of Pulverised Fuel Ash (PFA) and Furnace Bottom Ash (FBA)) waste from WBA. In addition to the potential high sulphate concentration and associated risk of degradation to buried concrete structures, PFA is susceptible to liquefaction and subsequent flow / compression collapse on wetting.

7.2.2 Wetting of PFA could be due to infiltration of surface water (percolation), rise in groundwater, leakage from buried drains, or a combination of these actions. Furthermore, any cracked, crushed or poorly-jointed drains could lead to wash-out of PFA and subsequent surface settlement.

7.2.3 Local ground settlement has previously occurred within the WBB operational site. This is believed to be attributed to the behaviour of buried PFA deposits.

7.2.4 Some potential mitigation strategies to limit the effects of PFA settlement on buried drainage are as follows:

- avoid construction of major structures over / within significant PFA deposits, if feasible
- local excavation of PFA and replacement with acceptable fill material
- local excavation of PFA, 'conditioning' of arising's by application of water, and re-filling of excavation using suitable compaction methodology

- impermeable membranes laid near-surface to limit infiltration of storm water
- impermeable membrane wrap to drainage pipes to limit leakage / infiltration potential
- suspended drainage system hung from underside of piled reinforced concrete road deck
- appropriate specification of pipe materials and fittings to mitigate localised settlement of surrounding ground

7.2.5 One or more of the above strategies could be used in the final scheme. We recommend a detailed study of options is carried out following publication of Geotechnical Investigation (GI) findings.

8. Conclusion & Recommendations

8.1.1 This strategy presents the outline drainage design options for the WBC site in order to assist in development of the detailed design, statutory approval, subsequent construction and maintenance of the final WBC drainage network in due course.

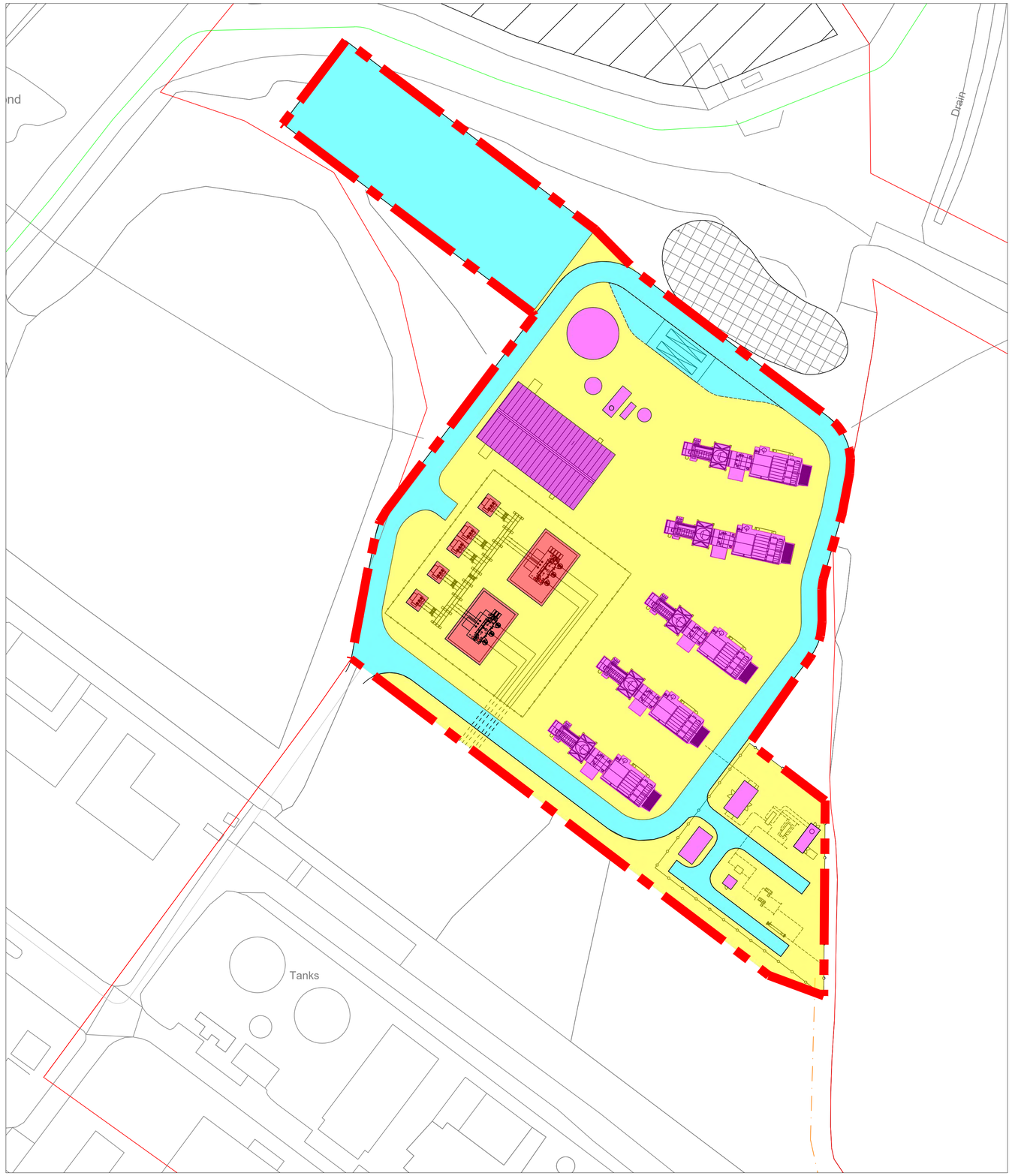
8.1.2 We recommend that the following activities are undertaken prior to detailed drainage design:

1. confirmation of the WBC layout;
2. confirmation of preferred WBC storm water drainage routing option;
3. confirmation of plant specifications including process water, fire suppression and drainage requirements;
4. confirmation of WBC platform levels;
5. site investigations to confirm possible presence of buried contaminants plus distribution and potential for wash-out of buried coal ash deposits;
6. software modelling and confirmation of final attenuation requirements;
7. confirmation of WBC Drainage Discharge Consents (if required);
8. internal dimensional and levels survey of outfall manholes for the proposed WBC drainage, plus confirmation of chamber location coordinates; and
9. production of the WBC drainage specification.

8.1.3 All of these activities would inform the drainage scheme to be submitted and approved by the local planning authority prior to commence of the development. Refer to the draft DCO (**Application document Ref. 2.1**) for details of the security mechanism.

9. References

1 National Grid Technical Specification 2.10.01 Issue 1 'National Grid Generic Electricity Substation Design Manual for Civil, Structural and Building Engineering – Section 01: Oil Containment' (April 2017)
2 The Control of Pollution (Oil Storage) (England) Regulations 2001
3 'Design and Analysis of Urban Storm Drainage: The Wallingford Procedure', HR Wallingford (1981)
4 'Flood risk assessments: climate change allowances', Environment Agency (19th Feb 2016)
5 Report No 124 'Flood Estimation for Small Catchments', Institute of Hydrology (June 1994)



KEY

BUILDINGS
(2,382m^2)

ROADS & CAR PARKING
(6,305m^2)

OILY WATER AREAS
(575m^2)

GENERAL SITE AREAS
(11,598m^2)

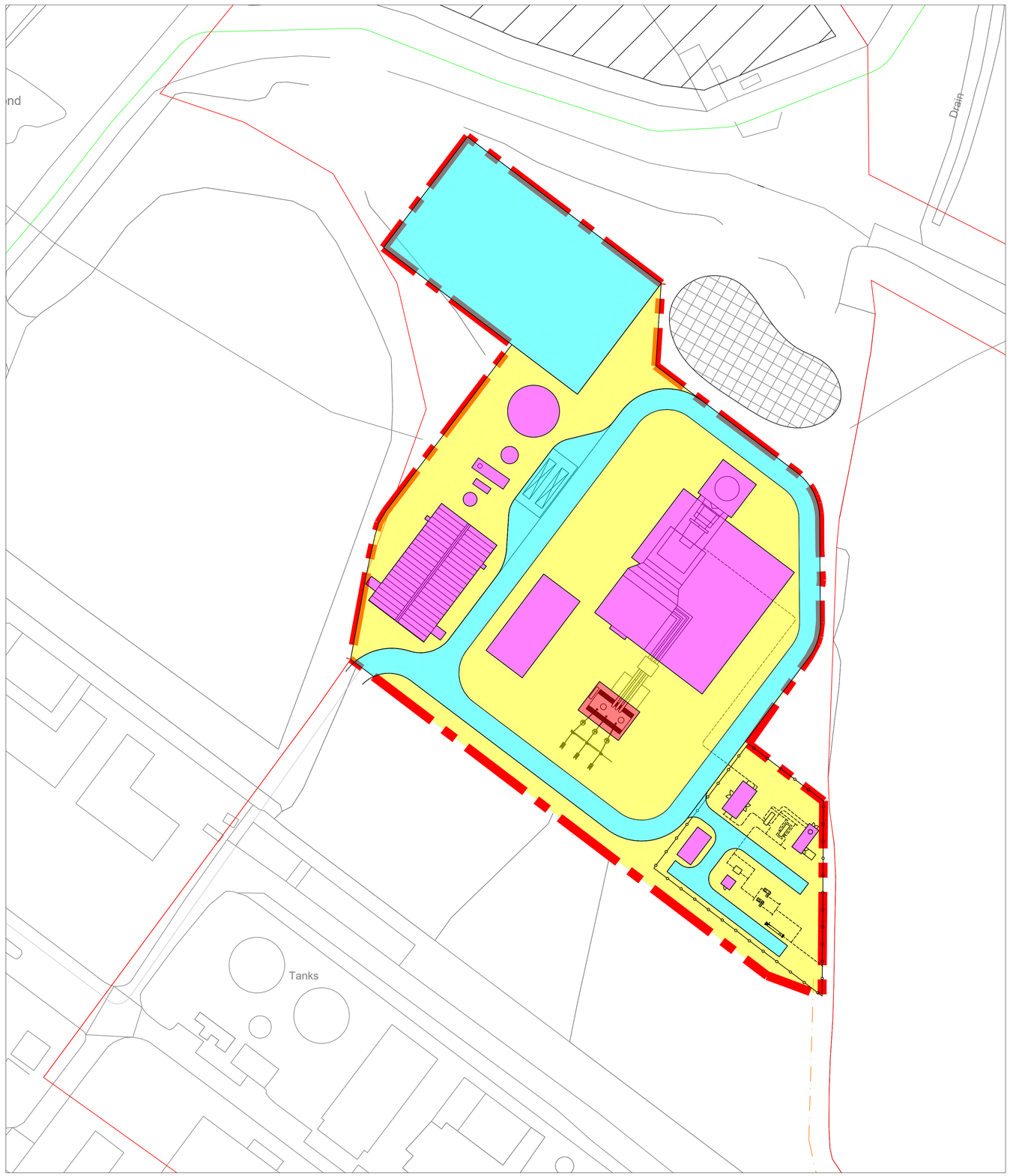
299MW SITE BOUNDARY
(SITE AREA = 20,860m^2)

wsp

TITLE:
WBC INDICATIVE OUTLINE DRAINAGE AREAS - UP TO FIVE SMALLER GAS TURBINES OPTION

FIGURE No:
70026635-REP-0006-SK-A1

File name F:\70026635-REP-0006-SK-A1 WBC DRAINAGE AREAS 1 - 04.04.19.DWG, printed on 24 April 2019 12:51:44, by AutoCAD



KEY

BUILDINGS
(3,377m^2)

ROADS & CAR PARKING
(5,790m^2)

OILY WATER AREAS
(150m^2)

GENERAL SITE AREAS
(9,403m^2)

299MW SITE BOUNDARY
(SITE AREA = 18,720m^2)

wsp

TITLE:

WBC INDICATIVE OUTLINE DRAINAGE AREAS - SINGLE LARGE GAS TURBINE OPTION

FIGURE No:

70026635-REP-0006-SK-A2

File name F:\70026635-REP-0006-SK-A2 WBC DRAINAGE AREAS 2 - 04.04.19.DWG, printed on 24 April 2019 12:50:44, by AutoCAD

conder
ENVIRONMENTAL SOLUTIONS

the conder range of **Oil Separators**

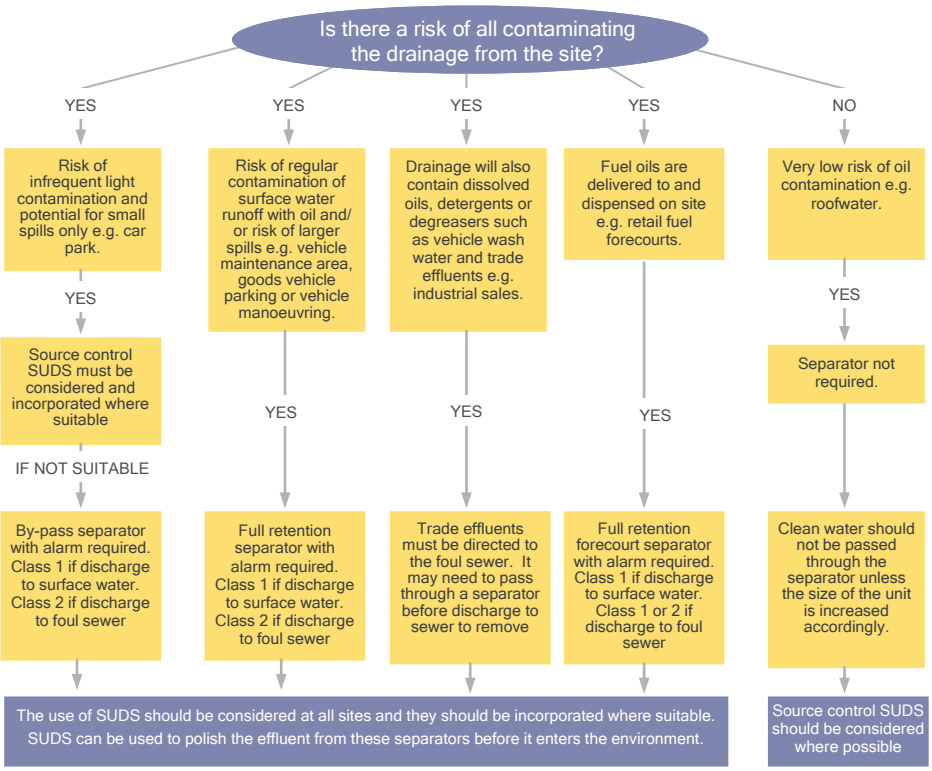
clereflo™ bypass separator
clereflo™ full retention separator
forecourt, washdown & silt separators
alarm systems

demand special treatment

product selector

This chart, prepared by the Environment Agency and other Environmental alliance members can be used to identify the correct type of Conder Oil Separator your project requires. Guidance is given for the use of Separators in surface water drainage systems that discharge to rivers and soakways.

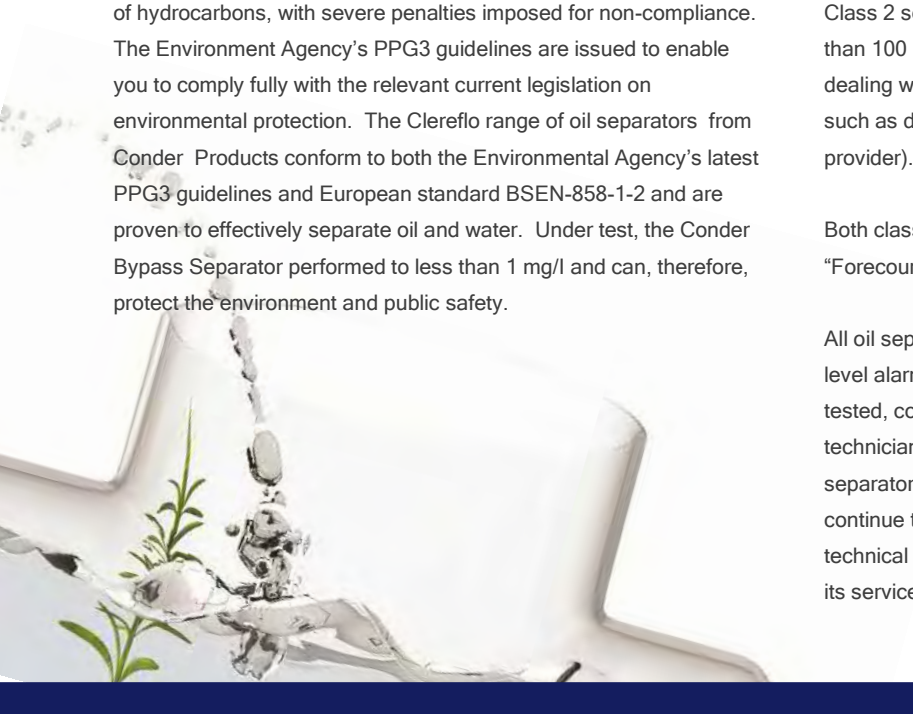
NB: Although discharge to foul water sewer is generally not covered by this chart, a Conder Separator should still be used. Please call for further advice.



separators

Pollution prevention is a critical part of sustainable drainage systems and verified oil separators are designed to protect the environment and prevent the pollution of our rivers and streams, by containing hydrocarbons (e.g. diesel, petrol or engine oil) that have entered a drainage system.

There are statutory regulations in force to control the discharge of hydrocarbons, with severe penalties imposed for non-compliance. The Environment Agency's PPG3 guidelines are issued to enable you to comply fully with the relevant current legislation on environmental protection. The Clereflo range of oil separators from Conder Products conform to both the Environmental Agency's latest PPG3 guidelines and European standard BSEN-858-1-2 and are proven to effectively separate oil and water. Under test, the Conder Bypass Separator performed to less than 1 mg/l and can, therefore, protect the environment and public safety.



THE EUROPEAN STANDARD REFERS TO TWO "CLASSES" OF SEPARATOR:

Class 1 separators are designed to achieve a concentration of less than 5 mg/l of oil under standard test conditions. These separators are required for discharges to surface water drains and the water environment.

Class 2 separators are designed to achieve a concentration of less than 100 mg/l oil under standard test conditions and are suitable for dealing with discharges where a lower quality requirement applies such as discharges to the foul sewer (with consent from your sewer provider).

Both classes can be produced as "Full retention", "By-Pass" or "Forecourt" separators.

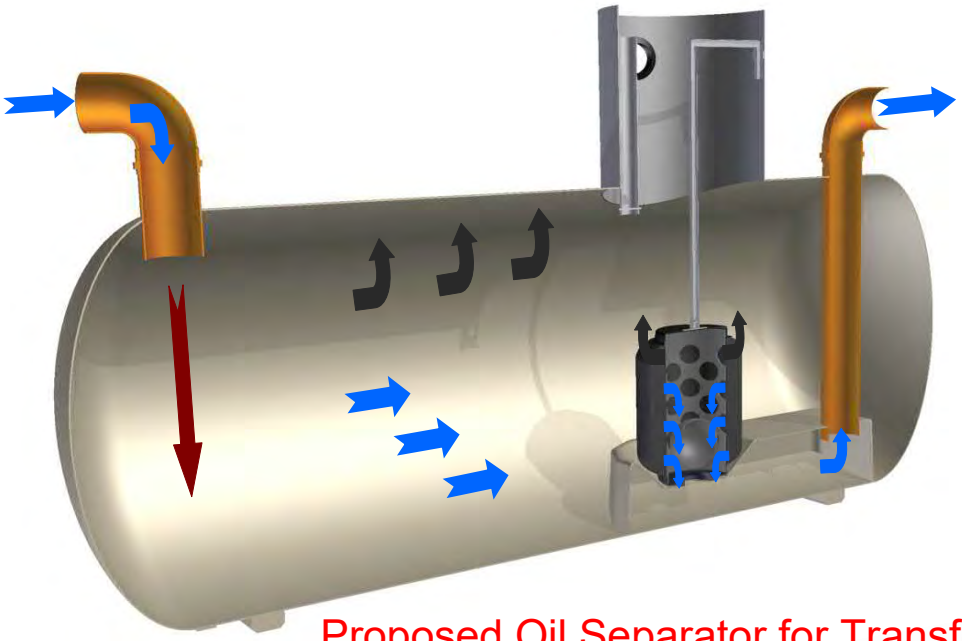
All oil separators are required by legislation to be fitted with an oil level alarm system and it is recommended that this alarm is installed, tested, commissioned and regularly serviced by a qualified technician. This automatic warning device will indicate when the separator is in need of immediate maintenance in order for it to continue to work effectively. Conder Products can offer a full technical and service package for a variety of alarm options through its service partner, Pims Service. (See separate section).

clereflo full retention separator

Full retention separators treat the full flow that can be delivered by a drainage system, which is normally equivalent to the flow generated by a rainfall intensity of 65mm/hr. Full retention separators are used where there is a risk of regular contamination with oil and a foreseeable risk of significant spillages e.g. vehicle maintenance areas and retail fuel forecourts. All full retention separators have an automatic closure device (ACD) filled as standard. Compulsory for all PPG3 compliant full retention separators, the ACD prevents accumulated pollutants flowing through the unit when maximum storage level is reached.

PROCESS & PERFORMANCE

Contaminated water enters the separator, the liquid is retained for a sufficient period to ensure that the lighter than water pollutants, such as oil and petrol, separate and rise to the surface of the water and are retained within the separator. Decontaminated water is discharged. Retained oil must be emptied from the separator once the level of oil is reached, or the oil level alarm is activated and the closure device operated.



Separator waste is a “special waste” and should be removed from the separator under the terms of The Waste Management Code of Practice.

Proposed Oil Separator for Transformer Area

AREA DRAINED (M²)	TANK CODE INCL. SILT	LENGTH INCL. SILT (mm)	SILT CAPAC-ITY (L)	TANK CODE EXC SILT	LENTGH EXC SILT (mm)	OIL STORAGE CAPACITY (mm)	DIAMETER (mm)	HEIGHT (mm)	BASE TO INLET INVERT (mm)	BASE TO OUTLET INVERT (mm)
222	CNS4s/**	2319	400	CNS4/**	1810	40	1010	1350	1125	1075
333	CNS6s/**	3414	600	CNS6**	2650	60	1010	1350	1125	1075
444	CNS8s/**	3197	800	CNS8**	2489	80	1210	1550	1325	1275
556	CNS10s/**	3957	1000	CNS10**	3073	100	1210	1550	1325	1275
833	CNS15s/**	3844	1500	CNS15**	2995	150	1510	1850	1600	1550
1111	CNS20s/**	5060	2000	CNS20**	3929	200	1510	1850	1600	1550
1667	CNS30s/**	5639	3000	CNS30**	4190	300	1880	2100	1850	1800
2222	CNS40s/**	7059	4000	CNS40**	5487	400	1880	2100	1850	1800
2778	CNS50s/**	4792	5000	CNS50**	3778	500	2600	2800	2550	4080
3333	CNS60s/**	5673	6000	CNS60**	4450	600	2600	2800	2550	4805
3889	CNS70s/**	6549	7000	CNS70**	5123	700	2600	2800	2550	5529
4444	CNS80s/**	7425	8000	CNS80**	5795	800	2600	2800	2550	6254
5000	CNS90s/21	8301	9000	CNS90***	6467	900	2600	2800	2550	6502
5556	CNS100s/**	9177	10,000	CNS100**	7139	1,000	2600	2800	2550	6751

** Enter 11 for Class1 Full Retention Separators /** Enter 12 for Class 2 Full Retention Separators
NOTE: It is a requirement of PPG3 that you have a silt capacity either in your tank or in an upstream catch pit.

FEATURES & BENEFITS

- All surface water treated
- Available in Class 1 & 2
- ACD fitted as standard

APPLICATION AREAS

- Sites with high risk of contamination
- Fuel storage depots
- Refuelling facilities
- Petrol forecourts
- Vehicle maintenance areas/workshops

forecourt separator

Forecourt separators are full retention separators specified to retain on site the maximum spillage likely to occur on a petrol filling station. They are required for both safety and environmental reasons and will treat spillages occurring during the vehicle refuelling and road tanker delivery. The size of the separator is increased in order to retain the possible loss of the contents of one compartment of a road tanker, which may be up to 7,600 litres. Forecourt separators can be Class 1 or 2 and may not need a coalescing filter if discharging, with water authority consent, into a foul sewer.

FEATURES & BENEFITS

- All surface water treated
- Available in Class 1 & 2
- ACD fitted as standard
- Includes 2000L silt capacity

APPLICATION AREAS

- Petrol forecourts
- Refuelling facilities
- Fuel storage depot

FORECOURT SEPARATORS

Proposed Oil Separator for Fuel Delivery Area

TANK CODE	VOLUME	LENTGH (mm)	DIAMETER (mm)	HEIGHT (mm)	BASE TO INLET (mm)	BASE TO OUTLET (mm)	ACCESS (mm)
ANO/11*	10000	4250	1800	2100	1600	1550	750
LNO/11**	10000	4250	1800	2100	1600	1550	750
ANT/12**	10000	4250	1800	2100	1600	1550	750

* Class 1 Forecourt Separator suitable for discharging to surface water drains **Class 1 Forecourt Separator suitable for installation in granular materials
*** Class 2 Forecourt Separator suitable for discharging to foul drains only

wash down & silt separators

CWS WASH DOWN SEPARATOR

The Environment Agency's PPG13 requires that discharge from pressure washers must discharge to a foul drainage system. Where there is no foul drainage available, the effluent must be contained within a sealed drainage system or catchpit for disposal by a licensed waste contractor.

Silt build-up is the main problem with wash down facilities, the Conder CWS range of wash down and silt separators are used to remove the silt and will allow some separation of hydrocarbons.

Detergents that are used in wash down areas will break down and disperse the hydrocarbons, hindering the separation process. Therefore, it is important to remember that the main function of wash down separators is to remove silt.

Although it is recognised that single stage separators give the most efficient separation, 2 and 3 chamber CWS silt separators are available on request.

APPLICATION AREAS

- Carwash facilities
- Tool hire depots
- Pressure washer facilities

FST SILT TRAP

Large quantities of silt can be associated with wash down areas. The Conder FST silt trap is ideal for easy removal of silt either manually or by a waste disposal contractor.

The FST range of silt traps are available with varying grades of covers from B125 up to D400 to allow installation in all types of vehicle or plant wash down facilities.

TANK CODE	CAPACITY (L)	SILT STORAGE	DIAMETER (mm)	LENGTH (mm)	ACCESS DIAMETER (mm)	BASE TO INLET INVERT (mm)	BASE TO OUTLET INVERT (mm)
CWS2/12	2000	1000	1000	2713	600	1290	1240
CWS3/12	3000	1500	1200	2853	600	1425	1375
CWS4/12	4000	2000	1200	3737	600	1425	1375
CWS6/12	6000	3000	1500	3636	600	1775	1725
CWS8/12	8000	4000	1800	3443	600	2030	1980
CWS10/12	10000	5000	1800	4250	600	2030	1980
CWS12/12	12000	6000	1800	5015	600	2030	1980
CWS14/12	14000	7000	1800	5800	600	2030	1980
CWS16/12	16000	8000	1800	6587	600	2030	1980
CWS18/12	18000	9000	2500	4117	600	2725	2675
CWS20/12	20000	10000	2500	4524	600	2725	2675

alarm systems

service & accessories

According to the Environment Agency's PPG3 guidelines, all separators must be provided with a robust device to provide visual and audible warning (if necessary to a remotely located supervised point) when the level of oil reaches 90% of the oil storage volume. This automatic warning device indicates that the separator is in need of immediate emptying for it to continue to work effectively.

Conder can supply a full range of visual and audible warning devices including: mains powered, solar powered alarms (with flashing beacon) or solar GSM (sends text message to a mobile phone or your choice). Three probes are fitted in the separator to automatically monitor the oil, silt and liquid levels. The probes will also indicate exactly when the separator needs emptying, eliminating unnecessary waste management visits.

If site conditions permit, the control can be used to monitor multiple probes in a number of different separators.

MAINS POWERED SYSTEM

This option is best suited to new build situations or sites where installation of the necessary cabling and ducting is straightforward and economical.

SOLAR POWERED SYSTEM–FLASHING BEACON

This option requires no mains power supply or any significant cabling and ducting making it economical for large sites and retro fitting alarms to existing oil separators. A High Intensity Beacon will flash when a problem is detected.

SOLAR GSM ALARM

The solar GSM alarm sends a status report of your separator to a mobile phone number of your choice. The status of the GSM alarm can also be tested at any time by simply sending a pre-recorded text message via your dedicated mobile phone.

The Environment Agency's PPG3 guidelines stipulate that, every six months, according to manufacturer's instructions, experienced personnel should:

- Physically inspect the integrity of the separator and all mechanical parts
- Assess the depth of accumulated oil and silt
- Service all electrical equipment such as alarms and separator management systems
- Check the condition of any coalescing device and replace if necessary
- Keep a detailed log of when the separator is inspected, maintained, emptied and serviced

Conder, through its approved service provider, Pims Service, can offer a full technical and service package including separator and alarm installation, commissioning, oil and silt removal, and routine service contracts.

SEPARATOR ACCESSORIES

Coalescing Filters

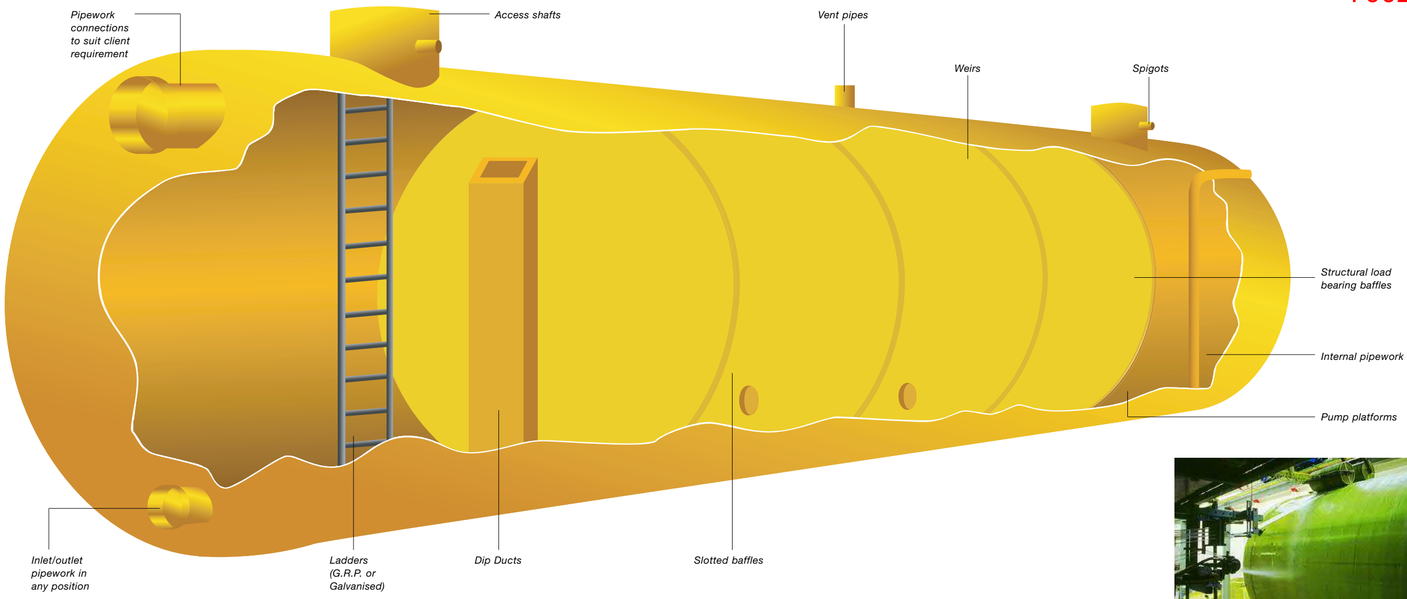
This filter (a cylindrical cartridge of open cell material - with handle for easy removal and cleaning) separates residual oil in already separated oil/water and ensures discharge quality of less than 5mg/litre of oil in water under test conditions. It is simple to maintain and replace.

FEATURES & BENEFITS

- Flashing beacons
- Flashing beacons with siren kit
- Kiosks
- Probe brackets
- Bas 1000 intrinsically safe junction box
- High level probe
- Silt level probe
- Oil level probe

ATTENUATION TANK SYSTEMS

- Wide range of tank sizes to meet any project requirement
- Choice of interior partitions, e.g. with by-pass ducts/weirs, pressure release valves, both load bearing and non-load bearing
- Choice of access shafts - standard or customised - whether circular, square or rectangular to your height specification
- Inlet and outlet connections may be installed in any specified position, to the size and angle required
- Interior tank walls are 'resin-rich' to provide a durable, chemical and corrosion resistant surface with excellent flow characteristics
- Pumps to raise storm water to local mains system can be installed on pump platforms or with an integral sump. Conder also supply packaged pumping stations
- Flow regulators to ensure controlled discharge of water to meet local authority requirements
- Full technical assistance, including supporting calculations, available to ensure your system meets predicted storm water capacity and allowable discharge rates



CONDER CELL

- Storm water attenuation modules for shallow installations, SUDS compliance & storage projects
- Flexible, low cost installation - easily cut on site
- Standard module dimensions: 2400mm (L), 610mm (H), 325mm (W). Custom sizes on request
- Loadings for: pedestrian, car parks and heavy duty

SPRINKLER TANKS

- Designed to meet any specification for sprinkler or fire fighting needs
- Comprehensive underground systems can be designed with load bearing structural partition dividing a dry pumping chamber, with ladder access, and an adjoining water storage tank
- Low level sumps available to maximise storage/discharge capacity
- Access requirements designed to suit the tank's specific inlet and fittings
- Complete range of ancillary items including access ladders, flanged pipework connections, ball floats, check valves and vortex inhibitors

1.0 Metre Diameter Vessels

Capacity (litres)	Length (mm)	Weight empty (kg)
1,000	1,400	50
1,500	2,036	70
2,000	3,310	105
3,000	3,946	120
5,000	6,493	190

1.2 Metre Diameter Vessels

Capacity (litres)	Length (mm)	Weight empty (kg)
1,500	1,480	75
2,500	2,366	110
3,000	2,810	125
4,500	4,135	175
6,000	5,460	230
8,000	7,230	300

1.5 Metre Diameter Vessels

Capacity (litres)	Length (mm)	Weight empty (kg)
3,000	1,947	155
6,000	3,645	285
7,500	4,495	350
9,000	5,343	410
12,000	7,040	540
15,000	8,738	670

1.8 Metre Diameter Vessels

Capacity (litres)	Length (mm)	Weight empty (kg)
5,000	2,265	175
9,000	3,837	300
12,000	5,016	400
15,000	6,195	490
18,000	7,374	590
22,000	8,946	710
27,000	10,911	875
30,000	12,090	975

2.5 Metre Diameter Vessels

Capacity (litres)	Length (mm)	Weight empty (kg)
15,000	3,510	670
18,000	4,120	760
22,000	4,930	880
27,000	5,950	1,030
30,000	6,560	1,150
40,000	8,600	1,440
50,000	10,640	1,705
60,000	12,670	2,000
70,000	14,710	2,300
84,000	17,560	2,700

3.0 Metre Diameter Vessels

Capacity (litres)	Length (mm)	Weight empty (kg)
25,000	4,040	1,100
50,000	7,570	1,825
80,000	11,820	2,700
90,000	13,230	3,000
100,000	14,650	3,300
110,000	16,060	3,600
120,000	17,480	3,850
130,000	18,890	4,150
140,000	20,300	4,450
150,000	21,720	4,750

4.0 Metre Diameter Vessels

Capacity (litres)	Length (mm)	Weight empty (kg)
50,000	4,640	2,475
100,000	8,610	3,950
150,000	12,590	5,375
165,000	13,790	5,825
180,000	14,980	6,250
200,000	16,570	6,850
220,000	18,160	7,450
240,000	19,750	8,050
260,000	21,340	8,625
275,000	22,540	9,050

UNDERGROUND STORAGE SIZING TABLES:

Tables are strictly for guidance only. Tanks are generally sized & manufactured to suit the application.

Weights are for basic vessels, concrete surround installation, all fittings etc. need to be added.

GENERAL UNDERGROUND STORAGE TANKS

- Designed to be suitable for storing a wide range of clean or corrosive liquids. Applications include potable water, fuels, industrial effluents, domestic sewage, chemicals and other bulk liquids
- Bespoke products and customised tanks designed and manufactured to meet individual applications and customer requirements
- Tanks are usually structured in three layers from BS 5705 materials. Specific additional resins can be incorporated into each layer to ensure durable, protective tank performance and the safe, risk-free storage of corrosive or aggressive liquids and chemicals
- Experienced Conder Specification Advisors are always on hand to discuss product storage projects, no matter how complex, and to advise on regulations, accessory options, and to ensure the correct resin selection - simply call for more information

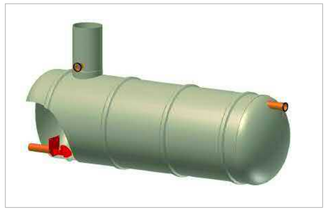
DOUBLE WALL TANKS

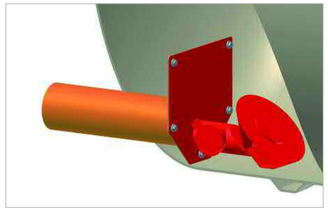
- **Double Wall GRP storage tanks manufactured using unique, computer-controlled patented rib design - fully compliant with PPG27 and BS EN ISO9001:2000**
- **Double Wall construction incorporates an interstitial space filled with a glycol/water mixture. Leak detection/alarm units available**

UNDERGROUND STORAGE TANKS

FEATURES AND BENEFITS

- Manufacture to BS 4994 and BS EN 976
- All vessels certified to BS EN ISO 9001 Design & Build
- Full expertise in the design of large farm or single tank stormwater balancing/attenuation systems, or sprinkler systems
- Proven high performance and specialist product storage/holding expertise
- Maintenance-free and corrosion resistant vessels
- Versatile manufacturing offers options for either granular or concrete backfill
- Lightweight construction allows easy installation
- Choice of standard tanks or custom-made systems with all access facilities, flanges, baffles, fittings and accessories, e.g. pumps and flow controllers, designed and installed to meet specific project requirements
- Full capability to manufacture grit arresting/sludge containment tanks, fire fighting reservoir tanks, oil dump tanks as well as systems which can hold solids in suspension or collect accidental chemical spillage
- Full technical, AutoCAD and product support





ACCESSORIES

SUBMERSIBLE PUMPS, PIPEWORK & VALVES

- The latest range of quality submersible pumps, vortex, channel or macerator products complete with internal pipework and valves - guide rail mounted or free-standing. Some sitework may be needed for deeper installations, otherwise products are generally factory fitted

ACCESS LADDERS

- Full range available to provide safe access to meet HSA and CDM regulations

FLOW REGULATORS

- Proven performance, high quality stainless steel flow regulators, complete with bypass door arrangements, for installation either integrally or downstream of the underground storage tank

BALL FLOATS, CHECK VALVES & VORTEX INHIBITORS

- Supplied with sprinkler tank systems to suit customer project requirements

let us make your environment
a better place to be...
demand special treatment

ASP 6-20pe Package Sewage Treatment Plant

NSAF 25-50pe

Techflo SAF 60-600pe single-stream and multi-stream up to 1800pe

MBR Membrane Technology Package Sewage Treatment Systems (up to 5000pe)

General Underground Storage Tanks

For product enquiries, specification advice, project assessments or further information, please contact the Conder team on:

conder ENVIRONMENTAL SOLUTIONS

t: 08702 640004 f: 08702 640005 e: sales@conderproducts.com
www.conderproducts.com
Conder Solutions Ltd, 2 Whitehouse Way,
South West Industrial Estate, Peterlee, Co Durham SR8 2RA

For nationwide service enquiries please contact:

PIMS GROUP

Pims (Services) Ltd
t: 0870 405 0902 f: 01252 516404 e: sales@pimsgroup.co.uk
www.pimsgroup.co.uk

A member of

BRITISH WATER · UVDB · CPD MEMBER · FM 81500 BS EN ISO 9001:2000 · eps Pumping & Treatment Systems

Attenuation & Storm Water Balancing

Class 1&2 Bypass & Full Retention oil/water separators

Package Pump Stations

Plus:

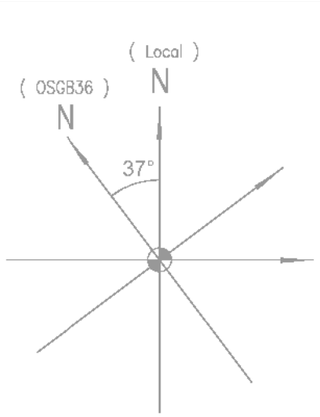
Double Wall Tanks
Fuel Tanks
Cesspools & Septics
Rainwater Harvesting Systems
Grease/Oil Separators
Bucket Lift Elevators
Screenpack CSOs
ConderCell Modular Storage
Above Ground Engineered Vessels
Sprinkler Tanks

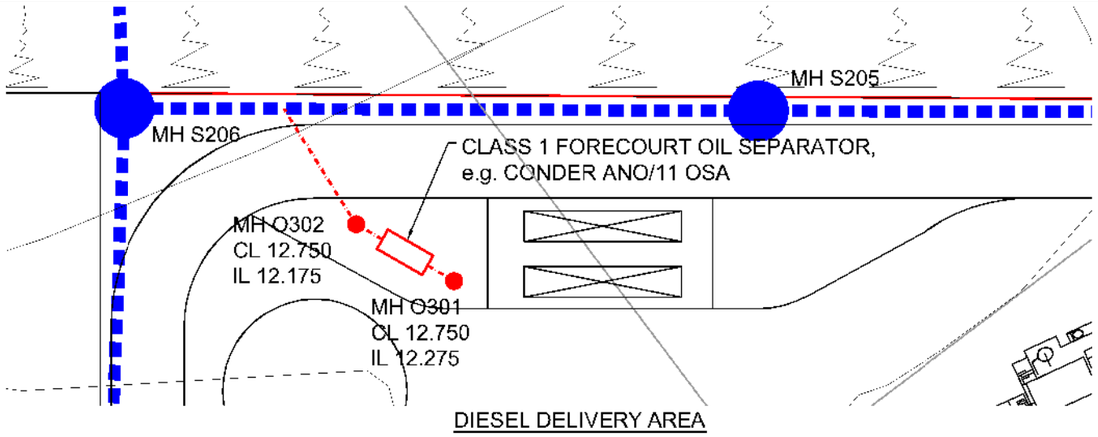
the conder **attenuation, sprinkler & storage** systems

Single & Double Wall Tanks for the storage of:

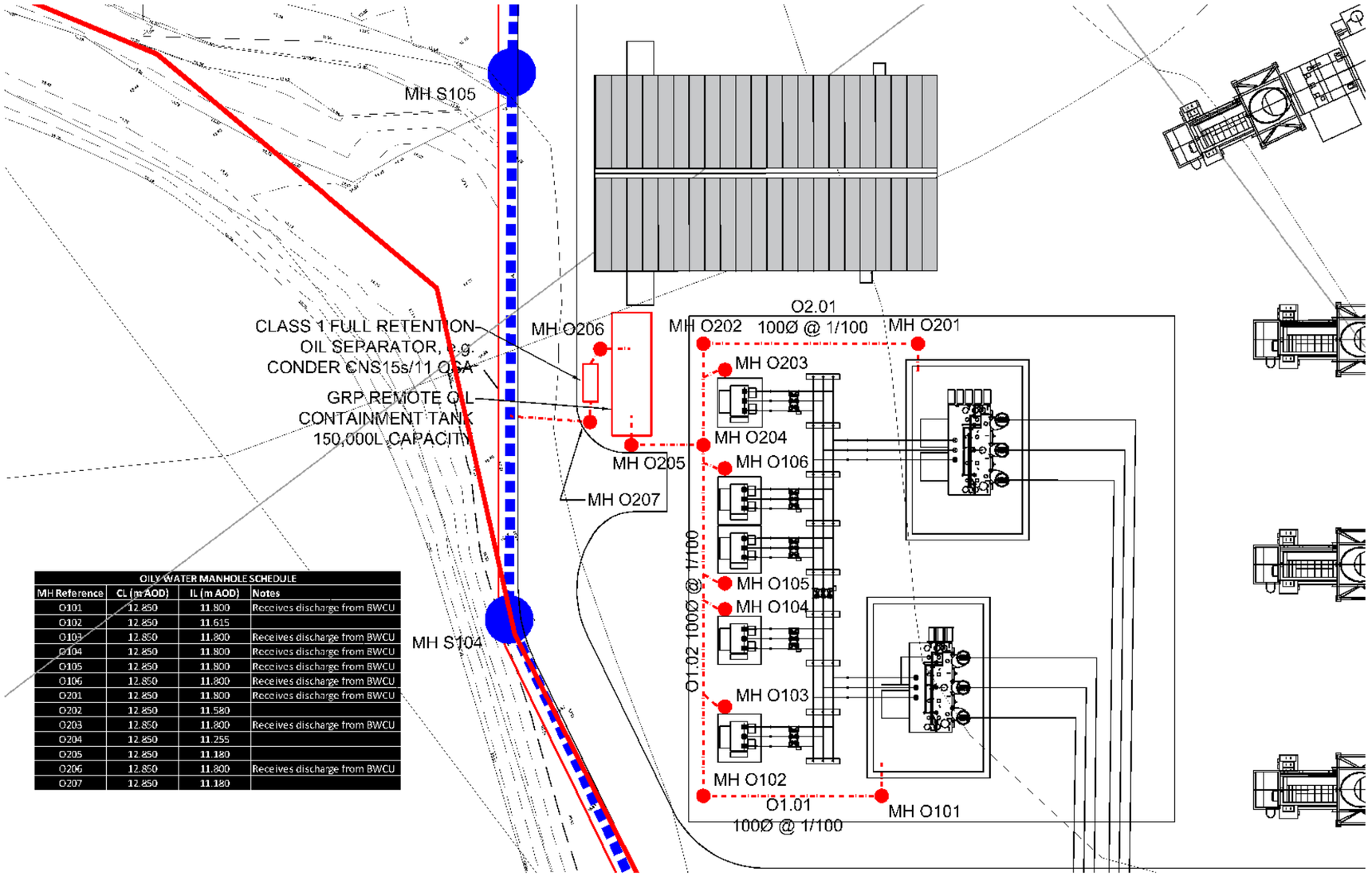
- Process Water
- Potable Water
- Chemicals
- Effluent
- Sewage
- Other Bulk liquids

demand special treatment





DIESEL DELIVERY AREA



OILY WATER MANHOLE SCHEDULE			
MH Reference	CL (m AOD)	IL (m AOD)	Notes
O101	12.850	11.800	Receives discharge from BWCU
O102	12.850	11.615	
O103	12.850	11.800	Receives discharge from BWCU
O104	12.850	11.800	Receives discharge from BWCU
O105	12.850	11.800	Receives discharge from BWCU
O106	12.850	11.800	Receives discharge from BWCU
O201	12.850	11.800	Receives discharge from BWCU
O202	12.850	11.580	
O203	12.850	11.800	Receives discharge from BWCU
O204	12.850	11.255	
O205	12.850	11.180	
O206	12.850	11.800	Receives discharge from BWCU
O207	12.850	11.180	

TRANSFORMER COMPOUND

DO NOT SCALE

KEY TO LINES & ABBREVIATIONS

	SURFACE WATER DRAIN
	OILY WATER DRAIN
MH	MANHOLE
CL	COVER LEVEL (m AOD)
IL	INVERT LEVEL (m AOD)
BWCU	BUND WATER CONTROL UNIT

REV	DATE	BY	DESCRIPTION	CHK	APP
P01	23/11/2017	CMM	FIRST ISSUE		

DRAWING STATUS:
S2 - FOR INFORMATION

wsp
Manchester Technology Centre, Oxford Road, Manchester, M1 7ED, UK
T+ 44 (0) 161 200 5000, F+ 44 (0) 161 200 5001
wsp.com

CLIENT:
EDF ENERGY (THERMAL GENERATION) LIMITED

ARCHITECT:

PROJECT:
WEST BURTON C

TITLE
OUTLINE OILY WATER DRAINAGE ARRANGEMENT

SCALE @ A3:	CHECKED:		APPROVED:
1:500	SM		RM
PROJECT No:	DESIGNED:	DRAWN:	DATE:
7026635	CMM	CMM	November 17

DRAWING No: 70026635-REP-0006-C
REV: P01

Surface Water Sewer Pipe Flow

Rainfall Intensity 44.3 mm/hr **(M100-60min)**

Gravitational Acceleration, g 9.81 m/s^2

Equivalent Internal Roughness, K_s 0.6 mm

Kinematic Viscosity of Water @ 10°C, v 1.31E-06 m^2/s

		Upstream Fitting				Downstream Fitting				Pipe Data										Flow Data								
	Drainage Run	Ref	CL (m AOD)	IL (m AOD)	Depth (m)	Ref	CL (m AOD)	IL (m AOD)	Depth (m)	Notes	Length (m)	Fall (m)	Gradient		Area Drained by Pipe (m^2)	% of Catchment Impermeable	Runoff Contribution (L/s)	Cumulative Additional Inflow (L/s)	Total Flow (L/s)	Required Dia (mm)	Full Flow Velocity (m/s)	Full Flow Capacity (L/s)	Proportion Full Flow Discharge	Proportional Depth	Proportion Full Flow Velocity	Actual Flow Velocity (m/s)	Time of Entry (mins)	Time of Flow (mins)	Time of Concentration (mins)
Southern WBC Platform Drainage	1.01	MH S101	12.850	11.455	1.395	MH S102	12.850	11.195	1.655	Solid wall	51.4	0.260	0.005	198	2661	85%	27.833	0.0	27.833	225	0.92	36.7	0.759	0.65	1.097	1.01	5.00	0.85	5.85
	1.02	MH S102	12.850	11.120	1.730	MH S103	12.850	10.840	2.010	Solid wall	55.7	0.280	0.005	199	2130	85%	22.279	27.8	50.113	300	1.11	78.3	0.640	0.58	1.058	1.17	5.85	0.79	6.64
	1.03	MH S103	12.850	10.840	2.010	MH S104	12.850	10.660	2.190	Solid wall	35.9	0.180	0.005	199	1086	85%	11.359	50.1	61.472	300	1.11	78.2	0.786	0.66	1.101	1.22	6.64	0.49	7.13
	1.04	MH S104	12.850	10.660	2.190	MH S105	12.850	10.260	2.590	Solid wall	55.9	0.400	0.007	140	2686	85%	28.095	61.5	89.567	400	1.59	199.9	0.448	0.46	0.964	1.53	7.13	0.61	7.74
	1.05	MH S105	12.850	10.260	2.590	MH S206	12.850	10.025	2.825	Solid wall	46.7	0.235	0.005	199	1319	85%	13.796	89.6	103.363	400	1.33	167.3	0.618	0.56	1.045	1.39	7.74	0.56	8.30
Northern WBC Platform Drainage	2.01	MH S201	12.850	11.385	1.465	MH S202	12.850	11.115	1.735	Solid wall	53.4	0.27	0.005	198	3848	85%	40.249	0.0	40.249	300	1.11	78.5	0.513	0.50	1.000	1.11	5.00	0.80	5.80
	2.02	MH S202	12.850	11.115	1.735	MH S203	12.850	11.025	1.825	Solid wall	17.4	0.09	0.005	193	544	85%	5.690	40.2	45.939	300	1.13	79.5	0.578	0.54	1.030	1.16	5.80	0.25	6.05
	2.03	MH S203	12.850	11.025	1.825	MH S204	12.850	10.805	2.045	Solid wall	43.8	0.22	0.005	199	1691	85%	17.687	45.9	63.626	300	1.11	78.2	0.813	0.68	1.109	1.23	6.05	0.60	6.65
	2.04	MH S204	12.850	10.805	2.045	MH S205	12.850	10.595	2.255	Solid wall	41.4	0.21	0.005	197	1288	85%	13.472	63.6	77.099	300	1.11	78.7	0.980	0.80	1.136	1.26	6.65	0.55	7.19
	2.05	MH S205	12.850	10.595	2.255	MH S206	12.850	10.125	2.725	Solid wall	51.7	0.47	0.009	110	1278	85%	13.368	77.1	90.466	300	1.50	105.7	0.856	0.71	1.120	1.67	7.19	0.51	7.71
	2.06	MH S206	12.850	9.975	2.875	MH S207	12.850	9.925	2.925	Solid wall	10.1	0.05	0.005	202	18531	85%	193.829	0.0	193.829	450	1.42	226.4	0.856	0.71	1.120	1.59	8.30	0.11	8.40
Vehicular Hardstanding Drainage	3.01	MH S301	10.620	9.420	1.200	MH S302	10.400	9.200	1.200	Solid wall	45.0	0.22	0.005	205	2684	85%	28.074	0.0	28.074	225	0.91	36.0	0.779	0.66	1.101	1.00	5.00	0.75	5.75
	3.02	MH S302	10.400	9.200	1.200	MH S207	10.150	8.975	1.175	Solid wall	45.0	0.225	0.005	200	0	85%	0.000	28.1	28.074	225	0.92	36.5	0.770	0.65	1.097	1.01	5.75	0.75	6.50
Pond outfall to existing Purge Line Pit 3	4.01	MH S401	8.800	7.110	1.690	MH S402	4.650	3.6	1.050	Solid wall	39.1	3.51	0.090	11	0	85%	0.000	5.0	5.000	150	3.03	53.6	0.093	0.20	0.618	1.87	10.00	0.35	10.35
	4.02	MH S402	4.650	3.600	1.050	MH S403	4.660	2.965	1.695	Solid wall	63.3	0.635	0.010	100	0	85%	0.000	5.0	5.000	150	1.00	17.7	0.282	0.36	0.858	0.86	10.35	1.23	11.57
	4.03	MH S403	4.660	2.965	1.695	EXTG PIT 3	5.800	1.660	4.140	Solid wall	34.8	1.305	0.038	27	0	0%	0.000	5.0	5.000	150	1.95	34.5	0.145	0.25	0.704	1.38	11.57	0.42	12.00

RIDGISTORMCheck Vortex Flow Control Chambers

Data Sheet

PRODUCT INFORMATION **P1** **ISSUE 1 - MAY 2016**

Where flows within a drainage system are required to be limited (i.e. prior to discharge from site), with improved hydraulic performance and reduced maintenance, we are able to offer our RIDGISTORMCheck Vortex Flow Control Chamber.

Pre-fabricated under factory controlled conditions, the RIDGISTORMCheck Chamber is available in a range of diameters from 1050-3000mm and incorporates a vortex flow control unit, fitted onto a preformed headwall. Each vortex flow control unit is manufactured to suit the unique hydraulic characteristics of the site's drainage system design. RIDGISTORMCheck Vortex Flow Control Chambers are typically supplied as a single unit, allowing simple installation and eliminating a number of construction risks associated with in-situ construction. When installed in conjunction with our range of pipe systems, they offer a fully integrated drainage system.

Applications

Site specific RIDGISTORMCheck Vortex Flow Control Chambers are engineered to suit a range of stormwater systems, providing a hydraulically efficient means of flow regulation that does not use moving parts or require power to operate.

Key Features and Benefits

- Self-activating vortex flow controller which controls forward flow of water
- No moving parts - virtually maintenance free
- Manufactured with an integral sump for silt catchment/removal
- Available as non-bypass or manual bypass with an optional built-in overflow
- Manufactured to adoptable standards
- Multiple inlet and outlet options, allowing quick and seamless connection to pipelines
- Depths can be tailored to suit project requirements
- Optional integral benching
- Optional step rungs to BS EN 13101 and ladders to BS EN 14396
- Optional riser section and riser location ring
- Integral lifting points available on request to improve Health and Safety during handling and installation
- Stub connections and rocker pipes are available
- Manufactured in a factory controlled environment for improved quality of finish
- Eliminates wastage associated with in-situ construction

Other fabrications in our RIDGISTORMCheck range:

- Orifice Plate Flow Control Chambers

Performance

RIDGISTORMCheck Vortex Flow Control Chambers are fabricated from Ridgistorm-XL pipework, which is manufactured to meet the material requirements of BS EN 13476:2007 (Part 1-3).

RIDGISTORMCHECK VORTEX FLOW CONTROL CHAMBER	
PHYSICAL PROPERTIES	
Diameter	1050-3000mm
Depth	To suit requirements
Material	HDPE
Colour	Black with Blue Interior
Flow control units	Grade 304 Stainless Steel
Chemical resistance	HDPE is naturally resistant to most chemicals associated with stormwater drainage systems
Inlets/outlets	100-3000mm
Hydraulic performance	Unit manufactured to suit site specific conditions

Our Ridgistorm-XL Fabrications range

All of our Ridgistorm-XL fabrications are tailor-made, fully-welded, watertight structured wall chambers to suit project-specific requirements. Health and Safety benefits become apparent during handling and installation, due to our fabrications' strong but light in weight nature. In addition, off-site construction ensures uncompromised, high quality products being delivered to site ready-to-install, reducing installation time and costs.

wrc approved PT/348/0614

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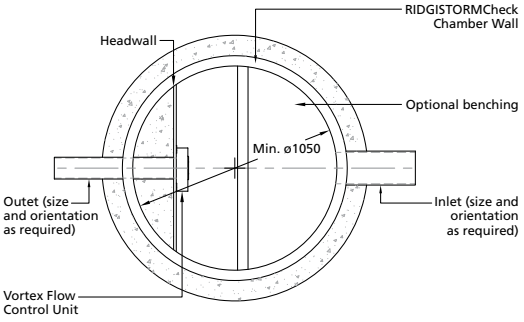
Polypipe

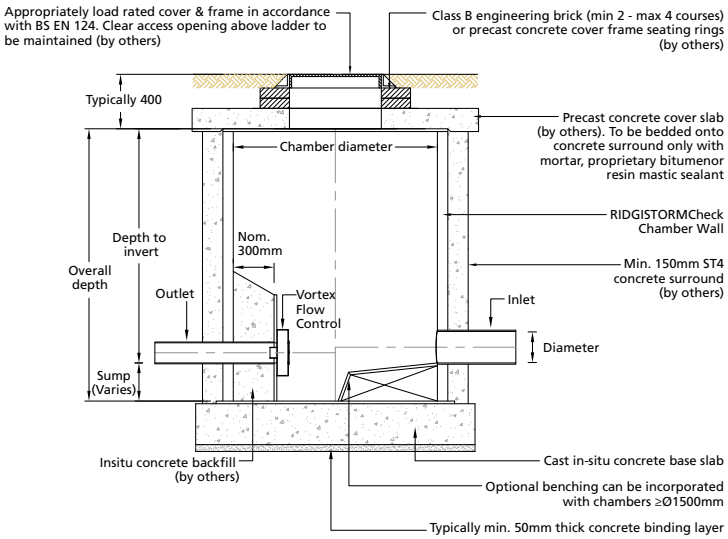
RIDGISTORMCheck Vortex Flow Control Chambers

Non-Bypass Chamber

For sites where discharge rates must be guaranteed to not exceed a prescribed limit(s).

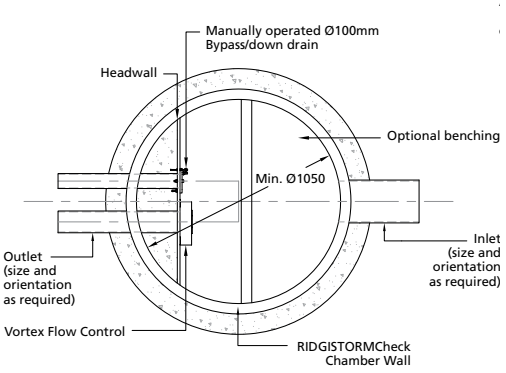


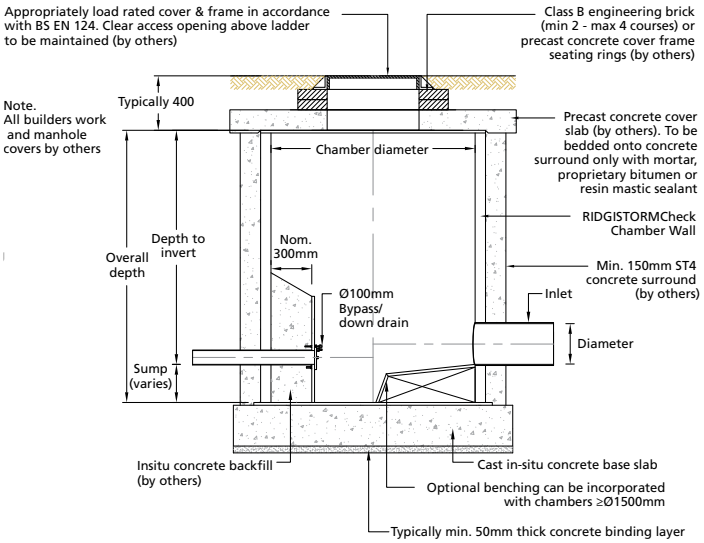
Note.
All builders work and manhole covers by others



Manual Bypass Design

The manual bypass design offers a bypass the ability to flow control device to facilitate maintenance. Manually operated from the surface, the activation of the bypass system opens a door in the head wall allowing water in the chamber to drain down via the bypass pipe.





For further information please contact our Technical Team on +44 (0) 1509 615100 or download our CAD Standard Details from our website www.polypipe.com/toolbox.

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Polypipe

Catchment Details

Site	WBC		
Hydrological Regio	5		
Soil Type	3		
SPR	0.37		
SOIL	0.40		
SAAR	600 mm		
M5-60	19 mm		
M5-60:M5-2day	0.40		
Cr	1.3	(ASSUMPTION)	
Cv	0.75	(ASSUMPTION)	
Catchment Area	20880 m2	*2.088 ha*	
PIMP	84.2 %	(ASSUMPTION)	
Effective Impermea	17578.7 m2	*1.75787 ha*	

Greenfield Runoff Rate (IH 124), EA Procedure

Area	50 ha	
QBAR,50	119.93 L/s	
QBAR	5.01 L/s	*2.40 L/s/ha*

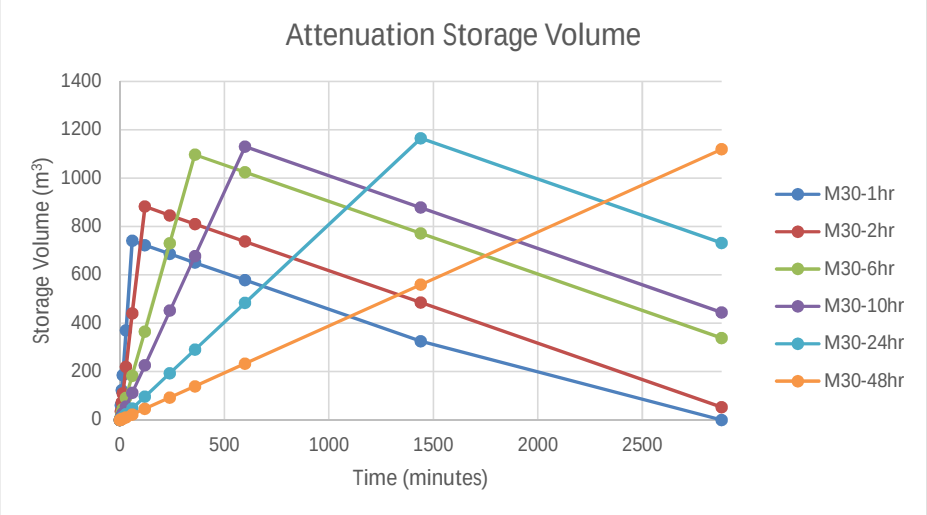
299MW Site Attenuation Storage Requirements

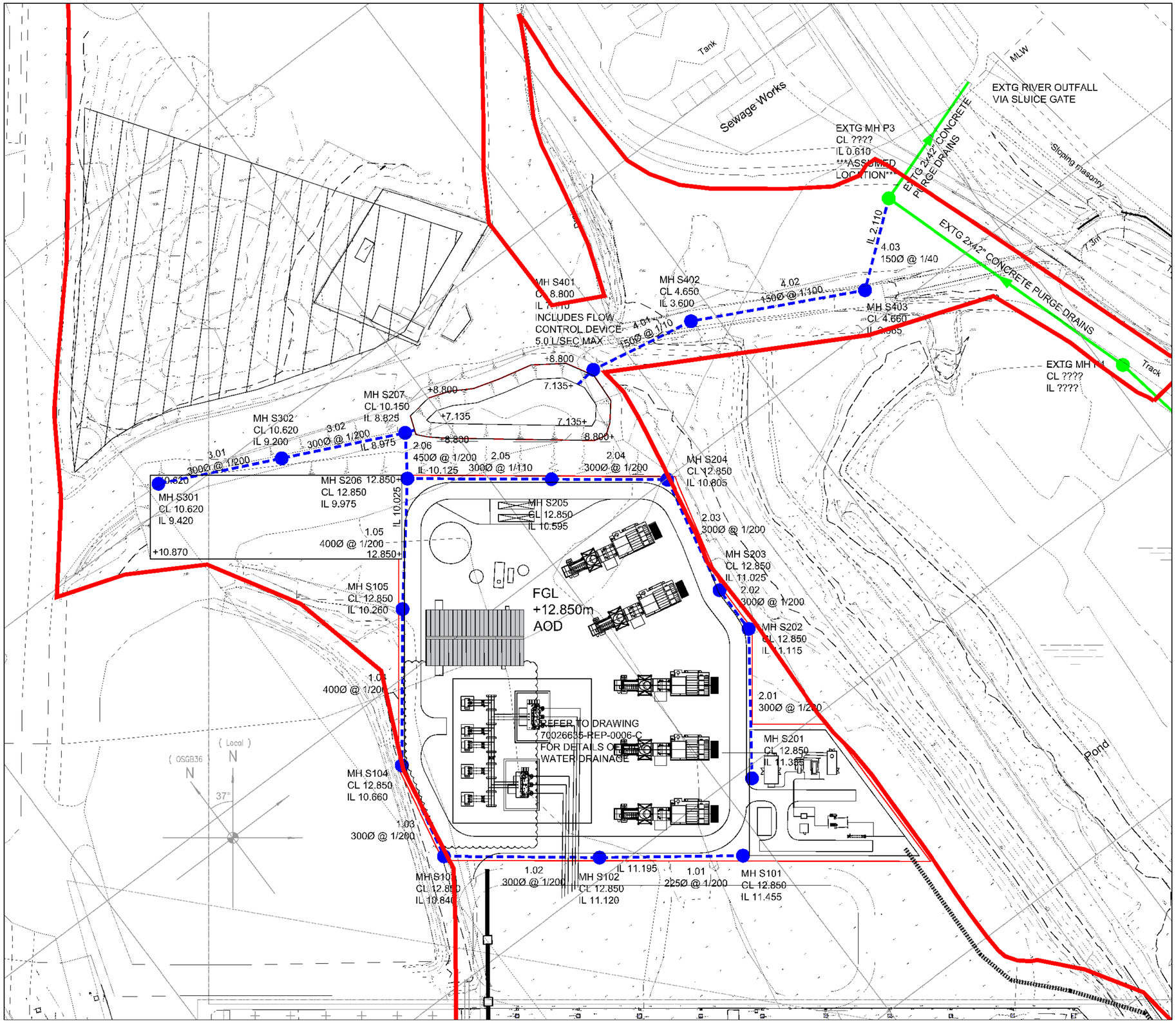
Time from Storm Commencement (mins)	Storm Event					
	M100-1 hour	M100-2 hour	M100-6 hour	M100-10 hour	M100-24 hour	M100-48 hour
0	0.0	0.0	0.0	0.0	0.0	0.0
5	61.8	36.8	15.2	9.4	4.0	1.9
10	123.5	73.6	30.5	18.8	8.1	3.9
15	185.3	110.3	45.7	28.3	12.1	5.8
30	370.6	220.7	91.4	56.5	24.3	11.7
60	741.2	441.3	182.8	113.1	48.5	23.3
120	723.2	882.6	365.6	226.2	97.1	46.6
240	687.1	846.5	731.1	452.3	194.1	93.3
360	651.1	810.5	1096.7	678.5	291.2	139.9
600	579.0	738.4	1024.6	1130.8	485.3	233.2
1440	326.5	485.9	772.2	878.4	1164.6	559.6
2880	0.0	53.2	339.4	445.7	731.9	1119.3
Maximum	741.2	882.6	1096.7	1130.8	1164.6	1119.3

Head-discharge allowance factor 1.25

Maximum Storage Requirement **1455.8 m^3**

Time to empty storage volume 4844.5 mins 80.74 hours





DO NOT SCALE

KEY TO LINES & ABBREVIATIONS

- SURFACE WATER DRAIN
- EXISTING WBA PURGE LINES
- WBC DEVELOPMENT BOUNDARY
- MH MANHOLE
- CL COVER LEVEL (m AOD)
- IL INVERT LEVEL (m AOD)

REV	DATE	BY	DESCRIPTION	CHK	APP
P01	23/11/2017	CMM	FIRST ISSUE	SM	RM

DRAWING STATUS: S2 - FOR INFORMATION

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CLIENT: EDF ENERGY (THERMAL GENERATION) LIMITED

ARCHITECT:

PROJECT: WEST BURTON C

TITLE: OUTLINE STORM WATER DRAINAGE ARRANGEMENT

SCALE @ A2:	CHECKED:		APPROVED:
1:1000	SM		RM
PROJECT No: 70026635	DESIGNED: CMM	DRAWN: CMM	DATE: November 17

DRAWING No: 70026635-REP-0006-D4 REV: P01

Rainfall Intensity 44.3 mm/hr **(M100-60min)**

Gravitational Acceleration, g 9.81 m/s^2

Equivalent Internal Roughness, K_s 0.6 mm

Kinematic Viscosity of Water @ 10°C, v 1.31E-06 m^2/s

		Upstream Fitting				Downstream Fitting				Pipe Data										Flow Data								
	Drainage Run	Ref	CL (m AOD)	IL (m AOD)	Depth (m)	Ref	CL (m AOD)	IL (m AOD)	Depth (m)	Notes	Length (m)	Fall (m)	Gradient		Area Drained by Pipe (m^2)	% of Catchment Impermeable	Runoff Contribution (L/s)	Cumulative Additional Inflow (L/s)	Total Flow (L/s)	Required Dia (mm)	Full Flow Velocity (m/s)	Full Flow Capacity (L/s)	Proportion Full Flow Discharge	Proportional Depth	Proportion Full Flow Velocity	Actual Flow Velocity (m/s)	Time of Entry (mins)	Time of Flow (mins)	Time of Concentration (mins)
Eastern WBC Platform Drainage	1.01	MH S101	12.850	11.525	1.325	MH S102	12.850	11.265	1.585	Solid wall	51.9	0.260	0.005	200	2007	85%	20.993	0.0	20.993	225	0.92	36.5	0.575	0.54	1.030	0.95	5.00	0.92	5.92
	1.02	MH S102	12.850	11.190	1.660	MH S103	12.850	10.950	1.900	Solid wall	47.8	0.240	0.005	199	4336	85%	45.353	21.0	66.346	300	1.11	78.3	0.848	0.70	1.117	1.24	5.92	0.64	6.56
	1.03	MH S103	12.850	10.850	2.000	MH S104	12.850	10.575	2.275	Solid wall	54.3	0.275	0.005	197	3661	85%	38.293	66.3	104.639	400	1.34	167.9	0.623	0.57	1.051	1.40	6.56	0.64	7.20
	1.04	MH S104	12.850	10.575	2.275	MH S105	12.850	10.390	2.460	Solid wall	36.5	0.185	0.005	197	892	85%	9.330	104.6	113.969	400	1.34	168.0	0.678	0.60	1.071	1.43	7.20	0.42	7.63
	1.05	MH S105	12.850	10.390	2.460	MH S301	12.850	10.225	2.625	Solid wall	27.5	0.165	0.006	167	466	85%	4.874	114.0	118.843	400	1.46	182.8	0.650	0.58	1.058	1.54	7.63	0.30	7.93
Western WBC Platform Drainage	2.01	MH S201	12.850	11.525	1.325	MH S202	12.850	11.305	1.545	Solid wall	43.8	0.22	0.005	199	1633	85%	17.081	0.0	17.081	225	0.92	36.5	0.467	0.48	0.982	0.90	5.00	0.81	5.81
	2.02	MH S202	12.850	11.305	1.545	MH S203	12.850	11.215	1.635	Solid wall	17.7	0.09	0.005	196	392	85%	4.100	17.1	21.181	225	0.93	36.8	0.575	0.54	1.030	0.95	5.81	0.31	6.12
	2.03	MH S203	12.850	11.140	1.710	MH S204	12.850	10.935	1.915	Solid wall	40.3	0.205	0.005	197	1746	85%	18.263	21.2	39.444	300	1.11	78.8	0.501	0.50	1.000	1.11	6.12	0.60	6.72
	2.04	MH S204	12.850	10.935	1.915	MH S205	12.850	10.740	2.110	Solid wall	39.0	0.195	0.005	200	2795	85%	29.235	39.4	68.679	300	1.10	78.1	0.879	0.72	1.122	1.24	6.72	0.52	7.24
	2.05	MH S205	12.850	10.640	2.210	MH S206	12.850	10.440	2.410	Solid wall	39.5	0.2	0.005	198	1408	85%	14.727	68.7	83.406	400	1.34	167.8	0.497	0.49	0.991	1.32	7.24	0.50	7.74
	2.06	MH S206	12.850	10.440	2.410	MH S301	12.850	10.225	2.625	Solid wall	42.8	0.215	0.005	199	1814	85%	18.974	83.4	102.380	400	1.33	167.2	0.612	0.56	1.045	1.39	7.74	0.51	8.25
Outfall to Attenuation Tank	3.01	MH S301	12.850	10.175	2.675	ATTENUATION TANK	12.850	10.130	2.720	Solid wall	8.6	0.045	0.005	191	0	85%	0.000	221.2	221.223	450	1.46	232.7	0.951	0.78	1.134	1.66	8.25	0.09	8.34

DO NOT SCALE

KEY TO LINES & ABBREVIATIONS

- SURFACE WATER DRAIN
- EXISTING WBA PURGE LINES
- WBC DEVELOPMENT BCUNDARY
- MH MANHOLE
- CL COVER LEVEL (m AOD)
- IL INVERT LEVEL (m AOD)

MH S101
CL 12.850
IL 11.525

1.01
225Ø @ 1/200

IL 11.265

MH S102
CL 12.850
IL 11.190

1.02
300Ø @ 1/200

MH S103
CL 12.850
IL 10.850

IL 10.950

FGL
+12.850m
AOD

MH S201
CL 12.850
IL 11.525

2.01
225Ø @ 1/200

MH S202
CL 12.850
IL 11.305

2.02
300Ø @ 1/200

IL 11.215

MH S203
CL 12.850
IL 11.140

2.03
300Ø @ 1/200

MH S204
CL 12.850
IL 10.955

2.04
300Ø @ 1/200

1.03
400Ø @ 1/200

MH S104
CL 12.850
IL 10.575

1.04
400Ø @ 1/200

MH S301
CL 12.850
IL 10.175

1.05
400Ø @ 1/167

2.06
400Ø @ 1/200

2.05
400Ø @ 1/200

IL 10.470

IL 10.225

IL 10.225

MH S105
CL 12.850
IL 10.390

MH S206
CL 12.850
IL 10.440

MH S205
CL 12.850
IL 10.640

TANK INLET
IL 10.130

ATTENUATION TANK
(1550m³ APPROX)
INTERNAL BASE
IL 8.230m AOD

MH S302
PUMP CHAMBER
CL 10.150
IL 8.080

100Ø RISING MAIN

EXTG MH GU36
CL 12.190
IL 10.590

Track

Pond

Tanks

Silos

REV	DATE	BY	DESCRIPTION	CHK	APP
P01	03/04/2018	CMM	FIRST ISSUE	SM	RM

DRAWING STATUS:
S2 - FOR INFORMATION

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wsp.com

CLIENT:
EDF ENERGY

ARCHITECT:

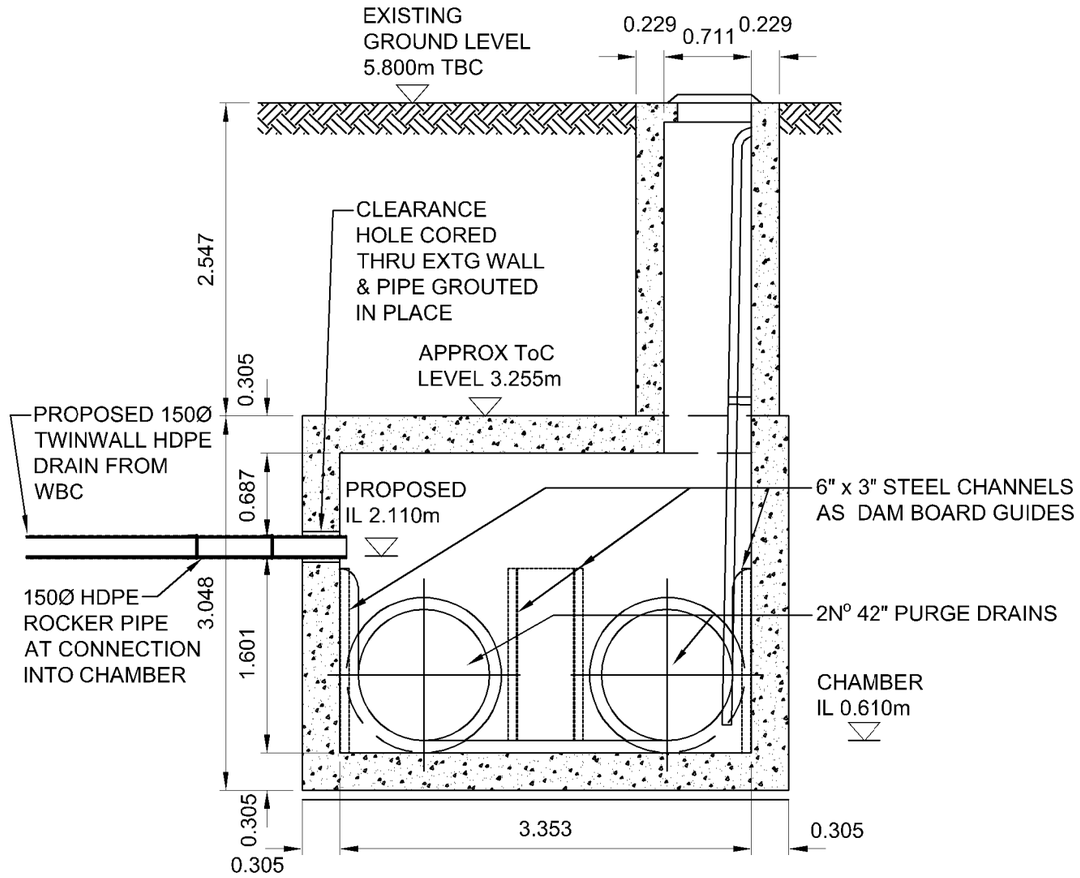
PROJECT:
WEST BURTON C

TITLE:
OUTLINE STORM WATER DRAINAGE ARRANGEMENT
OPTION 'C' - CONNECTION TO EXISTING WBB DRAINS

SCALE @ A2:	CHECKED:		APPROVED:
1:1000	SM		RM
PROJECT No:	DESIGNED:	DRAWN:	DATE:
70026635	CMM	CMM	March 18

DRAWING No: 70026635-REP-0006-D6 REV: P01

File name C:\USERS\CHRISTOPHER.MOORE\DOCUMENTS\WSP-PB\WEST BURTON 'C' DRAINAGE STUDY\70026635-SK-02 V10 WBB OPTION.DWG, printed on 03 April 2018 10:29:06, by Moore, Chris



TYPICAL SECTION

DO NOT SCALE

NOTES

1. THIS DRAWING IS BASED ON TYPICAL WBA PURGE LINE CHAMBER DRAWING 22.42/292.16 PROVIDED BY EDF ENERGY 17/10/2017. ACTUAL DIMENSIONS / LEVELS / ARRANGEMENT OF EXISTING CHAMBER P3 TBC.
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ASSOCIATED METHOD STATEMENT 70026635-REP-0006-E2.
3. REFER TO RISK ASSESSMENT 70026635-REP-0006-F FOR APPRAISAL AND MITIGATION OF HAZARDS ASSOCIATED WITH WORKING IN AND AROUND EXTG CHAMBER P3.
4. ALL DIMENSIONS STATED IN METRES U.N.O.
5. ALL LEVELS STATED IN METRES ABOVE ORDNANCE DATUM U.N.O.

REV	DATE	BY	DESCRIPTION	CHK	APP
P01	23/11/2017	CMM	FIRST ISSUE		

DRAWING STATUS: S2 - FOR INFORMATION

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CLIENT: EDF ENERGY (THERMAL GENERATION) LIMITED

ARCHITECT:

PROJECT: WEST BURTON C

TITLE: PROPOSED CONNECTION OF WBC DRAINAGE TO EXISTING WBA PURGE LINE CHAMBER P3

SCALE @ A3:	CHECKED:		APPROVED:
1:50	SM		RM
PROJECT No:	DESIGNED:	DRAWN:	DATE:
7026635	CMM	CMM	November 17

DRAWING No: 70026635-REP-0006-E1 REV: P01

Outline Method Statement

PROJECT NUMBER	70026635	**DATE**	20 November 2017
PROJECT NAME	West Burton 'C'	**PRODUCED**	C. Moore
CLIENT	EDF Energy (Thermal Generation) Limited	**CHECKED**	S. MacKillop
SUBJECT	Connection of WBC drainage to existing WBA Purge Line Chamber P3		

NOTE: The following outline methodology is provided to assist in the understanding of likely procedure for connection of WBC drainage to existing WBA drainage. The Contractor shall produce his own method statement for approval prior to commencement of the works, based on the detailed drainage design and proposed method of construction.

1. Undertake full dimensional survey of interior of chamber P3, plus accurately determine location and levels, in order to confirm outline design proposals. [HOLD POINT] NOTE – Chamber P3 is likely to be a CONFINED SPACE and suitable working methods should be adopted if man access cannot be avoided.
2. Remove vegetation along line of proposed drain from MH S403 to P3, plus sufficient working and laydown room.
3. Form temporary (permanent?) access road and hardstanding as necessary for duration of works (and future O&M?)
4. Excavate down to connection point invert on outer wall of chamber P3, plus additional depth locally for man / plant access for coring through existing chamber wall. Shoring / appropriate battering to excavation perimeter, plus dewatering as necessary, to prevent instability of excavation and for ease of access / working.
5. Remove access cover to chamber P3 in order to check internal water level is sufficiently low to prevent outflow once chamber wall is breached by core drill.
6. Coring works at connection point in accordance with appropriate risk assessment & method statement.
7. Insert pipe stub through new entry hole to chamber P3 and support as necessary.
8. Grout annulus between perimeter of pipe and wall of new entry hole using non-shrink cementitious grout* and allow to cure in accordance with manufacturer's instructions (note outer end of pipe stub should be capped if left exposed for any extended period of time)
9. Excavate, prepare and lay drain from pipe stub back towards new manhole S403 before backfilling full run up to chamber P3.

Note * - may necessitate man entry to chamber to complete works, in which case suitable working methodology required to mitigate confined space hazards.

Note – dewatering of chamber may be necessary prior to man access, if required by proposed working methodology. This could be achieved temporarily by insertion of dam boards at purge line entrance and exit from the chamber and removal of chamber water by pump to suitable tank or agreed location above ground

Project Number	70026635	Project Name/Location Address	West Burton 'C' - Below Ground Drainage
Risk Assessment Ref	70026635-REP-0006-F	Assessment Completed By	Chris Moore
Risk Assessment Date	16/01/2018	Assessment Checked By	Sunita MacKillop

Key to Risk Category Determination

		Consequence				
		Trivial	Minor Injury/ Disease	Serious Injury/ Disease	Major injury/ Disease	Fatal Injury/ Disease
Likelihood / Severity		1	2	3	4	5
Seldom	1	1	2	3	4	5
Unlikely	2	2	4	6	8	10
Often	3	3	6	9	12	15
Frequent	4	4	8	12	16	20
Certain	5	5	10	15	20	25

Risk Category	Risk Rating
Low Risk	1 to 3
Moderate Risk	4 to 7
High Risk	8 to 14
Extreme Risk	> 14

Design Risk Assessment

Significant Hazards Identified	Risk *(who might be harmed and how)*	Current Control Measures	Risk Rating See Matrix	Risk Grading *(automated)*	Additional Control Measures	Risk Rating See Matrix	Final Risk Rating *(automated)*
Risks Associated with general WBC Site Drainage							
Unstable / soft ground due to presence of river deposits and/or action of water on exposed PFA.	Risk of excavation collapse and asphixiation / crush injuries to construction workers.	None.	3 5	Extreme Risk	Contractor to use experience to identify appropriate shuttering / propping systems. Soil testing to ascertain potential issues with flow of saturated ash.	1 5	Moderate Risk

Significant Hazards Identified	Risk *(who might be harmed and how)*	Current Control Measures	Risk Rating See Matrix	Risk Grading *(automated)*	Additional Control Measures	Risk Rating See Matrix	Final Risk Rating *(automated)*
Unidentified existing site services / ground obstructions / archaeology etc.	Construction workers at potential risk of electrocution / high pressure release and potential disruption to existing power plant operations.	None.	3 4	High Risk	Land use desk study including review of EDF record data to indicate potential for unidentified buried services and any resulting need for site investigations / scans.	1 4	Moderate Risk
Existing heavy site traffic moving adjacent to excavations for drainage.	Construction workers at risk of crush injuries due to surcharge of excavation and associated collapse. Risk of vehicle entry to excavation and associated injury to both power plant machine operators and nearby construction workers.	None.	3 5	Extreme Risk	Contractor to ensure adequate traffic management to prevent unsafe situations.	1 5	Moderate Risk
Proposed GRP oil containment tank is large / bulky (4m diameter x 12.5m long).	Delivery to site: road/rail users & infrastructure. Installation: lifting issues with potential for dropped load and resulting crush injuries to construction workers.	None.	3 5	Extreme Risk	Alternative tank arrangements to be considered during detailed design phase to mitigate potential transportation issues. Feasibility of delivery to site to be assessed by desk study considering features of existing road and rail links. Lifting plan to be implemented during installation. ALTERNATIVELY oil containment tank to be formed in-situ to obviate requirement for site delivery.	1 5	Moderate Risk

Significant Hazards Identified	Risk *(who might be harmed and how)*	Current Control Measures	Risk Rating See Matrix	Risk Grading *(automated)*	Additional Control Measures	Risk Rating See Matrix	Final Risk Rating *(automated)*
Deep excavation (>5m) required for GRP oil containment tank.	Risk of excavation collapse and associated asphixiation / crush injuries to construction workers.	None.	3 5	Extreme Risk	Contractor to use experience to identify appropriate shuttering / propping systems. Soil testing to ascertain potential issues with flow of saturated ash. Minimise requirement for man entry to excavation.	1 5	Moderate Risk
Potential deep water and sudden inflow to attenuation pond.	Risk of drowning to site operatives.	None.	2 5	High Risk	Signage and training for site workers; possible provision of emergency alarm, lifebuoys etc. if considered necessary by EDF.	1 5	Moderate Risk
Attenuation pond operation and maintenance requirements and associated machine instability on steep slopes.	Overturning of machinery on steep slopes and associated injury to site operatives.	Slopes set to maximum gradient of 1:3 vertical:horizontal.	3 3	High Risk	Maintenance method statement required to be produced and implemented.	2 3	Moderate Risk
Depth and arrangement of proposed manhole chambers, sudden changes in drainage flow and/or possible ground gas may result in formation of 'confined spaces'.	Potential for asphixiation / drowning of site operatives entering chambers for inspection & maintenance purposes.	None.	2 5	High Risk	Confined spaces appraisal required and any resulting hazard mitigation to be implemented during manhole chamber inspection and maintenance.	1 5	Moderate Risk

Significant Hazards Identified	Risk *(who might be harmed and how)*	Current Control Measures	Risk Rating See Matrix	Risk Grading *(automated)*	Additional Control Measures	Risk Rating See Matrix	Final Risk Rating *(automated)*
Discharge of contaminated drainage to controlled waters via outfall.	Aquatic organisms / habitats in River Trent and associated tributaries damaged / destroyed by chemical discharge and associated reputational and economic damage to EDF.	Chemical, fire and oily water containment systems to be installed to limit potential for discharge.	2 4	High Risk	EDF to follow manufacturer's operational and maintenance requirements on handover in addition to ongoing plant maintenance and COSHH handling practices.	1 4	Moderate Risk
Wash-out of buried PFA deposits via new drainage.	Local settlement of ground causing potential damage to power plant structures / infrastructure and disruption to site operations. Additional costs associated with remedial works.	None.	3 2	High Risk	Any local soft spots to be removed and replaced with competent fill. Drain bedding, jointing and backfilling to be in accordance with design specification and industry best practice.	2 2	Moderate Risk
Possible exposure of construction workers to potential range of contaminants, including asbestos and heavy metals, during excavation of contaminated soil deposited as waste from previous power plant activities.	Risk of construction workers inhalation / ingestion / dermal contact with toxic / harmful substances.	None.	2 4	High Risk	Contaminated land study prior to commencement of works to identify any specific concerns. Construction workers to immediately report any suspect materials excavated during works and wait for all-clear before continuing.	1 4	Moderate Risk
Aggressive ground conditions.	Possible high sulfate conditions due to coal ash deposits leading to associated degradation of buried concrete.	None.	2 3	Moderate Risk	Ground aggressivity study recommended. Sulphate resistant concrete to be specified as necessary.	1 3	Low Risk

Significant Hazards Identified	Risk *(who might be harmed and how)*	Current Control Measures	Risk Rating See Matrix	Risk Grading *(automated)*	Additional Control Measures	Risk Rating See Matrix	Final Risk Rating *(automated)*
Specific Risks Associated With Outfall Connection to Purge Line Chamber P3							
Poor access from existing site roads to P3 due to steep embankment and heavy undergrowth.	Construction workers at risk due to instability of mechanical plant (plus exacerbated slips, trips, falls and lacerations from thorns, etc)	None.	3 4	High Risk	Local removal of undergrowth and installation of dedicated construction access.	1 4	Moderate Risk
Potential for unidentified existing buried services (especially site foul drain line) within locality of P3.	Possible injury to construction workers and disruption to existing power plant operations following damage to live services.	None.	2 4	High Risk	Land use desk study including review of EDF record data to indicate potential for unidentified buried services and any resulting need for site investigations / scans.	1 4	Moderate Risk
Wet / soft ground conditions in vicinity of P3.	Risk of excavation collapse and asphixiation / crush injuries to construction workers.	None.	3 5	Extreme Risk	Contractor to use experience to identify appropriate shuttering / propping systems. Soil testing to ascertain potential issues with flow of saturated ash.	1 5	Moderate Risk
Deep excavation (up to 4m approx.) for connection to P3.	Risk of excavation collapse and asphixiation / crush injuries to construction workers.	None.	3 5	Extreme Risk	Contractor to use experience to identify appropriate shuttering / propping systems. Soil testing to ascertain potential issues with flow of saturated ash. Minimise requirement for man entry to excavation.	1 5	Moderate Risk

Significant Hazards Identified	Risk *(who might be harmed and how)*	Current Control Measures	Risk Rating See Matrix	Risk Grading *(automated)*	Additional Control Measures	Risk Rating See Matrix	Final Risk Rating *(automated)*
Chamber P3 likely to be classified as 'confined space' for man entry purposes due to access limitations and potential hazards present within.	Risk of asphixiation / drowning of construction workers during connection of proposed WBC drainage and/or site staff during maintenance / inspection due to possible anoxic conditions or significant (possibly unexpected) drainage flows plus large diameter, unprotected outlet pipes.	None.	3 5	Extreme Risk	Man entry to chamber P3 to be minimised SFAIRP. Any entry shall be in accordance with approved permit to work system including all necessary PPE and equipment specified in the rescue plan. NOTE: P3 record drawings indicate facility for installation of dam boards to temporarily prevent inflow to manhole.	1 5	Moderate Risk
Hazards associated with coring of existing RC chamber wall.	Construction workers at risk of abrasions / lacerations / vibration / noise associated with use of power tools during WBC outfall connection works.	None.	2 3	Moderate Risk	All necessary PPE and precautions as specified in the Contractor's method statement.	1 3	Low Risk
Unconfirmed location / levels / arrangement of chamber P3	Additional design costs and construction programme overrun if existing construction details differ from current record drawings and assumptions (in lieu of complete info).	None.	4 2	High Risk	Full dimensional and levels survey to be carried out within chamber P3 prior to finalisation of design. NOTE potential confined spaces hazard identified above.	1 2	Low Risk

Significant Hazards Identified	Risk *(who might be harmed and how)*	Current Control Measures	Risk Rating See Matrix	Risk Grading *(automated)*	Additional Control Measures	Risk Rating See Matrix	Final Risk Rating *(automated)*
Root ingress to new drainage during design life.	Additional cost and disruption to site activities due to lack of performance of WBC drainage.	None.	3	Moderate Risk	Clearance and maintenance of vegetation along proposed line of drain between P3 and adjacent new WBC manhole.	1	Low Risk
			2			2	
High water level of River Trent and associated surcharge within chamber P3 prevents discharge of storm water from new drain.	Pressure build-up and associated flooding upstream of chamber P3 causing disruption of access along northern ash access road. Possible localised washout of supporting ground.	None.	1	Low Risk	If necessary, pressure relief fittings and controlled spillage to appropriate nearby site area could be considered.	1	Low Risk
			3			2	
Differential settlement of new drainage relative to chamber P3.	Additional cost and disruption to site activities due to lack of performance of WBC drainage.	None.	2	Moderate Risk	Insertion of flexible rocker pipe connection at entry to chamber P3.	1	Low Risk
			2			2	