ATTACHMENT-7-6-3-EMISSIONS TO GROUND CONTROLS

HYDRO ENVIRONMENTAL SERVICES

22 Lower Main St
Dungarvan
Co.Waterford
Ireland

tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

MIDLETON QUARRY, CO. CORK

Hydrogeological Assessment Report for the Proposed Discharge of Stormwater Runoff to Ground

FINAL REPORT

Prepared for:

ROADSTONE LTD

Prepared by:
HYDRO-ENVIRONMENTAL SERVICES

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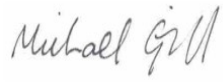
AUTHORS:	**DAVID BRODERICK** **MICHAEL GILL**
SIGNED:	 **MICHAEL GILL B.A., B.A.I., M.SC. DIP. GEOL, MIEI, MCIWEM** **MANAGING DIRECTOR – HYDRO-ENVIRONMENTAL SERVICES**

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1. INTRODUCTION

1.1 OVERVIEW

Hydro-Environmental Services (HES) were commissioned by Roadstone Ltd to prepare a hydrogeological assessment for the purpose of an EPA waste licence application for a proposed facility located at Midleton Quarry, Castleredmond, Carrigshane and Coppingerstown townlands, Midleton Co. Cork.

This hydrogeological assessment relates to the proposed indirect discharge of treated stormwater runoff to ground via a full retention oil interceptor.

1.2 PROJECT BACKGROUND

The development, which is already permitted (local authority planning reference No. 19/04719), will consist of a waste soils recovery facility for the importation of approximately 1.4Mm^3 of inert soil and stones material to fill quarry voids; final restoration and landscaping to revert the site to agricultural use; provision of internal access track linking Midleton Quarry with adjacent permitted Coppingerstown Quarry; ancillary services such as installation of a weighbridge, weighbridge office incorporating welfare facilities, wheelwash, inspection shed/quarantine area with skips; associated site development works; access to site via existing vehicular access points; all on a site of approximately 15.7ha.

A new car parking area (70m^2) and a dedicated machinery refuelling area (124m^2) which will also serve as an overnight plant parking area/equipment storage area, will drain to a full retention oil interceptor prior to discharge to ground via a soakaway. The soakaway will also receive direct (untreated) runoff from the proposed new site roads. The oil interceptor prior discharge will be installed to satisfy the Cork County Council Planning Conditions (see below).

The development will be subject to the requirements of an EPA waste licence. The proposed site layout is shown as **Figure 1** attached at the end of this report.

In order to comply with the discharge to ground requirements, a Tier 2 risk assessment as per EPA *Guidance on the Authorisation of Discharges to Groundwater* (2011) has been prepared as outlined in this report.

1.3 PLANNING CONDITIONS

Cork County Council Planning Conditions with respect hydrocarbons in stormwater runoff include the following:

Condition 13(a):

> *"Measures to be put in place for the management of Surface water runoff from machinery & equipment areas, hydrocarbons storage areas and diesel filling areas will not result in environmental risks".*

Condition 21:

> *"The operator of the site shall ensure that all site surface water draining from car parking/offloading areas or any site surface water contaminated with hydrocarbons shall discharge via a grit trap and appropriate interceptor".*

1.4 LEGISLATION & IMPACT ASSESSMENT CRITERIA

The control of discharges to waters (aquifer in this case) is governed by S.I. No. 42 of 1999: Local Government (Water Pollution) (Amendment) Regulations, 1999.

Article 40 (2) of S.I. 42 of 1999 details the requirements of the required Hydrogeological Assessment as follows:

40 (2) The prior investigation referred to in sub-article (1) shall include —

(a) an assessment of the environmental impact of alternative methods of disposal of the harmful substance, and

(b) an examination of the aquifer to which the licence application relates in respect of the following—

(i) the extent and estimated volume of water therein,
(ii) the quality of water therein,
(iii) the estimated rate of recharge,
(iv) the identification of any existing or proposed uses of the water therein,
(v) the hydrogeological conditions of the area in which the aquifer is located,
(vi) the nature and depth of overlying soil and subsoil and its effectiveness in preventing or reducing the entry of the harmful substance to water in the aquifer,
(vii) the risk of deterioration in the quality of the water therein due to the entry of the harmful substance,
(viii) the risk of the water therein being affected by the harmful substance so as to endanger human health or water supplies, harm living resources and the aquatic ecosystem or interfere with the use of the water for agricultural, commercial, domestic, fisheries, industrial or recreational purposes, and
(ix) such other matters as the local authority may reasonably require for the purpose of establishing whether the discharge of the harmful substance to the aquifer is a satisfactory method of disposal having regard to its environmental impact and the results of the assessment referred to in paragraph (a).

A "harmful substance" means substances and groups of substances specified in the First Schedule or in the Second Schedule, except where otherwise provided (S.I. No. 271/1992: Local Government (Water Pollution) Regulations, 1992). It is noted that some of the constituents (i.e. hydrocarbons) of the treated stormwater proposed for discharge at Midleton Quarry to groundwater may constitute definition as potential "harmful substances" under the schedules of the Local Government (Water Pollution) Regulations (1992). Therefore, this report details the alternative strategies considered and the results of the 'examination of the aquifer'.

The discharge must also be considered in the context of the Groundwater Regulations (2010), which do not specify groundwater limit concentrations but rather require no upward (improving) trend in groundwater concentrations.

EPA Guidance on the Authorisation of Discharges to Groundwater (December 2011)[1] requires that the proposed discharge is assessed according to the risk posed, which is assigned according to the magnitude of hydraulic loading proposed and the nature of the receiving

[1] *Environmental Protection Agency (EPA) Guidance on the Authorisation of Discharges to Groundwater (2011);*

environment. The chemical/hydraulic loading and impact assessment is presented in **Section 5** of this report.

1.5 REPORT STRUCTURE

In summary, the technical assessment is aimed at examining the following:

- Demonstrating that a site has sufficient infiltration capacity to physically —accept the effluent (i.e. treated stormwater runoff), thereby avoiding surface ponding and effluent runoff;
- Demonstrating that a site has adequate attenuation potential to limit the loading of substances to groundwater;
- In certain cases, predicting an impact on groundwater quality; and,
- Where necessary, verifying predicted impacts by checking compliance with relevant groundwater quality objectives and standards.

More specifically, a Tier 2 – Environmental Risk Assessment includes the following requirements:

- Desk study/environmental setting;
- Walkover survey;
- Infiltration capacity assessment;
- Assessment of chemical composition of input;
- Calculation of minimum separation distances;
- Groundwater flow direction inferred from site specific measurement and monitoring;
- Assessment of subsoil type, texture thickness and permeability;
- Assessment of aquifer type and hydraulic properties;
- Assessment of background groundwater quality;
- Identification of relevant receptors and associated water quality standards;
- ZOCs of downgradient abstraction points/schemes where these have not yet been delineated;
- Quantification of interaction between groundwater and surface water or GWDTE where appropriate and relevant;
- Conceptual model, backed up where necessary using using basic calculation procedures; and,
- Conclusions and recommendations.

2. DESK DTUDY - ENVIRONMENTAL SETTING

2.1 SITE DESCRIPTION & PROPOSED DEVELOPMENT

The Midleton limestone quarry, situated approximately 2.1km southeast of Midleton town centre, has an area of 15.51Ha (11.39ha of extraction area that will be backfilled) within a total landholding area of 46.6Ha in the ownership of the applicant.

The quarry has been worked extensively in the past, and the site includes large excavated areas (to ~8 - 9mOD), an open first bench which is currently being quarried (top level at ~21mOD), quarry workings are predominately in the centre and northeast of the site. The site also contains undeveloped sections which remain densely vegetated in the far north and north-western corner of the site.

The floor levels of all the extraction areas within the site and overall landholding of the applicant are above the local groundwater table. There are no discharges from the site or overall landholding.

Landuse in the surrounding area is largely agricultural with scattered rural pattern of residential dwellings along the N22 which runs immediately to the north of the site and along other local roads to the south and east of the site.

The location of the proposed oil interceptor and soakaway is shown in **Figure 1** attached at the end of this report. The oil interceptor will treat runoff just from the car park/refuelling area. However, the soakaway will be designed/sized to receive runoff from the proposed new roads also. A site location map is shown as Figure A.

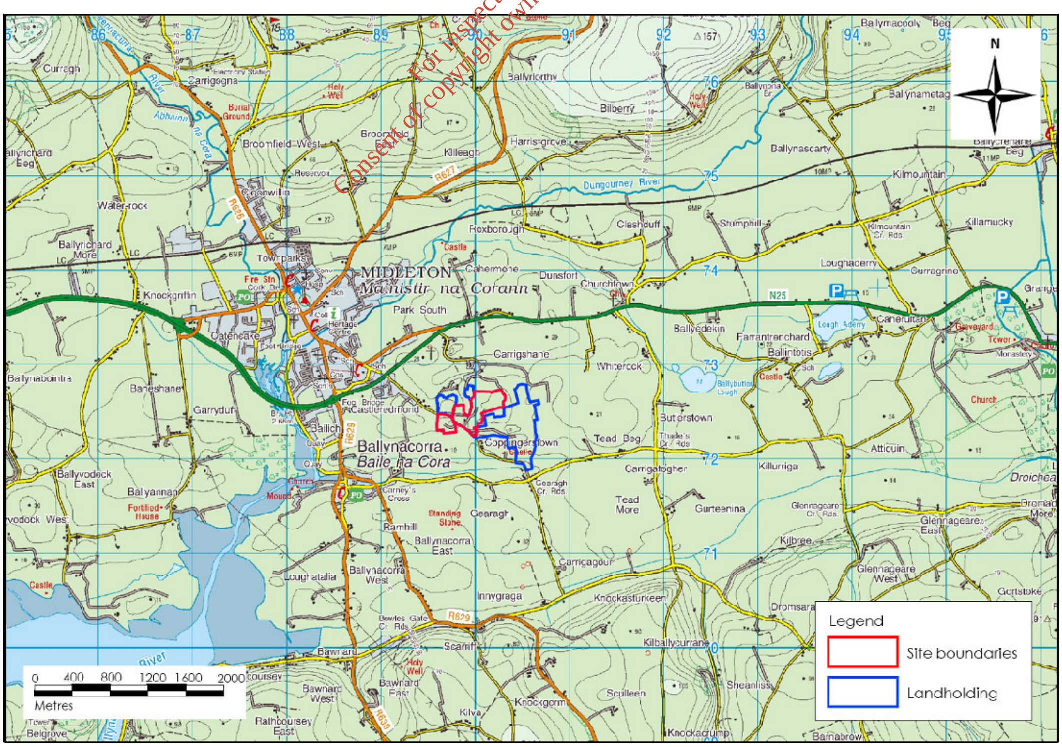


Figure A: Site Location

2.2 HYDROLOGY

2.2.1 Regional and Local Hydrology

Regionally, the site is located in the Owennacurra River surface water catchment within the South Western River Basin District.

The Owennacurra River flows through Midleton town, ~1.5km to the west of the site. Downstream of Midleton town this watercourse is referred to as the Ballynacorra River which flows into Cork Harbour further south.

In terms of mapped local hydrology, the northern section of the site is located in the Dungourney River catchment which flows in a westerly direction ~1.9km north of the site. The Dungourney River discharges into the Owennacurra River at Midleton town.

The southern section of the site (including the proposed soakaway location) is located in the West Ballynacorra Stream catchment. The source of the West Ballynacorra Stream is a karst spring which is located in the most southeastern part of the landholding. The West Ballynacorra Stream flows westerly and discharges into the Ballynacorra River estuary.

Other than the West Ballynacorra Stream, there are no other natural surface water features within the site or in close proximity to the boundary of the site.

A local hydrology map is shown as **Figure B.**

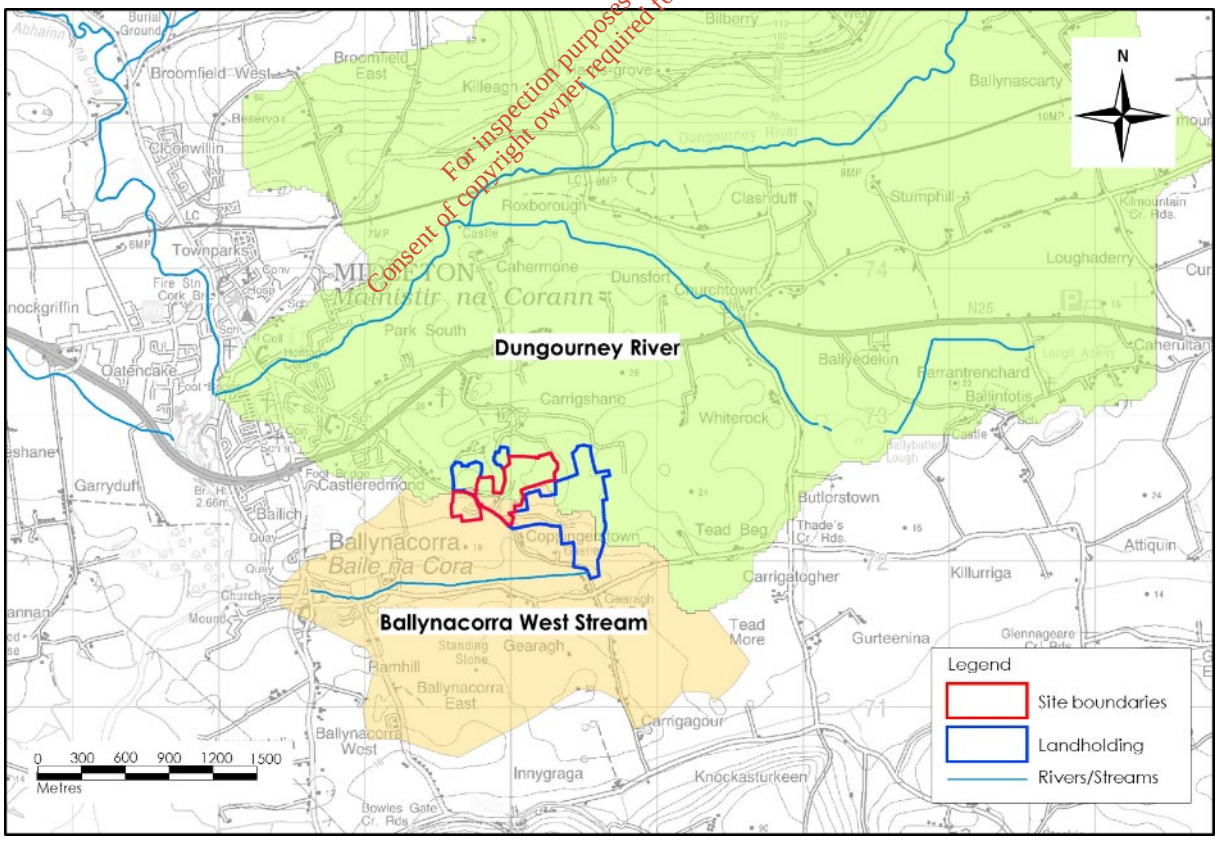


Figure B: Local Hydrology

2.2.2 Rainfall

The SAAR (Standard Average Annual Rainfall 1981 - 2010) recorded at Ballinacurra, which is located approx. 1km southwest of the site, is approx. 1,060mm (www.met.ie).

2.3 WFD SURFACE WATER BODY & STATUS

Local Surface water Body status and risk result are available from (www.catchments.ie).

The Dungourney_020 waterbody (IE_SW_19D070700) which drains the northern sections of the site has a Poor ecological status under the 2010-2015 WDR round.

The Knocknamadderee_010 waterbody (IE_SW_19K630910) which drains the lands to the south of the landholding has an unassigned ecological status under the 2010-2015 WFD round. (This watercourse is referred to as the West Ballynacorra Stream by the EPA).

2.4 LOCAL GEOLOGY

The GSI/Teagasc soils map (www.gsi.ie) for the site area indicates that the majority of the surrounding lands are overlain by Shallow well-drained mineral soils derived from mainly basic parent material (BminSW). There are also areas of deep well-drained mineral soils derived from mainly basic parent materials (BminDW) on the southeast of the site and in the land surrounding the landholding on the northern and eastern sides.

The GSI subsoils map for the area (www.gsi.ie) shows that the site is located in an area of bedrock outcrop or subcrop (Rck) with the surrounding area being overlain by limestone tills and sandstone tills. The proposed soakaway is located in an area where limestone tills are mapped.

In terms of bedrock geology, the Little Island formation composed of massive and crinoidal fine limestone underlies the site. A section of the applicant's landholding to the southeast of the site is mapped to be underlain by the Clashavodig Formation which comprises oolitic, peloidal, cherty, fine limestone. Both bedrock types are susceptible to karstification.

The GSI subsoil mapping and bedrock mapping is shown as **Figure D** and **Figure E** below.

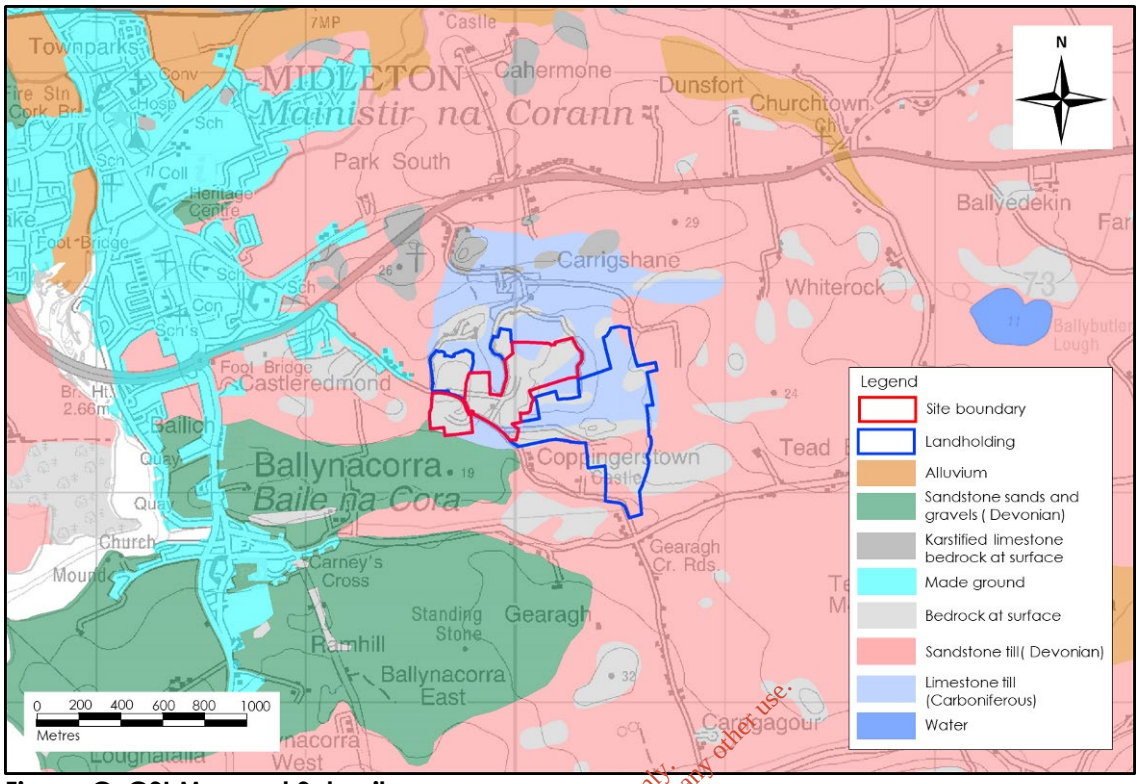


Figure C: GSI Mapped Subsoils

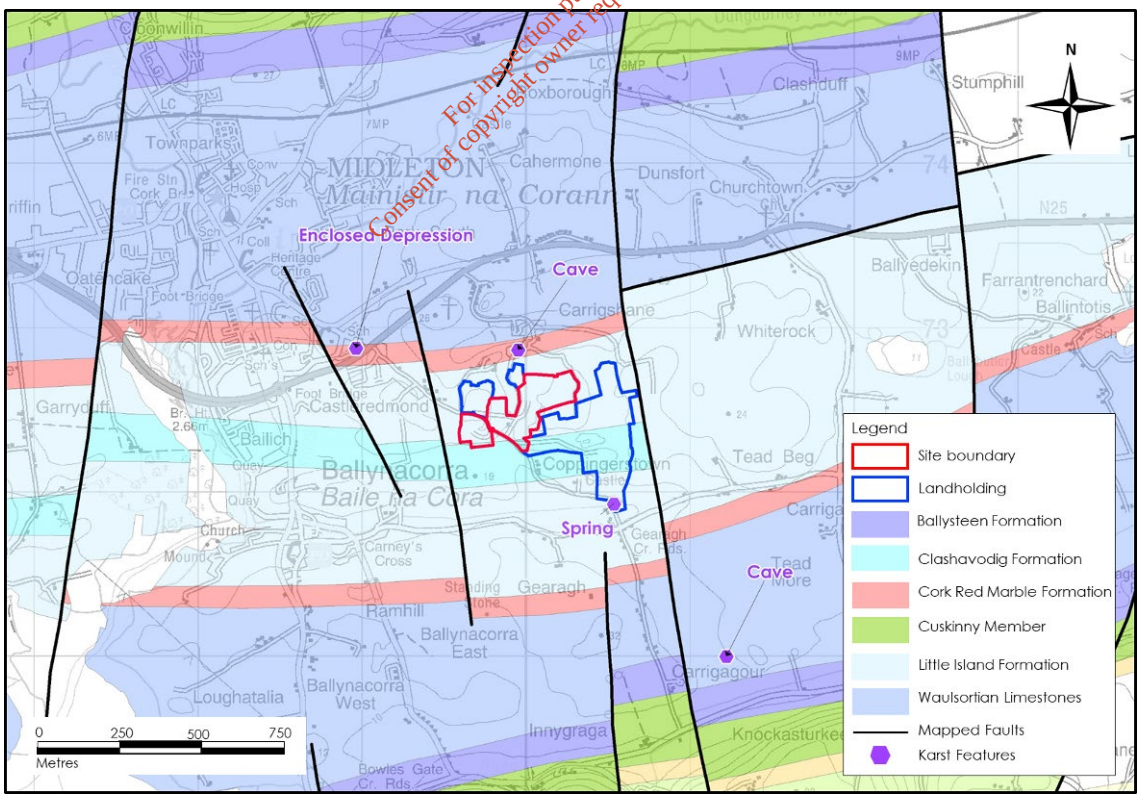


Figure D: GSI Mapped Bedrock Geology

2.5 REGIONAL AND LOCAL HYDROGEOLOGY

The different bedrock units which underlie the site are mapped by the GSI as part of the same Regionally Important Karstified (diffuse) Aquifer.

These rocks are devoid of intergranular permeability. Groundwater flow occurs in the many faults and joints, enlarged by karstification. Past depression of the sea level enabled karstification at depth, which further enhances the permeability of these rocks. Because of the high frequency of fissures in this region, overall groundwater flow is thought to be diffuse, although solutionally enlarged conduits and cave systems occur (GSI, 2014).

Most groundwater flow may occur in an epikarstic layer a couple of metres thick and in a zone of interconnected solutionally-enlarged fissures and conduits that extends approximately 30 m below this.

Groundwater flow paths can be up to several kilometers long but may be significantly shorter in areas where the water table is very close to the surface.

The GSI Midleton initial groundwater body characterisation report (GSI, 2004) gives aquifer transmissivity estimates of between 200 to over 2,000m^2/day. Assuming the majority of the groundwater flows occurs in the top 30m, this gives an aquifer permeability of between approximately 6 and 66m/day.

The regionally important limestone aquifer is the main groundwater body receptor with respect this assessment and this aquifer is shown in **Figure F** below. Site specific hydrogeological details are outlined in **Section 3** below.

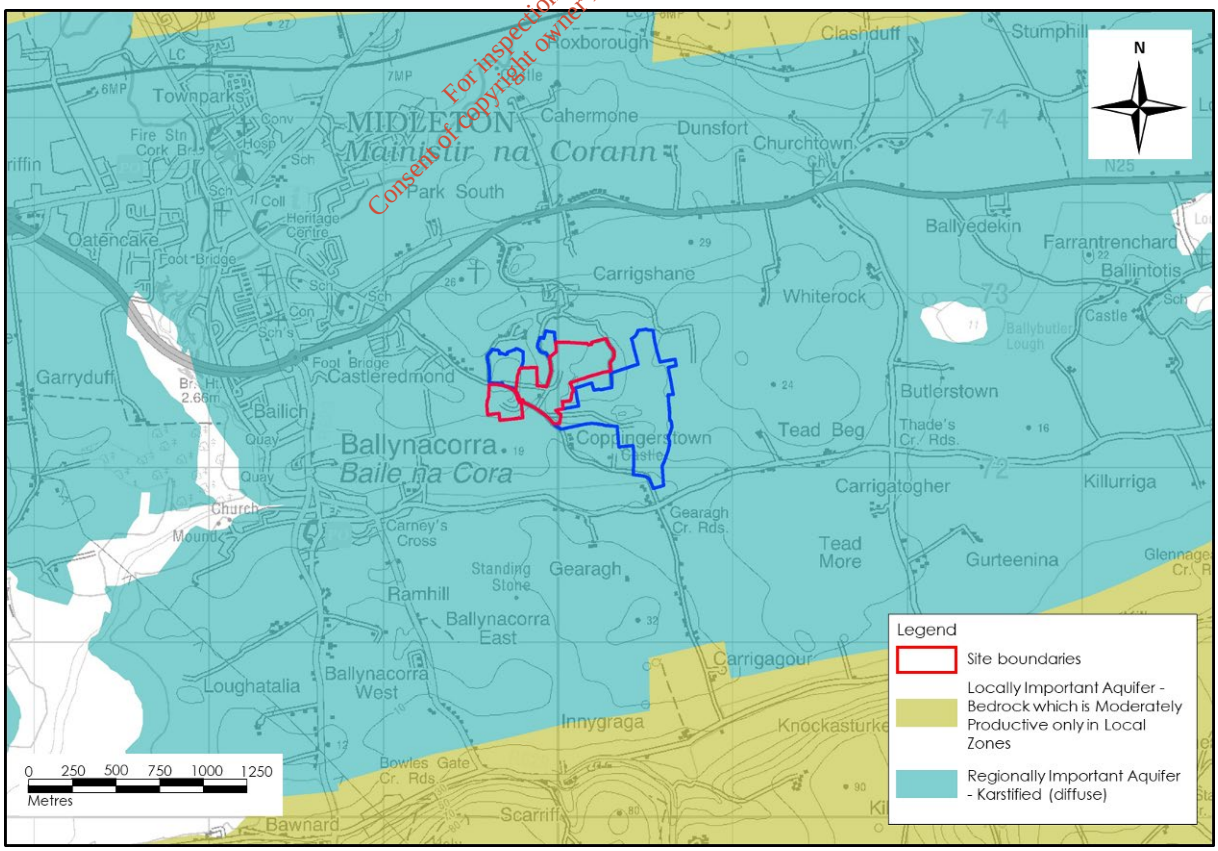


Figure E: GSI Bedrock Aquifer Mapping

2.6 GROUNDWATER VULNERABILITY

Based on the GSI mapping, the groundwater vulnerability rating (see GSI hydrogeological conditions in **Figure G** below) at the site ranges from Extreme-E (0 - 3m subsoils) to Extreme-X (rock at or near the surface). The groundwater vulnerability rating in the area of the proposed soakaway is Extreme E which suggests up to 3m of subsoil.

The type and depth of unsaturated material above the groundwater table at the proposed discharge location is discussed in **Section 3** below.

Vulnerability Rating	Hydrogeological Conditions				
	Subsoil Permeability (Type) and Thickness			Unsaturated Zone	Karst Features
	High permeability (sand/gravel)	Moderate permeability (e.g. Sandy subsoil)	Low permeability (e.g. Clayey subsoil, clay, peat)	(Sand/gravel aquifers only)	(<30 m radius)
Extreme (E)	0 - 3.0m	0 - 3.0m	0 - 3.0m	0 - 3.0m	-
High (H)	>3.0m	3.0 - 10.0m	3.0 - 5.0m	>3.0m	N/A
Moderate (M)	N/A	>10.0m	5.0 - 10.0m	N/A	N/A
Low (L)	N/A	N/A	>10.0m	N/A	N/A

Notes: (1) N/A = not applicable.
(2) Precise permeability values cannot be given at present.
(3) Release point of contaminants is assumed to be 1-2 m below ground surface.

Figure F: GSI Groundwater Vulnerability Rating

2.7 GROUNDWATER RECHARGE

The GSI estimate the average groundwater recharge in the local area is between 425 and 602mm/year. The hydrogeological setting for the lower end of the range is for "till overlain by well-drained soil" while the higher in the range is for "rock at or near the surface".

2.8 WFD GROUNDWATER BODY & STATUS

Local Groundwater Body status and risk result are available from (www.catchments.ie).

The Midleton GWB (IE_SW_G_058) is assigned Good status under the 2010-2015 WFD round.

2.9 WATER RESOURCES

Based on the GSI mapping there are no groundwater protection zones for existing public water or group water schemes mapped in the area of the quarry.

According to the GSI well database there is only 1 no. registered well within 1km of the proposed site and this well is located to the south of the site. GSI mapped wells with an accuracy of <50m are shown on **Figure H** below. As discussed in Section 3.5 below, the groundwater flow direction in the area of the site is in a west / south-west direction and therefore this mapped GSI well is not down-gradient of the proposed site or soakaway.

As the GSI well database is not exhaustive in terms of the locations of all wells in the area (as the database relies on the submission of data by drillers and the public etc.) a door to door

well survey of dwellings in close proximity (500m of site boundary) was carried out on 30th April 2018 for the purpose of the EIAR.

A total of 9 no. private wells were identified within 500m of the site boundary. These are also shown on **Figure H**. The wells are mainly located to the north and west of the site.

However, there are no mapped private wells within 500m downstream of the proposed soakaway location. The groundwater gradient (discussed below) is to the west - southwest

In addition, there are no private dwelling houses within 0.75km downstream of the proposed soakaway location.

Therefore, for the purposes of impact assessment (**Section 5** below) it is assumed that the closet private well is 0.75km downstream of the site. This location is used as a downstream Assessment Point (AP1) with respect the proposed discharge. This is discussed in **Section 5** below.

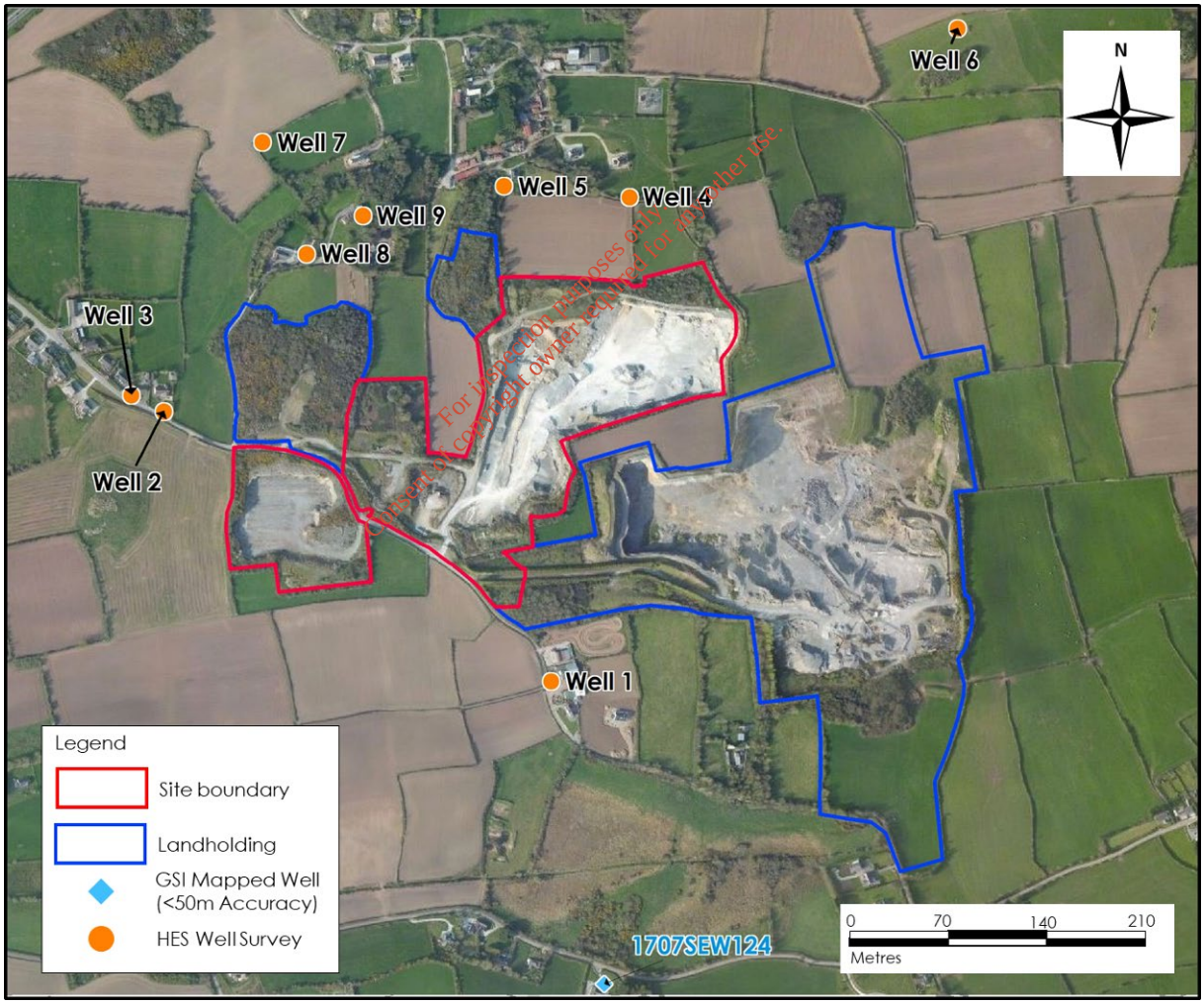


Figure G: GSI Mapped Wells

2.10 DESIGNATED SITES & GROUNDWATER DEPENDANT ECOSYSTEMS

Within the Republic of Ireland designated sites include National Heritage Areas (NHAs), Proposed National Heritage Areas (pNHAs), Special Areas of Conservation, candidate Special Areas of Conservation (cSAC) and Special Protection Areas (SPAs).

Downstream designated sites that are hydrogeologically connected to the site include Great Island Channel SAC (Site Code: 001058). Great Island Channel SAC is located approximately 2km downstream of the site. As stated above in the report there is no surface water discharge / runoff from the proposed site to either the Dungourney River or Ballynacora River and therefore there is no direct surface water flowpath between the two sites.

Groundwater flow from the local aquifer in the area of the proposed site is expected to discharge into the Ballynacora River/Estuary and therefore this is a potential indirect groundwater water flowpath to the SAC.

All other designated sites are sufficiently remote from the proposed development site to state with confidence that they are hydrogeologically disconnected from the proposed development site.

3. FIELD DATA COLLECTION AND INTERPRETATION

3.1 WALKOVER SURVEY

Site walkover surveys were completed by David Broderick of Hydro-Environmental Services in January 2018 and in October 2019.

This involved a water features survey, geological mapping of exposures of subsoils, including inspection and mapping of all relevant hydrological features, such as existing drainage ditches and streams. As discussed above a private well survey was also completed.

3.2 TRIAL PITS

A total of 2 no. trial pits were excavated at the area of the proposed stormwater soakaway on 23rd October 2019 to assess overburden lithology and depth.

A summary of the trial pit logs is shown in **Table A** below. The locations of the trial pits are shown in **Figure I** below.

Both trial pits intercepted firm, brown SILT/CLAY down to approximately 0.7m which was underlain by gravelly SILT/CLAY down to the end of the trial hole at 2.5m.

Table A: Summary of Trial Pit Logs

Location	Total Depth (mbgl)*	Easting	Northing	Summary Subsoil Description
TP01	2.5	189,955	72,286	SILT/CLAY over very gravelly SILT/CLAY
TP02	2.5	189,968	72,286	SILT/CLAY over sandy gravelly SILT/CLAY

***mbgl – metres below ground level**

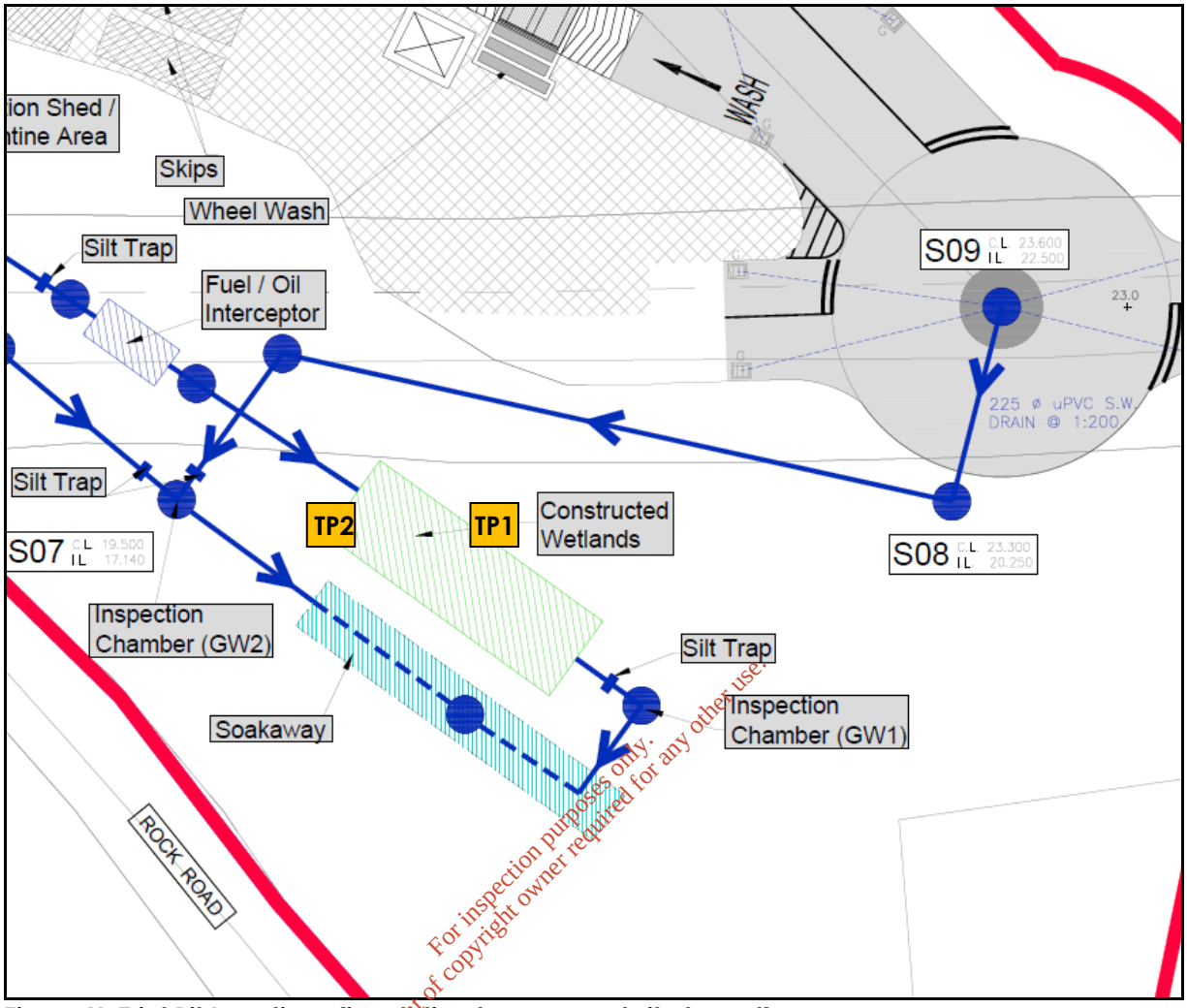


Figure H: Trial Pit Locations (in relation to proposed site layout)

3.3 INFILTRATION TEST

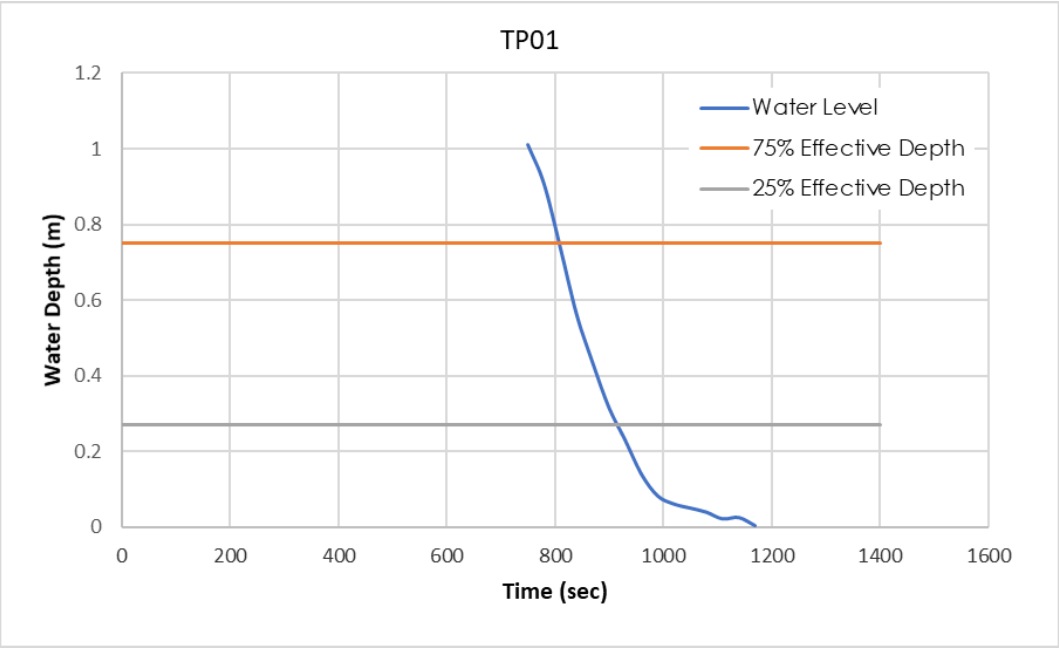
In order to demonstrate that the proposed discharge area has sufficient infiltration capacity to physically accept the treated stormwater and also to design the soakaway size, an Infiltration test, which carried out in accordance with BRE Digest 365, was undertaken on both trial holes.

Both holes were filled to the required effective depth (water level) with clean water using a tanker. Water level monitoring was undertaken both manually (dip tape) and with the use of a datalogger which was installed in the trial hole for the duration of the infiltration test.

An infiltration test water level plots are shown as **Figure J** below and infiltration calculation sheets are shown in **Appendix I.**

An infiltration rate of 1.6 x 10^{-3}m/s and 7.5 x 10^{-5}m was calculated for TP01 and TP02 respectively.

The proposed design of the soakaway based on the lowest infiltration rate is detailed in **Section 4** below.



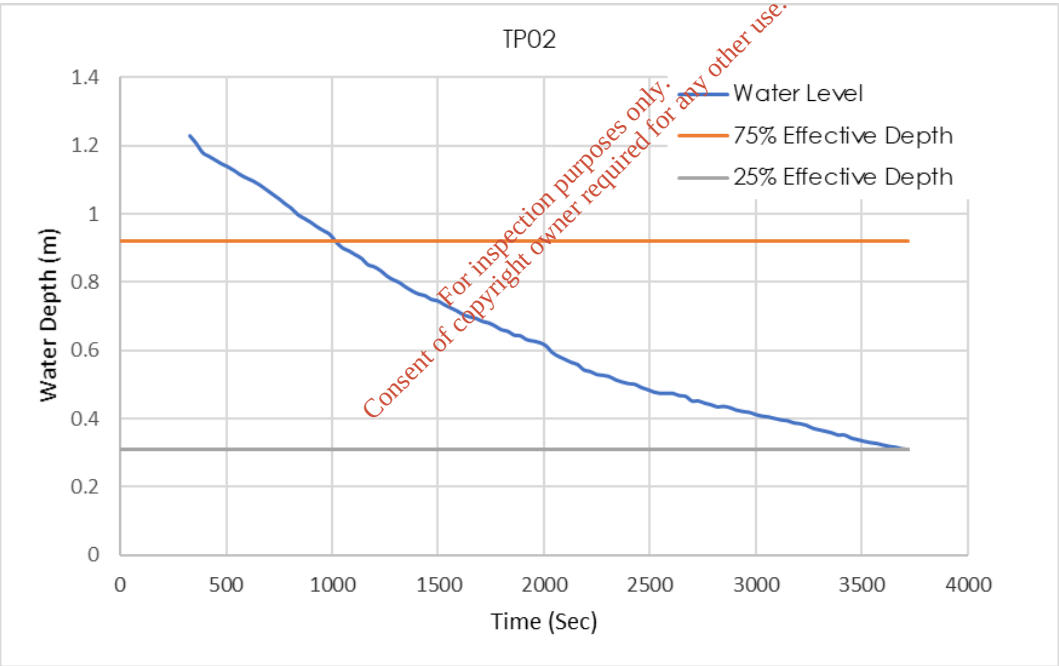


Figure I: Infiltration Test Plots

3.4 INVESTIGATION DRILLING

As part of the 2018 planning application/EIAR, 22 no. 4" blast hole drilling investigation points were completed between 15th and 16th November 2017. This was done to investigate the geological and hydrogeological conditions below the existing quarry floor.

The drilling results were variable. While many holes show solid limestone, and dust returns, with little fracturing, there are also several holes that suggest there are larger discrete fractures/conduits beneath the quarry floor. This is consistent with karstified limestone.

In addition, monitoring well drilling at the site was completed by Southern Pumps Drilling in October 2017 when 6 no. monitoring wells were installed at the site (MW1 – MW6). The drilling encountered weak to strong grey limestone which was found to be either slightly weathered or fractured to some extent in the majority of the wells. Soft brown clay infill was noted at many of the weathered/fractured sections.

The bedrock geology encountered during the drilling is consistent with karstified limestone.

The locations of the monitoring wells are shown in **Figure K** below. Monitoring well drilling logs are attached below as **Appendix II.**

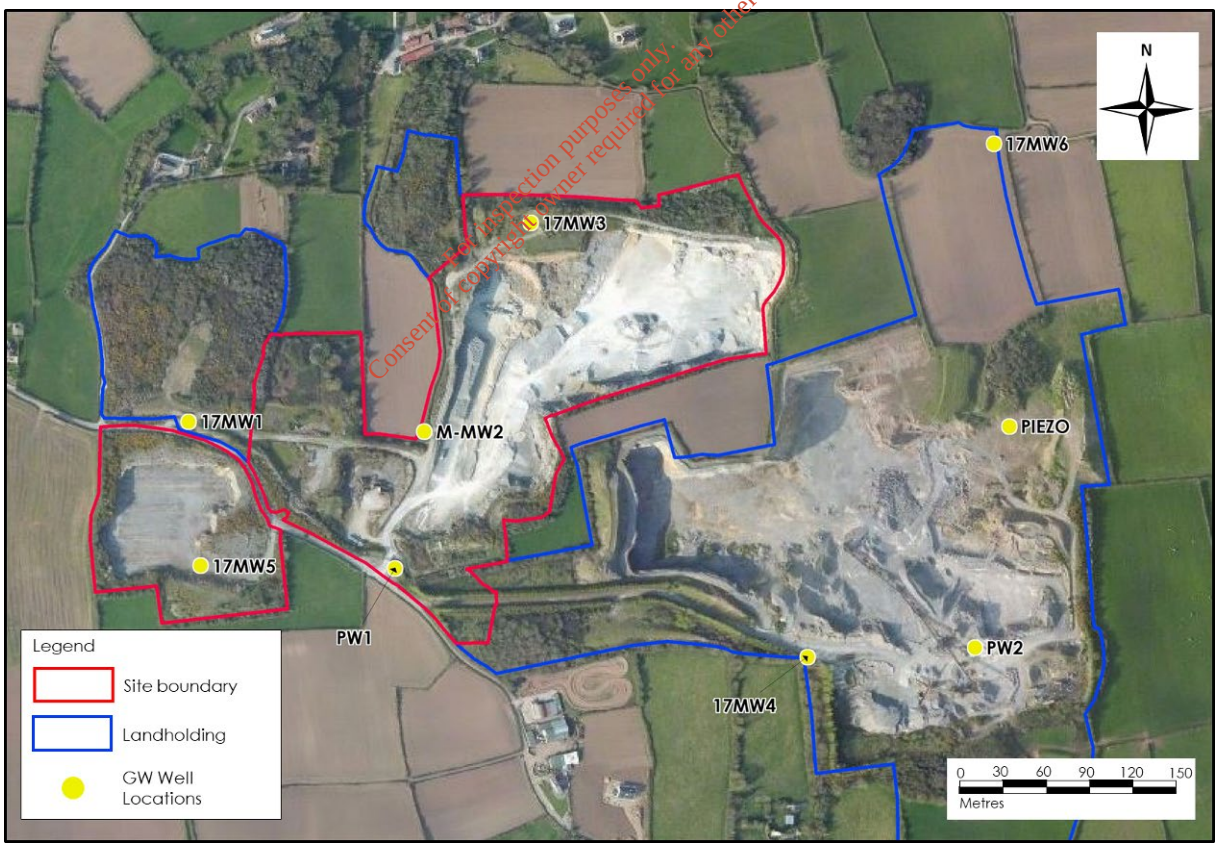


Figure J: Monitoring Well Locations

3.5 GROUNDWATER LEVELS & GRADIENTS

Groundwater level monitoring data for the on-site monitoring wells measured on 30th April 2018 and 23rd October 2019 are shown in **Table B** below.

Groundwater levels at the site on 23rd October 2019 varied between 14.133mbgl (7.373m OD) and 27.447mbgl (7.332m OD).

Based on the groundwater level elevations (m OD), the groundwater flow direction in the area of the site is in a west / south-west direction as shown in **Figure L** below. The groundwater gradient at the site is calculated to be approximately 0.003. This would be considered a relatively shallow groundwater gradient, and this is due to the high bulk permeability of the karstified aquifer which creates a more flattened groundwater table.

Based on the measured groundwater levels, the gradient and the ground elevation at the proposed soakaway (~20m OD), the groundwater level below the proposed soakaway area is expected to be between approximately 12mbgl.

Table B: Monitoring well water levels

Location	30/04/2018		23/10/2019	
	Water Level (mbgl)	Water Level (m OD)	Water Level (mbgl)	Water Level (m OD)
17-MW01	27.074	7.029	27.447	7.332
17-MW02	13.571	7.319	14.133	7.373
17-MW03	14.766	7.669	15.494	7.585
17-MW04	14.513	7.837	15.542	7.395
17-MW05	16.834	7.25	17.175	7.475
17-MW06	15.64	7.955	15.605	8.152

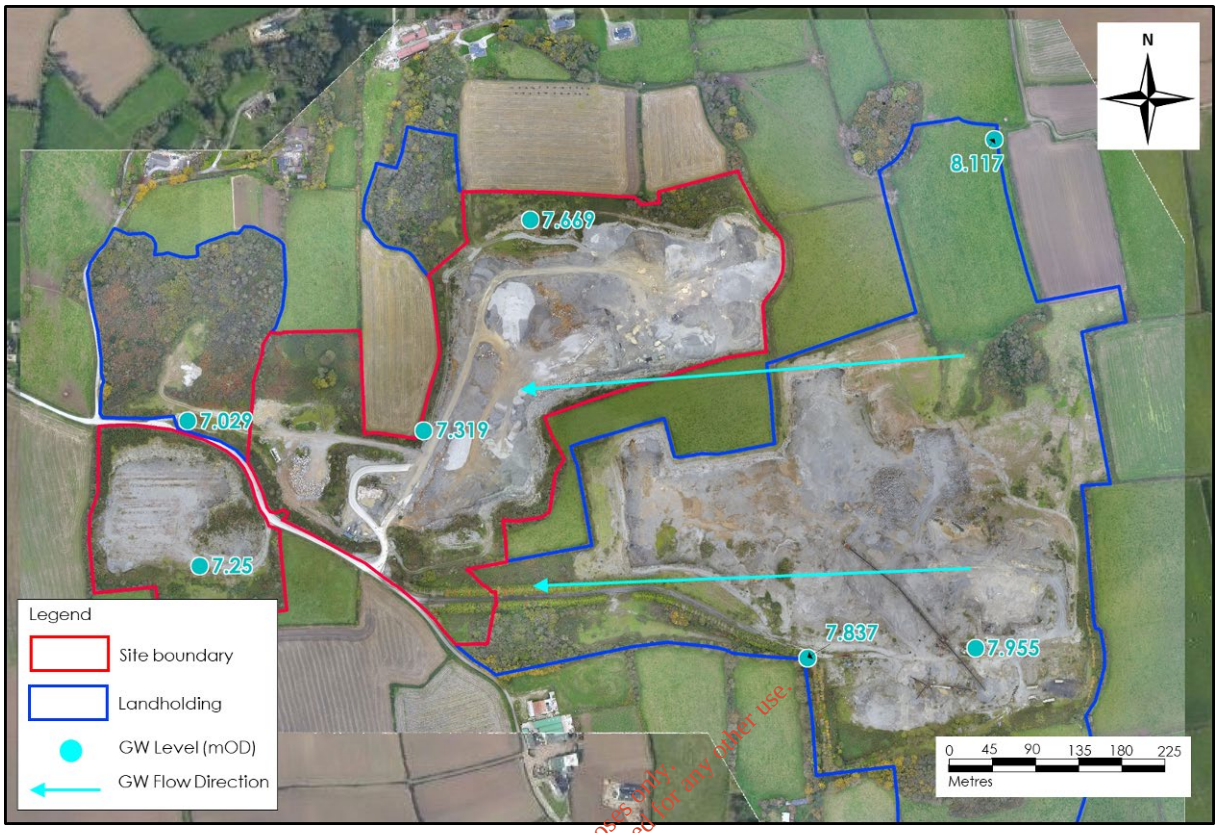


Figure K: Groundwater Levels and Flow Direction

3.6 GROUNDWATER QUALITY MONITORING

Groundwater quality monitoring was completed at the on-site monitoring wells (MW1-MW6) on 8th March 2018 for the purpose of the planning application and EIAR.

Original laboratory reports are attached as **Appendix III**.

Overall the results were quite variable, particularly with respect to nutrients and this is likely due to the heterogeneous nature of groundwater flows in a karst aquifer.

There were no exceedances with respect to the drinking water regulation values. There was only one exceedance with respect to the groundwater regulation values and this was for nitrate in MW3 which exists to the north (across-gradient) of the site.

Nitrate was also relatively elevated in MW4 and MW6 which is also likely due to agricultural practices such as fertiliser / slurry spreading on the lands surrounding the site. Ortho-phosphate was also elevated in MW3 and MW4 which suggests a fertilizer/slurry source. There was no detection of coliforms in any of the samples which might indicate a chemical fertilizer rather than manure/slurry or it may indicate that the groundwater vulnerability is not overly high locally. There were no detections of hydrocarbons.

Overall the groundwater quality is typical of a karstified aquifer where the main landuse is agriculture. Variable groundwater quality is often a characteristic of this aquifer type.

4. STORMWATER SYSTEM LAYOUT & DESIGN

4.1 OIL INTERCEPTOR DESIGN

The dedicated refuelling area/plant storage yard (124m^2) and car park (70m^2) that will be contributing runoff to the full retention oil interceptor have a combined area of 194m^2. Using a design 100 -year 24-hour rainfall depth of 95.8mm, the peak flow will be in the order of 18.6m^3/day.

The proposed full retention oil interceptor model is a FR-NS-40-CC (Molloy Precast) which has a hydraulic capacity of 40L/s which is well in excess of the actual runoff requirement. The oil interceptor design detail is attached as **Appendix IV.**

The interceptor is required to achieve a maximum concentration of 5 mg/L of total hydrocarbons in the final discharge as per the EN858-2002 standard (separator system for light liquids). This hydrocarbon concentration will be the assumed chemical loading value (see **Section 5** below).

The oil interceptor will be discharged to ground via a soakaway pit which is detailed below. The proposed location of the oil interceptor is shown on the site layout drawing (**Figure 1** attached).

4.2 SOAKAWAY DESIGN

The soakaway is sized to accommodate runoff from the refuelling yard, cark park (discussed above) and the site access roads (2,157m^2) which is a total hardstand area of 2,351m^2. Using a 100 -year 24-hour rainfall depth, the peak flow will be approximately 225m^3/day.

Using the lowest measured subsoil infiltration capacity of 7.5 x 10^{-5}m/s, the total hardstand area of 2,351m^2 and the 100-year 24-hour rainfall depth (95.8mm), a soakaway of the following dimension, 3m(W) x 1.5m (Effective Depth) x 18m (L) would be sufficient from a hydraulic design perspective. However, the proposed soakaway that will be installed at the discharge location will be oversized to 20m in length for conservative purposes.

The proposed location of the soakaway is shown on the site layout drawing (**Figure 1** attached).

The soakaway design calculations are shown in **Appendix V.**

5. HYDROGEOLOGICAL IMPACT ASSESSMENT

This section follows the general principles of a Tier 2 risk assessment which are rooted in the source-pathway receptor model of environmental risk assessment, as per EPA guidance (2011) and which result in a determination of risk and compliance of a discharge activity against relevant water quality standards and objectives.

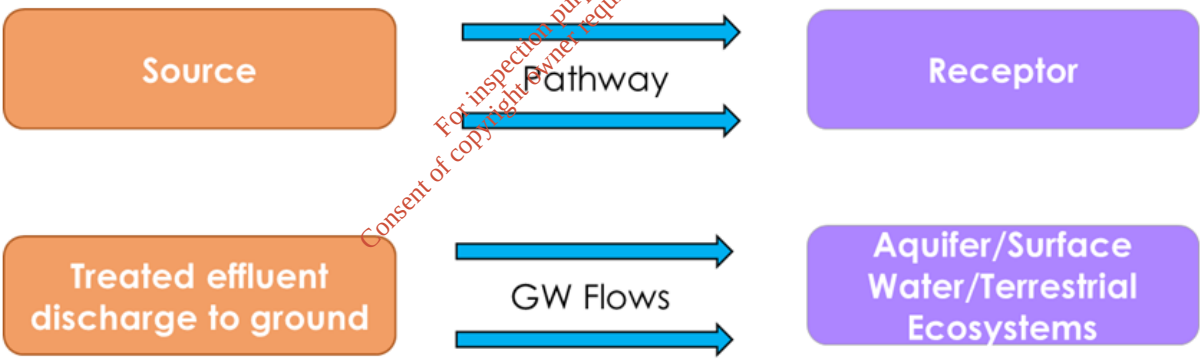
5.1 SOURCE – PATHWAY – RECEPTOR

The conventional source-pathway-target model (see below) for groundwater / surface water protection was applied to assess impacts on the groundwater body and downstream sensitive receptors such as potential wells and GWDTEs.

In the case of the subject site the primary source of impact is from discharge of treated stormwater from the soakaway whereby the primary potential hazard is leaching of residue levels of hydrocarbons to the local groundwater body causing a potential deterioration in groundwater quality.

The pathway in terms of groundwater flow paths is via the limestone aquifer which exists at below the soakaway.

The primary targets of concern is the underlying limestone aquifer and potential local wells (there are no GWDTEs present locally).



Based on the identified groundwater flow paths, a detailed Tier 2 hydrogeological assessment was developed and carried out at the site.

Based on this site specific hydrogeological information, various assessments, as required under the regulations (Refer to **Section 1.4**), are completed below.

5.2 COMPLIANCE WITH EPA GUIDANCE ON DISCHARGE ASSESSMENT

EPA (2011) Guidance on the Authorisation of Discharges to Groundwater outlines the risk-based approach and required level of field investigation required in the evaluation of a site's potential to accept a discharge of treated stormwater: This approach has been applied by HES in this case.

EPA (2011) Guidance on the Authorisation of Discharges to Groundwater States that "A technical assessment of a proposed discharge to groundwater activity has to address these basic questions (our responses are provided in bullet point format after each question):

1. ***What are the primary Source Pathway Risk factors associated with the site and discharge activity?***

    - **Source:** stormwater soakaway with hydrocarbon residues likely to be present in the final discharge.
    - **Pathway:** The pathway is vertical percolation down through at least 2m of unsaturated overburden followed by lateral groundwater movement (to the west/southwest) in the limestone aquifer.
    - **Receptor:** Receptors within the site include the underlying limestone aquifer with potential downstream receptors including local wells (the closet downstream dwelling is 0.75km and it is assumed a well is present).

2. ***What is the probable risk and predicted impact to groundwater quality and associated receptors?***

    - Given the relatively small surface area of the refuelling yard (and small loading volume), the appliance of best standard practice in terms of a full retention oil interceptor, the groundwater protection afforded by the depth of unsaturation overburden (2m), the potentially large flows in the bedrock aquifer from a dilution perspective and the large downstream distance to off-site receptors such as wells (0.75km), the probably risk and impact is Low. Impacts are addressed in **Section 5.4.**

3. ***What level of technical assessment is required to adequately define and verify risk factors?***

    - A 'Tier 2' level of assessment was carried for this site even though the EPA (2011) guidance states that "Tier 2 assessments generally cover moderate risk activities. A Tier 2 site assessment must demonstrate sufficient infiltration capacity and adequate attenuation potential. Tier 2 assessments also involve the prediction of an impact on groundwater quality using basic calculation procedures. A Tier 2 assessment also requires subsoil characterisation, and besides lithological information and establishing depths to bedrock, the subsoil characterisation should provide estimates of subsoil permeability which can subsequently be used to estimate (calculate) infiltration capacity. All of the above have been completed in this report.

4. ***Is the site hydraulically suitable for effluent disposal?***

    - As assessed in **Section 3.3** and **Section 4.2** above, the presence of moderate permeability subsoils and sufficiently deep groundwater table at the proposed discharge means a more than adequately sized soakaway can be installed to accommodate discharge from the oil interceptor and the other hardstand areas.

5. ***Does the site provide for adequate attenuation of pollutants?***

    - The site provides enough opportunity for attenuation of pollutants with respect the proposed load. The attenuation of pollutants is assessed in **Section 5.4** below.

6. ***What hydraulic and chemical loading may be acceptable such that groundwater quality objectives are not contravened, and harmful effects to human health or the status of aquatic or terrestrial ecosystems are avoided?***

    - The loadings and concentrations of the proposed discharge are presented in **Sections 5.3** below.

7. ***How should a source and groundwater monitoring system be designed and implemented to verify that the impact to groundwater quality and receptors is either negligible or acceptable?***

    - Regular monitoring of the performance of the oil interceptor will be sufficient to ensure groundwater quality effects are negligible.

The required impact assessments are presented below.

5.3 STORMWATER AND ENVIRONMENTAL LOADINGS

The total volumetric loading to the groundwater system is based on a combination of output from the oil interceptor (i.e. refuelling yard and car park runoff) and also "clean" surface water runoff from the site entrance and access road (it's assumed no hydrocarbons will be present in this runoff water). The initial chemical loading (i.e. hydrocarbons residues) is based on discharge from the oil interceptor only (i.e. 5mg/L).

The mixing of the "clean" surface water runoff with the treated water from the oil interceptor means any potential hydrocarbons residues in the oil interceptor discharge will be diluted down prior to being released to ground via the soakaway.

For environmental impact assessment purposes (i.e. groundwater quality), the volumetric loading is based on long term rainfall averages for the wettest month rather than a once off 100-year rainfall event. Based on the 30-year averages for Ballinacurra, the wettest month is October where the monthly average is 122mm which works out as a daily average of 3.9mm/day. Based on the hardstand area of the refuelling yard and car park (194m^2), the average daily discharge to the soakaway is calculated to be 0.75m^3/day during the wettest month.

Based on a road hardstand area of 2,157m^2, the "clean" surface water runoff component being released to the soakaway is 8.4m^3/day during the wettest month.

Therefore, this is a dilution factor of approximately 11 fold when the discharge from the oil interceptor is mixed with the "clean" surface water runoff.

Based on maximum hydrocarbon concentration 5 mg/L in the oil interceptor discharge, the final concentration of the hydrocarbons in the water being released would be approximately 0.45mg/L after mixing with the "clean" surface water runoff. The total volume being released (clean + oil interceptor water) would be 9.15m^3/day.

Prior to release into the soakaway it is then proposed to pass the discharge through a constructed wetland pond for further treatment (hydrocarbon removal) where concentrations can be reduced by between 50 and 85% (EPA 2006)[2]. Using an approximate average value of 65% reduction, the above hydrocarbon concentration from the proposed interceptor (0.45mg/L) will be reduced to 0.16mg/L when discharged to the soakaway. The proposed location of the constructed wetland is shown on the site layout drawing (**Figure 1** attached).

The constructed wetland will be designed to have a retention time of 48 hours (18.6m^3/day x 2 = 37.2m^3) (Refer to Figure 1). and will have the following dimensions – 15m(L) x 5m(W) x 0.5m(D).

After release into the soakaway, the effluent must percolate down through some 2 -3m of unsaturated overburden which will treat the effluent and reduce further the hydrocarbons concentrations.

EPA (2006) states that for a 3m depth of unsaturated overburden, hydrocarbons reductions of between 70 and 90% can be achieved. There by applying an average reduction of 80% to the post wetland effluent hydrocarbon concentration (i.e. 0.16mg/L), a hydrocarbon concentration of at least 0.031mg/L will be achieved before it reaches the groundwater table below the site.

5.4 RESULTANT GROUNDWATER CONCENTRATIONS

The risk of deterioration in the quality of groundwater from hydrocarbon residues was assessed by calculation based on adopting EPA (2011) Guidance on the Authorisation of Discharges to Groundwater. Effluent flow rate, groundwater flow rate, background groundwater concentrations and the concentrations in the final effluent are simulation inputs.

$$Cgw = [(Cin \times Qin) + (Cgwu \times Qgw)]/(Qin + Qgw)$$

Where,

Cgw = resulting concentration in downstream groundwater after mixing (mg/L)
Cin = concentration in the effluent water (0.031mg/L)
Qin = volumetric rate of effluent water (9.15m^3/day)
Qgwu = concentration in the aquifer from upgradient areas (Zero mg/L)
Qgw = groundwater flow rate through the bedrock aquifer (27m^3/day – see below)

The groundwater flow rate through the bedrock aquifer is estimated using the GSI reported permeability of the aquifer which is 30m/day (3.47 x 10^{-4}m/s), the measured groundwater gradient of 0.003 and an estimated groundwater mixing zone width and depth of 20m and 15m respectively downstream of the proposed discharge location. This results in a groundwater flow/flux of 27m^3/day below the soakaway discharge point.

Therefore, based on the above criteria and equation the resultant hydrocarbon concentration immediately downstream of the proposed soakaway discharge point after mixing is calculated to be ~0.008mg/L.

[2] *Impact Assessment of Highway Drainage on Surface Water Quality – 2000-MS-13-M2 – Main Report ERTD 149 (EPA, 2006)*

To estimate the hydrocarbon concentration at a further downstream Assessment Point – AP1 (we have taken this to be the nearest downstream dwelling/potential well, 0.75km to the west/south, the groundwater mixing zone width (20m) is extended to AP1 which is a plan area of 15,000m^2 (20m x 750m). Further dilution of residual hydrocarbons will occur at this point due to recharge of rainfall (reduction in hydrocarbon concentrations will also occur due to groundwater mixing itself, but due to the mathematical complexity of this mixing and the lack of data downstream of the site this has not being allowed for, therefore the below estimated hydrocarbon concentration at AP1 will be very conservative indeed).

The rainfall recharge (654mm/yr) occurring within the mixing zone footprint area (upstream of eastern boundary) is calculated to be 0.654m/year/365=0.0018m/day x 15,000m= 26.8m^3/day.

Therefore, when mixing of the groundwater flow/flux of 27m^3/day (with a conservative hydrocarbon concentration of 0.008mg/L) and the recharge rainfall, the resultant conservative concentration at the downstream eastern boundary (AP1) is calculated (using the above equation) to be 0.004mg/L. Again, no aquifer groundwater mixing is allowed for, therefore the actual value is likely to be significantly lower.

5.5 COMPLIANCE WITH GROUNDWATER QUALITY STANDARDS

The key legislative standards with respect groundwater quality are the Groundwater Regulations (S.I. No. 2010) and the Drinking Water Regulations (S.I. No. 122 of 2014). However, there is no threshold value provided for total hydrocarbons in these standards. The EPA Interim Guideline Value (IGV) is 0.01mg/L.

The conservative calculations carried out above for the two groundwater assessment points, Discharge Point and AP1, shown that concentrations of hydrocarbons in the groundwater downstream of the discharge point will comply with the IGV.

5.6 CULMULATIVE IMPACTS

With respect to the requirement to consider Cumulative Impacts (Section 3.7, EPA, 2011), there are no other significant stormwater discharges in the area. As such cumulative impacts are considered to be negligible.

5.7 IMPACT ON SURFACE WATER QUALITY

The closest downstream surface water body is the Owennacurra River which exists 1.5km downstream of the site. As demonstrated above, negligible groundwater quality effects are expected downstream of the discharge point.

5.8 REQUIRED SEPARATION DISTANCES

The closest potential downstream well is 0.75km or greater. Therefore, all required separation distances are adhered to.

5.9 MONITORING

Due to the very conservative nature of this assessment and the very low level of expected impacts, regular monitoring of the performance of the oil interceptor will be sufficient to ensure groundwater quality effects are negligible.

6. CONCLUSIONS

- The hydrogeological assessment relates to the proposed indirect discharge of treated stormwater runoff to ground via a full retention oil interceptor;
- A Tier 2 Hydrogeological Assessment is presented in this report and demonstrates the site geology and hydraulic capacity of local subsoils to receive the proposed discharge. An assessment of likely resulting groundwater quality is completed also;
- From a design and site suitability assessment perspective (discharge acceptance), the peak loading will be approximately 225m^3/day (100 -year 24-hour storm event);
- Infiltration tests and the follow on soakaway design demonstrate that the site is capable of hydraulically accepting the proposed discharge;
- For environmental impact assessment purposes, the volumetric loading is based on long term rainfall averages for the wettest month rather than a once off 100-year rainfall event. An average volumetric loading of 9.15m^3/day is taken to reflect the wettest month;
- A very conservative assessment with respect groundwater quality impacts was carried out and this indicates that negligible groundwater quality effects downstream of the proposed discharge point will occur, with all values being compliant with the EPA IGV for hydrocarbons; and,
- Due to the very conservative nature of this assessment, the relatively low loading rate and the very low level of expected impacts, regular monitoring of the performance of the oil interceptor will be sufficient to ensure groundwater quality effects are negligible.

****

7. REFERENCES

Appropriate Assessment of Plans and Projects in Ireland – Guidance for Planning Authorities (DoEHLG, 2009).

EPA (2006) Impact Assessment of Highway Drainage on Surface Water Quality – 2000-MS-13-M2 – Main Report ERTD 149.

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European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009).

Local Government (Water Pollution) Act, 1977.

Local Government (Water Pollution) Regulations, 1978.

Local Authority Services National Training Scheme Group (2011) - Guidance, Procedures and Training on Licensing of Discharges to Surface Waters and to Sewers.

Local Authority Services National Training Scheme Group (WSTG) - Discharge to Surface Waters, Guidance to the Applicant (August 2011)

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EPA (2011) Guidance on the Authorisation of Discharges to Groundwater. December 2011.

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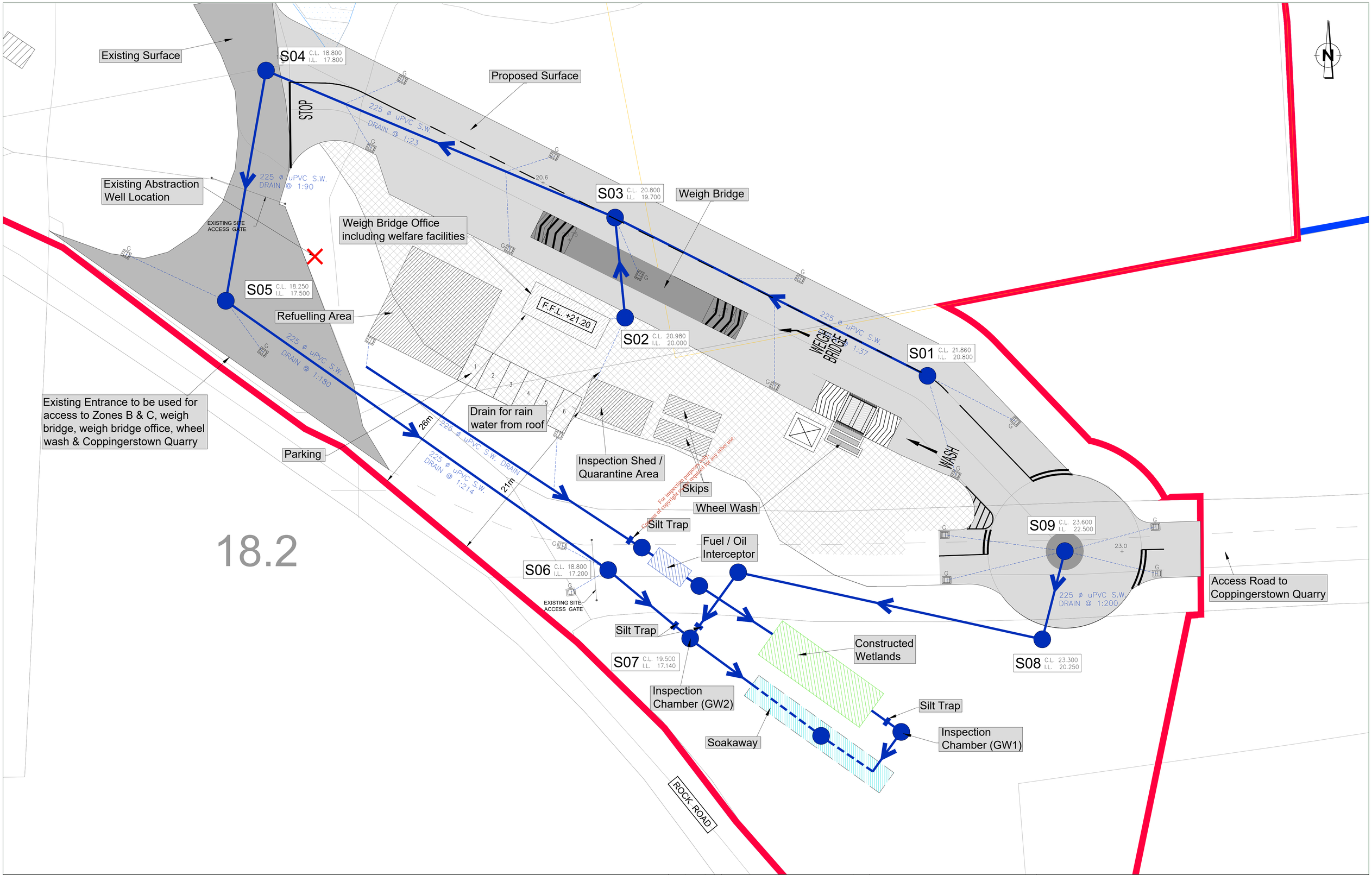
European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010)

Geological Survey of Ireland (2008b) Interactive Groundwater Maps www.gsi.ie

FIGURE 1



18.2

NOTES

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4. Issue of Drawings. Hard copies, dwf and pdf will form a controlled issue of the drawing. All other formats (dwg, dxf etc.) are deemed to be an uncontrolled issue and any work carried out based on these files is at the recipients own risk. RPS will not accept any responsibility for any errors arising from the use of these files, either by human error by the recipient, listing of un-dimensioned measurements, compatibility issues with the recipient's software, and any errors arising when these files are used to aid the recipients drawing production, or setting out on site.
5. Datum: Ordnance Survey Datum, Malin Head.
6. Final Technical layout to be agreed with Planning Authority prior to construction.
7. All Dimensions are indicative only and depend on the final system selected.

LEGEND :-

APPLICATION SITE AREA (157,237m²)

LANDS IN CONTROL OF LANDOWNERS (465846m²)

WAYLEAVE

OSI VECTOR MAPPING TILES :- OS6388-A, OS6388-B

OSI DISCOVERY MAPPING TILE :- OS1806_D

SITE AREA :- 157,237m²

MAPPING CENTER :- 589960 E, 572543 N (ITM)

No.	Date	Drn. Chk.	Amendment / Issue	App
P02	14.11.19	KT MS	ISSUE FOR WASTE LICENCE	M.L.
P01	29.11.18	KT MS	ISSUE FOR WASTE LICENCE	M.L.

Client: Roadstone Limited

Drawn By	Checked By	Approved By	Date
KT	MS	M.L.	July '19

RPS
Innishmore Ballincollig Co. Cork Ireland
T +353 21 4665900
F +353 21 4873742
W www.rpsgroup.com/ireland
E ireland@rpsgroup.com

Project: **Roadstone Midleton Site**

Drawing Status	Sheet Size	Scale
Draft	A1	1:200 @ A1 Half @ A3

Drawing Number: CP17028WL0008

Rev: P02

Title: PROPOSED SITE LAYOUT AT HARDSTANDING AREA AND PROPOSED DRAINAGE

CP17028WL0003.dwg

APPENDIX I: BRE365 INFILTRATION CALCULATION SHEET

Project: Roadstone, Midleton, Co. Cork
Appendix I: BRE365 Infiltration Test Sheet

q = soil infiltration rate

$q = V_{p75-25}/a_{p50} \times t_{p75-25}$

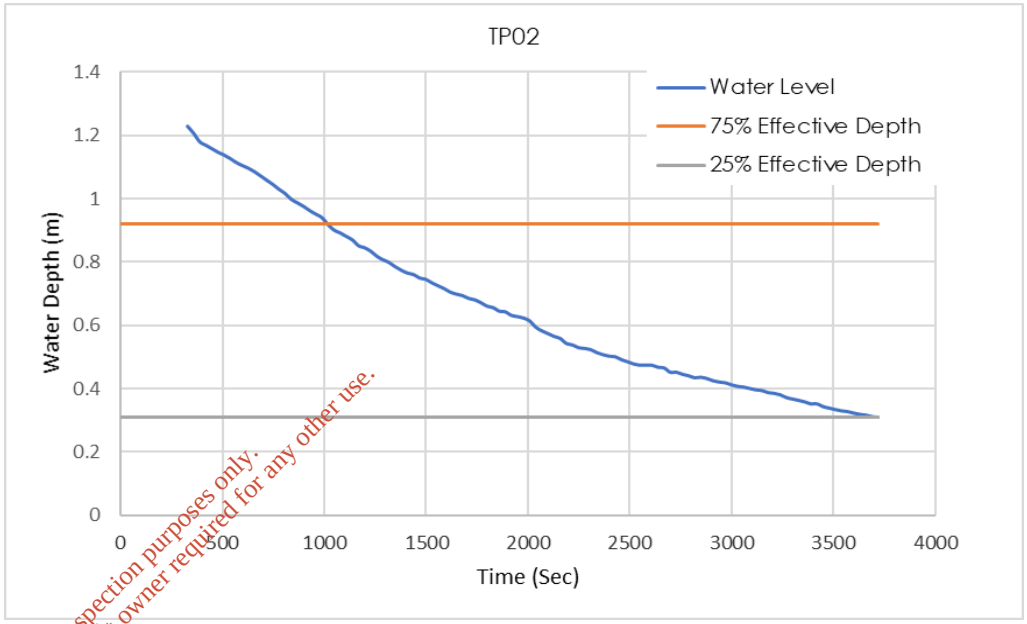
Test Pit Dimensions

Test Hole	Length	Width	Max Eff Depth
TP02	1.5	1	1.23

Formula	**Data**		
t_{p75-25}	45	mins	*(From graph)*
V_{p75-25}	0.9225	m^3	*(From above)*
a_{p50}	4.575	m^2	*(From above)*

Final Result

q	7.5E-05	m/s



Project: Roadstone, Midleton, Co. Cork
Appendix I: BRE365 Infiltration Test Sheet

q = soil infiltration rate

$q = V_{p75-25}/a_{p50} \times t_{p75-25}$

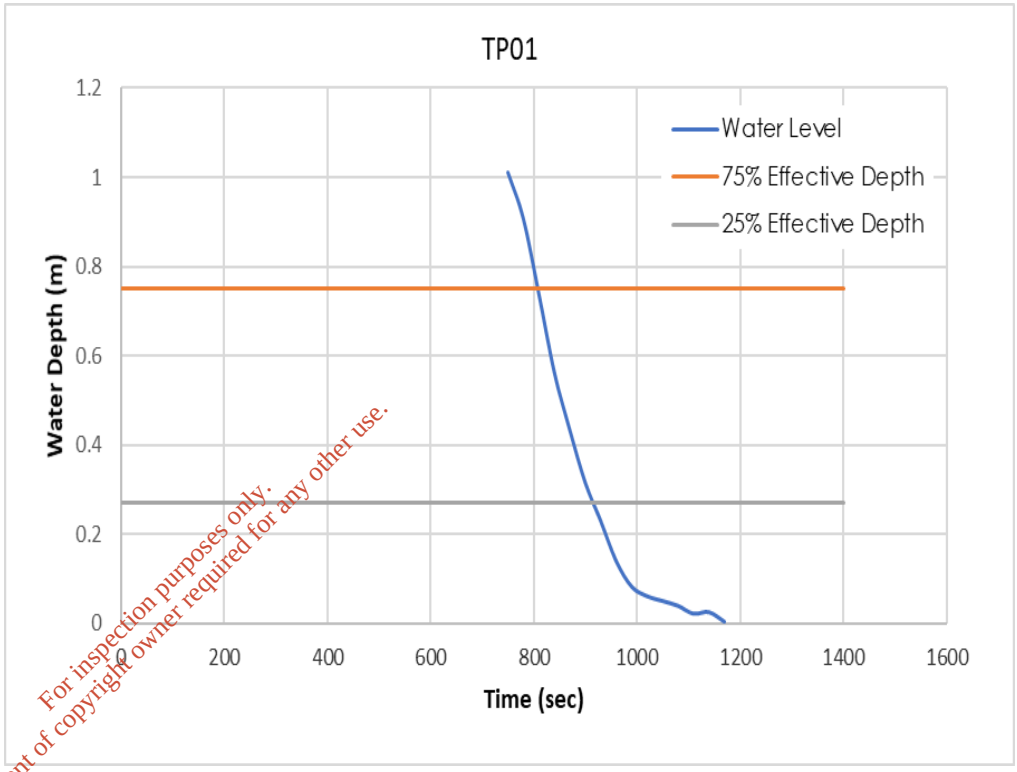
Test Pit Dimensions

Test Hole	Length	Width	Max Eff Depth
TP01	1.4	1.1	1

Formula	**Data**		
t_{p75-25}	2	mins	*(From graph)*
V_{p75-25}	0.77	m^3	*(From above)*
a_{p50}	4.04	m^2	*(From above)*

Final Result

q	1.6E-03	m/s



APPENDIX II: MONITORING WELL DRILLING LOGS

petersen drilling services ltd. on behalf of ROADSTONE — Rotary Drilling Log

Depth of Stratum Top (m)	Driller's Stratum Description
0.00	Firm brown silty sandy gravelly CLAY possible fill
0.70	Medium strong grey LIMESTONE weathered occasional clay infill
2.00	Very strong grey LIMESTONE

Sample / Hole / Test Details					Drilling Details				Standard Penetration Test											
No	Type	Insitu test	From (m)	To (m)	Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
1400			
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1800	21.50	Dry	2.00

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Bit serial No	Flush	Polymer

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)

Backfill (m)

Type	From (m)	To (m)

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks
		General; mobilisation to site near Midleton Co. Cork

SPT I.D. Number	pd1	Calibration Date	18/09/2017
SPT Rod Type	2 3/8 Regular	SPT Energy Ratio	0.00
Drilling Crew Details			CSCS No
Support Operative	john whyte		
Lead Driller	stephan petersen		
Site category	Green		
Project Engineer			
Lead Driller's signature			

Project Title

Midleton Quarry Roadstone

Weather	Fine	Project No	44/17
Date	05/12/2017	Day	Tuesday
Rig type	knebel hy79	Borehole Number	
Inclination		Orientation	17 MW1
Sheet	1 of 2	Completed	Y

AGS

Produced by KeyLogbook

petersen drilling services ltd. on behalf of **ROADSTONE** Rotary Drilling Log

Depth of Stratum Top (m)	Driller's Stratum Description	Sample / Hole / Test Details: No	Type	Insitu test	From (m)	To (m)	Drilling Details: Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Standard Penetration Test: Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)
			RO		0.00	45.50	0000		100	grey												Dry

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
0800	21.50	Dry	2.00
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1405	0.00		

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Bit serial No	Flush	Polymer
RO	154.00	0.00	2.00				DTH	115	Air	No
C	140.00	0.00	2.00							
RO	120.00	2.00	45.50				DTH		Air	No

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)

Backfill (m)

Type	From (m)	To (m)

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks

SPT I.D. Number	pd1	Calibration Date	18/09/2017
SPT Rod Type	2 3/8 Regular	SPT Energy Ratio	0.00
Drilling Crew Details			CSCS No
Support Operative	john whyte		
Lead Driller	stephan petersen		
Site category	Green		
Project Engineer			
Lead Driller's signature			

Project Title

Midleton Quarry Roadstone

Weather	Variable	Project No	44/17
Date	06/12/2017	Day	Wednesday
Rig type	knebel hy79	Borehole Number	
Inclination		Orientation	17 MW1
Sheet	2 of 2	Completed	Y

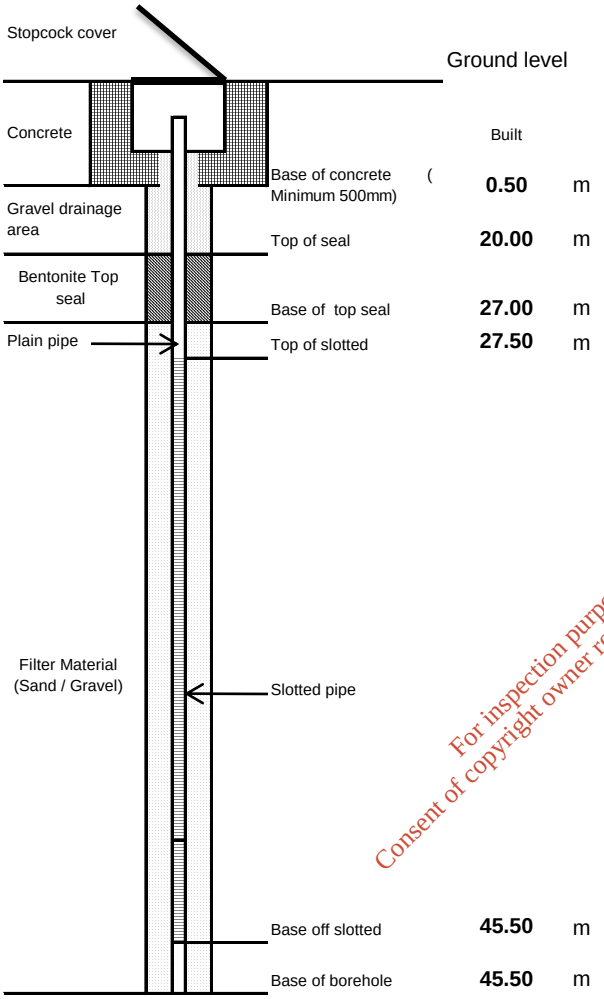
AGS

Produced by KeyLogbook

petersen drilling services ltd.

Summary of Standpipe Installation

Schematic Diagram (not to scale)



Installation Details

Standpipe diameter (id)	50	mm
Borehole diameter	120	mm
Slot size	1	mm
Geosock	Yes	
Gas tap	None	
Filter type	Gravel	
Type of cover	Upright	
Initial reading	Dry	m
Time of Initial reading	1405	hhmm

	Base (m)	Top (m)
Concrete	0.50	GL
Gravel drainage	20.00	0.50
Borehole seal top	27.00	20.00
Filter zone	45.50	27.00
Plain pipe	27.50	GL
Slotted zone	45.50	27.50
Base of borehole	45.50	

Remarks

Rig type	knebel hy79	**Project Title**			
Drilling Crew Details		Midleton Quarry Roadstone			
Support Operative	john whyte				
Lead Driller	stephan petersen	**Project No**		44/17	
Site category	Green	**Day**	Wednesday	**Date**	December 6, 2017
Engineer				**Borehole Number**	
Lead Driller's signature				**17 MW1**	

AGS

Produced by KeyLogbook

petersen drilling services ltd. on behalf of **ROADSTONE** Rotary Drilling Log

Depth of Stratum Top (m)	Driller's Stratum Description	Sample / Hole / Test Details: No	Type	Insitu test	From (m)	To (m)	Drilling Details: Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Standard Penetration Test: Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)
0.00	sandy fill with Brick limestone boulders MADE GROUND		RO		0.00	24.30	0000		100	grey												0.00
0.70	Firm to stiff brown reddish silty slightly gravelly CLAY with occasional limestone boulders																					
2.40	Very strong grey LIMESTONE occasional fractures																					
21.00	Very strong grey LIMESTONE rare fractures some soft brown clay infill																					

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
1405			
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1820	24.30	0.00	3.40

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Bit serial No	Flush	Polymer
C	140.00	0.00	3.40							
RO	154.00	0.00	3.40				DTH	115	Air	No
RO	120.00	3.40	24.30				DTH		Air	No

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)
1700	18.30	3.40	Very Slow	0.00	0.00	0.00	0.00	N/S
1800	21.50	3.40	Medium	0.00	0.00	0.00	0.00	N/S

Backfill (m)

Type	From (m)	To (m)

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks

SPT I.D. Number	pd1	Calibration Date	18/09/2017
SPT Rod Type	2 3/8 Regular	SPT Energy Ratio	0.00
Drilling Crew Details			CSCS No
Support Operative	john whyte		
Lead Driller	stephan petersen		
Site category	Green		
Project Engineer			
Lead Driller's signature			

Project Title

Midleton Quarry Roadstone

Weather	Showers	Project No	44/17
Date	06/12/2017	Day	Wednesday
Rig type	knebel hy79	Borehole Number	
Inclination		Orientation	17 MW2
Sheet	1 of 2	Completed	Y

AGS

Produced by KeyLogbook

petersen drilling services ltd. on behalf of **ROADSTONE** Rotary Drilling Log

Depth of Stratum Top (m)	Driller's Stratum Description	Sample / Hole / Test Details					Drilling Details				Standard Penetration Test												
		No	Type	Insitu test	From (m)	To (m)	Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
0800	24.30	14.70	3.40
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1025	0.00		

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Bit serial No	Flush	Polymer

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)

Backfill (m)

Type	From (m)	To (m)

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks

SPT I.D. Number	pd1	Calibration Date	18/09/2017
SPT Rod Type	2 3/8 Regular	SPT Energy Ratio	0.00
Drilling Crew Details			CSCS No
Support Operative	john whyte		
Lead Driller	stephan petersen		
Site category	Green		
Project Engineer			
Lead Driller's signature			

Project Title

Midleton Quarry Roadstone

Weather	Fine	Project No	44/17
Date	07/12/2017	Day	Thursday
Rig type	knebel hy79	Borehole Number	
Inclination	Orientation		17 MW2
Sheet	2 of 2	Completed	Y

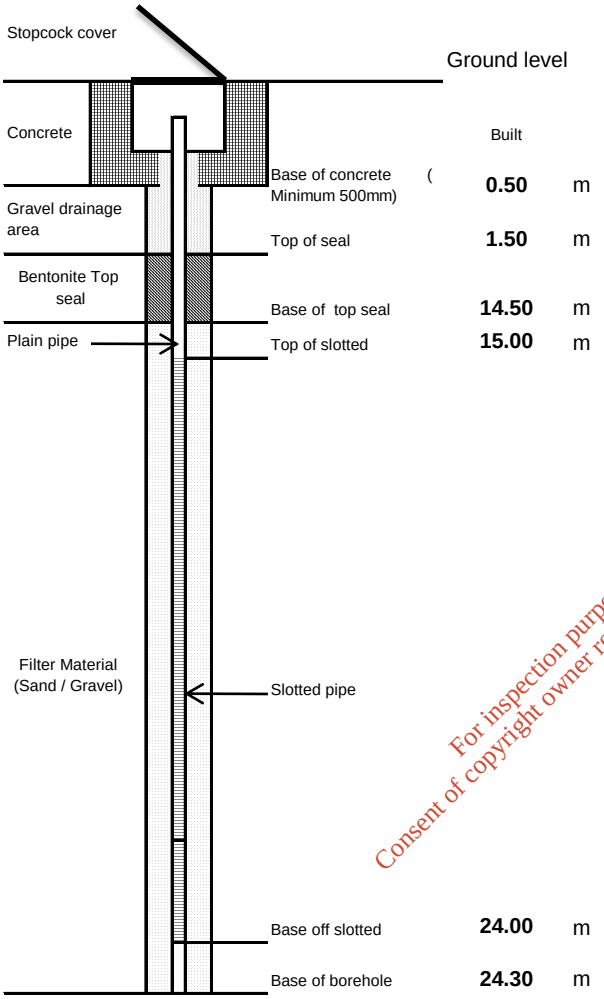
AGS

Produced by KeyLogbook

petersen drilling services ltd.

Summary of Standpipe Installation

Schematic Diagram (not to scale)



Installation Details

Standpipe diameter (id)	50	mm
Borehole diameter	120	mm
Slot size	1	mm
Geosock	Yes	
Gas tap	None	
Filter type	Gravel	
Type of cover	Upright	
Initial reading	14.70	m
Time of Initial reading	1025	hhmm

	Base (m)	Top (m)
Concrete	0.50	GL
Gravel drainage	1.50	0.50
Borehole seal top	14.50	1.50
Filter zone	24.30	14.50
Plain pipe	15.00	GL
Slotted zone	24.00	15.00
Base of borehole	24.30	

Remarks

Rig type	knebel hy79	**Project Title**			
Drilling Crew Details		Midleton Quarry Roadstone			
Support Operative	john whyte				
Lead Driller	stephan petersen	**Project No**		44/17	
Site category	Green	**Day**	Thursday	**Date**	December 7, 2017
Engineer				**Borehole Number**	
Lead Driller's signature				**17 MW2**	

AGS

Produced by KeyLogbook

petersen drilling services ltd. on behalf of ROADSTONE — Rotary Drilling Log

Depth of Stratum Top (m)	Driller's Stratum Description	Sample / Hole / Test Details: No	Type	Insitu test	From (m)	To (m)	Drilling Details: Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Standard Penetration Test: Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)
			RO		0.00	24.50	0000		100	brown												16.00
0.00	Hardcore MADE GROUND																					
0.20	Firm to stiff brown reddish very sandy silty CLAY																					
21.00	Strong grey LIMESTONE																					
22.30	Weak brown greyish LIMESTONE weathered																					
24.10	Strong grey LIMESTONE																					

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
1025			
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1545	0.00		

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Bit serial No	Flush	Polymer
C	140.00	0.00	22.00							
RO	154.00	0.00	22.00				DTH	115	Air	No
RO	120.00	22.00	24.50				DTH		Air	No

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)
1345	22.50	22.00	Fast	0.00	0.00	0.00	0.00	N/S

Backfill (m)

Type	From (m)	To (m)

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks

SPT I.D. Number	pd1	Calibration Date	18/09/2017
SPT Rod Type	2 3/8 Regular	SPT Energy Ratio	0.00
Drilling Crew Details			CSCS No
Support Operative	john whyte		
Lead Driller	stephan petersen		
Site category	Green		
Project Engineer			
Lead Driller's signature			

Project Title

Midleton Quarry Roadstone

Weather	Variable	Project No	44/17
Date	07/12/2017	Day	Thursday
Rig type	knebel hy79	Borehole Number	
Inclination		Orientation	17 MW3
Sheet	1 of 1	Completed	Y

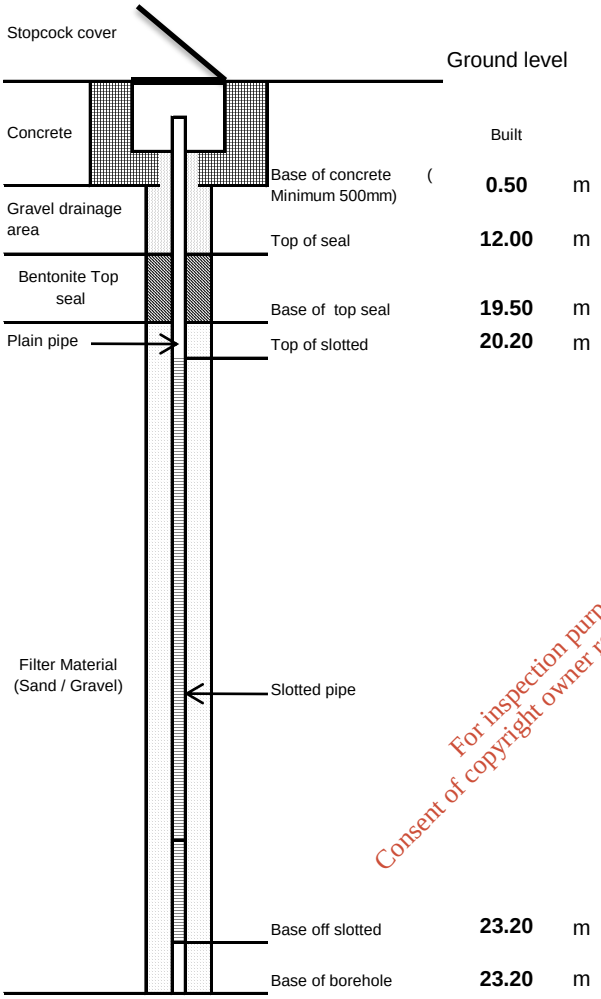
AGS

Produced by KeyLogbook

petersen drilling services ltd.

Summary of Standpipe Installation

Schematic Diagram (not to scale)



Installation Details

Standpipe diameter (id)	50	mm
Borehole diameter	120	mm
Slot size	1	mm
Geosock	Yes	
Gas tap	None	
Filter type	Gravel	
Type of cover	Upright	
Initial reading	16.00	m
Time of Initial reading	1545	hhmm

	Base (m)	Top (m)
Concrete	0.50	GL
Gravel drainage	12.00	0.50
Borehole seal top	19.50	12.00
Filter zone	23.20	19.50
Plain pipe	20.20	GL
Slotted zone	23.20	20.20
Base of borehole	23.20	

Remarks

Rig type	knebel hy79	**Project Title**			
Drilling Crew Details		Midleton Quarry Roadstone			
Support Operative	john whyte				
Lead Driller	stephan petersen	**Project No**		44/17	
Site category	Green	**Day**	Thursday	**Date**	December 7, 2017
Engineer				**Borehole Number**	
Lead Driller's signature				**17 MW3**	

AGS

Produced by KeyLogbook

petersen drilling services ltd. on behalf of **ROADSTONE** Rotary Drilling Log

Depth of Stratum Top (m)	Driller's Stratum Description	Sample / Hole / Test Details: No	Type	Insitu test	From (m)	To (m)	Drilling Details: Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Standard Penetration Test: Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)
0.00	sandy Hardcore MADE GROUND		RO		0.00	35.00	0000		100	grey												0.00
1.80	Firm brown reddish silty CLAY																					
2.40	Very strong grey LIMESTONE																					
16.50	Medium strong grey LIMESTONE weathered fractures																					
17.50	Very strong grey LIMESTONE																					
32.00	Soft to firm brown orangish silty gravelly CLAY fault infill																					

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
0820			
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1630	35.00	0.00	3.50

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Bit serial No	Flush	Polymer
C	140.00	0.00	3.50							
RO	154.00	0.00	3.50				DTH	115	Air	No
RO	120.00	3.50	35.00				DTH		Air	No

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)

Backfill (m)

Type	From (m)	To (m)

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks

SPT I.D. Number	pd1	Calibration Date	18/09/2017
SPT Rod Type	2 3/8 Regular	SPT Energy Ratio	0.00
Drilling Crew Details			CSCS No
Support Operative	john whyte		
Lead Driller	stephan petersen		
Site category	Green		
Project Engineer			
Lead Driller's signature			

Project Title

Midleton Quarry Roadstone

Weather	Fine	Project No	44/17
Date	08/12/2017	Day	Friday
Rig type	knebel hy79	Borehole Number	
Inclination		Orientation	17 MW4
Sheet	1 of 2	Completed	Y

AGS

Produced by KeyLogbook

petersen drilling services ltd. on behalf of **ROADSTONE** Rotary Drilling Log

Depth of Stratum Top (m)	Driller's Stratum Description	Sample / Hole / Test Details: No	Type	Insitu test	From (m)	To (m)	Drilling Details: Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Standard Penetration Test: Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
0820	35.00	14.00	3.50
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1405	0.00		

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Bit serial No	Flush	Polymer

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)

Backfill (m)

Type	From (m)	To (m)

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks
0830	0400	Dayworks: Airlift developing of well

SPT I.D. Number	pd1	Calibration Date	18/09/2017
SPT Rod Type	2 3/8 Regular	SPT Energy Ratio	0.00
Drilling Crew Details			CSCS No
Support Operative	john whyte		
Lead Driller	stephan petersen		
Site category	Green		
Project Engineer			
Lead Driller's signature			

Project Title

Midleton Quarry Roadstone

Weather	Variable	Project No	44/17
Date	11/12/2017	Day	Monday
Rig type	knebel hy79	Borehole Number	
Inclination		Orientation	17 MW4
Sheet	2 of 2	Completed	Y

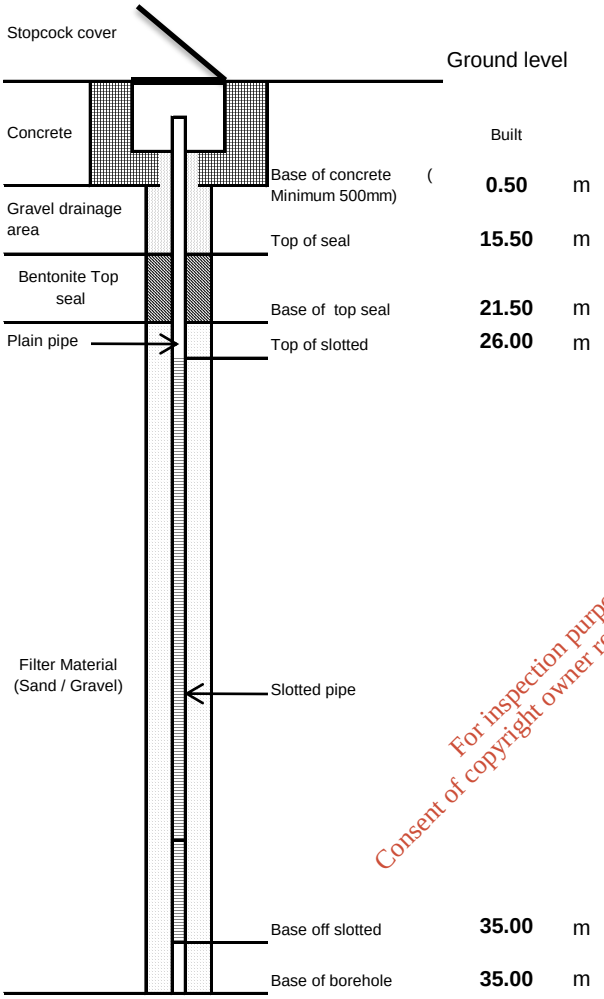
AGS

Produced by KeyLogbook

petersen drilling services ltd.

Summary of Standpipe Installation

Schematic Diagram (not to scale)



Installation Details

Standpipe diameter (id)	50	mm
Borehole diameter	120	mm
Slot size	1	mm
Geosock	Yes	
Gas tap	None	
Filter type	Gravel	
Type of cover	Upright	
Initial reading	19.00	m
Time of Initial reading	1355	hhmm

	Base (m)	Top (m)
Concrete	0.50	GL
Gravel drainage	15.50	0.50
Borehole seal top	21.50	15.50
Filter zone	35.00	21.50
Plain pipe	26.00	GL
Slotted zone	35.00	26.00
Base of borehole	35.00	

Remarks

Rig type	knebel hy79	**Project Title**			
Drilling Crew Details		Midleton Quarry Roadstone			
Support Operative	john whyte				
Lead Driller	stephan petersen	**Project No**		44/17	
Site category	Green	**Day**	Monday	**Date**	December 11, 2017
Engineer				**Borehole Number**	
Lead Driller's signature				**17 MW4**	

AGS

Produced by KeyLogbook

petersen drilling services ltd. on behalf of **ROADSTONE** Rotary Drilling Log

Depth of Stratum Top (m)	Driller's Stratum Description	Sample / Hole / Test Details: No	Type	Insitu test	From (m)	To (m)	Drilling Details: Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Standard Penetration Test: Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)
0.00	sandy rock fill MADE GROUND		RO		0.00	30.00	0000		100	grey												Dry
0.30	Strong grey LIMESTONE with occasional weathered layers																					

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
1405			
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1830	0.00		

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Bit serial No	Flush	Polymer
C	140.00	0.00	0.50							
RO	154.00	0.00	0.50				DTH	115	Air	No
RO	120.00	0.50	30.00				DTH		Air	No

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)
1505	9.00	0.50	Slow	0.00	0.00	0.00	0.00	N/S

Backfill (m)

Type	From (m)	To (m)

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks
		General; 26 to 27m weathered weak Limestone

SPT I.D. Number	pd1	Calibration Date	18/09/2017
SPT Rod Type	2 3/8 Regular	SPT Energy Ratio	0.00
Drilling Crew Details			CSCS No
Support Operative	john whyte		
Lead Driller	stephan petersen		
Site category	Green		
Project Engineer			
Lead Driller's signature			

Project Title

Midleton Quarry Roadstone

Weather	Variable	Project No	44/17
Date	11/12/2017	Day	Monday
Rig type	knebel hy79	Borehole Number	
Inclination		Orientation	17 MW5
Sheet	1 of 1	Completed	Y

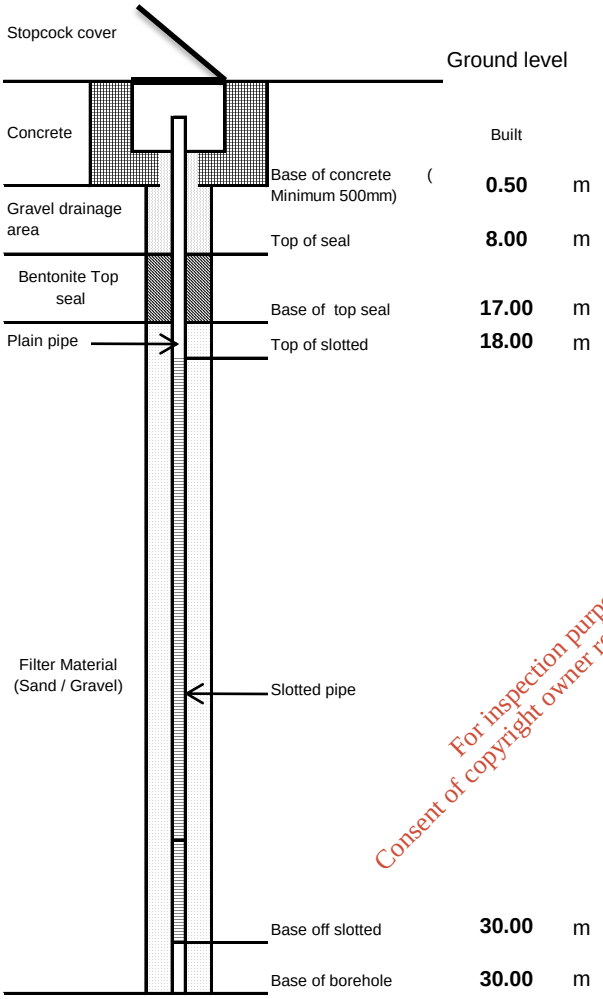
AGS

Produced by KeyLogbook

petersen drilling services ltd.

Summary of Standpipe Installation

Schematic Diagram (not to scale)



Installation Details

Standpipe diameter (id)	50	mm
Borehole diameter	120	mm
Slot size	1	mm
Geosock	Yes	
Gas tap	None	
Filter type	Gravel	
Type of cover	Upright	
Initial reading	0.00	m
Time of Initial reading	1740	hhmm

	Base (m)	Top (m)
Concrete	0.50	GL
Gravel drainage	8.00	0.50
Borehole seal top	17.00	8.00
Filter zone	30.00	17.00
Plain pipe	18.00	GL
Slotted zone	30.00	18.00
Base of borehole	30.00	

Remarks

Rig type	knebel hy79	**Project Title**			
Drilling Crew Details		Midleton Quarry Roadstone			
Support Operative	john whyte				
Lead Driller	stephan petersen	**Project No**		44/17	
Site category	Green	**Day**	Monday	**Date**	December 11, 2017
Engineer				**Borehole Number**	
Lead Driller's signature				**17 MW5**	

AGS

Produced by KeyLogbook

petersen drilling services ltd. on behalf of **ROADSTONE** Rotary Drilling Log

Depth of Stratum Top (m)	Driller's Stratum Description	Sample / Hole / Test Details: No	Type	Insitu test	From (m)	To (m)	Drilling Details: Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Standard Penetration Test: Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)
			RO		0.00	31.00	0000		100	grey												Dry
0.00	Firm TOPSOIL																					
0.20	Firm brown reddish silty CLAY																					
7.30	Weak grey LIMESTONE weathered with clay infill																					
8.40	Strong grey LIMESTONE with occasional clay infill																					
10.70	Very weak LIMESTONE clay filled fracture																					
11.50	Strong grey LIMESTONE																					

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
0805			
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1535	0.00		

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Bit serial No	Flush	Polymer
C	140.00	0.00	8.50							
RO	154.00	0.00	8.50				DTH	115	Air	No
RO	120.00	8.50	31.00				DTH		Air	No

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)
1320	26.00	8.50	Very Slow	0.00	0.00	0.00	0.00	N/S

Backfill (m)

Type	From (m)	To (m)

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks

SPT I.D. Number	pd1	Calibration Date	18/09/2017
SPT Rod Type	2 3/8 Regular	SPT Energy Ratio	0.00
Drilling Crew Details			CSCS No
Support Operative	john whyte		
Lead Driller	stephan petersen		
Site category	Green		
Project Engineer			
Lead Driller's signature			

Project Title

Midleton Quarry Roadstone

Weather	Showers	Project No	44/17
Date	12/12/2017	Day	Tuesday
Rig type	knebel hy79	Borehole Number	
Inclination		Orientation	17 MW6
Sheet	1 of 1	Completed	Y

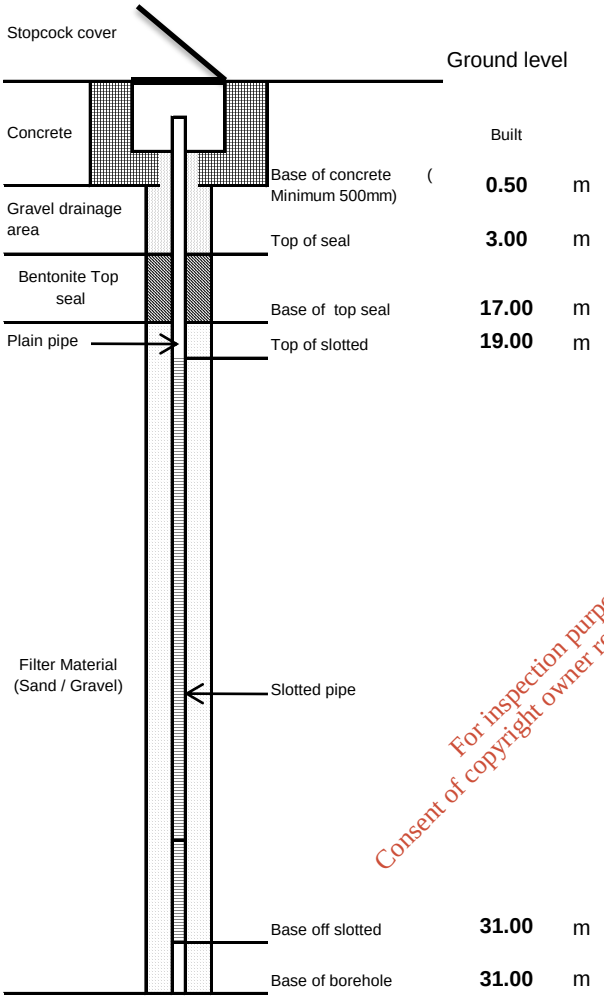
AGS

Produced by KeyLogbook

petersen drilling services ltd.

Summary of Standpipe Installation

Schematic Diagram (not to scale)



Installation Details

Standpipe diameter (id)	50	mm
Borehole diameter	120	mm
Slot size	1	mm
Geosock	Yes	
Gas tap	None	
Filter type	Gravel	
Type of cover	Upright	
Initial reading	27.50	m
Time of Initial reading	1515	hhmm

	Base (m)	Top (m)
Concrete	0.50	GL
Gravel drainage	3.00	0.50
Borehole seal top	17.00	3.00
Filter zone	31.00	17.00
Plain pipe	19.00	GL
Slotted zone	31.00	19.00
Base of borehole	31.00	

Remarks

Rig type	knebel hy79	**Project Title**			
Drilling Crew Details		Midleton Quarry Roadstone			
Support Operative	john whyte				
Lead Driller	stephan petersen	**Project No**		44/17	
Site category	Green	**Day**	Tuesday	**Date**	December 12, 2017
Engineer				**Borehole Number**	
Lead Driller's signature				**17 MW6**	

AGS

Produced by KeyLogbook

APPENDIX III: ORIGINAL LABORATORY REPORTS

ALS Environmental Ltd
Unit 11
Silkwood Park
Janes Hill
Off Albert Drive
Wakefield
WF5 9TG

T: +44 (0)1924 818100
F: +44 (0)1924 818101
www.alsenvironmental.co.uk

Mr O'Sullivan
ALS Life Sciences (Ireland)
Lismard Business Park
Timahoe Road
Portlaoise Laois

22 March 2018

Test Report: WAK/1518885/2018

Dear Mr O'Sullivan

Analysis of your sample(s) submitted on 09 March 2018 is now complete and we have pleasure in enclosing the appropriate test report(s).

An invoice for the analysis carried out will be sent under separate cover.

Should you have any queries regarding this report(s) or any part of our service, please contact Customer Services on +44 (0)1924 818100 who will be happy to discuss your requirements.

If you would like to arrange any further analysis, please contact Customer Services. To arrange container delivery or sample collection, please call the Couriers Department directly on 024 7685 6562.

Thank you for using ALS Environmental Ltd and we look forward to receiving your next samples.

Yours Sincerely,

Signed:

Name: C. Ulph

Title: Micro & Logistics Manager

Report Summary

UKAS TESTING
1314
0897
4409

ALS Environmental

Mr Thomas O'Sullivan
ALS Life Sciences (Ireland)
Lismard Business Park
Timahoe Road
Portlaoise
Laois

Date of Issue: **22 March 2018**

Report Number: **WAK/1518885/2018** Issue **1**

This issue replaces all previous issues

Job Description: General Analysis

Job Location: HYDR-416080318

Number of Samples included in this report **6**

Job Received: **09 March 2018**

Number of Test Results included in this report **54**

Analysis Commenced: **11 March 2018**

Signed:

Name: **C. Ulph** Date: **22 March 2018**

Title: **Micro & Logistics Manager**

ALS Environmental Ltd was not responsible for sampling unless otherwise stated.

Information on the methods of analysis and performance characteristics are available on request.
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. The results relate only to the items tested.
Tests marked 'Not UKAS Accredited' in this Report/Certificate are not included in the UKAS Accreditation Schedule for our laboratory.

Certificate of Analysis

UKAS TESTING
1314
0897
4409

ALS Environmental

Report Number: **WAK/1518885/2018** Issue **1**
Laboratory Number: **16922903** Sample **1** of **6**

Sample Source: **ALS Life Sciences (Ireland)**
Sample Point Description: **ALS Clonmel Waste**
Sample Description: **3009715 Midleton well 1**
Sample Matrix: **Ground Water**
Sample Date/Time: **08 March 2018**
Sample Received: **09 March 2018**
Analysis Complete: **22 March 2018**

Test Description	Result	Units	Analysis Date	Accreditation		Method
Calcium, Filtered as Ca	90.9	mg/l	21/03/2018	Y	Cov	WAS049
Copper, Filtered as Cu	<0.009	mg/l	21/03/2018	Y	Cov	WAS049
Iron, Filtered as Fe	<0.23	mg/l	21/03/2018	Y	Cov	WAS049
Magnesium, Filtered as Mg	15.5	mg/l	21/03/2018	Y	Cov	WAS049
Manganese, Filtered as Mn	<0.007	mg/l	21/03/2018	Y	Cov	WAS049
Nickel, Filtered as Ni	<0.003	mg/l	21/03/2018	Y	Cov	WAS049
Potassium, Filtered as K	4.39	mg/l	21/03/2018	Y	Cov	WAS049
Sodium, Filtered as Na	88.1	mg/l	21/03/2018	Y	Cov	WAS049
Arsenic, trace filtered as As	<0.0010	mg/l	15/03/2018	Y	Cov	WAS060

Analyst Comments for 16922903: No Analyst Comment

This issue replaces all previous issues
Accreditation Codes: Y = UKAS / ISO17025 Accredited, N = Not UKAS / ISO17025 Accredited, M = MCERTS.
Analysed at: CHE = Chester(CH4 9EP), CTD = Coatbridge(ML5 4FR), COV = Coventry(CV4 9GU), OTT = Otterbourne(SO21 2SW), S = Subcontracted, TRB = Subcontracted to Trowbridge(BA14 0XD), WAK = Wakefield(WF5 9TG).
For Microbiological determinands 0 or ND=Not Detected, For Legionella ND=Not Detected in volume of sample filtered.
I/S=Insufficient sample For soil/sludge samples: AR=As received, DW=Dry weight.

Signed: 

Name: **C. Ulph** Date: **22 March 2018**
Title: **Micro & Logistics Manager**

ALS Environmental Ltd
Unit 11, Silkwood Park, Janes Hill, Off Albert Drive, Wakefield, WF5 9TG
Tel:+44 (0)1924 818100 Fax:+44 (0)1924 818101

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ALS Environmental

Report Number: **WAK/1518885/2018** Issue **1**
Laboratory Number: **16922904** Sample **2** of **6**

Sample Source: **ALS Life Sciences (Ireland)**
Sample Point Description: **ALS Clonmel Waste**
Sample Description: **3009718 Midleton mw2**
Sample Matrix: **Ground Water**
Sample Date/Time: **08 March 2018**
Sample Received: **09 March 2018**
Analysis Complete: **22 March 2018**

Test Description	Result	Units	Analysis Date	Accreditation		Method
Calcium, Filtered as Ca	72.3	mg/l	21/03/2018	Y	Cov	WAS049
Copper, Filtered as Cu	<0.009	mg/l	21/03/2018	Y	Cov	WAS049
Iron, Filtered as Fe	<0.23	mg/l	21/03/2018	Y	Cov	WAS049
Magnesium, Filtered as Mg	2.1	mg/l	21/03/2018	Y	Cov	WAS049
Manganese, Filtered as Mn	<0.007	mg/l	21/03/2018	Y	Cov	WAS049
Nickel, Filtered as Ni	<0.003	mg/l	21/03/2018	Y	Cov	WAS049
Potassium, Filtered as K	2.92	mg/l	21/03/2018	Y	Cov	WAS049
Sodium, Filtered as Na	9.60	mg/l	21/03/2018	Y	Cov	WAS049
Arsenic, trace filtered as As	<0.0010	mg/l	15/03/2018	Y	Cov	WAS060

Analyst Comments for 16922904: No Analyst Comment

This issue replaces all previous issues
Accreditation Codes: Y = UKAS / ISO17025 Accredited, N = Not UKAS / ISO17025 Accredited, M = MCERTS.
Analysed at: CHE = Chester(CH4 9EP), CTD = Coatbridge(ML5 4FR), COV = Coventry(CV4 9GU), OTT = Otterbourne(SO21 2SW), S = Subcontracted, TRB = Subcontracted to Trowbridge(BA14 0XD), WAK = Wakefield(WF5 9TG).
For Microbiological determinands 0 or ND=Not Detected, For Legionella ND=Not Detected in volume of sample filtered.
I/S=Insufficient sample For soil/sludge samples: AR=As received, DW=Dry weight.

Signed: 

Name: **C. Ulph** Date: **22 March 2018**
Title: **Micro & Logistics Manager**

ALS Environmental Ltd
Unit 11, Silkwood Park, Janes Hill, Off Albert Drive, Wakefield, WF5 9TG
Tel:+44 (0)1924 818100 Fax:+44 (0)1924 818101

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ALS Environmental

Report Number: **WAK/1518885/2018** Issue **1**
Laboratory Number: **16922905** Sample **3** of **6**

Sample Source: **ALS Life Sciences (Ireland)**
Sample Point Description: **ALS Clonmel Waste**
Sample Description: **3009721 Midleton mw3**
Sample Matrix: **Ground Water**
Sample Date/Time: **08 March 2018**
Sample Received: **09 March 2018**
Analysis Complete: **22 March 2018**

Test Description	Result	Units	Analysis Date	Accreditation		Method
Calcium, Filtered as Ca	127	mg/l	21/03/2018	Y	Cov	WAS049
Copper, Filtered as Cu	<0.009	mg/l	21/03/2018	Y	Cov	WAS049
Iron, Filtered as Fe	<0.23	mg/l	21/03/2018	Y	Cov	WAS049
Magnesium, Filtered as Mg	4.6	mg/l	21/03/2018	Y	Cov	WAS049
Manganese, Filtered as Mn	0.009	mg/l	21/03/2018	Y	Cov	WAS049
Nickel, Filtered as Ni	<0.003	mg/l	21/03/2018	Y	Cov	WAS049
Potassium, Filtered as K	0.64	mg/l	21/03/2018	Y	Cov	WAS049
Sodium, Filtered as Na	10.2	mg/l	21/03/2018	Y	Cov	WAS049
Arsenic, trace filtered as As	<0.0010	mg/l	15/03/2018	Y	Cov	WAS060

Analyst Comments for 16922905: No Analyst Comment

This issue replaces all previous issues
Accreditation Codes: Y = UKAS / ISO17025 Accredited, N = Not UKAS / ISO17025 Accredited, M = MCERTS.
Analysed at: CHE = Chester(CH4 9EP), CTD = Coatbridge(ML5 4FR), COV = Coventry(CV4 9GU), OTT = Otterbourne(SO21 2SW), S = Subcontracted, TRB = Subcontracted to Trowbridge(BA14 0XD), WAK = Wakefield(WF5 9TG).
For Microbiological determinands 0 or ND=Not Detected, For Legionella ND=Not Detected in volume of sample filtered.
I/S=Insufficient sample For soil/sludge samples: AR=As received, DW=Dry weight.

Signed: 

Name: **C. Ulph** Date: **22 March 2018**

Title: **Micro & Logistics Manager**

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ALS Environmental

Report Number: **WAK/1518885/2018** Issue **1**
Laboratory Number: **16922906** Sample **4** of **6**

Sample Source: **ALS Life Sciences (Ireland)**
Sample Point Description: **ALS Clonmel Waste**
Sample Description: **3009724 Midleton mw4**
Sample Matrix: **Ground Water**
Sample Date/Time: **08 March 2018**
Sample Received: **09 March 2018**
Analysis Complete: **22 March 2018**

Test Description	Result	Units	Analysis Date	Accreditation		Method
Calcium, Filtered as Ca	75.3	mg/l	21/03/2018	Y	Cov	WAS049
Copper, Filtered as Cu	<0.009	mg/l	21/03/2018	Y	Cov	WAS049
Iron, Filtered as Fe	<0.23	mg/l	21/03/2018	Y	Cov	WAS049
Magnesium, Filtered as Mg	5.8	mg/l	21/03/2018	Y	Cov	WAS049
Manganese, Filtered as Mn	<0.007	mg/l	21/03/2018	Y	Cov	WAS049
Nickel, Filtered as Ni	<0.003	mg/l	21/03/2018	Y	Cov	WAS049
Potassium, Filtered as K	1.43	mg/l	21/03/2018	Y	Cov	WAS049
Sodium, Filtered as Na	13.2	mg/l	21/03/2018	Y	Cov	WAS049
Arsenic, trace filtered as As	<0.0010	mg/l	15/03/2018	Y	Cov	WAS060

Analyst Comments for 16922906: No Analyst Comment

This issue replaces all previous issues
Accreditation Codes: Y = UKAS / ISO17025 Accredited, N = Not UKAS / ISO17025 Accredited, M = MCERTS.
Analysed at: CHE = Chester(CH4 9EP), CTD = Coatbridge(ML5 4FR), COV = Coventry(CV4 9GU), OTT = Otterbourne(SO21 2SW), S = Subcontracted, TRB = Subcontracted to Trowbridge(BA14 0XD), WAK = Wakefield(WF5 9TG).
For Microbiological determinands 0 or ND=Not Detected, For Legionella ND=Not Detected in volume of sample filtered.
I/S=Insufficient sample For soil/sludge samples: AR=As received, DW=Dry weight.

Signed: 

Name: **C. Ulph** Date: **22 March 2018**

Title: **Micro & Logistics Manager**

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ALS Environmental

Report Number: **WAK/1518885/2018** Issue **1**
Laboratory Number: **16922907** Sample **5** of **6**

Sample Source: **ALS Life Sciences (Ireland)**
Sample Point Description: **ALS Clonmel Waste**
Sample Description: **3009727 Midleton mw5**
Sample Matrix: **Ground Water**
Sample Date/Time: **08 March 2018**
Sample Received: **09 March 2018**
Analysis Complete: **22 March 2018**

Test Description	Result	Units	Analysis Date	Accreditation		Method
Calcium, Filtered as Ca	68.1	mg/l	21/03/2018	Y	Cov	WAS049
Copper, Filtered as Cu	<0.009	mg/l	21/03/2018	Y	Cov	WAS049
Iron, Filtered as Fe	<0.23	mg/l	21/03/2018	Y	Cov	WAS049
Magnesium, Filtered as Mg	4.1	mg/l	21/03/2018	Y	Cov	WAS049
Manganese, Filtered as Mn	0.010	mg/l	21/03/2018	Y	Cov	WAS049
Nickel, Filtered as Ni	0.005	mg/l	21/03/2018	Y	Cov	WAS049
Potassium, Filtered as K	2.87	mg/l	21/03/2018	Y	Cov	WAS049
Sodium, Filtered as Na	81.1	mg/l	21/03/2018	Y	Cov	WAS049
Arsenic, trace filtered as As	<0.0010	mg/l	15/03/2018	Y	Cov	WAS060

Analyst Comments for 16922907: No Analyst Comment

This issue replaces all previous issues
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For Microbiological determinands 0 or ND=Not Detected, For Legionella ND=Not Detected in volume of sample filtered.
I/S=Insufficient sample For soil/sludge samples: AR=As received, DW=Dry weight.

Signed: 

Name: **C. Ulph** Date: **22 March 2018**

Title: **Micro & Logistics Manager**

ALS Environmental Ltd
Unit 11, Silkwood Park, Janes Hill, Off Albert Drive, Wakefield, WF5 9TG
Tel:+44 (0)1924 818100 Fax:+44 (0)1924 818101

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ALS Environmental

Report Number: **WAK/1518885/2018** Issue **1**
Laboratory Number: **16922908** Sample **6** of **6**

Sample Source: **ALS Life Sciences (Ireland)**
Sample Point Description: **ALS Clonmel Waste**
Sample Description: **3009730 Midleton mw6**
Sample Matrix: **Ground Water**
Sample Date/Time: **08 March 2018**
Sample Received: **09 March 2018**
Analysis Complete: **22 March 2018**

Test Description	Result	Units	Analysis Date	Accreditation		Method
Calcium, Filtered as Ca	104	mg/l	21/03/2018	Y	Cov	WAS049
Copper, Filtered as Cu	<0.009	mg/l	21/03/2018	Y	Cov	WAS049
Iron, Filtered as Fe	<0.23	mg/l	21/03/2018	Y	Cov	WAS049
Magnesium, Filtered as Mg	8.1	mg/l	21/03/2018	Y	Cov	WAS049
Manganese, Filtered as Mn	0.015	mg/l	21/03/2018	Y	Cov	WAS049
Nickel, Filtered as Ni	0.011	mg/l	21/03/2018	Y	Cov	WAS049
Potassium, Filtered as K	2.79	mg/l	21/03/2018	Y	Cov	WAS049
Sodium, Filtered as Na	50.4	mg/l	21/03/2018	Y	Cov	WAS049
Arsenic, trace filtered as As	<0.0010	mg/l	15/03/2018	Y	Cov	WAS060

Analyst Comments for 16922908: No Analyst Comment

This issue replaces all previous issues
Accreditation Codes: Y = UKAS / ISO17025 Accredited, N = Not UKAS / ISO17025 Accredited, M = MCERTS.
Analysed at: CHE = Chester(CH4 9EP), CTD = Coatbridge(ML5 4FR), COV = Coventry(CV4 9GU), OTT = Otterbourne(SO21 2SW), S = Subcontracted, TRB = Subcontracted to Trowbridge(BA14 0XD), WAK = Wakefield(WF5 9TG).
For Microbiological determinands 0 or ND=Not Detected, For Legionella ND=Not Detected in volume of sample filtered.
I/S=Insufficient sample For soil/sludge samples: AR=As received, DW=Dry weight.

Signed: 

Name: **C. Ulph** Date: **22 March 2018**

Title: **Micro & Logistics Manager**

ALS Environmental Ltd
Unit 11, Silkwood Park, Janes Hill, Off Albert Drive, Wakefield, WF5 9TG
Tel:+44 (0)1924 818100 Fax:+44 (0)1924 818101

ANALYST COMMENTS FOR REPORT WAK/1518885/2018 Issue 1

This issue replaces all previous issues

Date of Issue: **22 March 2018**

Sample No	Analysis Comments
16922903	
16922904	
16922905	
16922906	
16922907	
16922908	

Signed: 

Name: **C. Ulph** Date: **22 March 2018**

Title: **Micro & Logistics Manager**

DETERMINAND COMMENTS FOR REPORT WAK/1518885/2018

ISSUE 1

This issue replaces all previous issues

Date of Issue: 22 March 2018

Sample No	Description	Determinand	Comments

Signed: 

Name: **C. Ulph** Date: **22 March 2018**

Title: **Micro & Logistics Manager**

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Trading as ALS
Carrigeen Business Park, Clonmel, Co. Tipperary
Tel: +353 (0) 52 617 8100
Fax:+353 (0) 52 617 8103
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ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.166T

Report No: HYDR-414080318
Document No: EF0011

CERTIFICATE OF ANALYSIS

Client **Hydro Environmental Services**
22 Lower Main Street
Dungarvan
Co. Waterford

Date Received 08/03/2018
Date Reported 21/03/2018
Order Number N/A

For the Attention of: Hydro Environmental Services

Sample Reception 6 sample(s) received in good condition.

Comments N/A

Note: A # next to the result indicates that there was insufficient sample to carry out testing as per SOP .

Report Authorised by: Rosemary Thomas

Rosemary Thomas
Environmental Chemistry Manager

Conditions:
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2. *Reports may not be reproduced except in full without the approval of ALS Life Sciences Ltd*
3. *All queries regarding this report should be addressed to the Technical Manager at the above address*
4. *A * next to a method reference signifies that ALS Life Sciences Ltd is NOT INAB accredited for this method*
5. *Results reported as CFU/cm^2 are calculated based on information supplied by customer regarding area swabbed*
6. *CFU indicates Colony Forming Units, MPN indicates Most Probable Number*
7. SUBCON* indicates analysis subcontracted to approved subcontractors who do not hold accreditation for this test
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Trading as ALS
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Tel: +353 (0) 52 617 8100
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ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.166T

Report No: HYDR-414080318

Document No: EF0011

CERTIFICATE OF ANALYSIS

Date Received 08/03/2018
Date Reported 21/03/2018
Order Number N/A

Sample Type Water
Client ID Midleton Well 1
Date Tested 09/03/2018
ALS ID 3009714

Test	Result	Unit	Method
Suspended Solids	<5	mg / l	P202
Phosphorus	<0.10	mg/l P	P207
Hardness	296	mg/l CaCO3	P213
Alkalinity Total	220	mg/l CaCO3	P214
pH	7.5	Units	P233
Turbidity	1.21	NTU	P239
Sulphate	44.5	mg/l SO4	P243
Dissolved Solids @ 180 degree	458	mg / l	P269*
Dissolved Solids @ 260 degree	<1	mg / l	P269*
Ammonia	<0.02	mg/l NH3-N	P281
Ammonium	<0.03	mg/l NH4	P281
Nitrate	3.3	mg/l NO3N	P281
Nitrate	14.6	mg/l NO3	P281
Nitrite	<0.01	mg/l NO2N	P281
Nitrite	<0.05	mg/l NO2	P281
Orthophosphate	<0.02	mg/l P	P281
Chloride	185.1	mg/l CL	P281
Conductivity @ 20°C	966	µs/cm	P284

Report Authorised by: Rosemary Thomas

Rosemary Thomas
Environmental Chemistry Manager

ALS Life Sciences Ltd
Trading as ALS
Carrigeen Business Park, Clonmel, Co. Tipperary
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Fax:+353 (0) 52 617 8103
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ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.166T

Report No: HYDR-414080318

Document No: EF0011

CERTIFICATE OF ANALYSIS

Date Received 08/03/2018
Date Reported 21/03/2018
Order Number N/A

Sample Type Water
Client ID Midleton MW 2
Date Tested 09/03/2018
ALS ID 3009717

Test	Result	Unit	Method
Suspended Solids	63	mg / l	P202
Phosphorus	<0.10	mg/l P	P207
Hardness	190	mg/l CaCO3	P213
Alkalinity Total	183	mg/l CaCO3	P214
pH	7.6	Units	P233
Turbidity	19.10	NTU	P239
Sulphate	8.2	mg/l SO4	P243
Dissolved Solids @ 180 degree	320	mg / l	P269*
Dissolved Solids @ 260 degree	<1	mg / l	P269*
Ammonia	<0.02	mg/l NH3-N	P281
Ammonium	<0.03	mg/l NH4	P281
Nitrate	3.9	mg/l NO3N	P281
Nitrate	17.2	mg/l NO3	P281
Nitrite	<0.01	mg/l NO2N	P281
Nitrite	<0.05	mg/l NO2	P281
Orthophosphate	<0.02	mg/l P	P281
Chloride	21.7	mg/l CL	P281
Conductivity @ 20°C	393	µs/cm	P284

Report Authorised by: Rosemary Thomas

Rosemary Thomas
Environmental Chemistry Manager

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Report No: HYDR-414080318

Document No: EF0011

CERTIFICATE OF ANALYSIS

Date Received 08/03/2018
Date Reported 21/03/2018
Order Number N/A

Sample Type Water
Client ID Midleton MW 3
Date Tested 09/03/2018
ALS ID 3009720

Test	Result	Unit	Method
Suspended Solids	108	mg / l	P202
Phosphorus	0.48	mg/l P	P207
Hardness	344	mg/l CaCO3	P213
Alkalinity Total	298	mg/l CaCO3	P214
pH	7.3	Units	P233
Turbidity	92.40	NTU	P239
Sulphate	23.8	mg/l SO4	P243
Dissolved Solids @ 180 degree	342	mg / l	P269*
Dissolved Solids @ 260 degree	<1	mg / l	P269*
Ammonia	0.02	mg/l NH3-N	P281
Ammonium	<0.03	mg/l NH4	P281
Nitrate	9.5	mg/l NO3N	P281
Nitrate	41.9	mg/l NO3	P281
Nitrite	<0.01	mg/l NO2N	P281
Nitrite	<0.05	mg/l NO2	P281
Orthophosphate	0.12	mg/l P	P281
Chloride	26.1	mg/l CL	P281
Conductivity @ 20°C	634	µs/cm	P284

Report Authorised by: Rosemary Thomas

Rosemary Thomas
Environmental Chemistry Manager

ALS Life Sciences Ltd
Trading as ALS
Carrigeen Business Park, Clonmel, Co. Tipperary
Tel: +353 (0) 52 617 8100
Fax:+353 (0) 52 617 8103
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Report No: HYDR-414080318

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CERTIFICATE OF ANALYSIS

Date Received 08/03/2018
Date Reported 21/03/2018
Order Number N/A

Sample Type Water
Client ID Midleton MW 4
Date Tested 09/03/2018
ALS ID 3009723

Test	Result	Unit	Method
Suspended Solids	5948	mg / l	P202
Phosphorus	13.50	mg/l P	P207
Hardness	220	mg/l CaCO3	P213
Alkalinity Total	184	mg/l CaCO3	P214
pH	7.5	Units	P233
Turbidity	8459	NTU	P239*
Sulphate	32.5	mg/l SO4	P243
Dissolved Solids @ 180 degree	184	mg / l	P269*
Dissolved Solids @ 260 degree	<1	mg / l	P269*
Ammonia	0.04	mg/l NH3-N	P281
Ammonium	0.05	mg/l NH4	P281
Nitrate	8.1	mg/l NO3N	P281
Nitrate	35.5	mg/l NO3	P281
Nitrite	<0.01	mg/l NO2N	P281
Nitrite	<0.05	mg/l NO2	P281
Orthophosphate	0.06	mg/l P	P281
Chloride	27.4	mg/l CL	P281
Conductivity @ 20°C	457	µs/cm	P284

Report Authorised by: Rosemary Thomas

Rosemary Thomas
Environmental Chemistry Manager

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Carrigeen Business Park, Clonmel, Co. Tipperary
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Fax:+353 (0) 52 617 8103
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Report No: HYDR-414080318

Document No: EF0011

CERTIFICATE OF ANALYSIS

Date Received 08/03/2018
Date Reported 21/03/2018
Order Number N/A

Sample Type Water
Client ID Midleton MW 5
Date Tested 09/03/2018
ALS ID 3009726

Test	Result	Unit	Method
Suspended Solids	1892	mg / l	P202
Phosphorus	0.84	mg/l P	P207
Hardness	176	mg/l CaCO3	P213
Alkalinity Total	333	mg/l CaCO3	P214
pH	7.7	Units	P233
Turbidity	2574	NTU	P239*
Sulphate	71.1	mg/l SO4	P243
Dissolved Solids @ 180 degree	318	mg / l	P269*
Dissolved Solids @ 260 degree	<1	mg / l	P269*
Ammonia	0.03	mg/l NH3-N	P281
Ammonium	0.04	mg/l NH4	P281
Nitrate	3.1	mg/l NO3N	P281
Nitrate	13.5	mg/l NO3	P281
Nitrite	<0.01	mg/l NO2N	P281
Nitrite	<0.05	mg/l NO2	P281
Orthophosphate	<0.02	mg/l P	P281
Chloride	104.9	mg/l CL	P281
Conductivity @ 20°C	747	µs/cm	P284

Report Authorised by: Rosemary Thomas

Rosemary Thomas
Environmental Chemistry Manager

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CERTIFICATE OF ANALYSIS

Date Received 08/03/2018
Date Reported 21/03/2018
Order Number N/A

Sample Type Water
Client ID Midleton MW 6
Date Tested 09/03/2018
ALS ID 3009729

Test	Result	Unit	Method
Suspended Solids	7954	mg / l	P202
Phosphorus	4.10	mg/l P	P207
Hardness	246	mg/l CaCO3	P213
Alkalinity Total	300	mg/l CaCO3	P214
pH	7.4	Units	P233
Turbidity	7126	NTU	P239*
Sulphate	43.2	mg/l SO4	P243
Dissolved Solids @ 180 degree	382	mg / l	P269*
Dissolved Solids @ 260 degree	<1	mg / l	P269*
Ammonia	0.02	mg/l NH3-N	P281
Ammonium	<0.03	mg/l NH4	P281
Nitrate	6.4	mg/l NO3N	P281
Nitrate	28.2	mg/l NO3	P281
Nitrite	0.01	mg/l NO2N	P281
Nitrite	<0.05	mg/l NO2	P281
Orthophosphate	<0.02	mg/l P	P281
Chloride	89.5	mg/l CL	P281
Conductivity @ 20°C	790	µs/cm	P284

Report Authorised by: Rosemary Thomas

Rosemary Thomas
Environmental Chemistry Manager

ALS Life Sciences Ltd
Trading as ALS
Carrigeen Business Park, Clonmel, Co. Tipperary
Tel: +353 (0) 52 617 8100
Fax:+353 (0) 52 617 8103
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Report No: HYDR-415080318
Document No: EF0011

SUPPLEMENTARY CERTIFICATE OF ANALYSIS

Client **Hydro Environmental Services**
22 Lower Main Street
Dungarvan
Co. Waterford

Date Received 08/03/2018
Date Reported 10/03/2018
Order Number N/A

For the Attention of: Hydro Environmental Services

Sample Reception 6 sample(s) received in good condition.

Comments N/A

Note: A # next to the result indicates that there was insufficient sample to carry out testing as per SOP .

Report Authorised by: Rosemary Thomas

Rosemary Thomas
Environmental Chemistry Manager

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4. *A * next to a method reference signifies that ALS Life Sciences Ltd is NOT INAB accredited for this method*
5. *Results reported as CFU/cm^2 are calculated based on information supplied by customer regarding area swabbed*
6. *CFU indicates Colony Forming Units, MPN indicates Most Probable Number*
7. SUBCON* indicates analysis subcontracted to approved subcontractors who do not hold accreditation for this test
8. SUBCON^ indicates analysis subcontracted to approved subcontractors who hold accreditation for this test

9. This supplementary certificate replaces the previous certificate which must be destroyed

ALS Life Sciences Ltd
Trading as ALS
Carrigeen Business Park, Clonmel, Co. Tipperary
Tel: +353 (0) 52 617 8100
Fax:+353 (0) 52 617 8103
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ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.166T

Report No: HYDR-415080318

Document No: EF0011

SUPPLEMENTARY CERTIFICATE OF ANALYSIS

Date Received 08/03/2018
Date Reported 10/03/2018
Order Number N/A

Sample Type Water
Client ID Midleton Well 1
Date Tested 08/03/2018
ALS ID 3009716

Test	Result	Unit	Method
Enterococci	0	CFU/100ml	SP 071 Based on ISO 7899-2 (2000)
Coliform bacteria	0	CFU/100ml	SP 140 MODW Part 4,B 2009
Escherichia coli	0	CFU/100ml	SP 140 MODW Part 4,B 2009

Sample Type Water
Client ID Midleton MW 2
Date Tested 08/03/2018
ALS ID 3009719

Test	Result	Unit	Method
Enterococci	0	CFU/100ml	SP 071 Based on ISO 7899-2 (2000)
Coliform bacteria	0	CFU/100ml	SP 140 MODW Part 4,B 2009
Escherichia coli	0	CFU/100ml	SP 140 MODW Part 4,B 2009

Sample Type Water
Client ID Midleton MW 3
Date Tested 08/03/2018
ALS ID 3009722

Test	Result	Unit	Method
Enterococci	0	CFU/100ml	SP 071 Based on ISO 7899-2 (2000)
Coliform bacteria	0	CFU/100ml	SP 140 MODW Part 4,B 2009
Escherichia coli	0	CFU/100ml	SP 140 MODW Part 4,B 2009

Sample Type Water
Client ID Midleton MW 4
Date Tested 08/03/2018
ALS ID 3009725

Test	Result	Unit	Method
Enterococci	0	CFU/100ml	SP 071 Based on ISO 7899-2 (2000)
Coliform bacteria	0	CFU/100ml	SP 140 MODW Part 4,B 2009
Escherichia coli	0	CFU/100ml	SP 140 MODW Part 4,B 2009

Report Authorised by: Rosemary Thomas

Rosemary Thomas
Environmental Chemistry Manager

ALS Life Sciences Ltd
Trading as ALS
Carrigeen Business Park, Clonmel, Co. Tipperary
Tel: +353 (0) 52 617 8100
Fax:+353 (0) 52 617 8103
www.alsglobal.ie

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SUPPLEMENTARY CERTIFICATE OF ANALYSIS

Date Received 08/03/2018
Date Reported 10/03/2018
Order Number N/A

Sample Type Water
Client ID Midleton MW 5
Date Tested 08/03/2018
ALS ID 3009728

Test	Result	Unit	Method
Enterococci	0	CFU/100ml	SP 071 Based on ISO 7899-2 (2000)
Coliform bacteria	0	CFU/100ml	SP 140 MODW Part 4,B 2009
Escherichia coli	0	CFU/100ml	SP 140 MODW Part 4,B 2009

Sample Type Water
Client ID Midleton MW 6
Date Tested 08/03/2018
ALS ID 3009731

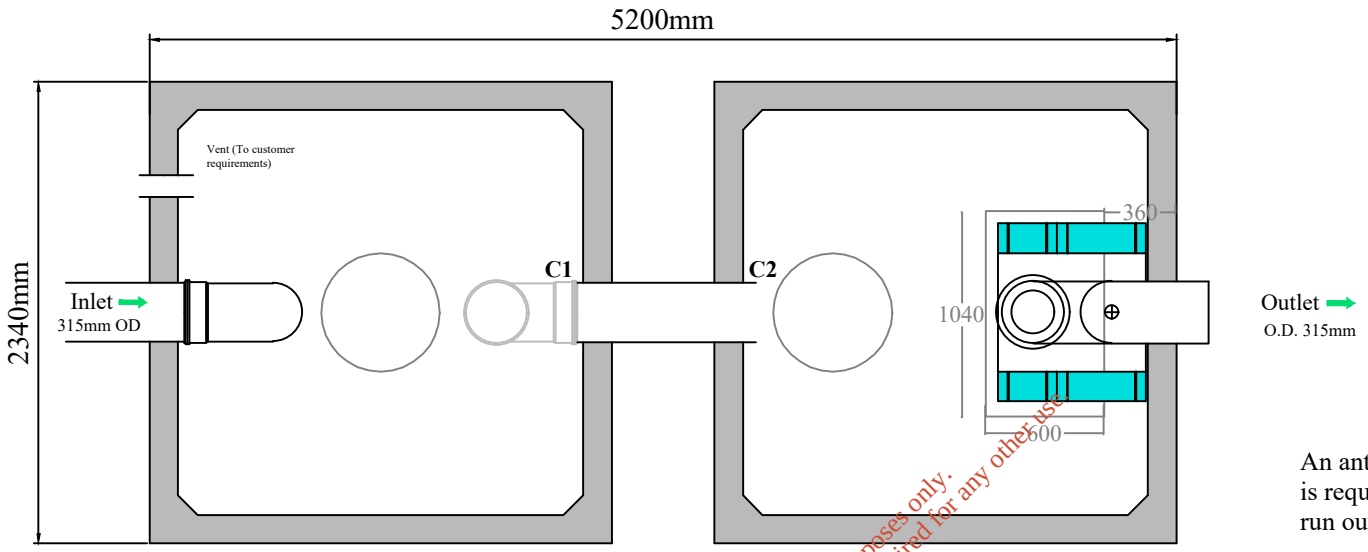
Test	Result	Unit	Method
Enterococci	0	CFU/100ml	SP 071 Based on ISO 7899-2 (2000)
Coliform bacteria	0	CFU/100ml	SP 140 MODW Part 4,B 2009
Escherichia coli	0	CFU/100ml	SP 140 MODW Part 4,B 2009

Report Authorised by: Rosemary Thomas

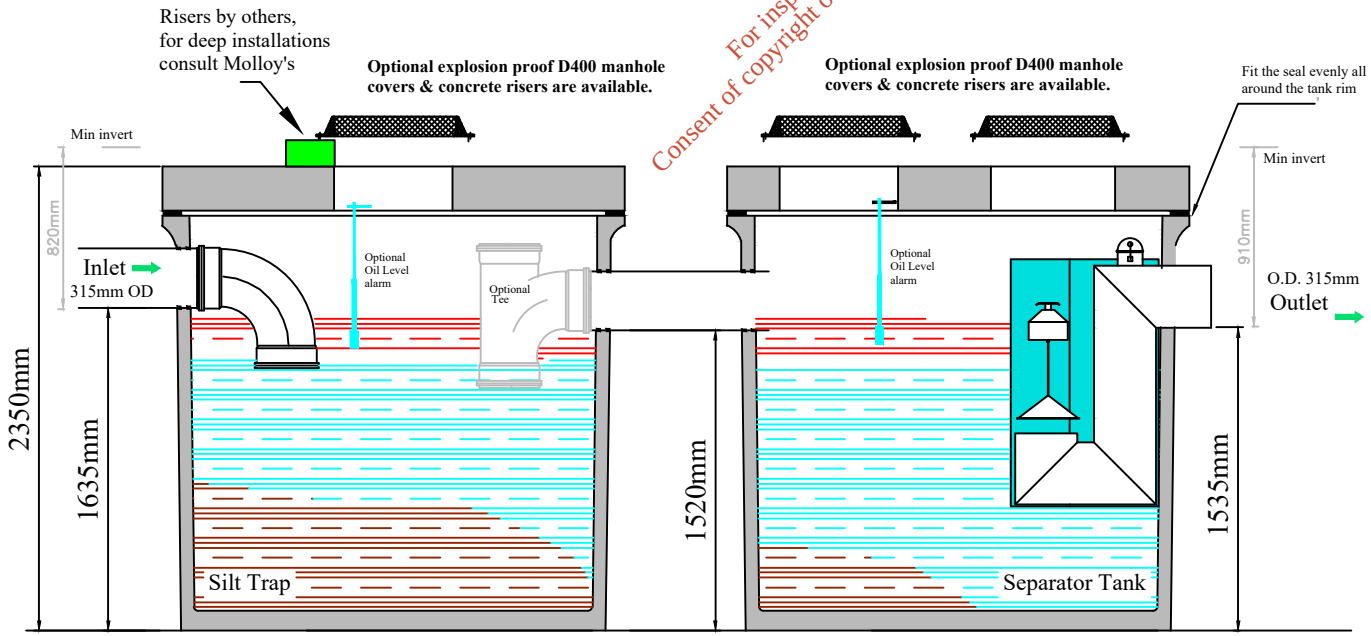
Rosemary Thomas
Environmental Chemistry Manager

APPENDIX IV: OIL INTERCEPTOR DESIGN

Full Retention Class 1 EN 858 Ortner FR-NS-40-CC Volume 16,000 lit



An anti-syphon vent is required for long run outflows



A good firm, rock free, perfectly level base is required. Soil conditions must be checked by the site engineer. See installation recommendations for guidance.

Notes:

Note: Observe all safety regulations in regard to excavation and lifting requirements. Never leave opening uncovered or unattended at any time.

Note: Specify any specific requirements prior to ordering. All civil works by customer.

Note: Do not scale from this drawing. Only for illustration purposes.

Tank Type: 2CFull Retention Interceptor

Tank Size: 4900mm x 2340mm

Height: 2350mm

Volume: 16000 liters

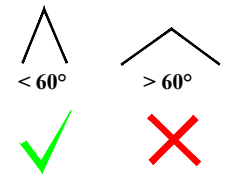
Weight: 4500kg (Each, Ex. Lid)

(**Tank Dim:** ± 20mm. **Weight:** ± 30Kg.)

40 l/s nominal flow @ 65mm/hr rain intensity
2,222m sq. coverage
5,000 lit. silt capacity
2,000 oil capacity
4,000 lit. emergency oil retention.

Accidental damage caused by incorrect lifting is the responsibility of the client.

Lifting limitations:
Max Chain Angle < 60°



CE

Aswa MOLLOY PRECAST Environmental Solutions
Clara Road, Tullamore, Co. Offaly, Ireland
Tel: 057 9326000 info@molloyprecast.com
Fax: 057 9326060 www.molloyprecast.com

Title: FR-NS-40-CC
Full Retention Interceptor

Date: Mar 2014

Drg. No.: D08 (NTS)

Drawn By: MC

ortner

APPENDIX V: SOAKAWAY DESIGN CALCULATION SHEET

Project Roadstone Ltd, Midleton, Co. Cork
Appendix V BRE365 Soakaway Design

Site specific info: Green
Storm specific info: Orange
Required input in Red
Result in Blue

A50=	31.1		**Site Area** =	2351	m*2
V =	23.9	m*3	**f=**	7.50E-05	m/s
O =	201.40	m*3	**Storm Duration =**	86400	s
I =	225.2	m*3	**Rainfall** =	95.8	mm
S = I - O =	23.8	m*3			
S = V	0.1				
T50 =	1.4254	hours			

%FREE V= 0.3

Effective Depth = 1.5 m

Width = 3 m

L = 17.72 m

For a valid design the time for the soakway to half empty from fulll should be less than 24hours

DESIGN OK

The soakpit has adeqaute dimensions when the free volume provided (V) equals the storage required (S)
(using the goal seek command set C26 to value of 0.1 by cahngng L21)

DESIGN OK