HYDROGEOLOGICAL RISK ASSESSMENT

CRAWBERRY HILL WELLSITE, EAST YORKSHIRE

For

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By

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Ref: P:\Rathlin SW Discharge (1763)\Crawberry Hill\HRA\Crawberry HRA Report r2.docx
March 2015

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Completed by	Date	Checked by	Date
PJ	20/03/2015	PH/JD	20/03/2015

HYDROGEOLOGICAL RISK ASSESSMENT

CRAWBERRY HILL WELLSITE, EAST YORKSHIRE

NON-TECHNICAL SUMMARY

Rathlin Energy (UK) Limited constructed a hydrocarbon exploration wellsite at Crawberry Hill in East Yorkshire ("the site") in 2013. Mining waste operations at the site are authorised by an environmental permit (Number EPR/BB3000KC).

The site was constructed in accordance with best practice and is self-contained in terms of the management of surface water. Consequently, rainfall derived surface water runoff at the site is collected in a perimeter ditch and tankered away when necessary.

During the 6 month period between June and November 2014, a total of 48 tankers removed 1,413m^3 of surface water from the site at a total cost of £65,058 (£1,355 per load). Over the course of a year, this equates to approximately 96 tankers at a total cost of £130,116.

To reduce tanker movements, Rathlin Energy proposes to discharge clean surface water to a purposefully designed and engineered soakaway at the site at a rate no greater than the calculated Greenfield runoff rate.

The proposed discharge will be controlled by a Surface Water Management Plan. This sets out methods for monitoring and analysing surface water to ensure the quality is suitable for discharge; and arrangements for ensuring discharge is carried out in a safe and controlled manner. The Surface Water Management Plan will be incorporated into the existing Waste Management Plan for the wellsite, as referenced in the environmental permit.

A hydrogeological impact assessment has been carried out which demonstrates there is a potential risk to groundwater receptors but that risks are reduced through embedded mitigation measures; resulting in a negligible overall residual risk associated with the proposed discharge.

A scheme of monitoring focusing on the monitoring of surface water prior to discharge and incorporating the existing scheme of groundwater monitoring specified in the existing environmental permit will demonstrate the effectiveness of the embedded mitigation.

The proposed discharge of clean surface water to soakaway represents best available technique (BAT) and does not increase environmental risk. There are positive environmental gains through the reduction in tanker movements and the requirements to process water at off-site disposal facilities; and no environmental dis-benefits.

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HYDROGEOLOGICAL RISK ASSESSMENT

CRAWBERRY HILL WELLSITE, EAST YORKSHIRE

1 INTRODUCTION

Rathlin Energy (UK) Limited constructed a hydrocarbon exploration wellsite at Crawberry Hill in East Yorkshire ("the site") in 2013. Mining waste operations at the site are authorised by an environmental permit (Number EPR/BB3000KC) [Ref 1].

The site was constructed in accordance with best practice and is self-contained in terms of the management of surface water. Consequently, rainfall derived surface water runoff at the site is collected in a perimeter ditch and tankered away when necessary.

During the 6 month period between June and November 2014, a total of 48 tankers removed 1,413m^3 of surface water from the site at a total cost of £65,058 (£1,355 per load). Over the course of a year, this equates to approximately 96 tankers at a total cost of £130,116.

To reduce tanker movements, Rathlin Energy proposes to discharge clean surface water to a purposefully designed and engineered soakaway at the site at a rate no greater than the calculated Greenfield runoff rate.

Although the discharge of clean surface water runoff is not classed as a 'water discharge activity' as defined in the Environmental Permitting (England and Wales) Regulations 2010; Rathlin Energy wish to regulate the discharge through a variation to their existing environmental permit.

1.1 Report Objective

This report presents a Hydrogeological Risk Assessment (HRA) for the proposed discharge and the mitigation measures that will be implemented to reduce hydrogeological risks. The report will be submitted as a technical appendix in support of a variation to the existing environmental permit.

1.2 Report Context

This HRA has been conducted in accordance with the technical framework for groundwater risk assessment set out in Groundwater protection: Principles and practice (GP3) [Ref.2] and includes:

1. A review of the baseline hydrology, geology and hydrogeology around the wellsite.
2. Identification of surface water and groundwater features in close proximity to the wellsite.
3. A conceptual hydrogeological model.
4. A risk assessment carried out in accordance with DEFRA's Green Leaves III (GL III) [Ref. 3] and proposals to mitigate hydrogeological risk.

1.3 Consultation

The discharge concept and approach to permitting was presented to the Environment Agency at a meeting in December 2014. The outcome of the meeting was an agreement in principal to the discharge concept, subject to the submission of full details for managing discharge and a HRA.

2 SITE DESCRIPTION

2.1 Site Setting

The Crawberry Hill wellsite is located approximately 2km southwest of the village of Bishop Burton and 12km northwest of Hull at NGR SE 9760 3780 (approximate centre of site). The wellsite covers an area of approximately 0.9ha and is situated at an elevation of approximately 85mAOD, with local ground level falling towards the northeast. The location and setting of the site is shown on Figure 1.

2.2 Wellsite Construction

The wellsite comprises a flat area of hardstanding surrounded by a perimeter ditch and earth bunds. The base of the wellsite is underlain by a High Density Polyethylene (HDPE) membrane, which covers the footprint of the wellsite and perimeter containment ditches, to ensure any surface water collecting on the wellsite is retained. Surface water collecting on the site percolates through the hardstanding, is intercepted by the membrane and is directed to the perimeter ditch, where it is collected. A wellsite layout plan is presented on Figure 2.

2.3 Hydrological Setting

The land surrounding the site drains towards the northeast towards Flowery Dale, which is a dry valley. Flowery Dale runs towards the northeast towards Crawberry Hill and then northwards towards Bishop Burton. The base of the valley is at an elevation of approximately 70mAOD at NGR 97675 37925, approximately 150m north of the site.

There is a network of dry valleys in the Wolds area of Yorkshire and there is little surface drainage on the outcrop as the water table rarely intersects ground surface.

The soil type at the wellsite (taken from the LandIS Soilscapes website, developed by Cranfield University accessed on 08/01/2015 [Ref. 4]) is classified as 'freely draining lime-rich loamy soils'. Based on OS mapping, there are no surface water features in close proximity to the site, which corresponds with the free draining soil type and underlying geological and hydrogeological setting (see Section 2.4 & 2.5 below) in the area.

2.4 Geological Setting

The geological setting has been characterised using British Geological Survey (BGS) Map Sheet 72 (Beverley) and is presented on Figure 3. The geological map indicates that there are no superficial deposits present beneath the site but superficial deposits in the form of Dry Valley Deposits (gravel) are present along the base of Flowery Dale.

Up to 150m of the Chalk Group is present at the site comprising the Welton and Burnham Chalk Formations (undivided), which represent the Middle and Upper Chalk. The Chalk is further underlain by up to 50m of the Lias Group.

2.5 Hydrogeological Setting

The hydrogeological setting has been characterised using information from the BGS major aquifers database [Ref 5].

The Chalk Group is a Principal aquifer and is unconfined at the site. Groundwater flow in the Chalk is primarily through fractures. Usable groundwater storage comprises storage within macro and micro fractures and also a small amount from within the matrix. Recharge to the Chalk is via direct infiltration at surface. Recharge through the unsaturated zone can occur very rapidly through fractures or slowly within the matrix [Ref 5].

Transmissivity values in Yorkshire range from 1 to over 10,000m^2/day with a geometric mean of 1258m^2/day. Storage coefficients range from $1.5x10^{-4}$ to $1.0x10^{-1}$ with a geometric mean of $7.2x10^{-3}$ [Ref 5].

Data from two nearby Environment Agency observation boreholes at Walkington Wold and Northlands (locations shown on Figure 4) indicate that the Chalk groundwater level in the area fluctuates by up to 30m and that the peak groundwater level is in the region of 35mAOD. This means that there is a large unsaturated thickness (~50m) of chalk at the site. The general groundwater flow direction in the vicinity of the site is towards the northeast.

2.6 Environmental Setting

An environmental search has been undertaken within a 2km radius of the site to identify any nearby sensitive features. The search results are presented on Figure 4.

2.6.1 Protected Environmental Areas

A search of the Natural England online database (MAgiC) has been undertaken, which has identified no protected environmental area within the 2km radius.

2.6.2 Licensed Abstractions

Based on a search of the abstraction licence database undertaken by the Environment Agency, there are no licensed abstractions within the 2km radius.

2.6.3 Discharge Permits

Based on a search of the discharge permit database undertaken by the Environment Agency, there are no discharge permits within the 2km radius.

2.6.4 Private Water Supplies

A search of East Riding of Yorkshire Council's register of private water supplies has been undertaken. East Riding of Yorkshire Council has confirmed that they have no recorded Private Water Supplies within the 2km radius (pers comm. Jon Tait).

The council has also provided details of a number of historic wells, which although considered to be disused, are provided on Figure 4 as 'potential private water supplies' for completeness. A number of remote properties have also been marked on Figure 4 as potentially having a water supply. The closest of the potential private water supplies is located approximately 0.9km north of the site.

2.6.5 BGS Boreholes and Wells

A search of the BGS boreholes and wells online database has been undertaken, which has identified one borehole record within the 2km radius. Record SE93/32 is located approximately 1.4km south of the site and comprises an 80m deep borehole constructed into the Chalk Group. The record describes the Chalk as being 'damp' from 76m. This record is considered to be the Walkington Wold Environment Agency Observation Borehole described in Section 2.3.

2.6.6 Source Protection Zones

The site is not within a Source Protection Zone (SPZ). Part of an Outer Zone (Zone 2) associated with the public water supply boreholes near Cottingham is present within the 2km radius. The closest part of the SPZ is approximately 1.3km southeast of the site.

3 CONCEPTUAL HYDROGEOLOGICAL MODEL

Based on the preceding data review, the conceptual hydrogeological model for the wellsite can be summarised as follows:

- Freely draining lime-rich loamy soils are present at the wellsite, which are underlain by up to 150m of the Chalk Group. The Chalk Group is a Principal aquifer and is unconfined at the site.
- Groundwater flow in the Chalk is via fractures. The aquifer properties suggest that the majority of groundwater is stored in fractures and groundwater flow can be rapid.
- Natural recharge to the unconfined Chalk Group is by direct infiltration of effective rainfall.
- Groundwater levels in the Chalk fluctuate by up to 30m. Even at the peak recorded groundwater level (35mAOD), there is a large unsaturated thickness (~50m) of chalk at the site. The large unsaturated thickness provides a hydraulic break between groundwater and surface.
- The general groundwater flow direction in the vicinity of the site is towards the northeast.

4 PROPOSED DISCHARGE METHOD

Rathlin Energy proposes to discharge clean surface water runoff generated at the Crawberry Hill Wellsite to a purpose designed and engineered soakaway at the site; at a rate no greater than the calculated greenfield runoff rate.

The proposed method of discharge is described in the 'Crawberry Hill Wellsite Surface Water Management Plan' (Ref. 6 and Appendix A); is illustrated on the general discharge arrangement diagram shown on Figure 5; and can be summarised as follows:

i. Surface water will collect in the perimeter ditch.

ii. The water will be passed through a monitoring station and the water quality checked to make sure it meets the requirements for discharge.

iii. If the water meets the requirements for discharge, then it will be discharged from the perimeter ditch under gravity via a Class 1 Oil Separator to a soakaway.

iv. If the water does not meet the requirements for discharge, water will be discharged from site by tanker.

v. Samples of discharge water will be collected for laboratory analysis of key indicators to demonstrate compliance.

The above method is discussed in further detail in Sections 5 to 8 of the Surface Water Management Plan in Appendix A, which includes details on monitoring, analysis and discharge arrangements. The intention is for the Surface Water Management Plan to be incorporated into the existing Waste Management Plan for the wellsite, as referenced in Table S1.2 (Operating Techniques) of the environmental permit [Ref 1].

5 HYDROGEOLOGICAL RISK ASSESSMENT

5.1 Assessment Methodology

DEFRA's GL III [Ref. 3] contains generic guidelines for the assessment and management of environmental risks. GL III outlines a staged approach to risk assessment and the document is intended to guide regulatory staff in Government and its agencies, as well as those carrying out assessments, to reach a decision on managing environmental risk.

A hydrogeological risk assessment for the proposed development has been carried out in accordance with GL III using the Source-Pathway-Receptor (S-P-R) methodology described in the Environment Agency's H1 Environmental Risk Assessment framework – Annex J (Groundwater) [Ref. 7]. Where S-P-R linkages have been identified, the sensitivity of the receptor, magnitude of impact and significance of effect has been considered in order to assess potential risks.

5.1.1 Receptor Sensitivity

The sensitivity of water resource receptors is based on their status and considered resource value, as described in Table 1.

Table 1 Receptor Sensitivity

Receptor Sensitivity	Description	Examples
Very High	Water resource with an importance and rarity at an international level with limited potential for substitution.	• A water resource making up a vital component of an SAC or SPA under the EC Habitats Directive • A water body achieving a status of 'High status or potential' under the WFD • Principal aquifer providing potable water to a large population • EC designated Salmonid fishery
High	Water resource with a high quality and rarity at a national or regional level and limited potential for substitution.	• A water resource designated or directly linked to a SSSI. • Principal aquifer providing potable water to a small population • A river designated as being of Good status or with a target of Good status or potential under the WFD • A water body used for national sporting events such as regattas or sailing events

Receptor Sensitivity	Description	Examples
		• EC designated Cyprinid fishery
Medium	Water resource with a high quality and rarity at a local scale; or Water resource with a medium quality and rarity at a regional or national scale.	• Secondary aquifer providing potable water to a small population • An aquifer providing abstraction water for agricultural and industrial use
Low	Water resource with a low quality and rarity at a local scale.	• A non 'main' river or stream or other water body without significant ecological habitat

5.1.2 Magnitude of Impact

The magnitude of a potential impact on a receptor depends on the nature and extent of the proposed development, and is independent of the sensitivity of the water resource, as described in Table 2.

Table 2 Magnitude of Impact

Magnitude of Impact	Description	Examples
High	Results in a major change to attributes.	• Loss of EU designated Salmonid fishery • Change in WFD classification of a water body. • Compromise employment source • Loss of flood storage/increased flood risk • Pollution of potable source of abstraction
Medium	Results in impact on integrity of attribute or loss of part of attribute.	• Loss / gain in productivity of a fishery. • Contribution / reduction of a significant proportion of the effluent in a receiving river, but insufficient to change its WFD classification • Reduction / increase in the economic value of the feature
Low	Results in minor impact to attributes.	• Measurable changes in attribute, but of limited size and/or proportion
Very Low	Results in an impact on attribute but of insignificant magnitude to affect use and/or integrity.	• Physical impact to a water resource, but no significant reduction/ increase in quality, productivity or biodiversity • No significant impact on the economic value of the feature • No increase in flood risk

5.1.3 Significance of Effect

The significance of the potential effect is derived by combining the assessments of both the sensitivity of the water resource and the magnitude of the impact in a simple matrix, as presented in Table 3. Effects which are assessed to be major or moderate are considered to be significant, whilst those that are minor or negligible are not significant.

Table 3 Significance of Effect

Receptor Sensitivity	Magnitude of Impact			
	High	**Medium**	**Low**	**Very Low**
Very High	Major	Major/Moderate	Moderate	Moderate/Minor
High	Major/Moderate	Moderate	Moderate/Minor	Minor
Medium	Moderate	Moderate/Minor	Minor	Negligible
Low	Moderate/Minor	Minor	Negligible	Negligible

5.2 Hazard Identification

The data review has identified sensitive receptors that may be at risk from the proposed development. Table 4 presents the source-pathway-receptor linkage for the hazards and shows that there are pollutant linkages (pathways) between potentially polluting activities and groundwater receptors.

Table 4 Source-Pathway-Receptor (S-P-R) Linkage

Hazard	Source (S)	Pathway (P)	Receptors (R)	S-P-R Linkage
Hydrocarbons and additives from operations	Exploration well and on site hydrocarbon storage	Spillage and infiltration through base of wellsite; and infiltration to groundwater through the unsaturated zone	Surface water	No
			Groundwater (Chalk Group & abstractors)	Yes
		Direct discharge of water from perimeter ditch to soakaway and infiltration to groundwater through the unsaturated zone	Surface water	No
			Groundwater (Chalk Group & abstractors)	Yes

Table 4 shows the only hazard is hydrocarbons and additives from operations relating to the exploration well and storage of hydrocarbons at the site. Pathways include spillage and infiltration through the base of the wellsite and direct discharge of surface water from the perimeter ditch; both of which could infiltrate to groundwater through the unsaturated zone.

Receptors are groundwater receptors; comprising the Chalk Group (Principal aquifer) and any nearby abstractors targeting the aquifer. Groundwater features in close proximity of the site have been identified in Section 2.6 and as a precautionary approach these are all considered to be at risk from the proposed development as part of this assessment.

As discussed in Section 2.5, there are no surface water receptors in close proximity to the site and therefore none are considered further in this assessment.

5.3 Risk Assessment

A risk assessment has been carried out in accordance with the methodology presented above. A summary is presented in Table 5 and discussed in the subsections below.

5.3.1 Receptor Sensitivity

Receptor sensitivity has been assigned in accordance with Table 1. The Chalk Group is a Principal aquifer of regional importance and has been assessed as having a very high sensitivity.

5.3.2 Magnitude of Impact

Magnitude of Impact has been assigned with reference to Table 2. If the Chalk Group became contaminated through leakage or discharge of surface water containing hydrocarbons, the magnitude of the impact would be classed as high, because there could be a major change to the water quality.

5.3.3 Significance of Effect

Significance of Effect has been assigned with reference to Table 3. It follows that the discharge of surface water containing hydrocarbons could result in a major effect to the Chalk Group aquifer.

5.4 Embedded Mitigation

The Environment Agency regulates the environmental aspects of the onshore oil and gas industry in England through the Environmental Permitting Regulations (EPR) 2010.

The base of the Crawberry Hill wellsite has been constructed in accordance with best practice in wellsite construction and incorporates a HDPE membrane, which prevents vertical leakage of any surface water runoff generated at the site into the underlying Chalk.

The proposed discharge will be carried out in accordance with a Surface Water Management Plan (Ref. 6 and Appendix A). The plan includes monitoring of surface water in the perimeter ditch prior to discharge and a discharge arrangement designed to eliminate the potential for uncontrolled discharge.

The proposed discharge arrangement includes a Class 1 Oil Separator, which provides a general level of protection to groundwater in the highly unlikely event that an uncontrolled discharge of contaminated water occurred.

In addition, the large unsaturated thickness of Chalk that is present at the wellsite provides a natural hydraulic break between the point of discharge and the groundwater receptor. This would allow a high level of natural attenuation in the highly unlikely event that an uncontrolled discharge of contaminated water occurred.

5.5 Residual Risk

As shown in Table 5, with the above embedded mitigation measures in place, the likelihood of occurrence and therefore the residual risk associated with the identified hazards is negligible.

5.6 Scheme of Monitoring

The effectiveness of the mitigation measures will be demonstrated through the scheme of monitoring detailed in the Surface Water Management Plan (Ref. 6 and Appendix A) and the existing scheme of groundwater monitoring specified in the existing environmental permit.

6 BEST AVAILABLE TECHNIQUE

The discharge of clean surface water to ground will reduce tanker movements, which is currently estimated at approximately 96 tankers per year. Discharging water to soakaway will reduce the number of tankers on the road and reduce the emissions associated with the vehicles, and the requirement to process water at off-site disposal facilities. The annual cost associated with the current tanker movements is £130,116, and the reduction in cost will be an added benefit.

Consequently, the proposed discharge of surface water to ground does not increase environmental risk. There are positive environmental gains through the reduction of tanker movements and no environmental dis-benefits.

7 SUMMARY & CONCLUSIONS

Rathlin Energy wishes to regulate the discharge of clean surface water from their Crawberry Hill wellsite using a soakaway.

A hydrogeological impact assessment has been carried out in accordance with the methodology described in the Environment Agency's H1 Environmental Risk Assessment framework – Annex J (Groundwater).

The assessment demonstrates that there is a potential major risk to groundwater receptors in the event that contaminated surface water leaks through the base of the site or is unintentionally discharged; and infiltrates to groundwater through the unsaturated zone.

These risks are reduced through embedded mitigation measures, resulting in there being a negligible overall residual risk associated with the proposed discharge.

Risks are mitigated through the best practice approach to wellsite construction and adoption of a Surface Water Management Plan that includes monitoring of surface water in the perimeter ditch prior to discharge and a discharge arrangement designed to eliminate the potential for uncontrolled discharge. The inclusion of an Oil separator prior to discharge and the natural hydraulic break provided by the large unsaturated thickness of Chalk that is present at the wellsite further reduces risk.

A scheme of monitoring focusing on the monitoring of surface water prior to discharge and incorporating the existing scheme of groundwater monitoring specified in the existing environmental permit will demonstrate the effectiveness of the embedded mitigation measures.

The proposed discharge of clean surface water to soakaway represent BAT and does not increase environmental risk. There are positive environmental gains through the reduction in tanker movements and the requirements to process water at off-site disposal facilities; and no environmental dis-benefits.

Envireau Water
20/03/2015

Table 5 Risk Assessment Summary

Hazard	Source	Pathway	Receptor	Receptor Sensitivity	Magnitude of Impact	Significance of Effect	Embedded Mitigation	Likelihood of Occurrence	Residual Risk after Mitigation
Hydrocarbons and additives from operations	Exploration well and on site hydrocarbon storage	Spillage and infiltration through base of wellsite; and infiltration to groundwater through the unsaturated zone	Groundwater (Chalk Group & abstractors)	Very High	High	Major	Best practice in wellsite construction removes pathway, e.g. well pad is underlain by HDPE membrane; storage tanks will be bunded	Very Low	Negligible
		Direct discharge of water from perimeter ditch to soakaway and infiltration to groundwater through the unsaturated zone	Groundwater (Chalk Group & abstractors)	Very High	High	Major	Discharge will be controlled following a written surface water management plan; the discharge arrangement incorporates a Class 1 Oil Separator; the unsaturated thickness of the Chalk provides for natural attenuation	Very Low	Negligible

8 REFERENCES

Ref. 1: Crawberry Hill Wellsite Environmental Permit EPR/BB3000KC, Environment Agency, 02/05/2014

Ref. 2: Groundwater Protection: Principles and Practice (GP3), Version 1.1, Environment Agency, August 2013

Ref. 3: Green Leaves III - Guidelines for Environmental Risk Assessment and Management: Green Leaves III. Revised Departmental Guidance Prepared by Defra and the Collaborative Centre of Excellence in Understanding and Managing Natural and Environmental Risks, Cranfield University November, 2011

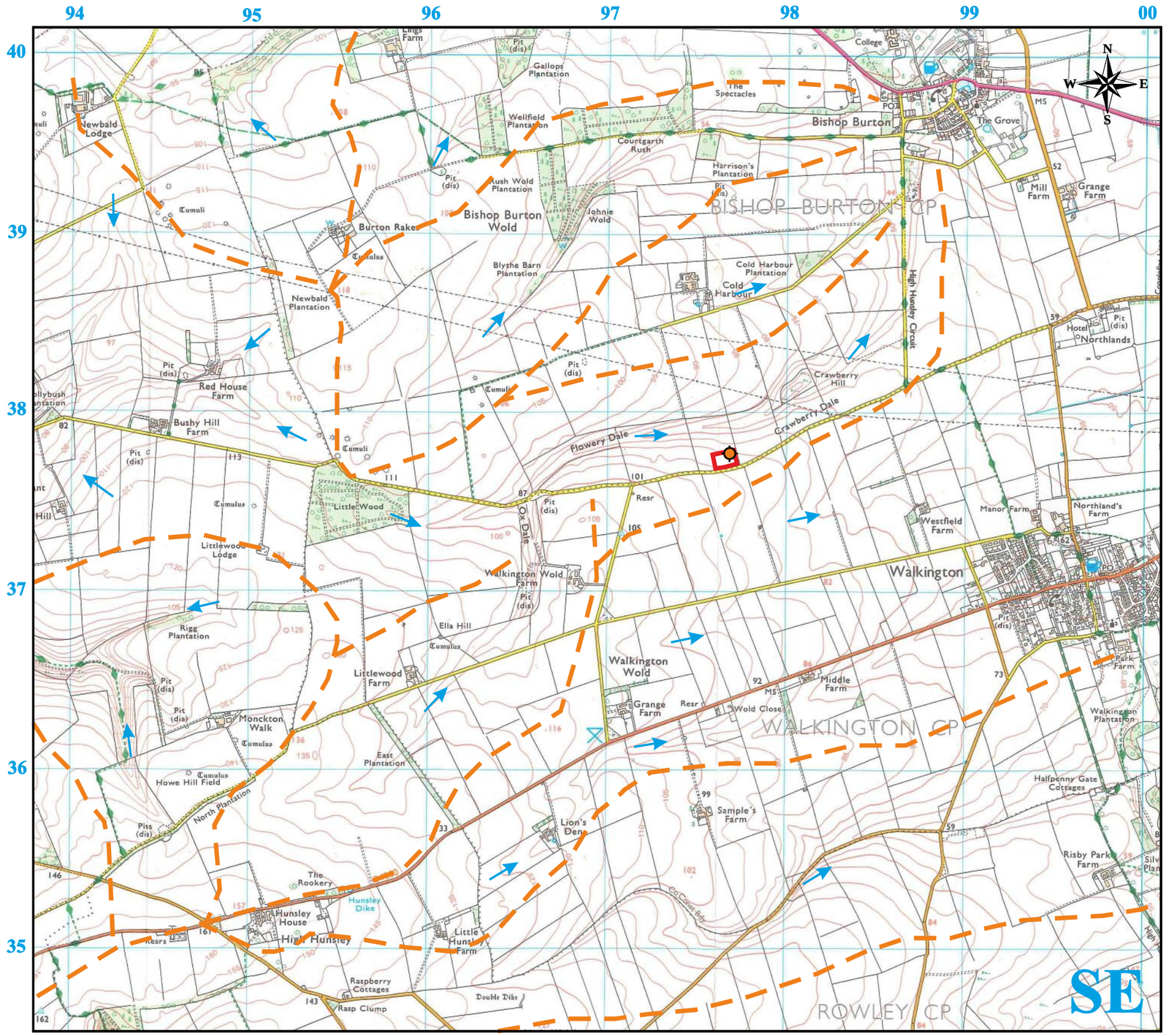
Ref. 4: Soilscapes (Cranfield University) Cranfield Soil and AgriFood Institute, January 2015

Ref. 5: Allen D J, et al. The physical properties of major aquifers in England and Wales. BGS Tech. Rep. WD/97/34. Environment Agency R&D publc. 8, 1997

Ref. 6: Crawberry Hill Wellsite Surface Water Management Plan (Version 1.0), Envireau Water, March 2015

Ref. 7: H1 Environmental Risk Assessment framework – Annex J (Groundwater). Environment Agency, 2010

FIGURES



KEY

- Wellsite boundary
- Generalised surface water runoff direction
- Catchment divide delineated from OS topography
- Proposed discharge location

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Ref: P:\Rathlin SW Discharge (1763)\Crawberry Hill\HRA\Figures\Figure 1 - Site Loc and SW Features.cdr Date: 20/03/2015	Rathlin Energy (UK) Ltd - Crawberry Hill
Figure 1	Site Location and Surface Water Features

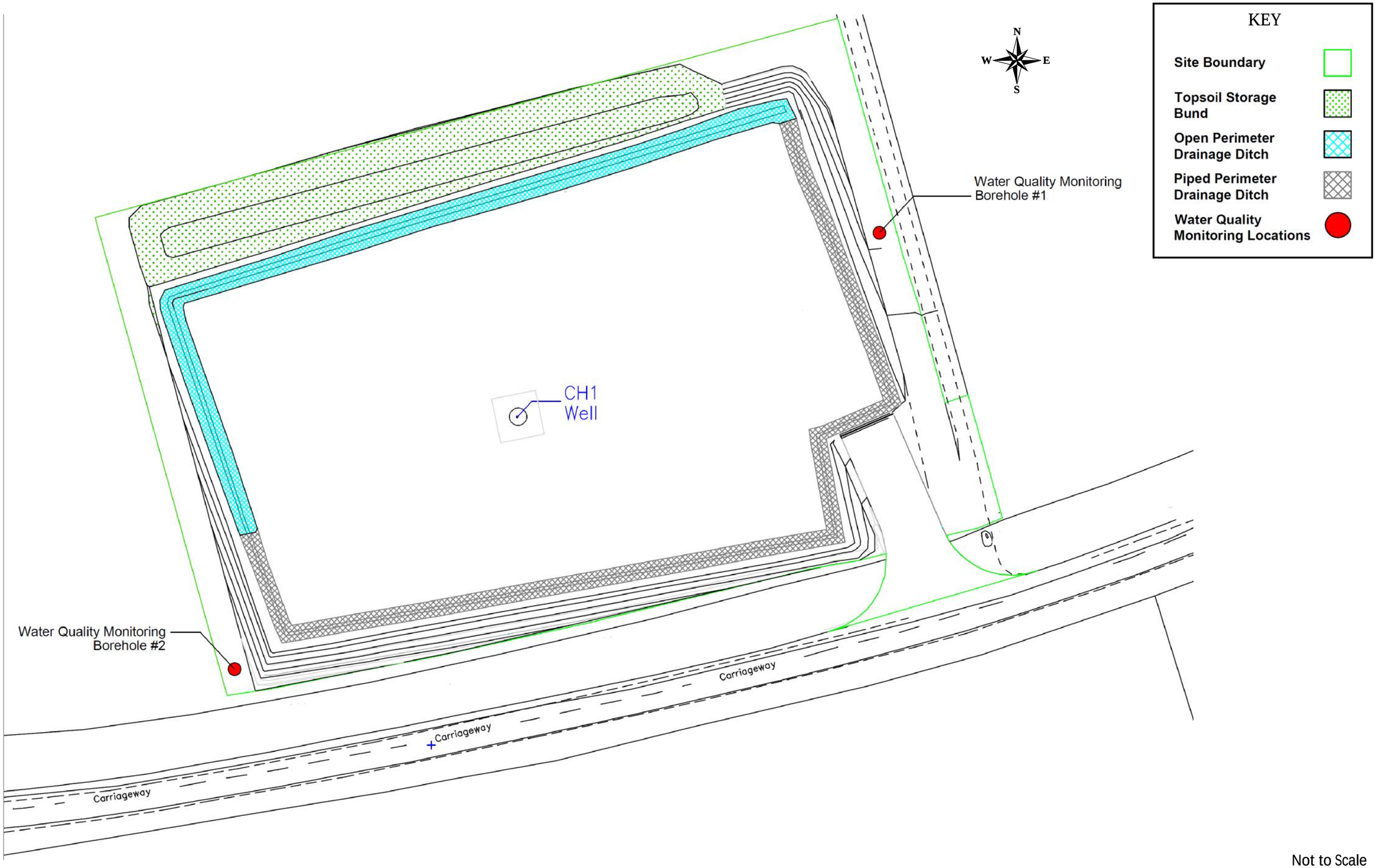

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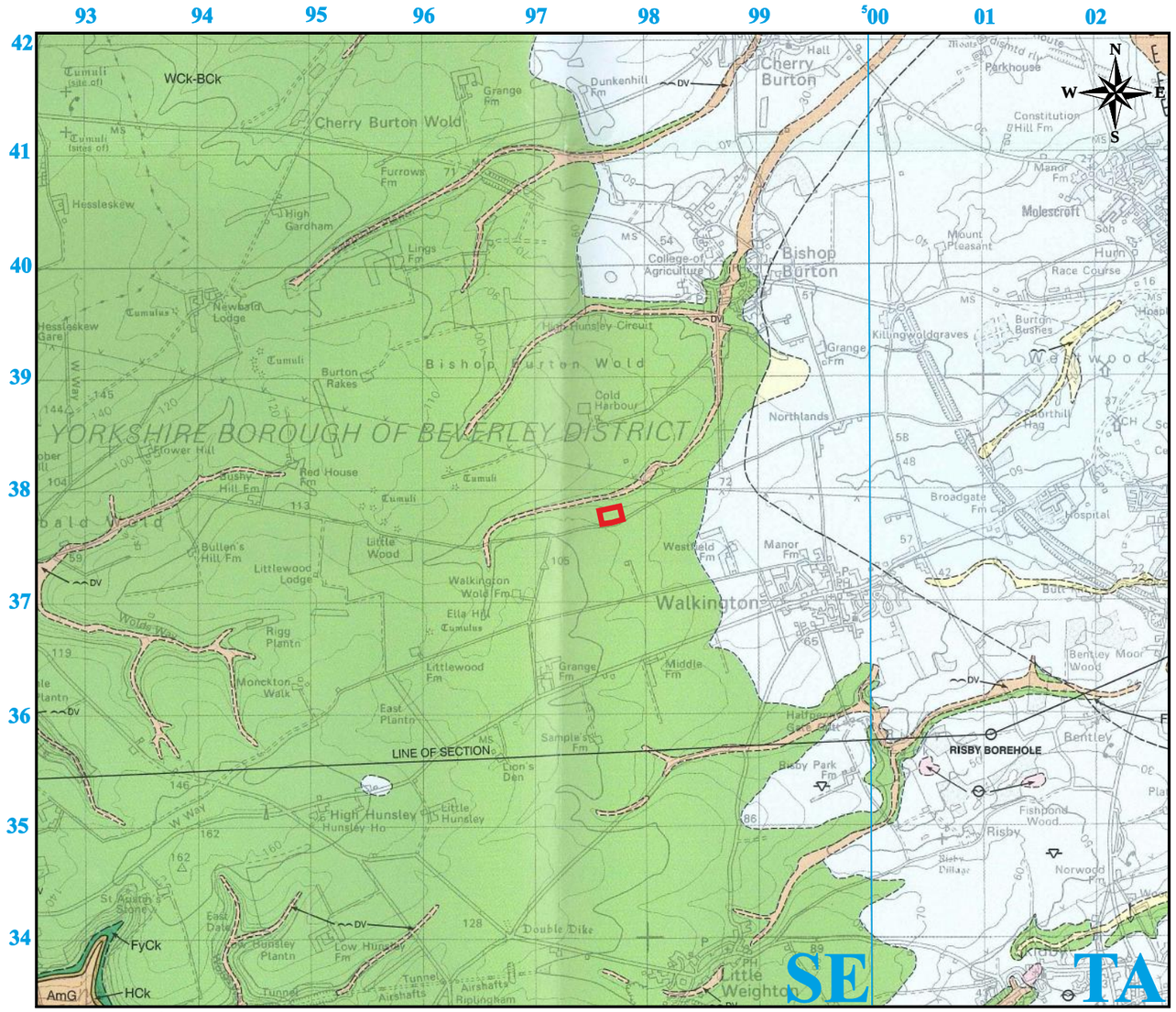
Figure 2	Wellsite Layout Plan



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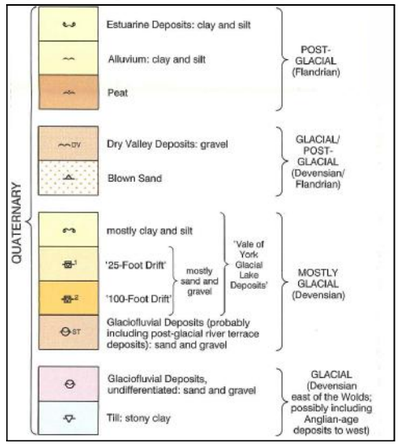
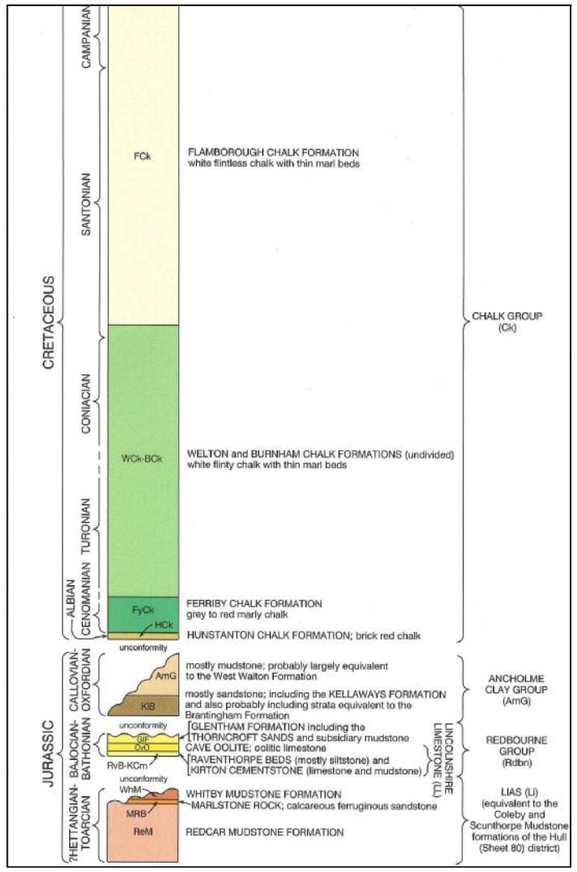
SUPERFICIAL DEPOSITS



SOLID GEOLOGY



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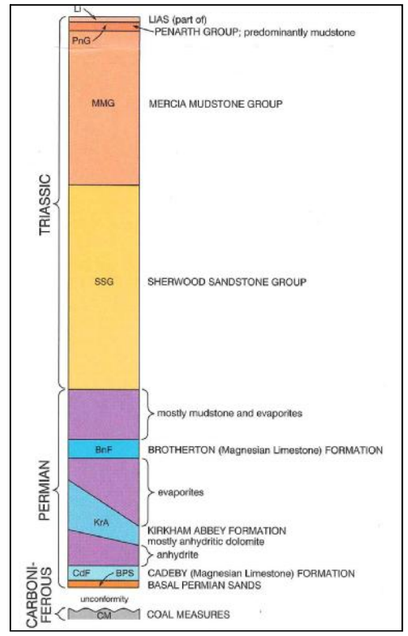

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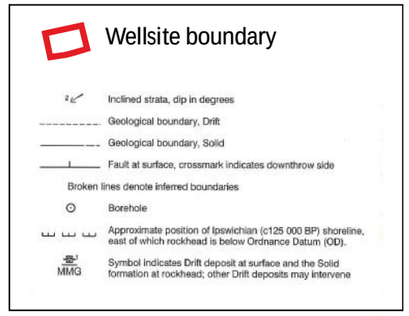

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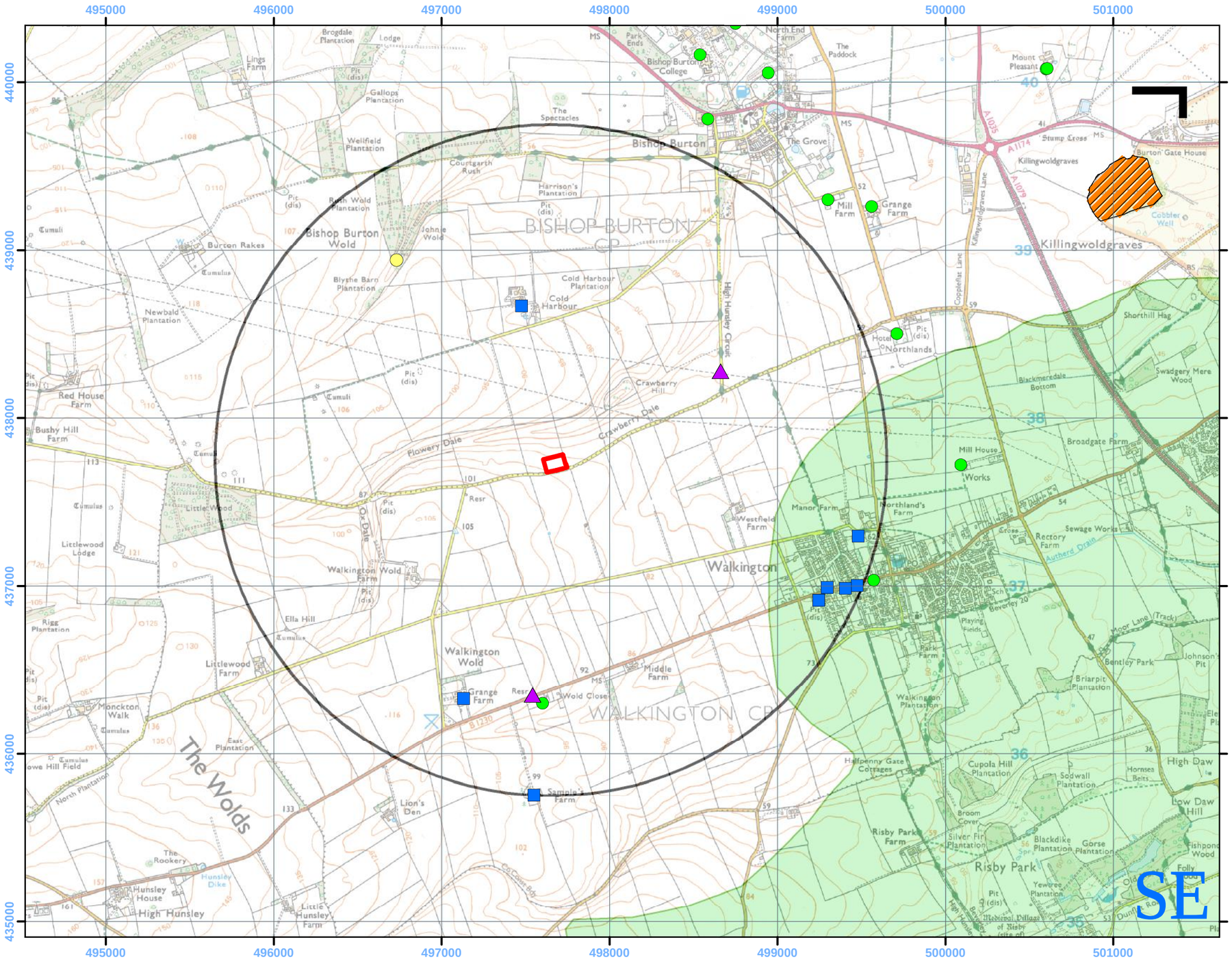
Ref: P:\Rathlin SW Discharge (1763)\Crawberry Hill\HRA\Figures\Figure 3 - Geology.cdr Date: 20/03/2015	Rathlin Energy (UK) Ltd - Crawberry Hill
Figure 3	Geology



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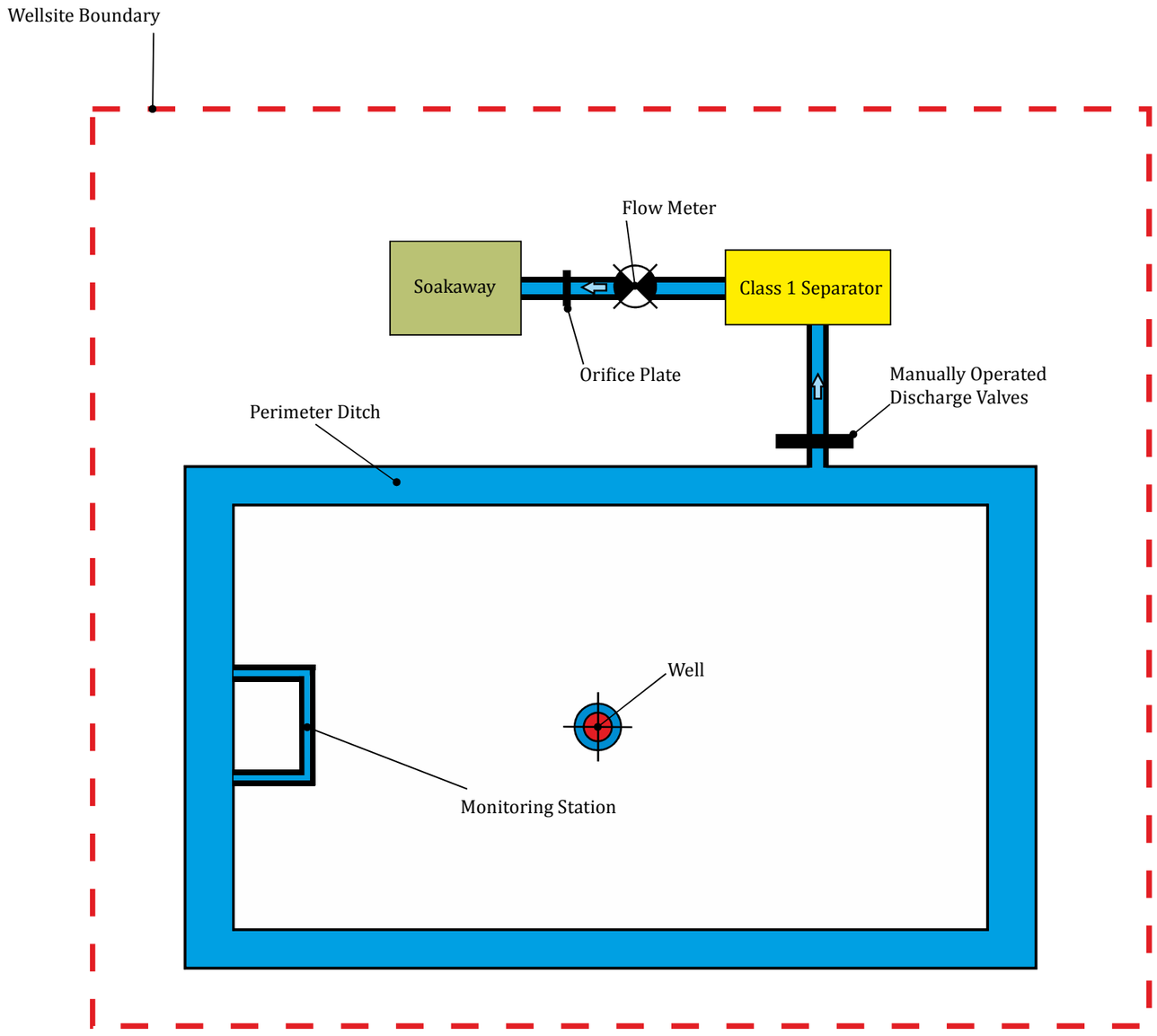
Ref: Rathlin SW Discharge (1763)\Crawberry Hill\HRA\Figures\Figure 4 - Env setting.cdr Date: 20/03/2015	Rathlin Energy (UK) Ltd - Crawberry Hill
Figure 4	Environmental Setting



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Ref: P:\Rathlin SW Discharge (1763)\ Figures\ Crawberry Hill\HRA\Figure 5 - Discharge Arrangement.cdr Date: 20/03/2015	Rathlin Energy (UK) Ltd - Crawberry Hill
Figure 5	Surface Water Discharge Arrangement

APPENDIX A

Surface Water Management Plan
(Version 1.0)

Rathlin Energy (UK) Limited

Crawberry Hill Wellsite

SURFACE WATER MANAGEMENT PLAN
Version 1.0

for

Rathlin Energy (UK) Limited
8 Wimpole Street
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by

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Ref: P:\Rathlin SW Discharge (1763)\Crawberry Hill\Management Plan\SW management plan r3.docx
March 2015

SURFACE WATER MANAGEMENT PLAN
Version 1.0

Rathlin Energy (UK) Limited, Crawberry Hill Wellsite

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APPENDICES

Envireau Ltd. Registered in England & Wales No. 6647619. Registered office: Cedars Farm Barn, Market Street, Draycott, Derbyshire, DE72 3NB, UK.

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Completed by	*Date*	*Checked by*	*Date*
PH	26/02/2015	JD	20/03/2015

SURFACE WATER MANAGEMENT PLAN

Crawberry Hill Wellsite

1 INTRODUCTION

This document sets a management plan for surface water at the Crawberry Hill Wellsite.

2 SITE DESCRIPTION

2.1 Site Location and Setting

The Crawberry Hill wellsite is located approximately 2km southwest of the village of Bishop Burton and 12km northwest of Hull at NGR SE 9760 3780 (approximate centre of site).

The wellsite address is as follows:

Crawberry Hill Wellsite
Rathlin Energy (UK) Limited
Land Southwest of Crawberry Hill
Walkington Heads
Beverley
HU17 8RU

The wellsite covers an area of approximately 0.9ha and is situated at an elevation of approximately 85mAOD, with local ground level falling towards the northeast.

The location and setting of the wellsite is shown on Figure 1.

2.2 Wellsite Layout

The wellsite comprises a flat area of hardstanding surrounded by a perimeter ditch and earth bunds. The base of the wellsite is underlain by a High Density Polyethylene (HDPE) membrane, which covers the footprint of the wellsite and perimeter containment ditches, to ensure any surface water collecting on the wellsite is retained.

A wellsite layout plan is presented on Figure 2.

3 SURFACE WATER RUNOFF

Surface water collecting on the site percolates through the hardstanding, is intercepted by the HDPE membrane and is directed to the perimeter containment ditch, where it is collected.

3.1 Greenfield Runoff Rate

Based on the IH 124 method [Ref 1] the estimated Greenfield Runoff Rate (GRR) for the wellsite area has been calculated as 2.08 l/s/ha for a 1 in 100 year storm event (1% annual probability of occurrence).

3.2 Attenuation Capacity

Based on the estimated GRR and wellsite area, the amount of water that needs to be attenuated at the wellsite during a 1 in 100 year (+20% allowance for climate change) storm event is 896m^3. The perimeter ditch and hardstanding area provides 439m^3 of attenuation storage capacity. The remaining 457m^3 is provided by allowing the wellsite to flood to an estimated depth of 150mm; which is a conservative assumption based on 50% of the wellsite area being occupied by plant or equipment.

4 DISCHARGE METHOD

The method of discharge is represented by the decision tree on Figure 3 and can be summarised as follows:

i. Surface water will collect in the perimeter ditch.

ii. The water will be passed through a monitoring station (see Section 5) and the quality checked to make sure it meets the requirements for discharge.

iii. If the water meets the requirements for discharge, then it will be discharged from the perimeter ditch under gravity via a Class 1 Separator to a soakaway (see Section 6 & 8).

iv. If the water does not meet the requirements for discharge, arrangements will be made for disposal by alternative methods, e.g. disposal by authorised haulage tanker to a licensed waste disposal facility/water treatment facility.

v. Samples of discharge water will be collected for laboratory analysis of key indicators to demonstrate compliance (see Section 7).

A general discharge arrangement diagram is shown on Figure 4.

5 MONITORING STATION

The monitoring station is shown schematically on Figure 4 & 5. The operation is summarised as follows:

i. A transfer pump will be used to abstract water from the perimeter ditch.

ii. The water will be run through pipework containing a Hach Lange SC Solitax turbidity sensor and Hach Lange SC FP360 oil-in-water sensor to monitor turbidity (suspended solids) and liquid phase

hydrocarbons. The sensors will be wired into a Hach Lange SC controller to provide continuous data recording. Data sheets for the sensors and controller are provided as Appendix A.

iii. The water will be returned to the perimeter ditch approximately 10m from the abstraction point.

iv. The abstraction rate of the water will be controlled to ensure that a representative volume of water passes through the monitoring station.

v. The monitoring station will be operated for at least one hour and readings taken at one minute intervals to demonstrate the quality of the water. Records will be kept of all data collected.

vi. The data will be reviewed and the average hydrocarbon and suspended solids concentration of the water will be calculated based on one hour of continuous 1 minute data.

6 GRAVITY DISCHARGE

As shown schematically on Figure 6, a gravity discharge pipe will connect the perimeter ditch to the Oil separator and will be operated as follows:

i. Discharge will only take place when the site is manned. The discharge will be controlled using two isolation valves. The valves will be manually operated and secured when not in operation. The keys for the valves will be held in the site office.

ii. To facilitate discharge, the keys will be obtained from the site office and the two valves will be manually opened. Discharge will take place under until water levels in the perimeter ditch are reduced to the required level. The discharge will then be stopped by closing the two valves. The valves will be secured on completion and the keys returned to the site office.

iii. The two valves will be secured at all times whilst the wellsite is unmanned and discharge operations are not being undertaken. This will prevent unauthorised discharges of water by unauthorised personnel.

7 WATER SAMPLING & ANALYSIS

To provide calibration data for the sensors, water samples will be collected from the discharge pipe using sterilised, specified sampling containers. The water samples will be transported the same day in a safe and suitable manner to a UKAS accredited laboratory.

The following parameters will be analysed for:

- **ü** pH, conductivity, major ions, total petroleum hydrocarbons, suspended solids

Water samples will be collected on a monthly basis, when the discharge is in operation.

8 DISCHARGE TO SOAKAWAY

Water will be discharged from the perimeter ditch to a soakaway via a Class 1 SPEL oil-water Separator. The SPEL Separator is designed, manufactured and tested in accordance with the European Standard BS EN 858-1 and meets the requirement of the Environment Agency's Pollution Prevention Guidelines (PPG3) and the Construction Products Regulations.

The discharge arrangement means there is a negligible risk that free phase hydrocarbons would be present in the discharge; however, the Separator does provide an additional level of environmental protection. The specification of the SPEL Separator is provided in Appendix B.

The discharge valves and the inspection plate of the Separator will be secured at all times whilst the wellsite is unmanned and discharge operations are not being undertaken. This will prevent unauthorised discharges of water by unauthorised personnel.

The soakaway will be designed and constructed in accordance with the best practice set out in BRE 365 [Ref 2].
An orifice plate will be placed on the discharge pipe to ensure the maximum rate of discharge does not exceed the estimated GRR of 2.08 l/s/ha.

An MCERTS accredited flow meter will be installed on the discharge pipe to record the flow rates and demonstrate compliance.

The water being discharged to soakaway will be visually inspected during discharge to ensure it is free from solids and visible oil and grease.

9 DISCHARGE RECORDS

Records of all the monitoring, sampling and discharge activities will be recorded within the Rathlin Energy Environmental Management System. Records will be made available to the Environment Agency for inspection. The records will include the date, time and all relevant results of monitoring and analysis.

10 ADDITIONAL CHECKS

During periods of non-operations, the discharge equipment will be inspected on a regular basis and the condition recorded on the Rathlin Energy Checklist 8 form – (RE-05-CHK-008). Any issues identified will be addressed. Records will be made available to the Environment Agency for inspection.

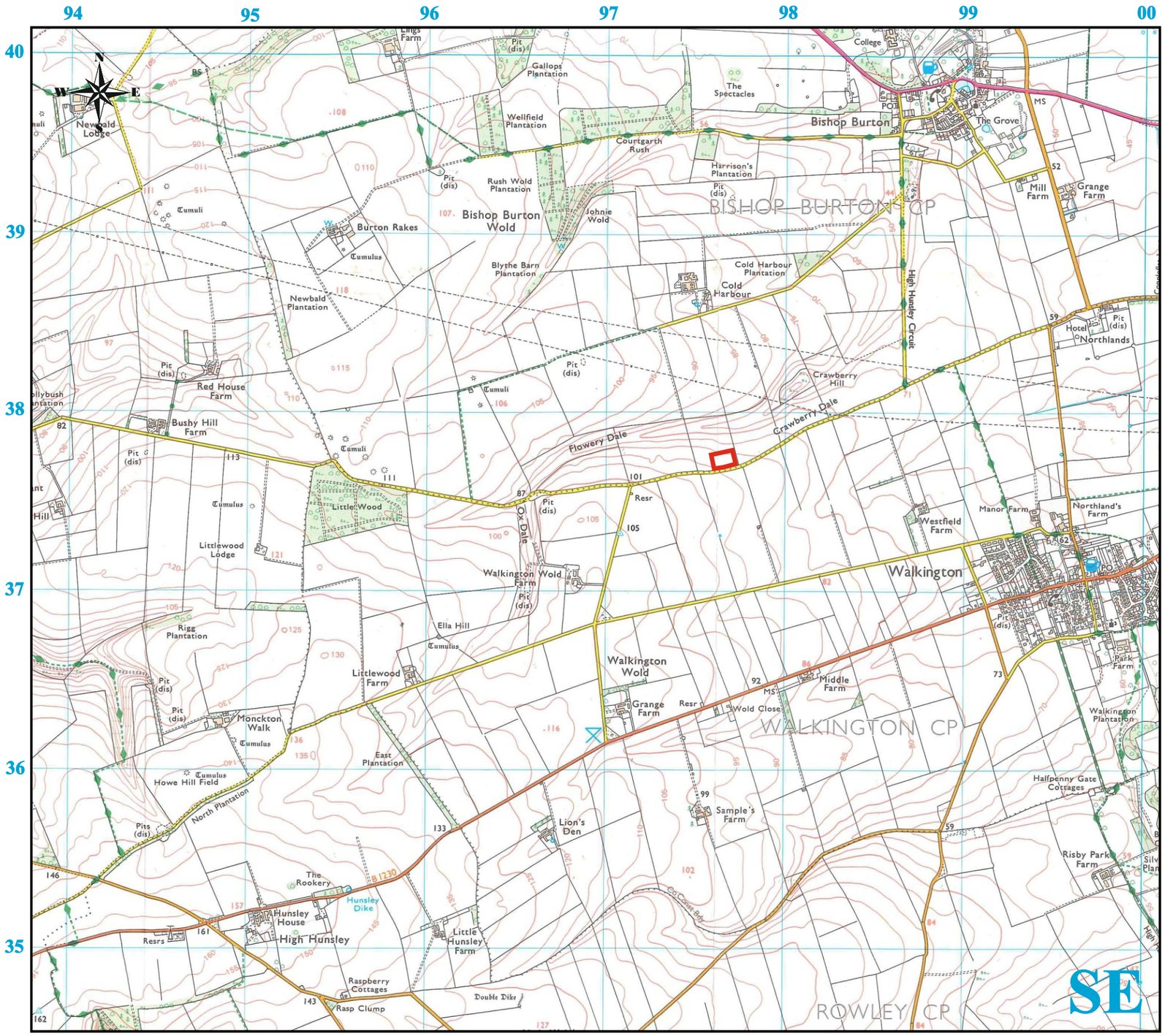
11 TRAINING

All personnel involved in the discharge operation will be trained and competent and a record of training held within the Rathlin Energy Environmental Management System.

12 REFERENCES

Ref 1: D C W Marshall & A C Bayliss. Flood estimation for small catchments. Institute of Hydrology Report 124, June 1994.

Ref 2: Soakaway Design. BRE Digest 36, March 2007.



KEY

Site boundary

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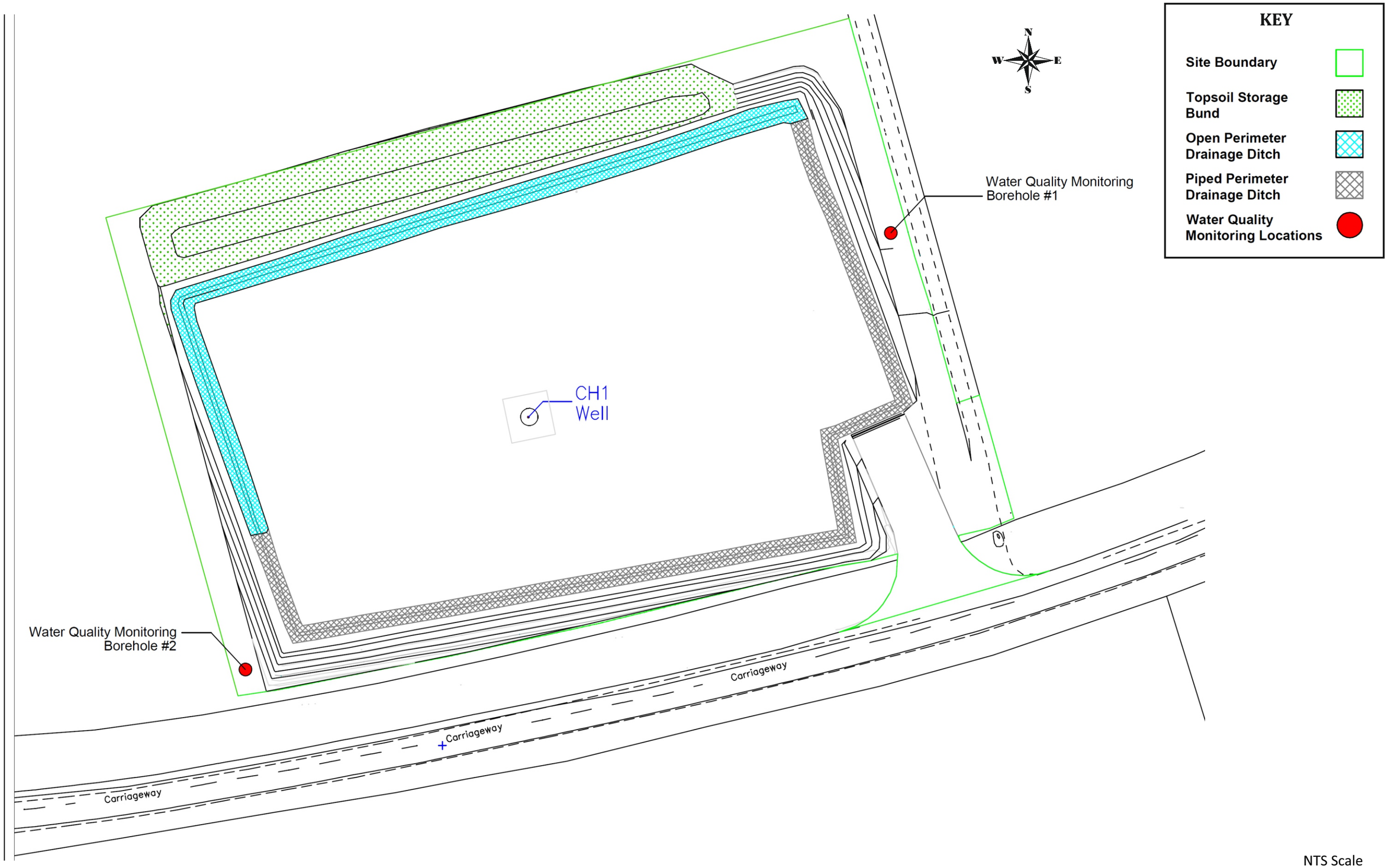
Scale 1: 25,000 (at A3)

envireau WATER

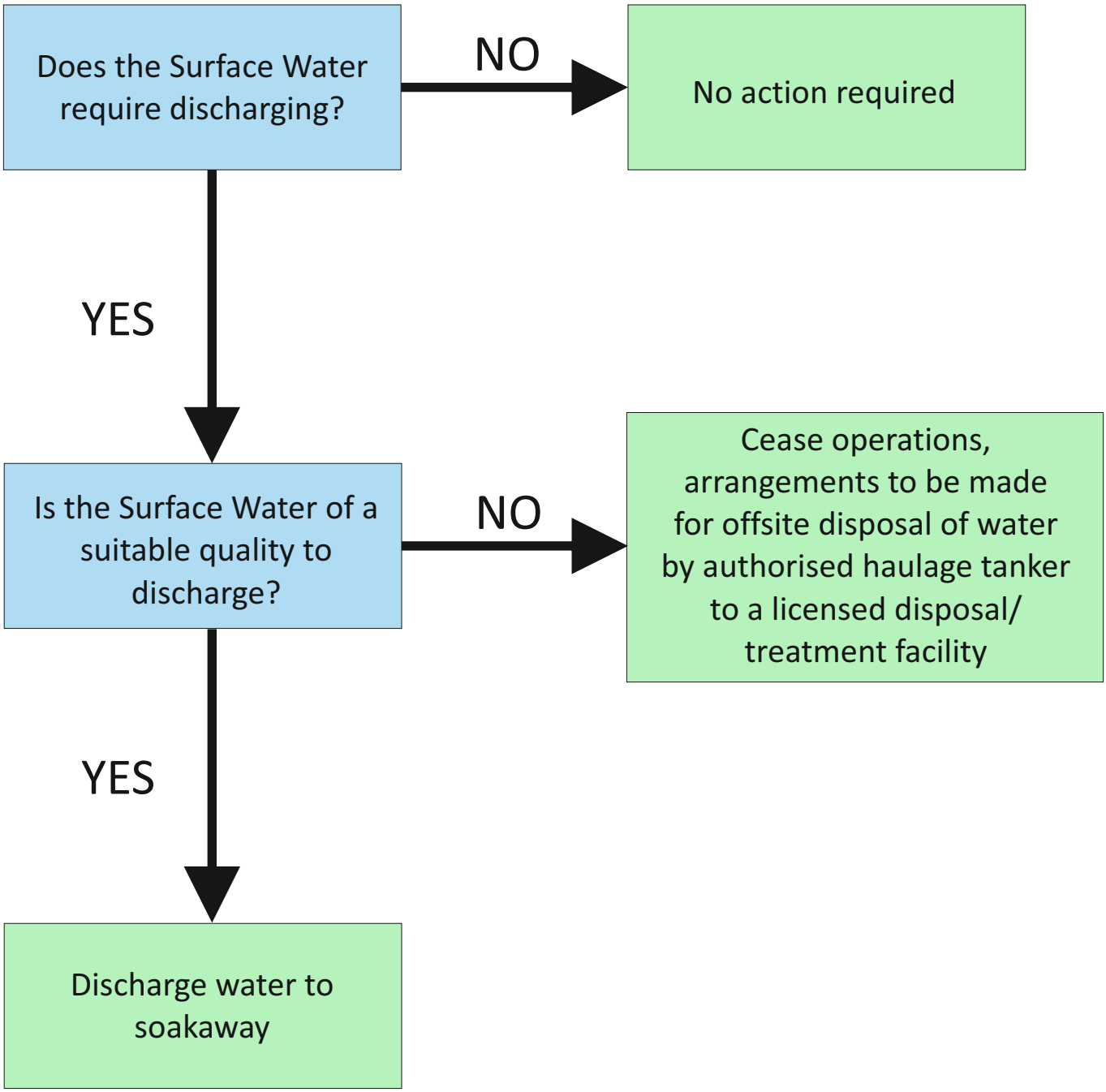
Ref: P:\Rathlin SW Discharge (1763)\Crawberry Hill\Management Plan\Fig 1 - Site Loc.cdr Date: 09/02/2015	**Rathlin Energy (UK) Ltd - Crawberry Hill**
Figure 1	Site Location



NTS Scale

envireau WATER

Ref: P:\Rathlin SW Discharge (1763)\Crawberry Hill\Management Plan\Fig 2 - Wellsite Layout.cdr Date: 06/02/2015	**Rathlin Energy (Uk) Ltd - Crawberry Hill**
Figure 2	Wellsite Layout Plan



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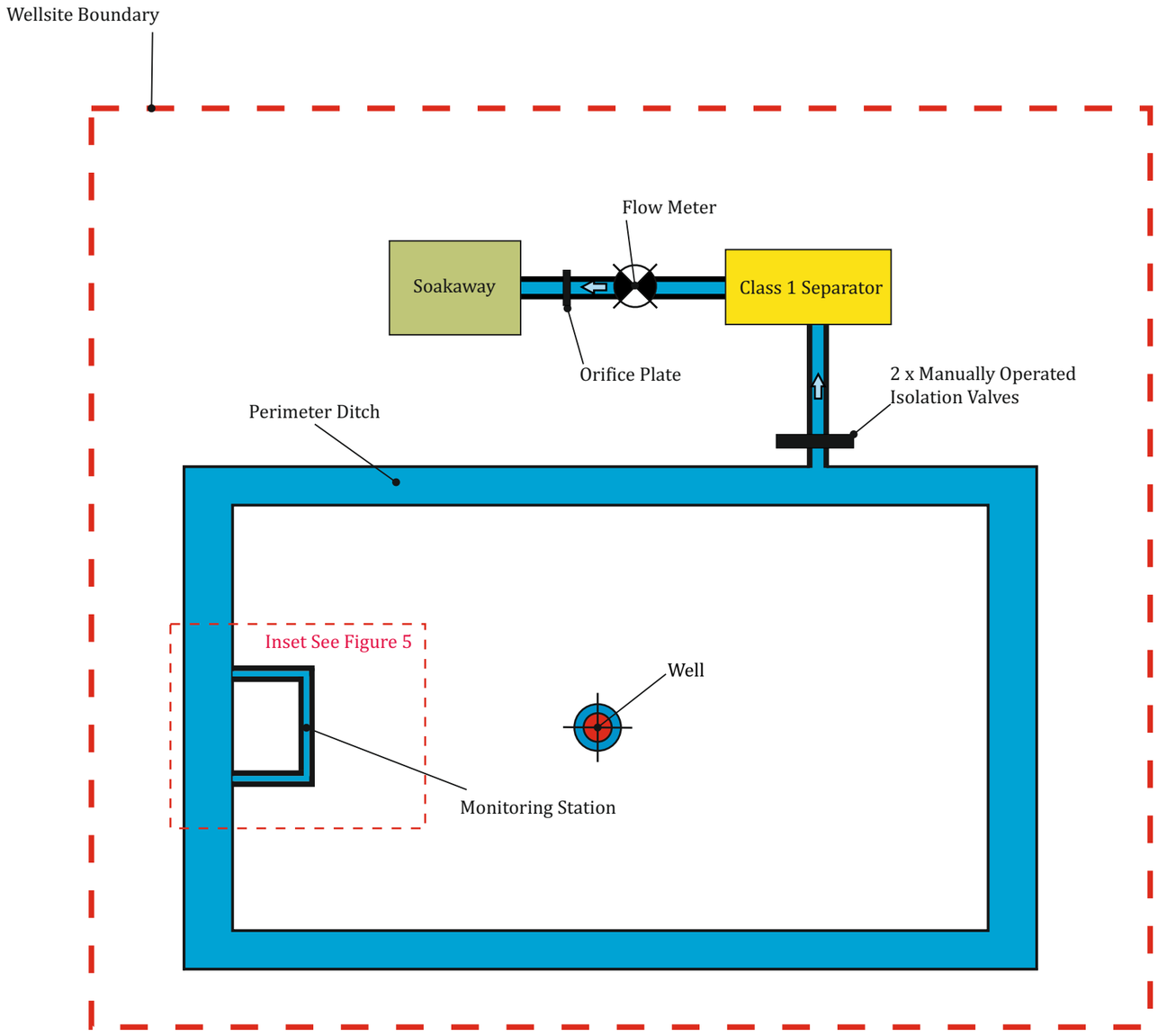
Ref:P:\Rathlin SW Discharge(1763)\ Crawberry Hill\Management Plan\Figure3 Surface Water Discharge Decision Tree Date: 09/02/2015	**Rathlin Energy (UK) Ltd Crawberry Hill**
Figure 3	Surface Water Discharge Decision Tree



Not to scale
This is a schematic only

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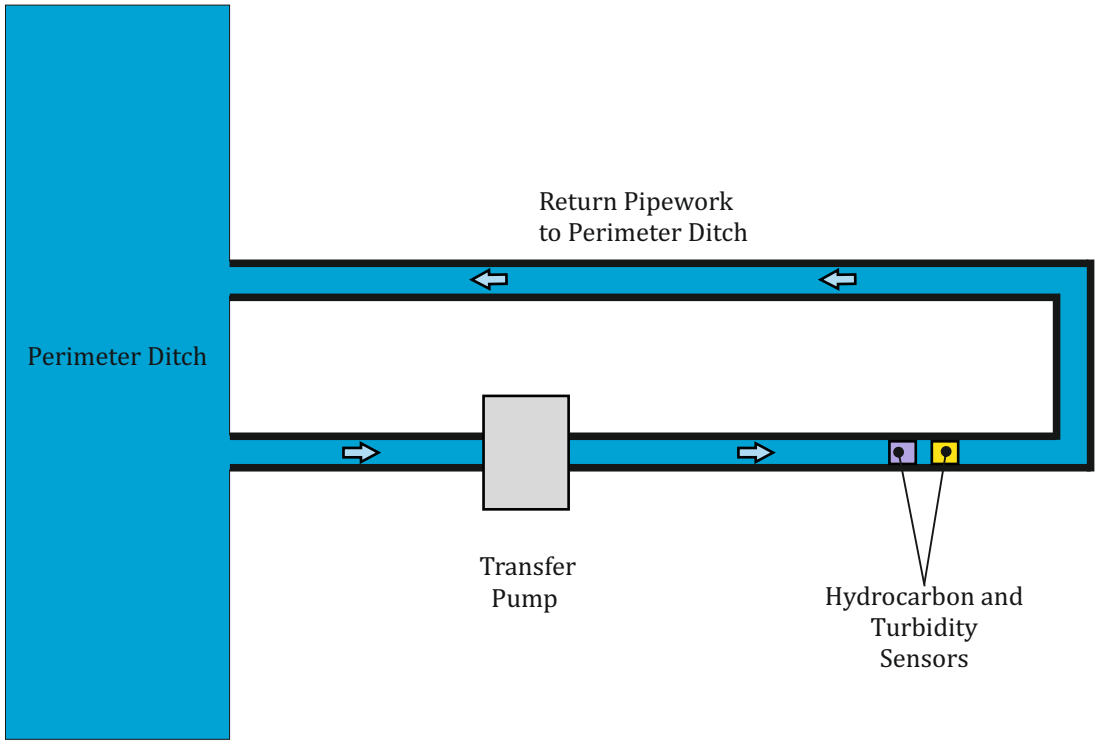
Ref: P:\Rathlin SW Discharge (1763) \ Crawberry Hill\Management Plan\Figures \Fig 4 - Discharge Arrangement.r1.cdr Date: 11/03/2015	**Rathlin Energy (UK) Ltd - Crawberry Hill**
Figure 4	Surface Water Discharge Arrangement



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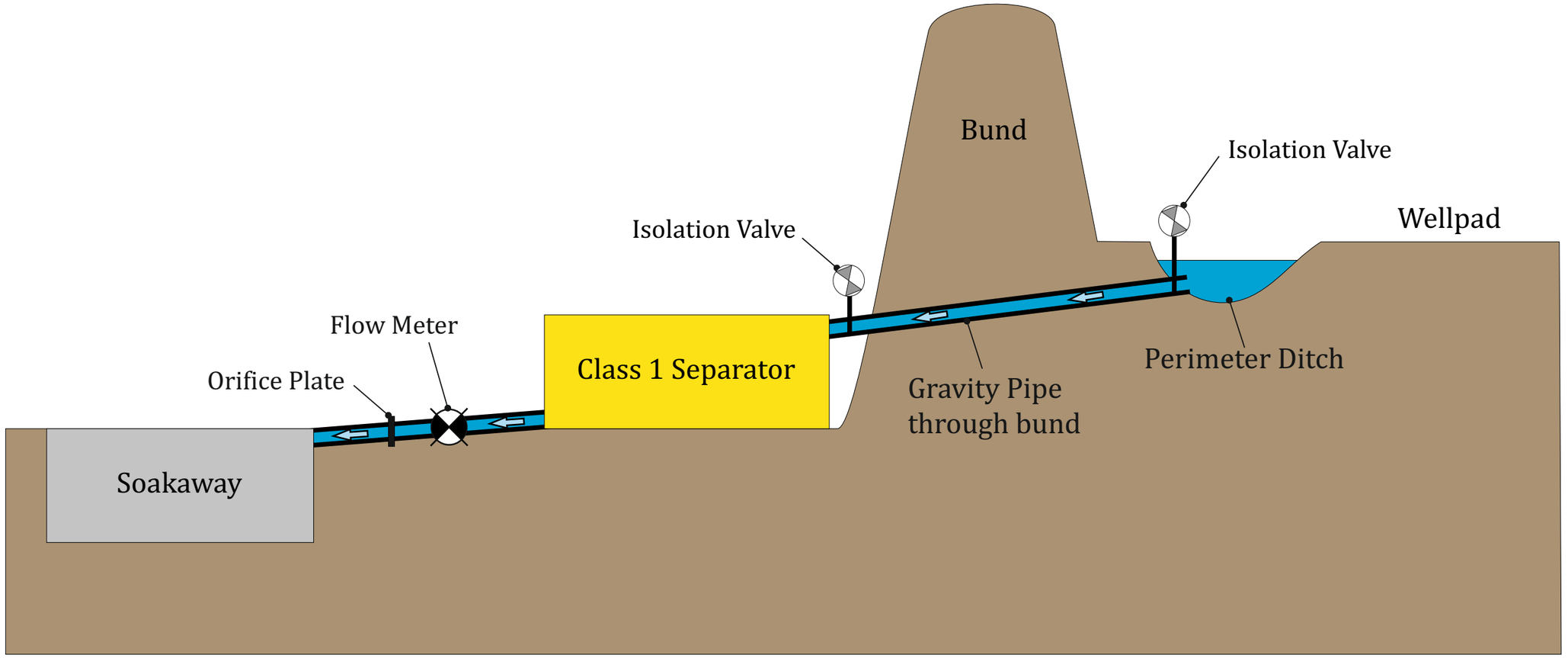
Ref:P:\Rathlin SW Discharge (1763)\Crawberry Hill\Management Plan\Fig 5 - Proposed Monitoring Arrangement.cdr Date: 09/02/2015	**Rathlin Energy (UK) Ltd - Crawberry Hill**
Figure 5	Monitoring Arrangement



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Ref: P:\Rathlin SW Discharge(1763)\Crawberry Hill\Management Plan\Fig 6 - Syphon Discharge Arrangement.r1.cdr Date: 11/03/2015	**Rathlin Energy (UK) Ltd - Crawberry Hill**
Figure 6	Gravity Discharge Arrangement

APPENDIX A

Sensor Data Sheets

PRODUCT INFORMATION
PROCESS ANALYSIS
SOLITAX SC

For the lowest turbidity and the highest solids content: SOLITAX sc

- **Colour-independent measurement of solids**
- **No calibration**
- **Proven cleaning system**
- **As in-tank or in-pipe probe**
- **Combinable with probes for O_2, NO_3, pH, etc**

Wide field of application

The high-precision process probes of the SOLITAX sc family determine turbidity in ultraclear to strongly turbid liquids, and solids concentrations in activated, primary and digested sludges. The potential applications for SOLITAX sc therefore range from drinking and wastewater treatment to the monitoring of surface water and the treatment of sludge.

Economically efficient

Time-consuming multipoint calibrations with dilution series are replaced by a single correction factor. The wide range from 0.001 FNU to 150 g/l covers the optimal solution for every application. The measurement data is displayed and processed with the help of the SC100 or SC1000 Controller. In short: Advantages that are long-lasting and economically efficient.

Persuasive advantages: SOLITAX sc

Maximum time saving

All SOLITAX sc probes are factory calibrated in conformity with DIN EN ISO 7027 for long-term calibration stability. A correction factor replaces the time-consuming multipoint on-site calibrations. The automatic wiper eliminates soiling of the measurement window as it occurs. The result: more stable measured values and lower maintenance costs.

Maximum variability

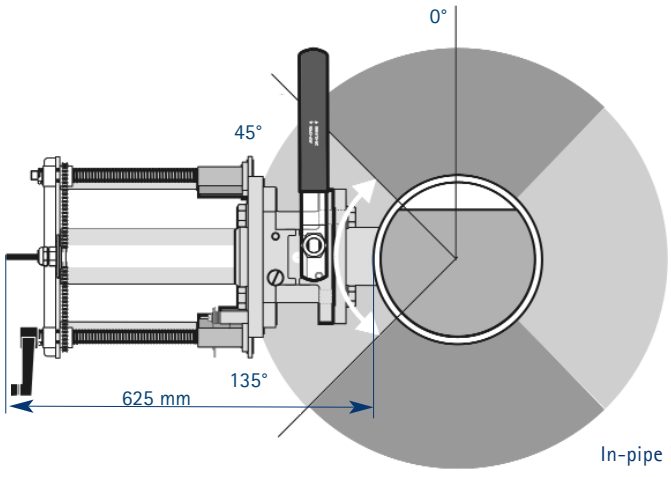
Turbidity and solids measurement, plastic or stainless steel housing, with or without wiper system - SOLITAX sc offers the right probe for every field of application.
This variability is also reflected in the fixing systems for the immersion and in-pipe probes.

SOLITAX sc variants

	t-line sc	ts-line sc	inline sc	hs-line sc	highline sc
TURBIDITY MEASUREMENT					
Drinking water	●	●	●	●	●
Wastewater	●	●	●	●	●
SOLIDS MEASUREMENT					
Primary sludge				●	●
Thickened sludge				●	●
Active sludge		●	●	●	●
Return sludge		●	●	●	●
Dewatered return sludge		●	●	●	●
Digested sludge				●	●
Centrate		●	●	●	●
Lime sludge		●	●	●	●

● suitable

Installing SOLITAX sc as insertion probe



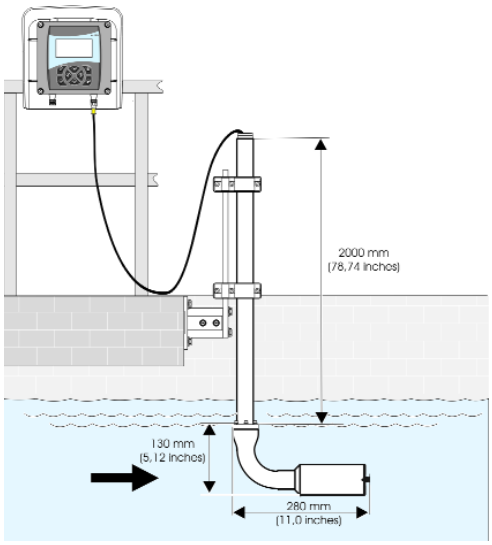
In-pipe installation with the help of safety fitting; recommended mounting angle 45° to 135°.

Technical data

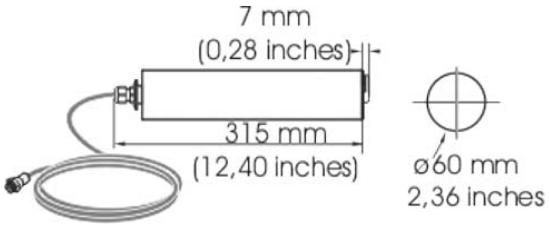
	t-line sc	ts-line	inline sc	hs-line sc	highline sc
Parameters	Turbidity -	Turbidity Solids			
Measurement procedure	90° IR scatter light	IR dual scatter light			
- Turbidity	DIN EN ISO 7027	DIN EN ISO 7027			
- Solids	-	Equivalent to DIN 37414			
Measuring range					
- Turbidity*	0.001 - 4,000 FNU	0.001 - 4,000 FNU			
- Solids	-	0.001 - 50 g/l		0.001 - 150 g/l	
Accuracy					
- Turbidity*	<1% or 0.001 FNU	<1% or 0.001 FNU			
- Solids	-	<5%			
Response time	1 - 300 sec	1 - 300 sec			
Sample temperature	0 - 40 °C	0 - 40 °C			
Flow rate	3 m/s	3 m/s			
Immersion depth	0.1 - 10 m	0.1 - 10 m/60 m**	-	0.1 - 10 m/60 m**	-
Pressure range	1 bar	1 bar/6 bar**	6 bar	1 bar/6 bar**	6 bar
Weight	520 g/ - **	520g/1400 g**	- /2400 g**	520g /1400 g**	- /2400 g**
Dimensions (D x L)	60 x 200 mm	60 x 200 mm	60 x 315 mm	60 x 200 mm	60 x 315 mm
Housing	PVC	PVC/stainless steel	Stainless steel	PVC/stainless steel	Stainless steel
Cleaning	With automatic wiper/without				
Cable length	10 m fixed, max. 100 m extension cable				
Type of fitting	Immersion probe	Immersion probe	Insertion probe	Immersion probe	Insertion probe
Display unit	SC 100 Controller (model LXV401) or SC 1000 Controller (model LXV400 and model LXV402)				

* For user-specific offset and gradient correction; ** PVC/ stainless steel

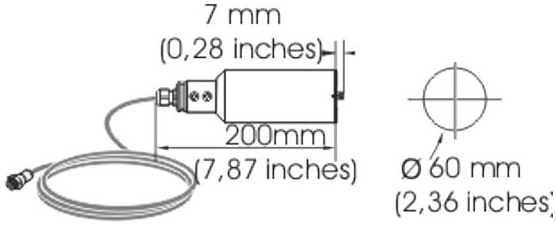
Installing SOLITAX sc as immersion probe



SOLITAX sc insertion probe



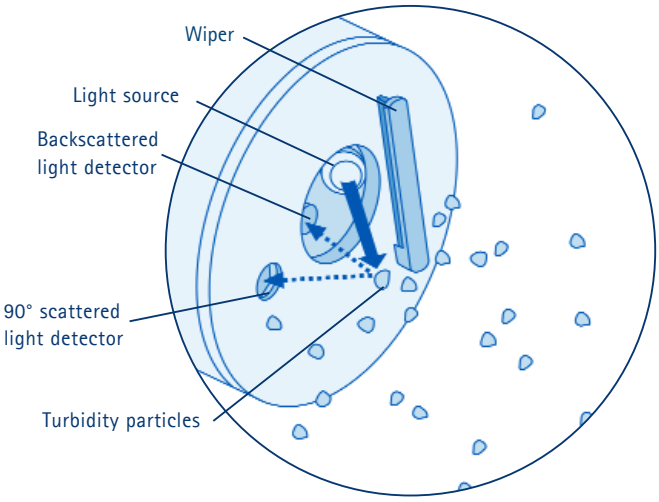
SOLITAX sc immersion probe



The SOLITAX sc principle

Unique colour-independent measurement of solids

Primary and active sludges with different structures and colours, dark digested sludges and light lime sludges make the highest demands on the precise measurement of solids. Only SOLITAX sc solids probes with the patented dual scattered light method can satisfy these demands. The key principle: Parallel evaluation of different scattered light signals.



Function of SOLITAX sc

SC 100 Controller
Up to two SC probes can be connected, e.g. SOLITAX sc with O_2, pH, NO_3, etc.

SC 1000 Controller
Up to eight SC probes can be connected; optional expansion through networking.

HACH LANGE Services

Ordering, information and advice:
UK: +44 (0)161 872 14 87
IRL: +353(0)1 4602522
EU: +49 (0)211 52 88-0

On site technical support.

Ordering information

DESCRIPTION	ART. NO.
SOLITAX sc, stainless steel, with wiper*	
- ts-line	LXV423.99.00100
- hs-line	LXV423.99.00200
- inline	LXV424.99.00100
- highline	LXV424.99.00200
SOLITAX sc, plastic (PVC), with wiper*	
- t-line	LXV423.99.10000
- ts-line	LXV423.99.10100
- hs-line	LXV423.99.10200
ACCESSORIES	
Tank rim mounting	LZX414.00.10000
In-flow safety fitting, stainless steel	LZX337
In-flow fitting, stainless steel	LZX461
Weld-on flange, stainless steel	LZX660
Extension cable	
- 5 m	LZX848
- 10 m	LZX849
- 15 m	LZX850
- 20 m	LZX851
- 30 m	LZX852
- 50 m	LZX853
SC 100 Controller	LXV401
SC 1000 Controller	LXV400 and LXV402
SPARE PARTS AND CONSUMABLES	
Wiper profiles, silicone (5 mm)	LZX050
Wiper profiles, Viton (5 mm)	LZX578

* All SOLITAX sc probes are also available without a wiper.

DOC063.52.00353.Oct06

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info@hach-lange.ie
www.hach-lange.ie

FP 360 sc OIL-IN-WATER CONTINUOUS ONLINE MONITORING SENSOR

Applications

- Industrial water
- Power
- Wastewater
- Drinking water

Continuous oil-in-water monitoring for the right price.

The FP 360 sc is the only online oil-in-water instrument that delivers the highest sensitivity and selectivity with the lowest total cost of ownership.

The right technology for the right price

Due to its unique combination of submersible probe design and UV fluorescence sensing technology, the FP 360 sc delivers the best technology to detect oil in water and is priced below competitive UV fluorescent instruments.

Minimal maintenance

The FP 360 sc has no tubes, pumps, or valves that can foul or require constant maintenance interventions. Maintenance is limited to occasional wiping of the sensor's measurement window, calibration once every two years, and Xenon lamp replacement every four years.

Reduced laboratory testing

While laboratory testing is the ultimate method of measuring oil in water, it is a long and complex process that requires special equipment and trained lab personnel. The FP 360 sc provides a cost-effective, continuous online monitoring solution to maintain process control and avoid oil contamination with minimal laboratory testing.

High sensitivity and selectivity

The FP 360 sc can detect and measure polycyclic aromatic hydrocarbons (PAHs) from 1.2 ppb to up to 5000 ppb (µg/L). This is approximately equivalent to a concentration of mineral oil between 0.1 to 150 ppm (mg/L). Furthermore, the FP 360 sc method of detection makes it impervious to interferences by turbid water or natural organic and biological matter that impact online light scattering, UV absorbance, and VIS fluorescence instruments.

One to eight sensors

The HACH LANGE Digital Controller Family can receive data from up to eight HACH LANGE digital sensors, including oil-in-water, suspended solids, turbidity, pH/ORP, dissolved oxygen, conductivity, ammonium, phosphate, SAC, and nitrate in any combination.

There's no complicated wiring or set up procedures with the family of controllers. Just plug the sensor to any HACH LANGE digital controller and it's ready to use because it's "plug and play."

Technical Data*

Measurement method	UV fluorescence method for polycyclic aromatic hydrocarbons (PAH)
Light Source	Miniature xenon flashlamp with interference filter
Detector	UV photodiode with interference filter; Compensation of daylight and flashlamp intensity fluctuations
Excitation	Wavelength 254 nm
Wavelength	Measurement: 360 nm
Measuring range	Low Range: 0 - 50 ppb (µg/L) and 0 - 500 ppb (µg/L) (PAH)** 0.1 - 1.5 ppm (mg/L) and 0.1 - 15 ppm (mg/L) (oil)** High Range: 0 - 500 ppb (µg/L) and 0 - 5,000 ppb (µg/L) (PAH)** 0.1 - 15 ppm (mg/L) and 0.1 - 150 ppm (mg/L) (oil)**
Resolution	0.1 ppb (µg/L) (PAH) in the lowest measuring range
Reproducibility	2.5 % of measured value at constant temperature (PAH)
Response time	10 s (T90)
Calibration	Factory calibrated with UV fluorescence standard or process calibration with results of a grab sample analysis.
Sample temperature	1 - 40 °C
Pressure range	Max. 30 bar
Material	Housing: stainless steel 316Ti (1.4571) or titanium
Dimensions (W x H x D)	68 x 306 mm (D x L; without connector and suspension pin)
Weight	Stainless steel: 2.8 kg Titanium: 1.8 kg
Warranty	2 years

**Subject to change without notice.*

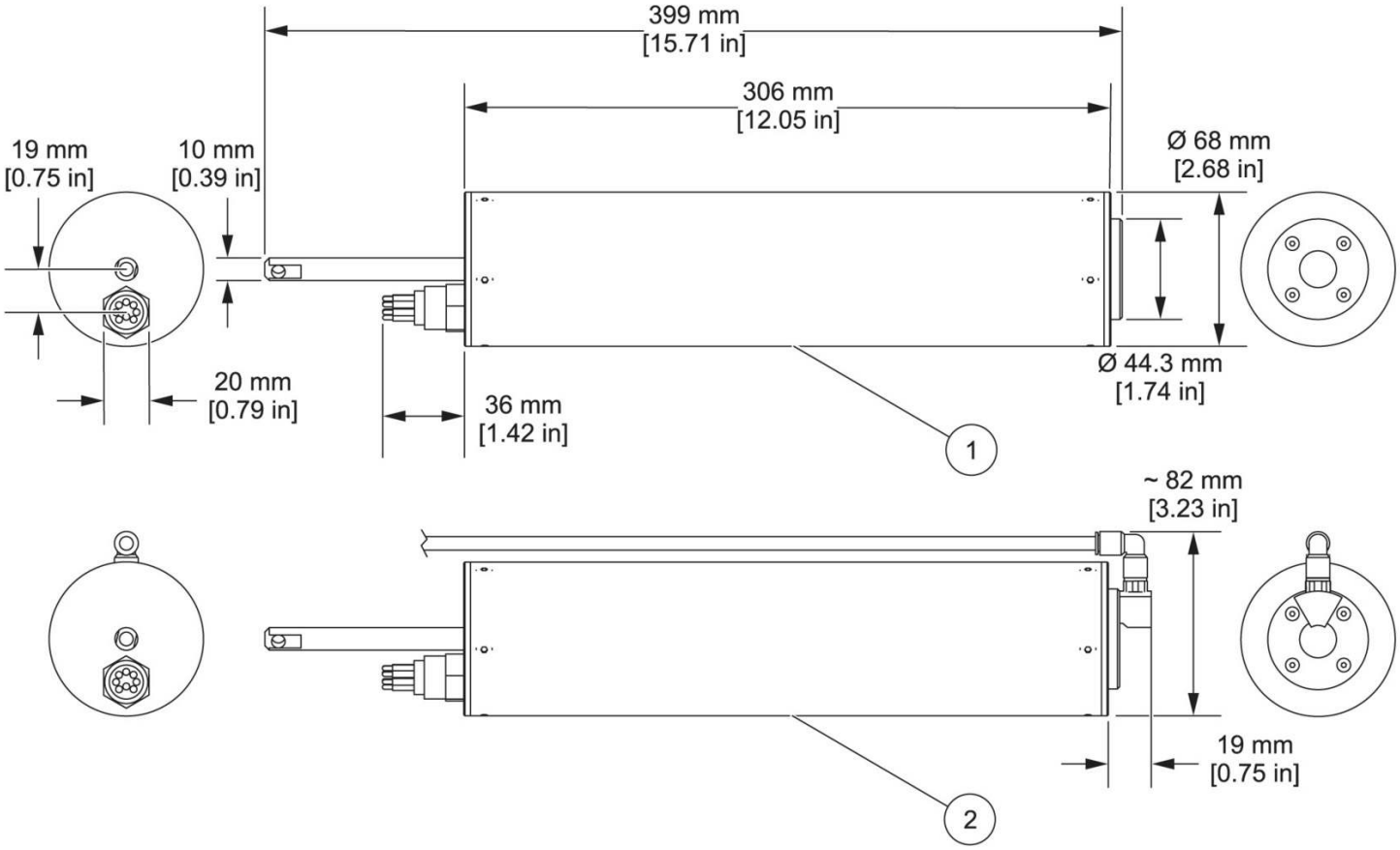
***With calibration standard.*

Principle of Operation

The FP 360 sc measures intensity of fluorescence light at a wavelength of 360 nm emitted by polycyclic aromatic hydrocarbons (PAH) after UV irradiation of the sample at 254 nm. Since PAHs are components of most mineral oils, the FP 360 sc can detect the presence of oil contamination in surface, process, or industrial waters. In addition, since the intensity of the emitted light is proportional to the PAHs concentration, the FP 360 sc can be calibrated to measure oil concentration in stable matrices.

Dimensions

Figure 1 shows the sensor without the cleaning unit. Figure 2 shows the sensor with the cleaning unit.



Order Information

Sensors

LXV441.99.11101	FP 360 sc PAH/Oil Fluorescence probe, 0-500 ppb, stainless steel body, 10 m cable, w/o cleaning
LXV441.99.11201	FP 360 sc PAH/Oil Fluorescence probe, 0-500 ppb, stainless steel body, 10 m cable, with cleaning
LXV441.99.11301	FP 360 sc PAH/Oil Fluorescence probe, 0-500 ppb, stainless steel body, 1.5 m cable, w/o cleaning
LXV441.99.12101	FP 360 sc PAH/Oil Fluorescence probe, 0-500 ppb, titanium body, 10 m cable, w/o cleaning
LXV441.99.12201	FP 360 sc PAH/Oil Fluorescence probe, 0-500 ppb, titanium body, 10 m cable, with cleaning
LXV441.99.12301	FP 360 sc PAH/Oil Fluorescence probe, 0-500 ppb, titanium body, 1.5 m cable, w/o cleaning
LXV441.99.21101	FP 360 sc PAH/Oil Fluorescence probe, 0-5000 ppb, stainless steel body, 10 m cable, w/o cleaning
LXV441.99.21201	FP 360 sc PAH/Oil Fluorescence probe, 0-5000 ppb, stainless steel body, 10 m cable, with cleaning
LXV441.99.21301	FP 360 sc PAH/Oil Fluorescence probe, 0-5000 ppb, stainless steel body, 1.5 m cable, w/o cleaning
LXV441.99.22101	FP 360 sc PAH/Oil Fluorescence probe, 0-5000 ppb, titanium body, 10 m cable, w/o cleaning
LXV441.99.22201	FP 360 sc PAH/Oil Fluorescence probe, 0-5000 ppb, titanium body, 10 m cable, with cleaning
LXV441.99.22301	FP 360 sc PAH/Oil Fluorescence probe, 0-5000 ppb, titanium body, 1.5 m cable, w/o cleaning

Accessories

LZX914.99.11110	Stainless steel chain mounting set
LZY669	Flow cell with mounting panel for FP 360 sc

Controllers

SC 200	The SC 200 Universal Controller is the most versatile controller on the market. It allows the use of digital and analogue sensors, either alone or in combination, to provide compatibility with the broadest range of sensors.
SC 1000	Get the same great features as the SC 200 Controller above - “plug and play”, all digital operation and communication - but with the SC 1000 Controller, up to eight HACH LANGE sensors can be used with one controller in any combination. The SC 1000 Controller is also expandable and upgradeable to easily adapt to your needs.

Service Packages

TSE-COM-FP360SC	Commissioning for FP 360 sc. Includes first level training.
TSE-BC-FP360SC	Basic maintenance contract for FP 360 sc. Includes one onsite visit and final reporting.
TSE-CC-FP360SC	Comfort maintenance contract for Oil-in-water sensor FP 360 sc. Includes one onsite visit and final reporting. Extended warranty up to 60 months.
TSE-MC-FP360SC	Onsite one-off inspection for Oil-in-water sensor FP 360 sc. I ncludes one onsite visit on demand and final reporting.

DOC053.52.35024.Dec14

APPENDIX B

SPEL Separator Data Sheet

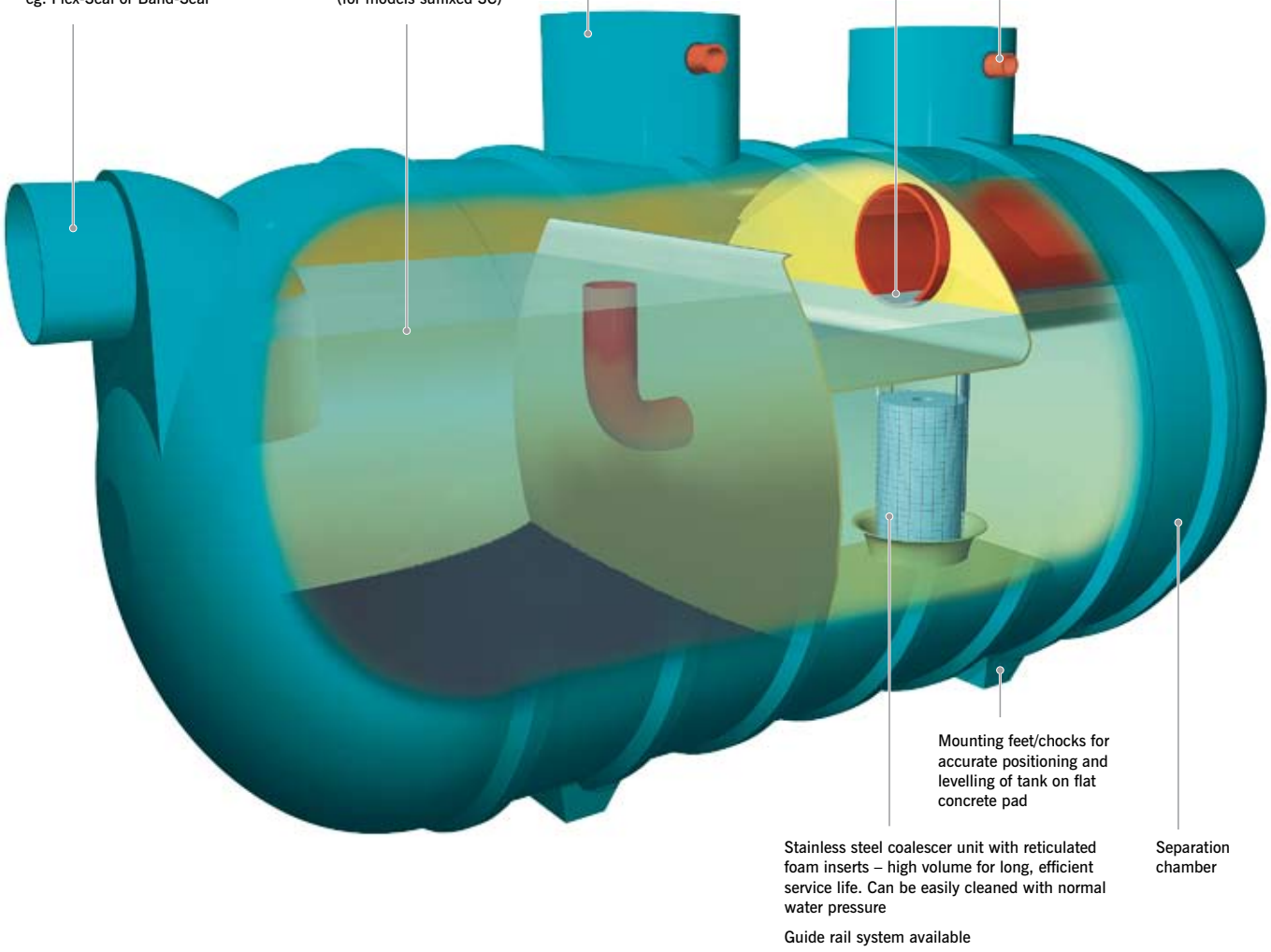
Section 6
SPEL Stormceptor®
by-pass separators

The SPEL Stormceptor is the first Environment Agency listed class 1 by-pass separator to BS EN 858-1:2002.

The Stormceptor provides a very effective means of separating oil and other light liquids from stormwater drainage systems.

Compliant to the European Standard BS EN 858-1, the Environment Agency's Pollution Prevention Guidelines PPG3 and the Construction Products Regulations.

Compliant to the European Standard BS EN 858-1, the Environment Agency's Pollution Prevention Guidelines PPG3 and the Construction Products Regulations.



The 'heart' of SPEL Separators is the unique long life, low maintenance coalescer unit which 'polishes' the final effluent AFTER 90% hydrocarbons of silt have been separated out.

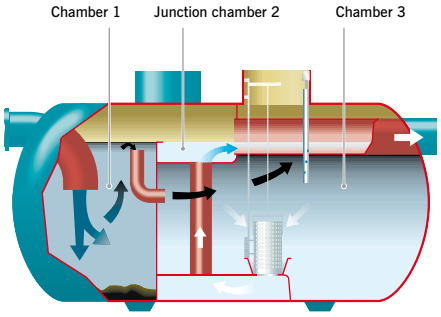
The SPEL Stormceptor is a well proven high quality factory-made unit specially designed and fabricated to provide a very effective means of separating oil and other light liquids from stormwater drainage systems.

The SPEL Stormceptor was the first Environment Agency listed class 1 by-pass separator to BS EN 858-1:2002.

The SPEL Stormceptor has been used effectively throughout the UK and abroad since 1985. All sizes and types of development have been catered for, including industrial development sites, hypermarkets and airports. Areas of up to 30 hectares can be covered with a single unit.

Protecting coastal waters

Surface water draining from runways at a busy RAF station in Anglesey is being treated by two SPEL Stormceptor class 1 by-pass separators.

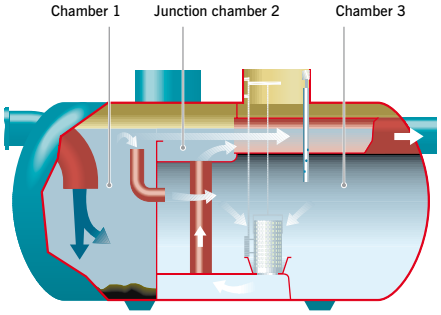


Flows according to nominal size (NSB)

The polluted surface water first enters the primary chamber where silt settles out and is retained. The fuel, oil and other pollutants lighter than water, rise to the surface and are efficiently skimmed off and transferred to the separation chamber.

In normal conditions all the flow is through the separation chamber, where the quiescent conditions allow the pollutants to separate out efficiently. Water from the cleanest zone in the separation chamber flows through a coalescer unit, to remove smaller globules of oil, up to the junction chamber and thence to the outlet.

The reclaimed former opencast coal site at Bermuda Park, Warwickshire. The main contractor – Tarmac Construction Midlands – has installed three SPEL 500 series Stormceptor by-pass separators with Econoskim fuel/oil skimming and separate fuel/oil containment facilities. These cater for an impermeable area of 68 acres.



Storm flows above NSB

During a storm the level in the primary chamber rises and the stormwater passes over the weir into the junction chamber and to the outlet.

The design keeps the turbulence within the separation chamber to a minimum which avoids disturbing the contaminants retained.

Above and left: SPEL Stormceptor series 600 class 1 by-pass separator for a catchment area of 30 hectares.

Selecting size of SPEL Stormceptor

The nominal size (NSB) is obtained by this formula: NSB = 0.0018A(m^2) where A is the catchment area.

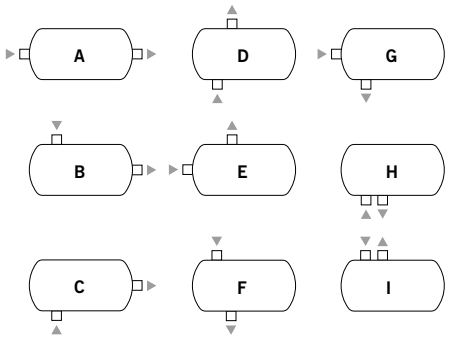
	NSB	Model	Class 1 or 2 C1 or C2	Silt Cap. SC	Orientation inlet/outlet	Inlet/outlet diameter
Example 1	20	320	C1	SC	D	600/600
Example 2	50	4100	C2	–	A	900/900

Example 1

SPEL Stormceptor class 1 by-pass separator NSB 20 model 320C1/SC/D 600/600 (with silt capacity).

Example 2

SPEL Stormceptor class 2 by-pass separator NSB 100 model 4100C2/A 900/900 (without silt capacity).



How to select and specify

1. In accordance with the EA Pollution Prevention Guidelines PPG3:
   - Determine the type of separator – full retention or by-pass.
   - Determine the class of separator – class 1 or 2.
   - Specify whether silt capacity is required integrally or separately upstream of the separator.
2. Against the catchment area within which your requirements fall, the SPEL Separator nominal size can be ascertained.
3. Inlet/outlet pipe connection orientation A-I (see options below).
4. Inlet/outlet diameter in mm.
5. SPEL Separators are available in four specifications to suit invert depths and ground water conditions. Standard, Heavy, Extra Heavy and Special, see tables alongside.
6. Optional extras available see 5.6 and 5.7.
   - SPEL coalescer unit guide rail system.
   - SPEL coalescer unit lifting/locating/ locking system.
   - SPEL Econoskim® light liquid skimming and separate containment system.
   - SPEL mechanical anchoring system. See 4.11/4.12.
7. SPEL automatic alarm/monitoring system. See 5.7.

Choice of pipe connections

The orientation of inlet/outlet connections indicated depends on the pipe diameter (see under A–I and D–I overleaf) except for Class 2 Stormceptors which accommodate the larger diameter. Any special requirements contact Technical Sales.

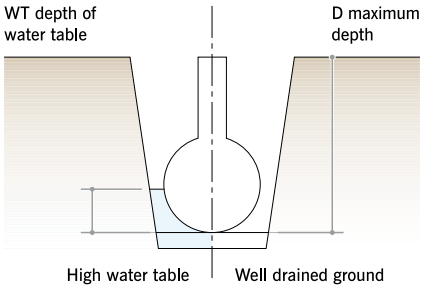
Both inlet and outlet connections are spigots (GRP or PVCU) and can be connected to the site pipework using Flex-Seal, Band-Seal or similar flexible couplings.

Specification

Standard, heavy, extra heavy or special specification available dependent upon tank burial depth and water table level in winter. The tables below refer to tanks with a concrete surround. For extra heavy and special specification range and pea gravel surround refer to section 4 or contact technical sales.

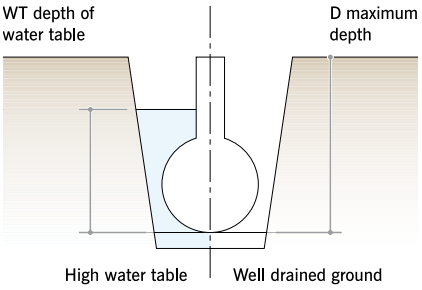
Standard tanks

Series	WT(m)	D(m)
100/200	1.0	4.0
300	0.9	4.0
400	1.3	5.0
500	1.9	5.7
600	2.4	6.2



Heavy tanks

Series	WT(m)	D(m)
100/200	2.0	6.0
300	2.8	5.6
400	3.5	6.0
500	4.5	7.25
600	4.7	7.3



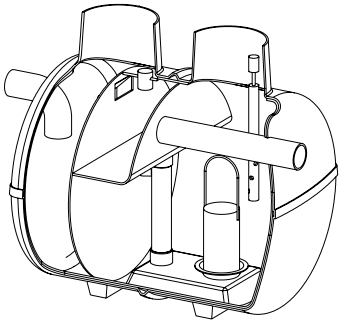
6.4 SPEL Stormceptor® by-pass separators 100 and 200 series, class 1 and 2 models

Compliant to the European Standard BS EN 858-1, the Environment Agency's Pollution Prevention Guidelines PPG3 and the Construction Products Regulations

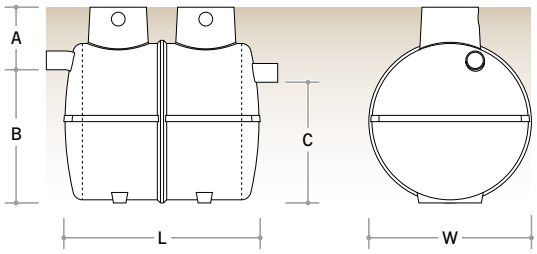
Class 2 models available for 100 and 200 series – change C1 for C2 when quoting model reference.

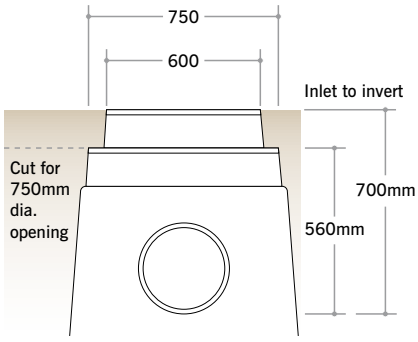
Model	Nominal size (NSB)	Catchment area a (m²)	Oil storage (litres)	Silt storage (litres)	Overall length (mm) L	Overall diameter (mm) W	Inlet Invert (mm) A	Base to Inlet (mm) B	Base to outlet (mm) C	Max in/out pipe diameter (mm) for orientation		Number of access shafts diameter (mm)			
										type A-C	type D-I	450	600	750	900
103 C1/SC	3	1667	45	300	1550	1300	500	1015	965	160	160	2	-	-	-
206 C1/SC	6	3333	90	600	2110	1225	560*	1350	1300	300	300	-	*	1	-
208 C1/SC	8	4444	120	800	2260	1225	560*	1350	1300	300	300	-	*	1	-
210 C1/SC	10	5556	150	1000	2920	1225	560*	1350	1300	300	300	-	*	1	-
215 C1/SC	15	8333	225	1500	4227	1225	560*	1350	1300	400	400	-	*	1	-

* 200 Series Stormceptors have a dual size access shaft. For units that will collect silt we recommend using the 750mm diameter access which provides enough room for the silt removal hose to be lowered into the tank during maintenance. The value of 'A' here is for the 750mm access – the 600mm access has an 'A' value of 700mm.

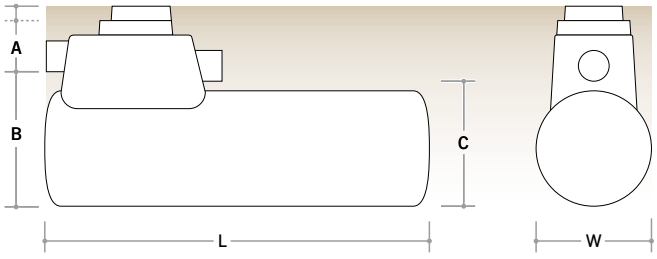


100 series





200 series



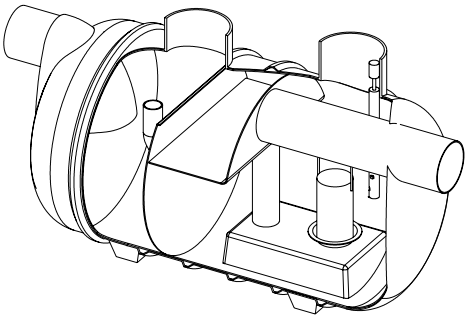
Dual access shaft openings

For access to desludge primary chamber, cut 750mm dia. access shaft opening. Where a silt trap is incorporated upstream or silt build up will not occur 600mm diameter access shaft may be adequate.

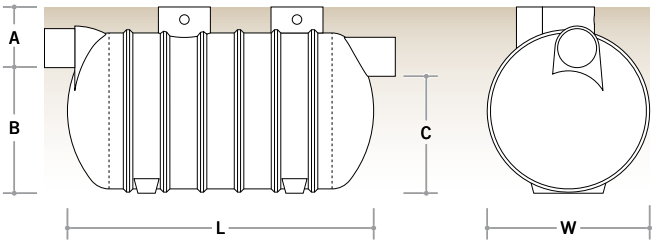
Refer to 6.7 and 6.8 for more comprehensive data including installation.

Class 2 models available for 300 and 400 series – change C1 for C2 when quoting model reference.

Model	Nominal size (NSB)	Catchment area a (m²)	Oil storage (litres)	Silt storage (litres)	Overall length (mm) L	Overall diameter (mm) W	Inlet Invert (mm) A	Base to Inlet (mm) B	Base to outlet (mm) C	Max in/out pipe diameter (mm) for orientation		Number of access shafts diameter (mm)			
										type A-C	type D-I	450	600	750	900
318 C1/SC	18	10000	270	1800	3200	1875	700	1450	1350	450	600	-	2	-	-
320 C1/SC	20	11111	300	2000	3535	1875	700	1450	1350	450	600	-	2	-	-
325 C1/SC	25	13889	375	2500	4420	1875	700	1450	1350	450	600	-	2	-	-
330 C1/SC	30	16667	450	3000	5070	1875	700	1450	1350	450	600	-	1	-	1
340 C1/SC	40	22222	600	4000	7060	1875	740	1410	1310	450	600	-	1	-	1
345 C1/SC	45	25000	675	4500	7615	1875	740	1410	1310	450	600	-	1	-	1
350 C1/SC	50	27778	750	5000	8255	1875	740	1410	1310	450	600	-	1	-	1

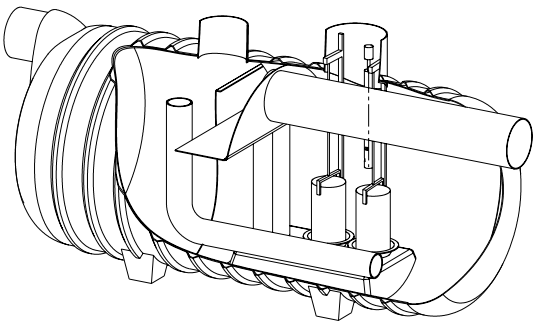


300 series

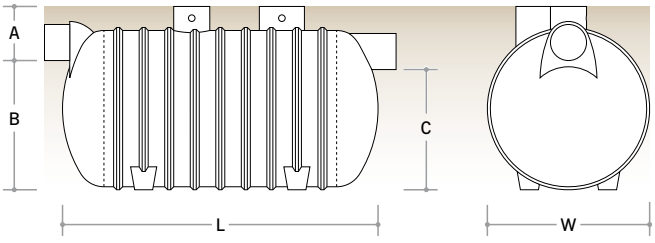


Model	Nominal size (NSB)	Catchment area a (m²)	Oil storage (litres)	Silt storage (litres)	Overall length (mm) L	Overall diameter (mm) W	Inlet Invert (mm) A	Base to Inlet (mm) B	Base to outlet (mm) C	Max in/out pipe diameter (mm) for orientation		Number of access shafts diameter (mm)			
										type A-C	type D-I	450	600	750	900
460 C1/SC	60	33333	900	6000	4400	2700	950	2100	2000	600	750	-	1	-	1
470 C1/SC	70	38889	1050	7000	5250	2700	950	2100	2000	600	750	-	1	-	1
480 C1/SC	80	44444	1200	8000	6170	2700	950	2100	2000	600	750	-	1	-	1
4100 C1/SC	100	55556	1500	10000	7400	2700	1100	1950	1850	750	900	-	1	-	1
4125 C1/SC	125	69444	1875	12500	9050	2700	1100	1950	1850	750	900	-	1	-	1
4150 C1/SC	150	83333	2250	15000	9950	2700	1100	1950	1850	750	900	-	-	-	2
4160 C1/SC	160	88889	2400	16000	11830	2700	1250	1800	1700	750	900	-	1	1	1

400 series – models without silt capacity are available if required – details on application.



400 series



Compliant to the European Standard BS EN 858-1, the Environment Agency's Pollution Prevention Guidelines PPG3 and the Construction Products Regulations

These Stormceptors are individually designed in accordance with specific site requirements according to catchment area, class, silt capacity, inlet/outlet connection size and orientation. The following is an approximate guide to the range of models available. Please contact our technical department for your specific requirements. Class 2 models available – change C1 for C2 when quoting model reference.

Model	Nominal size (NSB)	Catchment drainage area hectares	Oil storage litres NSBx15	Silt** storage litres NSBx100	*Overall length (mm) L	*Overall diameter (mm) W	Inlet Invert (mm) A	Base to Inlet (mm) B	Base to outlet (mm) C	Max in/out pipe diameter (mm) for orientation type A-C	Max in/out pipe diameter (mm) for orientation type D-I
5180C1SC	180	10	2700	18000	10040	3650	1260	2615	2390	900	1200
5200C1SC	200	11.1	3000	20000	11140	3650	1260	2615	2400	900	1200
5250C1SC	250	13.9	3750	25000	13840	3650	1260	2615	2400	900	1200
6300C1SC	300	16.7	4500	30000	14250	4150	1425	2850	2600	1200	1500
6350C1SC	350	19.4	5250	35000	16635	4150					
6400C1SC	400	22.2	6000	40000	18259	4150					
6500C1SC	500	27.8	7500	50000	22250	4150					
6500C1	500	27.8	7500	Nil	16635	4150					
6600C1	600	33.3	9000	Nil	19899	4150					
6700C1	700	38.9	10500	Nil	23050	4150					
6750C1	750	41.7	11250	Nil	24650	4150					
6800C1	800	44.4	12000	Nil	–	4150					
61000C1	1000	55.5	15000	Nil	–	4150					

Subject to site drainage requirements

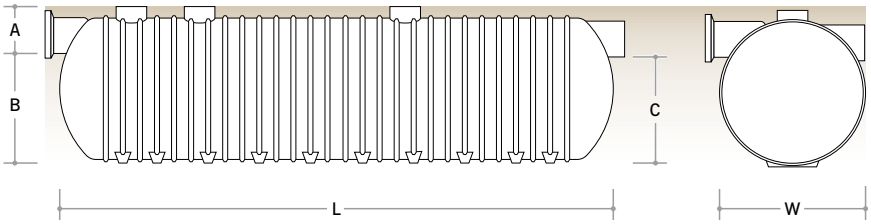
*Tank shell – fittings extra. **Where silt capacity required it is available on the models indicated.

Pipe size and orientation designed to suit site pipework and class 1 or 2.

Silt capacity normally provided for integrally in accordance with PPG3.

Series 500
Inside diameter 3500mm, outside diameter 3650mm.

Series 600
Inside diameter 4000mm, outside diameter 4150mm.



Features

Filament wound shells are lightweight but have great strength and durability.

Life expectancy in excess of fifty years.

Smooth, high gloss, corrosion resistant, resin-rich internal surface.

External 'flow coat' water penetration barrier.

25 year warranty.

Stainless steel coalescer units (class 1 separators) with durable high volume reticulated foam inserts for long life and long term efficiency.

SPEL automatic alarm/monitoring system

This is to indicate when separator requires emptying or SPEL Tankstor® with Econoskim®. See 5.7.

Optional extras

SPEL coalescer unit guide rail system. See 9.7.

SPEL coalescer unit lifting/locating/locking system with lifting chains. See 9.6/9.7.

SPEL Econoskim light liquid skimming and separator containment system. Manual or automatic systems which save conventional emptying costs by 90%. Section 11.

SPEL pollution monitoring and containment systems. Section 11.

SPEL mechanical anchoring systems. See 4.11/4.12.

GRP non slip ladder/s with stainless steel fixings.

Regulation/specification compliance as appropriate

Environment Agency's Pollution Prevention Guidelines PPG3.

European Standard; Separator systems for light liquids BS EN 858-1:2002.

British Standard; Specification for design and construction of vessels and tanks in reinforced plastics BS 4994 : 1987.

European Standard; Underground tanks of glass reinforced plastics (GRP) BS EN 976-1 : 1997.

Materials to BS 3532, BS 3691 and or BS 2782 or equivalent standards.

Compliant to the European Standard BS EN 858-1, the Environment Agency's Pollution Prevention Guidelines PPG3 and the Construction Products Regulations.

The 200 Series Stormceptor class 1 by-pass separators are single access shaft units with integral silt capacity. There is complete access to both the primary chamber and the fuel/oil separation chamber for desludging by suction tanker provided the 750mm dia. access shaft is utilised.

If a silt trap is situated upstream of the Stormceptor and/or no build up of silt will occur in the primary chamber the smaller 600mm dia. access shaft can be utilised.

Performance

SPEL Stormceptor class 1 by-pass separators incorporate a coalescer unit and are designed to meet the requirements of the European Standard BS EN 858-1 and the Environment Agency's Pollution Prevention Guidelines PPG3, where the maximum permissible content of residual oil in the outlet is 5mg/l.

The coalescer unit has a robust high volume reticulated foam insert. The insert efficiently coalesces the finer globules of hydrocarbons for gravity separation and due to its large volume, lasts for long periods before requiring cleaning. Cleaning is then a simple operation using normal pressure water. The insert can be reused again and again, rarely requiring replacement.

The inlet/outlet diameters and fall across the separator as indicated ensure optimum performance.

The light liquid storage capacity (fuel, oil etc.) is 15 times the nominal size (NS) in litres, eg. SPEL Stormceptor NSB6 has a light liquid storage capacity of 90 litres.

The first primary chamber can be desludged by a suction tanker providing the 750mm dia. access together with the cover and frame to suit is incorporated.

Specification

SPEL 200 series Stormceptor class 1 by-pass separators incorporate a strong filament wound shell and are manufactured in standard and heavy specification depending on burial depths and water table height as in the table above. See also 6.3.

Inlet/outlet connections

Both inlet and outlet connections are either 225/300/400 dia. Quantum spigots. Flex-Seal/ Band-Seal or similar couplings are available for connecting to site pipework if required.

Burial depths for standard and heavy specification tanks

Standard	Maximum burial depth to bottom of tank	4 metres
	Maximum height of water table above bottom of tank	1 metre
Heavy	Maximum burial depth to bottom of tank	6 metres
	Maximum height of water table above bottom of tank	2 metres

Handling

Tanks should be lifted using slings not chains or wire ropes. DO NOT drag tanks along the ground for any distance and avoid jarring or bumps. DO NOT lift with water in the tank. See 4.2.

Preliminary

Remove the plastic tie used to hold the coalescer unit inside the tank.

Insert the coalescer unit securely into the base socket.

Ensure the foam insert is fitted inside the stainless steel coalescer unit.

During installation, it is important the foam inserts are not clogged with dust, debris or drops of wet concrete. To safeguard against this, we recommend covering the access shaft with a sheet of polythene.

Installation guidance notes

Installation should be carried out by a competent contractor in accordance with the following procedures, Health & Safety at Work legislation and good building practice.

For detailed instructions see section 4 or installation instructions supplied with every tank.

1. Determine the size of the excavation allowing for the drain invert depth and a concrete surround. Allowance should be made for consolidating concrete under the unit when backfilling.
2. Pour concrete base to correct depth and level off.
3. When the concrete has set sufficiently, place the tank in position, check for levels (including inlet/outlet inverts) and fill with water to a maximum depth of: 200 series – 200mm, 300 series – 300mm, 400 series – 400mm. Ensure concrete slab is clean ready for placing concrete surround. Surround should preferably be placed within 48 hours of casting the base slab.
4. Place backfill concrete (ST4 mix) up to the depth of the water in the tank ensuring the concrete is properly consolidated under the tank to prevent voids. Consolidate by hand – do not use vibrating pokers. Connect up pipework.
5. Continue backfilling with concrete and at the same time filling the tank with water to equalise pressure and resist floatation. Where the tank is divided into chambers ensure all chambers are filled equally.
6. Top up the tank with water to inlet/outlet invert level and place remainder of concrete to a depth of approximately 150-200mm above the top of the tank. Where extension access shaft is fitted, this can be surrounded in concrete once the main tank concrete surround has set. (See Extension access shafts).
7. Where the concrete slab over the tank is to take vehicle loading it should be reinforced in accordance with good practice to take the maximum load and should be extended onto unexcavated ground. It is important that vehicle loading is not transferred to the tank shell or its concrete surround.
8. Incorporate inspection cover and frame. NOTE: For access to desludge the primary chamber fit only 750mm dia. manhole cover and frame.

Venting

SPEL Separators are governed by the requirements of petroleum regulations: Petrol filling stations: Construction and Operation HS(G)41, ISBN 0-11885449-6. These state in paragraph 45, that each chamber of a petrol interceptor should be vented and vent pipes should extend to not less than 2.4m above ground level, should not be less than 75mm diameter and of a robust construction, and should be manifolded above ground.

Extension access shafts

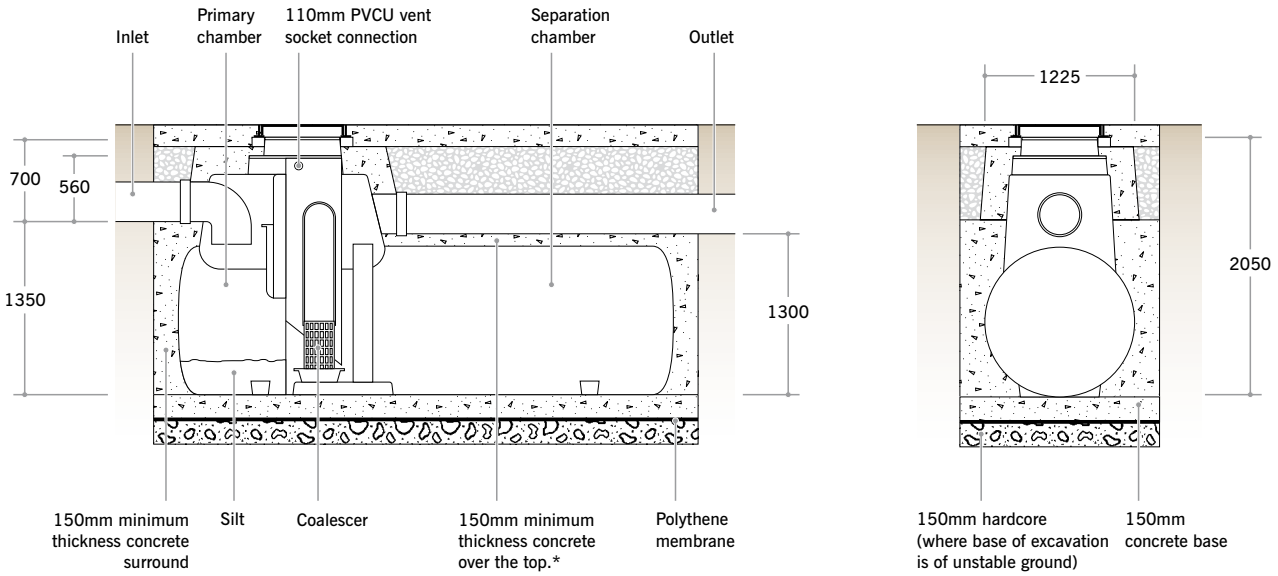
SPEL extension shafts are available in standard lengths of 500mm upwards and 500mm increments. When these should be surrounded with concrete, pour in lifts of approximately 500mm, allowing the concrete to set between each lift.

Commissioning

On completion of installation, check the foam insert is fitted inside the stainless steel coalescer unit, the coalescer unit is inserted securely into the base socket and the tank is free of debris etc.

6.8 SPEL Stormceptor® by-pass separators

200 series, class 1 with silt capacity



* Fabric reinforcement may be necessary where vehicle loading has to be taken into account or where high extension access shafts are to be fitted

SPEL automatic alarm/monitoring system

Requirement of the Environment Agency's Pollution Prevention Guidelines PPG3

The SPEL automatic alarm/monitoring system provides continuous monitoring of the separator contents by sensing when the light liquid within the separator has filled to a predetermined level (with design safety margins), and provides a simple audio-visual warning to alert the operator that the separator needs to be emptied.

Maintenance

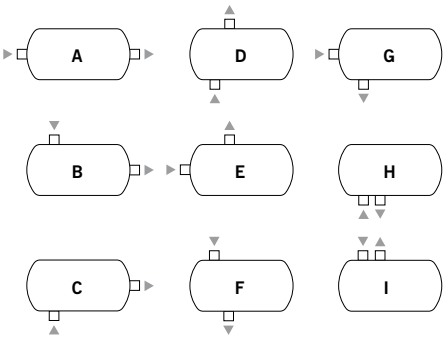
The SPEL 200 series Stormceptor class 1 by-pass separators have good access to both the primary chamber and the light liquid separation chamber for periodic emptying of retained light liquids and silt which is essential to maintain the units optimum performance.

Periods between emptying will have to be determined depending on site conditions but normally at least twice a year.

For detailed instructions see section 9.

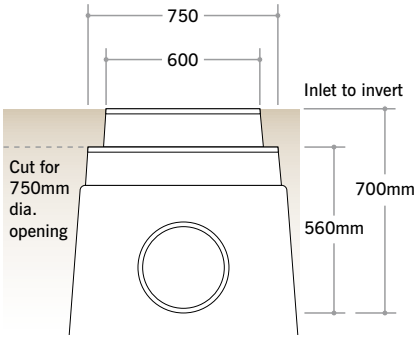
Procedure in brief

1. Lift handle and coalescer unit out of the tank and place ahead of the separator.
2. Remove foam insert and wash with normal water pressure, ensuring the dirty water runs into the separator.
3. Empty light liquids and silt alternating between both chambers to avoid excessive pressure one side of the partition.
4. Re-insert the foam insert into the stainless steel coalescer unit and re-insert the coalescer unit into the separator.



Choice of pipe connections

Orientation of inlet/outlet pipe connections.



Dual access shaft openings

For access to desludge primary chamber, cut 750mm dia. access shaft opening. Where a silt trap is incorporated upstream or silt build up will not occur 600mm diameter access shaft may be adequate.

Catchment area m²	SPEL ref	Nominal size NSB	Oil storage litres NSBx15	Silt storage litres NSBx100	Overall length (mm)	Max pipe (mm)
3333	206C1SC	6	90	600	2110	300
4444	208C1SC	8	120	800	2260	300
5556	210C1SC	10	150	1000	2920	300
8333	215C1SC	15	225	1500	4227	300