

Corwen Wastewater Treatment Works

Groundwater Abstraction Transfer License

Hydrogeological Assessment

February 2025

Project Information	
Project:	Corwen Wastewater Treatment Works
Report Title:	Hydrogeological Assessment
Client:	Eric Wright Water Limited
File Ref:	15725 - Hydrological Assessment-01

Approval Record	
Author:	Aled Williams BSc (Hons) MCIWEM C.WEM

Document History		
Revision	Date	Comment
01	14/02/2025	First issue

The copyright in this document (including its electronic form) shall remain vested in Waterco Limited (Waterco) but the Client shall have a licence to copy and use the document for the purpose for which it was provided. Waterco shall not be liable for the use by any person of the document for any purpose other than that for which the same was provided by Waterco. This document shall not be reproduced in whole or in part or relied upon by third parties for any use whatsoever without the express written authority of Waterco.

This report will remain valid for a period of twelve months (from the date of last issue) after which the source data should be reviewed in order to reassess the findings and conclusions on the basis of latest available information.

Contents

Introduction1

Scope1

Development Proposals1

Ground Conditions1

Interaction of Pumped Groundwater on Watercourses2

Rate & Volume of Abstraction.....2

Water Quality2

Programme of Works3

Impact on Fish in the River Dee.....3

Conclusions3

Appendices

Appendix A Location Plan

Appendix B Development Proposals

Appendix C Borehole Records

Appendix D Soil Sampling Analysis

Appendix E Dewatering Flow Estimates

Appendix F Chemical Data Sheets

Introduction

Waterco has undertaken a Hydrogeological Assessment in support of a groundwater abstraction transfer license application at Corwen Wastewater Treatment Works (WwTW), Green Lane, Corwen.

The groundwater abstraction transfer license is required in support of improvement works to Corwen WwTW, specifically to dewater an excavation in order to construct a new Humus Tank.

A site location plan is included in Appendix A.

Scope

The scope of this Hydrogeological Assessment is set out below:

- Specify the interaction of pumped groundwater with watercourses.
- Specify the instantaneous rate of abstraction.
- Detail the quality of water to be dewatered.
- Detail the timing of the abstraction.
- Detail the location of discharge and volumes to be discharged.

Development Proposals

As part of the scheme, a partly below ground Humus Tank will be constructed. To facilitate construction, dewatering of the excavation will be required. Proposed scheme drawings are included in Appendix B.

Ground Conditions

Ground investigations and associated reporting has been undertaken by Geotechnics in April 2024. The Factual Ground Investigation Reports (document reference Corwen WwTW – B17490-118564-ZZ-ZZ-RP-GB-BH0005) supports the abstraction licence application. Borehole records together with a borehole location plan are included as Appendix C. Borehole BH05 is located in the position of the proposed Humus Tank (where dewatering will occur).

The geology at BH05 and across the wider site comprises sandy clay over gravel. At BH05, topsoil and gravel are recorded from ground level to 0.3m below ground level (m.bgl). Sandy clay is recorded from 0.3m.bgl to 2.3m.bgl. Sandy Gravel is recorded from 2.3m.bgl to 4.6m.bgl and is underlain by Silt to the base of the borehole at 15.45m.bgl.

Groundwater was struck in BH05 at 1.2m.bgl. The groundwater is considered to be in hydraulic continuity with the River Dee.

Interaction of Pumped Groundwater on Watercourses

Discharge of the abstracted groundwater (following treatment for sediment removal) will be made direct to the River Dee at SJ 08276 43589. The discharge location is shown on the Location Plan in Appendix A. Given the elevation of the site (+130m AOD), the water will not be brackish.

The Factual Ground Investigation Reports (document reference Corwen WwTW – B17490-118564-ZZ-ZZ-RP-GB-BH0005) includes groundwater PH analysis from a sample taken from BH05. A PH level of 7.1 was recorded. Soil samples were also sent for laboratory testing for a range of determinands with the results included as Appendix D. No notable ground contamination was recorded. As such, no treatment to the abstracted groundwater (dewatering), other than sediment removal, will be required.

Rate & Volume of Abstraction

Dewatering flow estimates have been provided by the specialist dewatering contractor for the scheme and are included as Appendix E. A dewatering flow rate of 7,339m³ per day is estimated. This equates to approximately 305.79m³ per hour (dewatering will be continuous i.e. 24 hours per day).

The dewatering pump rate, and approximate discharge rate to the River Dee will be approximately 84.9 l/s.

Water Quality

The water abstracted from the excavation will be discharged to a Siltbuster Lamella unit which will remove suspended solids. Multiple Lamella Units will be run in parallel in order to accommodate the estimated flow rates. The water treatment proposals will aim to achieve the following levels of treatment prior to release to a watercourse:

- Total suspended solids 30mg/l - 60mg/l
- pH 6-9

Based on the clay content of the superficial deposits (sandy clay to 2.3m.bgl), coagulant and /or flocculant dosing will be required to remove particles from water. The safety data sheets for the coagulants and flocculants (Polyaluminium chloride hydroxide sulphate) are included in Appendix F.

Programme of Works

The construction of the Humus Tank is due to start on 26th May 2025. The construction of the Humus Tank and associated dewatering is anticipated to take 14 weeks. The abstraction license application makes an allowance for a 28-week duration. This accounts for any uncertainty and potential construction delays.

Impact on Fish in the River Dee

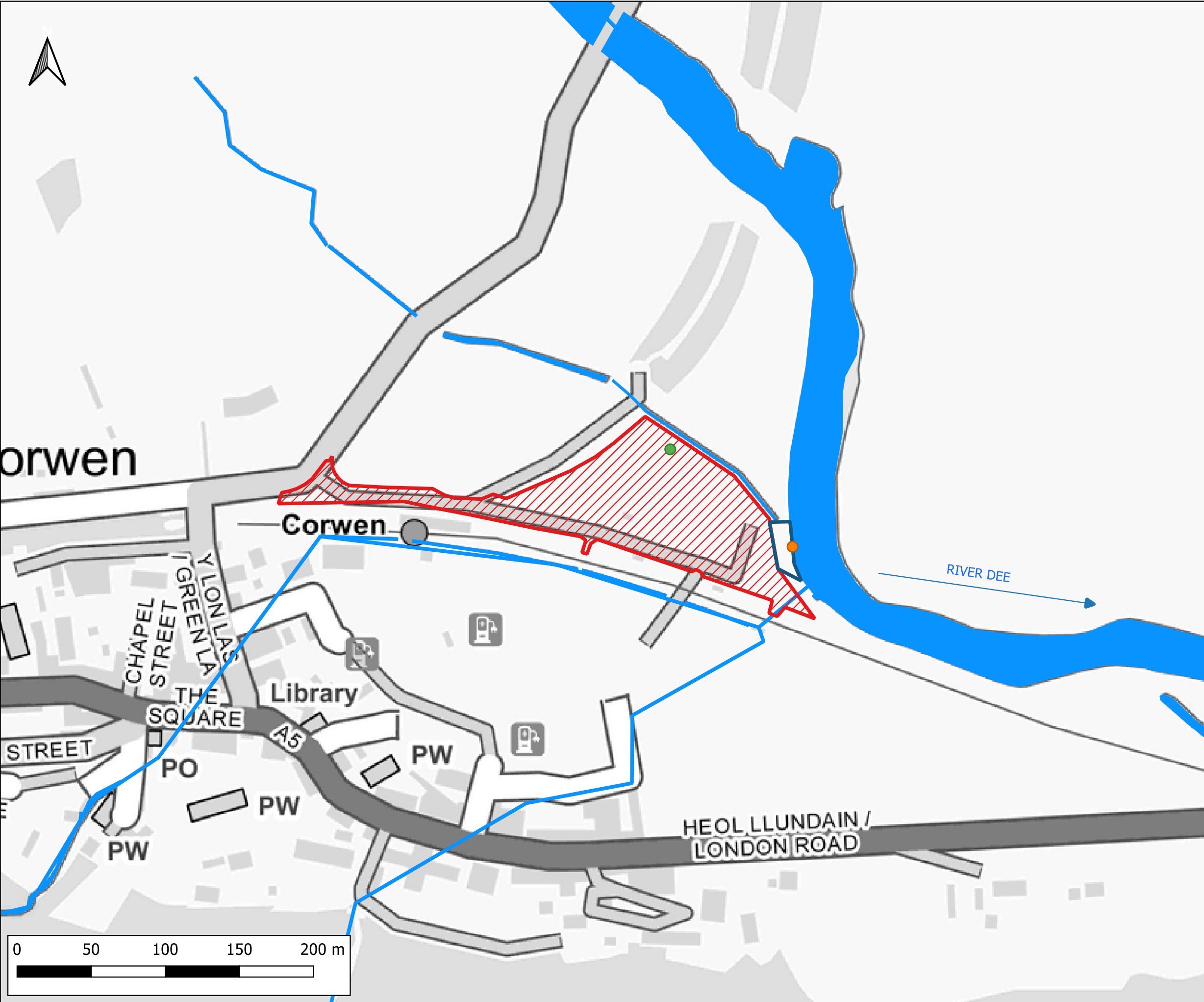
A detailed survey of species has not been undertaken, however common species in the River Dee include salmon, trout, grayling and sea trout. To protect fish, a bar screen with 30mm spacing is proposed on the outlet to the River Dee. The 30mm screen size is selected to protect fish and is taken from NRW's 'Intake screening for fish' guidance.

Conclusions

The proposed abstraction to facilitate construction of the Humus Tank is considered to have negligible impact on the local water environment (both groundwater and surface waters).

Abstracted water will be treated (sediment removal) and returned to the River Dee.

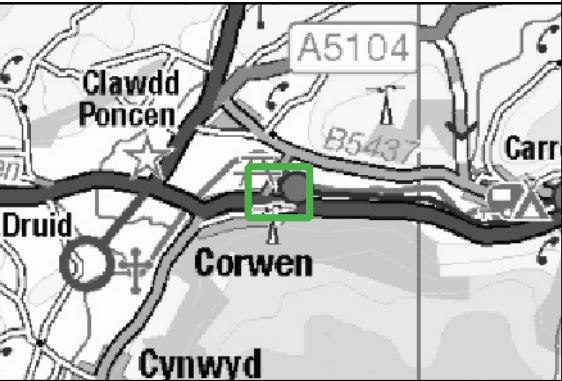
Appendix A Location Plan



Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

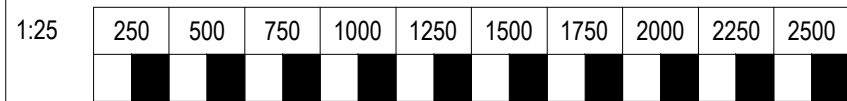
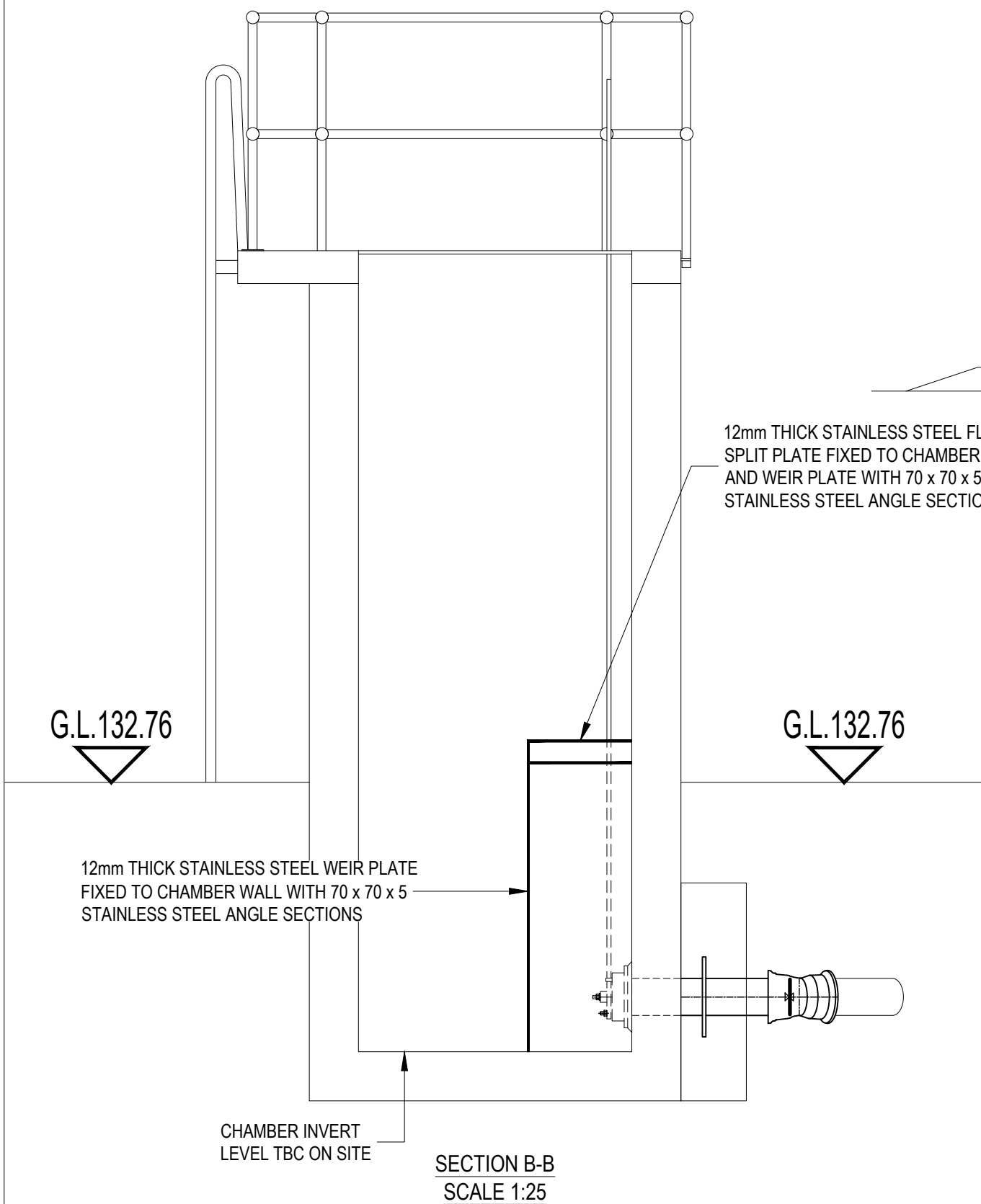
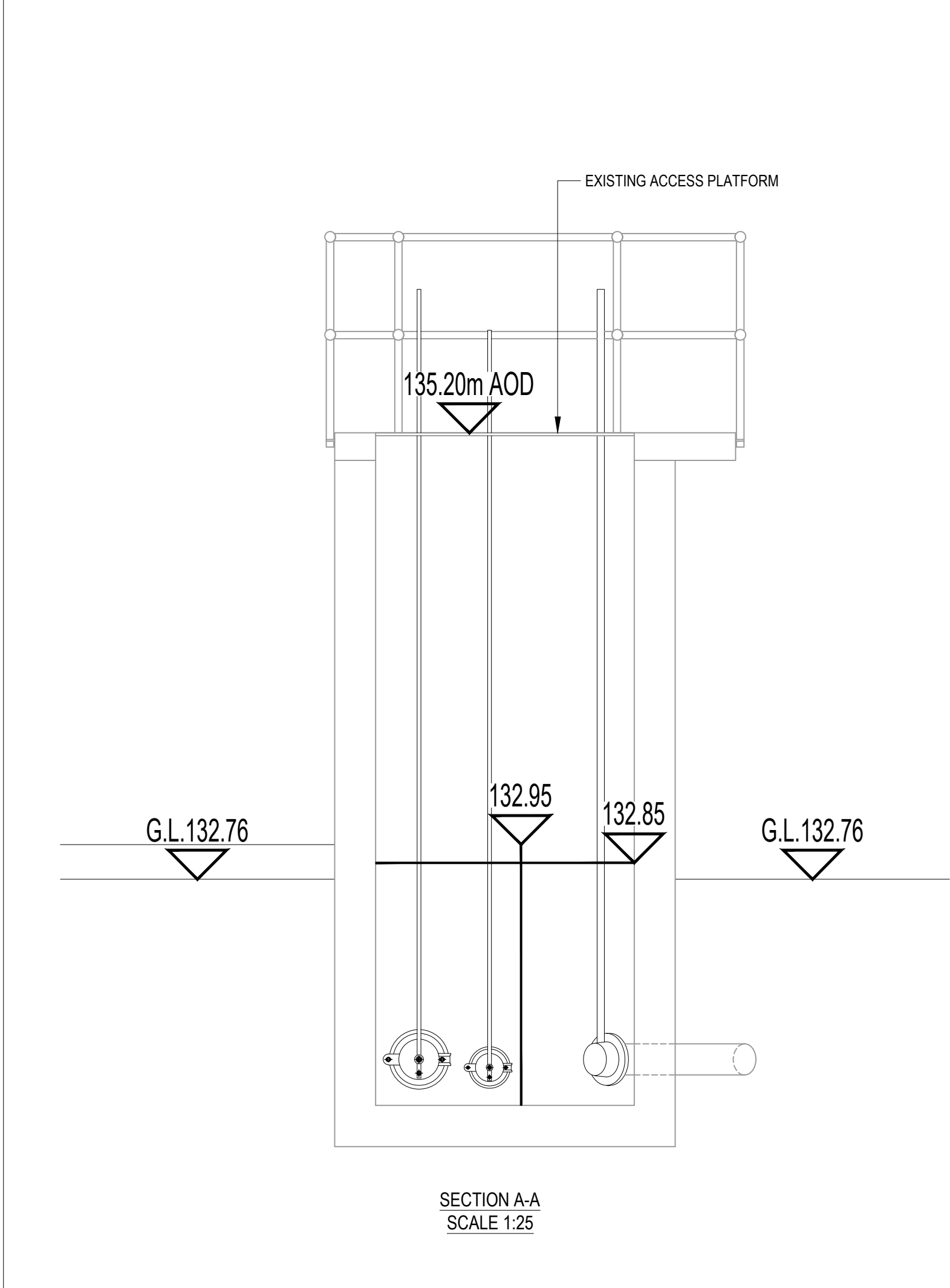
LEGEND

- Land in Welsh Water Ownership
- Land with Rights of Access
- Proposed Abstraction Point
- Proposed Discharge Location

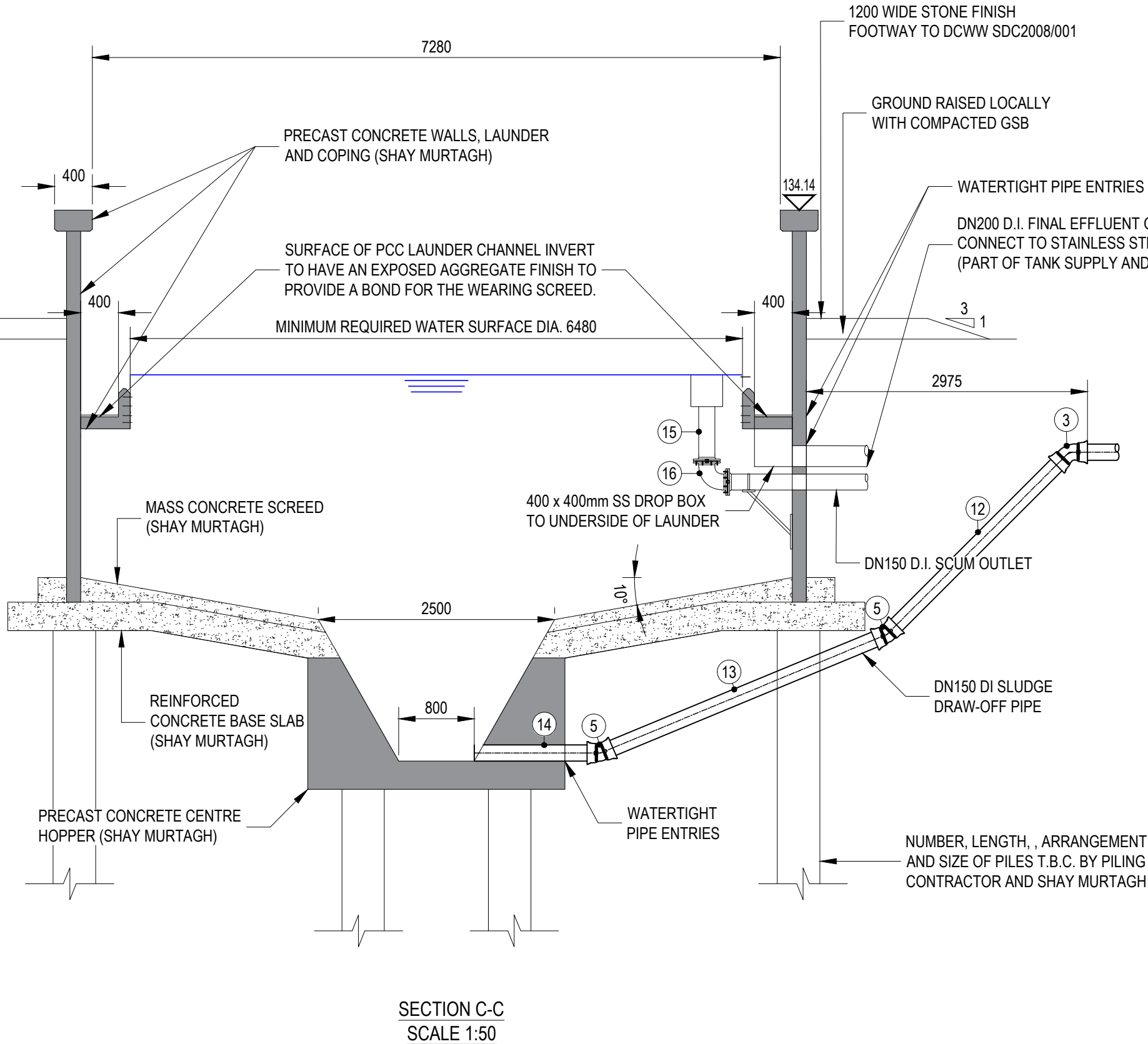
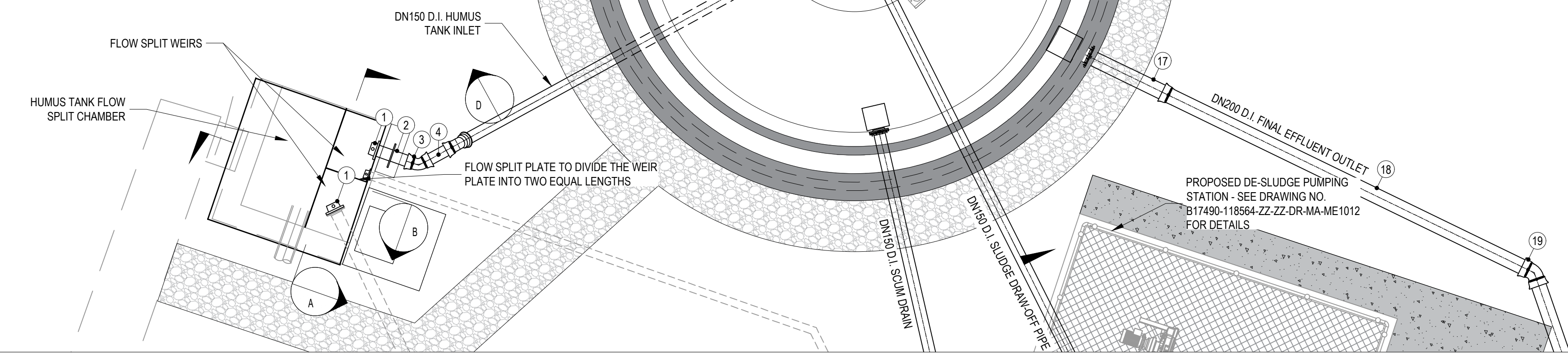


CLIENT:		Eric Wright Water	
<div>waterco</div> <div>www.waterco.co.uk</div>			
SCHEME:		Corwen WwTW - Phosphate Removal	
PLOT TITLE:		Location Plan	
PLOT STATUS:		FINAL	DATE: 27-01-2025
DRAWN: JP	CHECKED: AW	APPROVED: NJ	PLOT SCALE AT A3: 1:2500
PLOT NAME: 15725_Location_Plan			REVISION: -

Appendix B Development Proposals

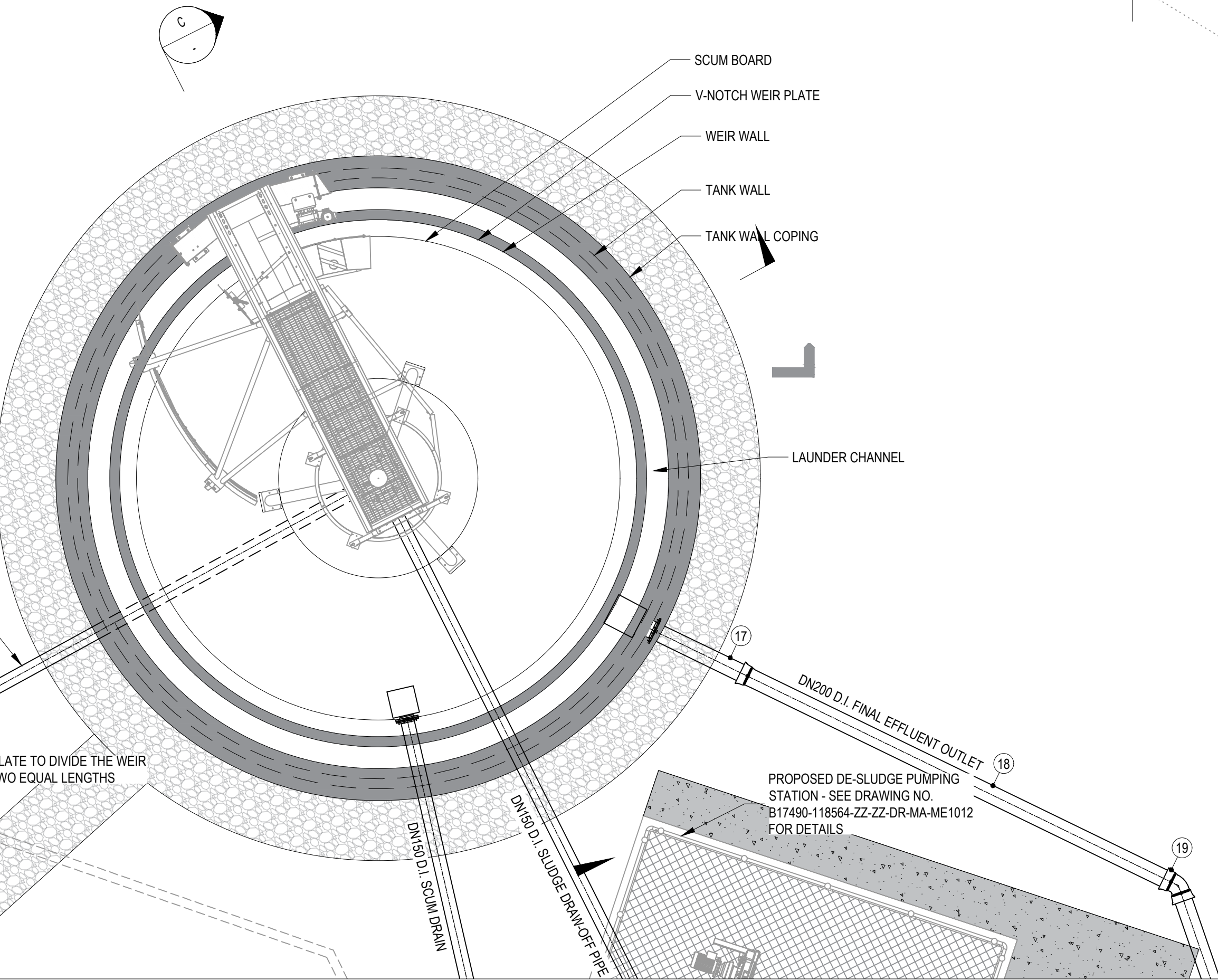


FITTING SCHEDULE			
REF	MATERIAL	DESCRIPTION	QTY
1	DI	DN150 FLANGED DISC FLUSHING VALVE WITH OPERATING ROD EXTENDED TO 900mm ABOVE ACCESS PLATFORM	2
2	DI	DN150 DOUBLE SPIGOT PIPE 450mm LONG WITH WELDED CENTRAL PUDDLE FLANGE	1
3	DI	DN150 SOCKET JOINT 45° BEND WITH ANCHOR GASKETS	3
4	DI	DN150 DOUBLE SPIGOT PIPE 300mm LONG	1
5	DI	DN150 DOUBLE SPIGOT PIPE 2500mm LONG	1
6	DI	DN150 SOCKET JOINT 22.5° BEND WITH ANCHOR GASKETS	4
7	DI	DN150 DOUBLE SPIGOT PIPE 2700mm LONG	1
8	DI	DN150 FLANGED SPIGOT PIPE 1600mm LONG	1
9	DI	DN150 DOUBLE FLANGED 90° DUCK FOOT BEND	1
10	DI	DN150 DOUBLE FLANGED PIPE 3400 LONG	1
11	DI	DN150 FLANGED BELLMOUTH	1
12	DI	DN150 DOUBLE SPIGOT PIPE 2400mm LONG	1
13	DI	DN150 DOUBLE SPIGOT PIPE 3000mm LONG	1
14	DI	DN150 DOUBLE SPIGOT PIPE 1200mm LONG	1
15	DI	DN150 FLANGED SPIGOT PIPE 500mm LONG	1
16	DI	DN150 DOUBLE FLANGED 90° BEND	1
17	DI	DN200 FLANGED SPIGOT PIPE 1400mm LONG	1
18	DI	DN200 PUSHFIT ANCHOR PIPE 5900mm LONG	1

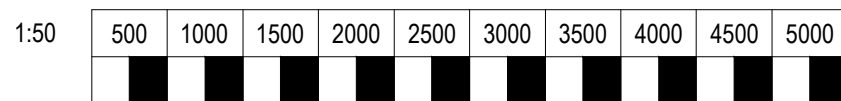


SECTION C-C
SCALE 1:50

FITTING SCHEDULE			
REF	MATERIAL	DESCRIPTION	QTY
19	DI	DN200 PUSHFIT ANCHOR 45° BEND	1



SECTION D-D
SCALE 1:50



OWNER

A1

Waterco Consultants

Eden Court
11 Lon Parcer, Ruthin LL15 1NJ
Tel: 01772 702220
www.waterco.co.uk

Eric Wright Water

Unit 506 Green Place
Bamber Bridge, Preston PR5 8AY
Tel: 01772 698622
Fax: 01772 628811
www.ericwright.co.uk

NOTES

- ALL DIMENSIONS IN MILLIMETRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM UNLESS SHOWN OTHERWISE.
- DRAWING TO BE READ IN CONJUNCTION WITH SCHEME REGISTER, DOCUMENT REFERENCE B17490-118564-ZZ-ZZ-RB-ZG-DH0001 TO ESTABLISH ALL SUPPORTING INFORMATION.
- ALL WORK TO BE CARRIED OUT IN ACCORDANCE WITH CESWI 7 (CIVIL ENGINEERING SPECIFICATION FOR THE WATER INDUSTRY (7TH EDITION)) SUPPLEMENTED BY THE 'DCWW CIVIL ENGINEERING SPECIFICATION CS501A'.
- THE PRECAST CONCRETE TANK SHALL COMPLY WITH THE REQUIREMENTS OF BS EN 1992-3.
- THE CONCRETE STRUCTURE SHALL BE DESIGNED FOR SEVERE EXPOSURE CATEGORY, AND ALSO CONTINUOUS CONTACT WITH SEWAGE DOSED WITH FERRIC SULPHATE.
- THE COMPLETED TANK SHALL BE WATERTIGHT AND MUST PASS A FULL HYDROSTATIC TEST BEFORE IT IS ACCEPTED.
- CONCRETE TO BE PROVIDED IN ACCORDANCE WITH THE REQUIREMENTS OF BS EN 206:2013, CESWI 7TH EDITION.
- CONCRETE GRADES PROVIDED IN ACCORDANCE WITH THE RECOMMENDATIONS OF BS 8500-1:2015+A2:2019.
- THE SITE IS SUBJECT TO FLOODING TO A LEVEL 134.14MAOD; THE TANK SHALL BE DESIGNED TO HAVE A FOS OF 1.1 AGAINST FLOTATION WHEN THE SITE IS FLOODED.
- THE BASE OF THE TANK WILL BE CONTINUOUSLY SWEEP BY SLUDGE SCRAPER BLADES; ANY JOINTS IN THE TANK BASE SHALL BE FLUSH WITH A MAXIMUM ALLOWABLE STEP OF 1mm BETWEEN ADJACENT PANELS.
- THE SCRAPER BRIDGE DRIVE UNIT WILL RUN ON THE COPING OF THE EXTERNAL WALL OF THE TANK; ANY VERTICAL JOINTS IN THE EXTERNAL WALL SHALL BE FLUSH ACROSS THE COPING, WITH A MAXIMUM ALLOWABLE STEP OF 1mm BETWEEN ADJACENT PANELS.
- MAXIMUM ALLOWABLE TOLERANCE ON DIMENSIONS AND LEVELS IS +/- 5mm.
- WEIR PLATES, SCUM BOARDS, SCRAPER BRIDGE TRIPOD AND PIPEWORK TO BE SUPPLIED AND INSTALLED BY OTHERS. PIPE ENTRIES TO BE CAST-IN OVER-SIZED HOLES TO ALLOW FOR 'LINK-SEAL COUPLINGS' TO BE USED WITH PIPES.
- SURFACE FINISHES TO COMPLY WITH CESWI 7TH EDITION. HORIZONTAL SURFACES OF STRUCTURAL CONCRETE TO HAVE STEEL FLOAT FINISH UNLESS NOTED OTHERWISE. VERTICAL SURFACES TO HAVE FAIR FACED FINISH TO BS 8110 UNLESS NOTED OTHERWISE.
- CONCRETE CONSTRUCTION (WORKMANSHIP AND EXECUTION) SHOULD BE CARRIED OUT IN ACCORDANCE WITH THE REQUIREMENTS OF BS EN 13670:2009 EXECUTION OF CONCRETE STRUCTURES.
- TANK STRUCTURE DESIGNED AND PROVIDED BY SHAY MURTAGH, AS SHOWN ON THEIR DRAWING NO. 99.05.24.04.S02.SMPL.GA.1000.P01 (11.06.24).
- CABLE DUCTS SHALL BE FORMED OF A CONTINUOUS LENGTH OF PE PIPE, WITH NO JOINTS PERMITTED. PE PIPE TO BE LAID TO A CURVE ON SITE AS REQUIRED TO ACHIEVE AN ACCEPTABLE INSTALLATION, MINIMUM BEND RADIUS 25x PIPE OD.

P02	23/12/24	CJC	FLOW SPLIT CHAMBER DETAILED	DRD	CJ	TM	23/12/24
P01	28/06/24	CJC	FIRST ISSUE	CJC	CJ	TM	28/06/24
Rev.	Date.	Drawn.	Description.	Rvd.	Chkd.	Appd.	Date.

Capital Delivery Alliance

Cynghair Cyflawni Cyfaloaf

Ty Awen, Spooner Close, Coed Kernew, Newport, NP108FZ

Project Name.

CORWEN WtWt PHOSPHATE REMOVAL SCHEME

Drawing Title.

PROPOSED HUMUS SETTLEMENT TANK
GENERAL ARRANGEMENT

Suitability.

PRELIMINARY

S4

Originator.

CJC

Designer.

CJ

Date.

28/06/2024

Internal Project Number.

-

Scale.

1 : 50

Rev.

P02

Drawing Number.

B17490-118564-ZZ-ZZ-DR-CA-CI2103



CAF411 - AMP 7 - A1 SITE - March 2020

THIS DESIGN AND DRAWING IS CONFIDENTIAL AND ALL RIGHTS THEREIN INCLUDING COPYRIGHT AND DESIGN RIGHT ARE THE PROPERTY OF DWR CYMRU CYFYNGEDIG AND SHOULD NOT BE DISCLOSED TO A THIRD PARTY OR REPRODUCED WITHOUT PRIOR CONSENT OF DWR CYMRU CYFYNGEDIG. ©

Appendix C Borehole Records



Legend

-  Locations By Type - CP
-  Locations By Type - SLSW



Unit 1B Borders Industrial Park
River Lane
Saltney
Chester CH4 8RJ

Phone: 01244 671117
Email: mail@geotechnics.co.uk
www.geotechnics.co.uk

Engineer:
Waterco Limited

Client:
Eric Wright Water Limited

Project:
Corwen WwTW

Drawing Title:
Exploratory Hole Location Plan

Scale:
1:500 at A3

Date:
15/03/2024

Project No.:
PN244620

**Exploratory Hole
Location Plan**

BOREHOLE RECORD - Cable Percussion

Project	Corwen WwTW	Engineer	Waterco Limited	Project No.	PN244620
Client	Eric Wright Water Limited	National Grid Coordinates	308171.8 E 343592.6 N	Borehole	BH01
				Ground Level	132.89 m OD

Sampling			Properties			Strata		Scale 1:50		
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w(%)	SPT N	Description	Depth	Legend	Level (m OD)	
0.20	ES					MADE GROUND: Grey concrete.	0.15		132.74	
						MADE GROUND: Grey angular fine to coarse gravel of limestone (Sub base).	0.25		132.64	
						MADE GROUND: Grey angular slightly sandy gravel of basalt.				
0.60	ES					Soft bluish grey slightly sandy CLAY.	0.60		132.29	
1.20	ES									
1.60 - 1.80	ES									
1.80	D	1.90 (0.50)			S41	Dense grey subangular to rounded fine to coarse slightly sandy GRAVEL of various lithologies. Medium subrounded cobble content.	1.90		130.99	
2.00 - 2.45	B									
2.00 - 2.45	D									
3.00 - 3.45		3.00 (0.70)			S26	Below 3.00m, medium dense, sandy.				
3.00 - 3.45	B									
3.80	D									
4.00 - 4.45		4.00 (0.90)			S17					
4.00 - 4.45	B									
4.80	D									
5.00 - 5.45	UT73	4.80 (1.70)				Medium dense grey SILT with occasional pockets and bands of clay.	4.50		128.39	
5.50	D									
6.00	D									
6.50 - 6.95		6.20 (6.30)			S13					
6.50 - 6.95	B									
6.50 - 6.95	D									
7.50	D									
8.00 - 8.45	UT57									
8.50	D									
9.00	D	9.40 (1.90)			S14					
9.50 - 9.95										
9.50 - 9.95	B									
9.50 - 9.95	D									

Boring				Progress				Groundwater					
Depth	Hole Dia.	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed
1.60	0.50	Inspection Pit	EW	0.00		DRY	09/02/24	08:00	1.90	1.80	0.50	20	
8.00	0.20	Cable Percussion	SL	3.00	3.00	0.80	09/02/24	16:00	6.80	6.50	0.70	20	
20.50	0.15	Cable Percussion	SL	3.00	3.00	0.70	12/02/24	08:00					
				14.50	14.50	4.90	12/02/24	17:00					

Remarks Concrete slab broken out and starter pit excavated by Eric Wright Water Limited to 1.60m depth and no services were found. ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars and 1 x 1 litre plastic tub. Chiselling: 2.40-2.70m for 55 minutes and 3.50-3.70m for 35 minutes. Aquifer protection undertaken by installing a 0.5m thick bentonite seal at 8.00m depth and reducing casing diameter to 150mm. A 50mm standpipe was installed to 6.00m with a geowrapped slotted section from 2.00m to 6.00m with a flush cover installed. Backfill details from base of hole: bentonite pellets up to 6.00m, gravel filter up to 2.00m, bentonite seal up to 1.00m, arisings up to 0.30m, concrete up to ground level. Logged in accordance with BS5930:2015 + A1:2020										Logged by LP Checked by JK Figure Sheet 1 of 3 27/02/2024			

BOREHOLE RECORD - Cable Percussion

Project	Corwen WwTW	Engineer	Waterco Limited	Project No.	PN244620
Client	Eric Wright Water Limited	National Grid Coordinates	308171.8 E 343592.6 N	Borehole	BH01
				Ground Level	132.89 m OD

Sampling			Properties			Strata		Scale 1:50	
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w(%)	SPT N	Description		Depth	Legend
10.50	D								
11.00 - 11.45	UT49	10.90 (2.80)							
11.50	D								
12.00	D								
12.50 - 12.95		12.50 (3.30)			S14				
12.50 - 12.95	B								
12.50 - 12.95	D								
13.50	D								
14.00 - 14.45	UT46	14.00 (4.60)							
14.50	D								
15.00	D								
15.50 - 15.95		15.50 (1.90)			S17				
15.50 - 15.95	B								
15.50 - 15.95	D								
16.50	D								
17.00 - 17.45	UT47	17.00 (2.30)							
17.50	D								
18.00	D								
18.50 - 18.95		18.50 (2.60)			S16				
18.50 - 18.95	B								
18.50 - 18.95	D								
19.50	D								
20.00 - 20.45	UT53	20.00 (2.70)							

Boring				Progress					Groundwater				
Depth	Hole Dia.	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed
				14.50	14.50	1.30	13/02/24	08:00					
				20.50	20.00	2.70	13/02/24	17:00					

Remarks


Symbols and abbreviations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged by

Checked by

Figure

LP

JK

Sheet 2 of 3

27/02/2024

 GEOTECHNICS

Logged in accordance with BS5930:2015 + A1:2020

[illegible]

BOREHOLE RECORD - Cable Percussion

Project	Corwen WwTW	Engineer	Waterco Limited	Project No.	PN244620
Client	Eric Wright Water Limited	National Grid Coordinates	308191.1 E 343587.0 N	Borehole	BH02
				Ground Level	133.00 m OD

Sampling			Properties			Strata		Scale 1:50	
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w(%)	SPT N	Description	Depth	Legend	Level (m OD)
0.20	D					Grass over TOPSOIL: Soft brown clay with many rootlets.			
0.20	ES					MADE GROUND: Soft to firm greyish brown slightly sandy slightly gravelly clay. Gravel is subangular fine to coarse of various lithologies.	0.30		132.70
0.40	D								
0.50	ES								
0.50 - 1.00	B								
1.00	D					Very soft bluish grey very sandy CLAY. Between 1.20-1.65m, SPT gear sank 450mm for 1 blow.	1.00		132.00
1.00	ES								
1.20 - 1.65		(1.15)			S0				
1.20 - 1.65	D								
1.20 - 2.00	B					Medium dense grey slightly sandy subangular to rounded GRAVEL of various lithologies. Low to medium subrounded cobble content.			
2.00 - 2.10	UTF50	1.70 (DRY)					2.10		130.90
2.10 - 2.55		1.70 (DRY)			S25				
2.10 - 2.55	B								
2.10 - 2.55	D					Below 4.00m, occasional pockets of soft clay.			
3.00 - 3.45		2.90 (1.50)			S22				
3.00 - 3.45	B								
3.00 - 3.45	D								
4.00 - 4.45		3.90 (1.50)			S22	Medium dense grey SILT with occasional pockets and bands of clay.			
4.00 - 4.45	B								
4.00 - 4.45	D								
5.00 - 5.45		4.70 (1.50)			S23				
5.00 - 5.45	B						5.40		127.60
5.00 - 5.45	D								
5.70	D								
5.70 - 6.00		5.90 (1.50)			S21				
6.00 - 6.45									
6.00 - 6.45	B								
6.00 - 6.45	D								
7.50	UT45	7.40 (DRY)							
7.95 - 8.10	D								
9.00 - 9.45		8.90 (7.00)			S11				
9.00 - 9.45	B								
9.00 - 9.45	D								

Boring				Progress				Groundwater					
Depth	Hole Dia.	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed
1.20	0.30	Inspection Pit	GC	0.00			07/02/24	08:00	1.20		1.15	20	1.50
6.00	0.20	Cable Percussion	GC	6.00	5.90	1.50	07/02/24	17:00	2.10	1.70	1.50	20	
15.45	0.15	Cable Percussion	GC	6.00	5.90	2.50	08/02/24	08:00					
				15.45	14.90	6.00	08/02/24	17:00					

Remarks	LP	Inspection pit hand excavated to 1.20m depth and no services were found.	Logged by	LP
	JK	ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars and 1 x 1 litre plastic tub.	Checked by	JK
		Aquifer protection undertaken by installing a 0.5m thick bentonite seal at 6.00m depth and reducing casing diameter to 150mm.	Figure	Sheet 1 of 2
		Water was added to assist boring between 8.50m and 15.00m.		27/02/2024
		09.02.2024 - A 50mm standpipe was installed to 15.00m with a geowrapped slotted section from 8.00m to 15.00m with a flush cover installed.		
		Backfill details from base of hole: gravel filter up to 8.00m, bentonite seal up to 1.00m, arisings up to 0.30m, concrete up to ground		
		Logged in accordance with BS5930:2015 + A1:2020		



BOREHOLE RECORD - Cable Percussion

Project		Corwen WwTW		Engineer		Waterco Limited		Project No.		PN244620	
Client		Eric Wright Water Limited		National Grid Coordinates		308191.1 E 343587.0 N		Borehole		BH02	
								Ground Level		133.00 m OD	

Sampling			Properties			Strata			Scale 1:50		
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w(%)	SPT N	Description	Depth	Legend	Level (m OD)		
10.50	UTF50	10.40 (9.00)									
10.50 - 10.95	B										
12.00 - 12.45		11.90 (6.00)			S17						
12.00 - 12.45	B										
12.00 - 12.45	D										
13.50 - 13.95		13.40 (6.00)			S15						
13.50 - 13.95	B										
13.50 - 13.95	D										
15.00 - 15.45		14.90 (6.00)			S18						
15.00	D										
						End of Borehole	15.45		117.55		

Boring				Progress					Groundwater					
Depth	Hole Dia.	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater

Remarks

level.

Symbols and abbreviations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

Logged by

Checked by

Figure

LP

JK

Sheet 2 of 2

27/02/2024

GEOTECHNICS

BOREHOLE RECORD - Cable Percussion

Project	Corwen WwTW	Engineer	Waterco Limited	Project No.	PN244620
Client	Eric Wright Water Limited	National Grid Coordinates	308212.3 E 343602.2 N	Borehole	BH03
				Ground Level	133.14 m OD

Sampling			Properties			Strata	Scale 1:50			
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w(%)	SPT N	Description	Depth	Legend	Level (m OD)	
0.00 - 0.50	B	(DRY)				Grass over TOPSOIL: Soft brown clay with many rootlets.	0.10		133.04	
0.20	ES					MADE GROUND: Soft brown slightly sandy gravelly clay with medium subangular to subrounded cobble content. Gravel is angular to subangular fine to coarse of various lithologies.	0.50		132.64	
0.50	ES					Firm brownish grey mottled orange brown sandy CLAY.				
0.50 - 1.20	B									
1.00	ES									
1.20 - 1.65	UT32									
1.70	D									
1.80	D									
1.90	ES									
2.00 - 2.45						1.70 (1.00)	S19		Medium dense brownish grey angular to subrounded fine to coarse sandy GRAVEL of various lithologies. Medium subrounded cobble content.	2.00
2.00 - 2.45	B	3.00 (1.30)	S32	Below 3.00m, dense.		128.74				
2.00 - 2.45	D									
2.80	D									
3.00 - 3.45										
3.00 - 3.45	B									
3.00 - 3.45	D									
3.80	D									
4.00 - 4.45					4.00 (1.70)		S31			
4.00 - 4.45	B						S20	Medium dense grey SILT with occasional pockets and bands of clay.	4.40	
4.00 - 4.45	D									
4.80	D									
5.00 - 5.45		4.80 (2.10)								
5.00 - 5.45	B									
6.00	D									
6.50 - 6.95	UT57	6.30 (2.60)								
7.00	D									
7.50	D									
8.00 - 8.45		8.00 (1.40)	S12							
8.00 - 8.45	B	9.50 (1.50)								
8.00 - 8.45	D									
9.00	D									
9.50 - 9.95	UT59									
10.00	D									

Boring				Progress				Groundwater					
Depth	Hole Dia.	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed
1.20	0.50	Inspection Pit	SL	0.00		DRY	21/02/24	08:00	2.00	1.70	1.00	20	
6.50	0.20	Cable Percussion	SL	7.00	7.00	2.80	21/02/24	17:00					
15.50	0.15	Cable Percussion	SL	7.00	7.00	1.00	22/02/24	08:00					
				15.50	15.00	2.90	22/02/24	17:00					

Remarks	AGS	Inspection pit hand excavated to 1.20m depth and no services were found. ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars and 1 x 1 litre plastic tub. Chiselling: 3.40-3.70m for 40 minutes and 4.30-5.00m for 80 minutes. Aquifer protection undertaken by installing a 0.50m thick bentonite seal at 6.50m depth and reducing casing diameter to 150mm. A 50mm standpipe was installed to 15.00m with a geowrapped slotted section from 6.00m to 15.00m with a flush cover installed. Backfill details from base of hole: gravel filter up to 6.00m, bentonite seal up to 1.00m, arisings up to 0.30m, concrete up to ground level. Logged in accordance with BS5930:2015 + A1:2020	Logged by LP Checked by JK Figure Sheet 1 of 2 27/02/2024
---------	-----	---	--




BOREHOLE RECORD - Cable Percussion

Project		Corwen WwTW		Engineer		Waterco Limited		Project No.		PN244620	
Client		Eric Wright Water Limited		National Grid Coordinates		308212.3 E 343602.2 N		Borehole		BH03	
								Ground Level		133.14 m OD	

Sampling			Properties			Strata		Scale 1:50	
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w(%)	SPT N	Description	Depth	Legend	Level (m OD)
10.50	D								
11.00 - 11.45		11.00 (1.30)			S10				
11.00 - 11.45	B								
11.00 - 11.45	D								
12.00	D								
12.50 - 12.95	UT47	12.40 (1.70)							
13.00	D								
13.50	D								
14.00 - 14.45		14.00 (2.20)			S11				
14.00 - 14.95	B								
14.00 - 14.95	D								
15.00	D								
15.00 - 15.45	UT43	15.00 (2.90)							
15.50	D					End of Borehole	15.50		117.64

Boring				Progress					Groundwater					
Depth	Hole Dia.	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater

Remarks


Symbols and abbreviations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged by

Checked by


Figure

LP

JK

Sheet 2 of 2

27/02/2024

 GEOTECHNICS

Logged in accordance with BS5930:2015 + A1:2020

BOREHOLE RECORD - Cable Percussion

Project	Corwen WwTW	Engineer	Waterco Limited	Project No.	PN244620
Client	Eric Wright Water Limited	National Grid Coordinates	308208.1 E 343630.8 N	Borehole	BH04
				Ground Level	132.77 m OD

Sampling			Properties			Strata		Scale 1:50		
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w(%)	SPT N	Description		Depth	Legend	Level (m OD)
0.10 - 0.30	B					Grass over TOPSOIL: Soft brown sandy clay with many rootlets.		0.10		132.67
0.20	ES					MADE GROUND: Soft brown slightly sand slightly gravelly clay with medium subangular to subrounded cobble content. Gravel is angular fine to coarse of various lithologies.		0.30		132.47
0.30 - 0.60	B					Greyish brown silty fine SAND.		0.60		132.17
0.50	ES					Brown silty fine to medium SAND.				
0.60 - 1.10	B					Medium dense brownish grey angular to subrounded fine to coarse sandy GRAVEL of various lithologies. Medium subrounded cobble content.		1.10		131.67
1.00	ES									
1.40 - 1.85		(0.60)			S16					
1.40 - 1.85	B									
1.40 - 1.85	D									
2.00	D									
2.00	ES									
2.40 - 2.85		2.40 (0.80)			S18					
2.40 - 2.85	B									
2.40 - 2.85	D									
3.00	D									
3.40 - 3.85		3.40 (0.80)			S40	Below 3.40m, dense.				
3.40 - 3.85	B									
3.40 - 3.85	D									
4.00	D									
4.40 - 4.85		4.40 (1.30)			S41					
4.40 - 4.85	B									
4.40 - 4.85	D									
5.00	D									
5.30	D									
5.40 - 5.85	UT59	5.40 (0.60)				Medium dense grey SILT with occasional pockets and bands of clay.		5.30		127.47
5.90	D									
6.50	D									
7.00 - 7.45		7.00 (1.70)			S11					
7.00 - 7.45	B									
7.00 - 7.45	D									
8.00	D									
8.50 - 8.95	UT58	8.50 (2.10)								
9.00	D									
9.50	D									
10.00 - 10.45		10.00 (2.90)			S11					

Boring				Progress				Groundwater					
Depth	Hole Dia.	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed
1.20	0.50	Inspection Pit	SL	0.00		DRY	19/02/24	08:00	1.10		0.60	20	
6.50	0.20	Cable Percussion	SL	6.20	6.20	1.70	19/02/24	17:00					
15.45	0.15	Cable Percussion	SL	6.20	6.20	1.30	20/02/24	08:00					
				15.45	14.50	2.80	20/02/24	17:00					

Remarks Inspection pit hand excavated to 1.20m depth and no services were found. ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars and 1 x 1 litre plastic tub. Aquifer protection undertaken by installing a 0.50m thick bentonite seal at 6.50m depth and reducing casing diameter to 150mm. A 50mm standpipe was installed to 6.50m with a geowrapped slotted section from 1.10m to 6.50m with a flush cover installed. Backfill details from base of hole: bentonite pellets up to 6.50m, gravel filter up to 1.10m, bentonite seal up to 0.30m, concrete up to ground level. Logged in accordance with BS5930:2015 + A1:2020										Logged by LP Checked by JK Figure Sheet 1 of 2 27/02/2024			
Symbols and abbreviations are explained on the accompanying key sheets. All dimensions are in metres.										GEOTECHNICS			

Project		Corwen WwTW		Engineer		Waterco Limited		Project No.		PN244620	
Client		Eric Wright Water Limited		National Grid Coordinates		308208.1 E 343630.8 N		Borehole		BH04	
								Ground Level		132.77 m OD	

Sampling			Properties			Strata							Scale 1:50		
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w(%)	SPT N	Description							Depth	Legend	Level (m OD)
10.00 - 10.45	B D														117.32
10.00 - 10.45	D														
11.00	D														
11.50 - 11.95	UT44	11.50 (3.30)													
12.00	D														
12.50	D														
13.00 - 13.45		13.00 (2.80)			S13										
13.00 - 13.45	B D														
13.00 - 13.45	D														
14.00	D														
14.50 - 14.95	UT47	14.50 (2.80)													
15.00	D					End of Borehole									

Boring					Progress					Groundwater				
Depth	Hole Dia.	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater

Remarks

Symbols and abbreviations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged by

Checked by

Figure

LP

JK

Sheet 2 of 2

27/02/2024

GEOTECHNICS

Logged in accordance with BS5930:2015 + A1:2020

BOREHOLE RECORD - Cable Percussion

Project	Corwen WwTW	Engineer	Waterco Limited	Project No.	PN244620
Client	Eric Wright Water Limited	National Grid Coordinates	308192.5 E 343650.1 N	Borehole	BH05
				Ground Level	132.90 m OD

Sampling			Properties			Strata	Scale 1:50		
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w(%)	SPT N	Description	Depth	Legend	Level (m OD)
0.10 - 0.30	B					Grass over TOPSOIL: Soft brown sandy clay with many rootlets.	0.10		132.80
0.20	ES					Brown angular to subrounded fine to coarse clayey GRAVEL of various lithologies. Low to medium cobble content.	0.30		132.60
0.50	ES					Soft to firm bluish grey very sandy CLAY.			
0.50 - 1.20	B								
1.00	ES								
1.20 - 1.65	UT11	(1.10)							
1.70	D								
1.80	D								
2.00 - 2.45		1.90 (1.70)			S19	Between 2.00-2.23m, SPT gear sank under own weight.			
2.00 - 2.45	B						2.30		130.60
2.00 - 2.45	D					Dense brownish grey sandy subangular to subrounded fine to coarse GRAVEL of various lithologies. Low to medium subrounded cobble content. Between 2.30m and 4.60m, driller notes boulders.			
2.80	D								
3.00 - 3.45		3.00 (1.10)			C47				
3.00 - 3.45	B								
3.80	D								
4.00 - 4.45		4.00 (0.90)			C16	Below 4.00m, medium dense.			
4.00 - 4.45	B								
4.80	D					Medium dense grey SILT with occasional pockets and bands of soft clay.	4.60		128.30
5.00 - 5.45	UT57	4.70 (1.70)							
5.50	D								
6.00	D								
6.50 - 6.95		6.20 (1.80)			S10				
6.50 - 6.95	B								
6.50 - 6.95	D								
7.50	D								
8.00 - 8.45	UT44	8.00 (2.10)							
8.50	D								
9.00	D								
9.50 - 9.95		9.30 (2.30)			S12				
9.50 - 9.95	B								
9.50 - 9.95	D								

Boring				Progress				Groundwater					
Depth	Hole Dia.	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed
1.20	0.50	Inspection Pit	SL	0.00		DRY	14/02/24	08:00	1.20		1.10	20	
5.00	0.20	Cable Percussion	SL	4.00	4.00	1.10	14/02/24	17:00	2.30	1.90	0.90	20	
15.45	0.15	Cable Percussion	SL	4.00	4.00	0.90	15/02/24	08:00					
				15.45	15.00	3.60	15/02/24	17:00					

Remarks	AGS	Inspection pit hand excavated to 1.20m depth and no services were found. ** Drillers description. ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars and 1 x 1 litre plastic tub. Chiselling: 3.10-3.40m for 40 minutes and 3.80-4.00m for 45 minutes. Water was added to assist boring between 4.50m and 15.00m. Aquifer protection undertaken by installing a 0.50m thick bentonite seal at 5.00m depth and reducing casing diameter to 150mm. 16.02.2024 - A 50mm standpipe was installed to 4.00m with a geowrapped slotted section from 2.00m to 4.00m and a deeper 50mm standpipe was installed to 15.00m with a geowrapped slotted section from 10.00m to 15.00m. A flush cover was installed. Logged in accordance with BS5930:2015 + A1:2020	Logged by LP Checked by JK Figure Sheet 1 of 2 27/02/2024
---------	-----	--	--



BOREHOLE RECORD - Cable Percussion

Project		Corwen WwTW		Engineer		Waterco Limited		Project No.		PN244620	
Client		Eric Wright Water Limited		National Grid Coordinates		308192.5 E 343650.1 N		Borehole		BH05	
								Ground Level		132.90 m OD	

Sampling			Properties			Strata		Scale 1:50		
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w(%)	SPT N	Description	Depth	Legend	Level (m OD)	
10.50	D	10.90 (2.60)			S15					
11.00 - 11.45	UT43									
11.50	D									
12.00	D									
12.50 - 12.95		12.30 (3.10)			S15					
12.50 - 12.95	B									
12.50 - 12.95	D									
13.50	D	14.00 (3.30)								
14.00 - 14.45	UT41									
14.50	D									
15.00 - 15.45										
15.00	D	15.00 (3.60)			S13	End of Borehole	15.45			117.45

Boring				Progress					Groundwater					
Depth	Hole Dia.	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater

Remarks

Backfill details from base of hole: gravel filter up to 10.00m, bentonite seal up to 4.00m, gravel filter up to 2.00m, bentonite seal up to 1.00m, arisings up to 0.30m, concrete up to ground level.

Symbols and abbreviations are explained on the accompanying key sheets.

All dimensions are in metres.

Logged by LP

Checked by JK

Figure Sheet 2 of 2

27/02/2024

Appendix D Soil Sampling Analysis



Certificate of Analysis

Certificate Number 24-03214

Issued: 22-Feb-24

Client Geotechnics LTD
The Geotechnical Centre
Unit 1B Borders Ind. Park
River Lane
Saltney
Chester
CH4 8RJ

Our Reference 24-03214

Client Reference PN244620

Order No ON39710

Contract Title Corwen WwTW

Description One Soil sample.

Date Received 15-Feb-24

Date Started 15-Feb-24

Date Completed 22-Feb-24

Test Procedures Identified by prefix DETSn (details on request).

Notes Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

Kirk Bridgewood
General Manager



Summary of Chemical Analysis

Soil Samples

Our Ref 24-03214

Client Ref PN244620

Contract Title Corwen WwTW

Lab No	2300246
Sample ID	BH02
Depth	0.50
Other ID	
Sample Type	SOIL
Sampling Date	n/s
Sampling Time	n/s

Test	Method	LOD	Units	
Metals				
Arsenic	DETSC 2301#	0.2	mg/kg	12
Boron, Water Soluble (2.5:1)	DETSC 2311#	0.2	mg/kg	0.3
Cadmium	DETSC 2301#	0.1	mg/kg	< 0.1
Chromium	DETSC 2301#	0.15	mg/kg	29
Copper	DETSC 2301#	0.2	mg/kg	21
Lead	DETSC 2301#	0.3	mg/kg	25
Mercury	DETSC 2325#	0.05	mg/kg	< 0.05
Nickel	DETSC 2301#	1	mg/kg	29
Selenium	DETSC 2301#	0.5	mg/kg	0.6
Zinc	DETSC 2301#	1	mg/kg	92
Inorganics				
pH	DETSC 2008#		pH	7.4
Cyanide, Total	DETSC 2130#	0.1	mg/kg	0.3
Cyanide, Free	DETSC 2130#	0.1	mg/kg	< 0.1
Sulphate Aqueous Extract as SO ₄ (2:1)	DETSC 2076#	10	mg/l	20
Sulphur as S, Total	DETSC 2320	0.01	%	0.02
Sulphate as SO ₄ , Total	DETSC 2321#	0.01	%	0.04
Sulphate as SO ₄ , Total	DETSC 2321#	100	mg/kg	442
Petroleum Hydrocarbons				
Aliphatic C5-C6	DETSC 3321*	0.01	mg/kg	< 0.01
Aliphatic C6-C8	DETSC 3321*	0.01	mg/kg	< 0.01
Aliphatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg	< 1.5
Aliphatic C12-C16	DETSC 3072#	1.2	mg/kg	< 1.2
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg	< 1.5
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg	< 3.4
Aliphatic C5-C35	DETSC 3072*	10	mg/kg	< 10
Aromatic C5-C7	DETSC 3321*	0.01	mg/kg	< 0.01
Aromatic C7-C8	DETSC 3321*	0.01	mg/kg	< 0.01
Aromatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01
Aromatic C10-C12	DETSC 3072#	0.9	mg/kg	< 0.9
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg	< 0.5
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg	< 0.6
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg	< 1.4
Aromatic C5-C35	DETSC 3072*	10	mg/kg	< 10
TPH Ali/Aro Total C5-C35	DETSC 3072*	10	mg/kg	< 10
PAHs				
Naphthalene	DETSC 3301	0.1	mg/kg	< 0.1
Acenaphthylene	DETSC 3301	0.1	mg/kg	< 0.1
Acenaphthene	DETSC 3301	0.1	mg/kg	< 0.1
Fluorene	DETSC 3301	0.1	mg/kg	< 0.1

Summary of Chemical Analysis

Soil Samples

Our Ref 24-03214

Client Ref PN244620

Contract Title Corwen WwTW

Lab No	2300246
Sample ID	BH02
Depth	0.50
Other ID	
Sample Type	SOIL
Sampling Date	n/s
Sampling Time	n/s

Test	Method	LOD	Units	
Phenanthrene	DETSC 3301	0.1	mg/kg	< 0.1
Anthracene	DETSC 3301	0.1	mg/kg	< 0.1
Fluoranthene	DETSC 3301	0.1	mg/kg	< 0.1
Pyrene	DETSC 3301	0.1	mg/kg	< 0.1
Benzo(a)anthracene	DETSC 3301	0.1	mg/kg	< 0.1
Chrysene	DETSC 3301	0.1	mg/kg	< 0.1
Benzo(b)fluoranthene	DETSC 3301	0.1	mg/kg	< 0.1
Benzo(k)fluoranthene	DETSC 3301	0.1	mg/kg	< 0.1
Benzo(a)pyrene	DETSC 3301	0.1	mg/kg	< 0.1
Indeno(1,2,3-c,d)pyrene	DETSC 3301	0.1	mg/kg	< 0.1
Dibenzo(a,h)anthracene	DETSC 3301	0.1	mg/kg	< 0.1
Benzo(g,h,i)perylene	DETSC 3301	0.1	mg/kg	< 0.1
PAH 16 Total	DETSC 3301	1.6	mg/kg	< 1.6
Phenols				
Phenol - Monohydric	DETSC 2130#	0.3	mg/kg	< 0.3

Summary of Asbestos Analysis Soil Samples

Our Ref 24-03214

Client Ref PN244620

Contract Title Corwen WwTW

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
2300246	BH02 0.50	SOIL	NAD	none	Keith Wilson

Crocidolite = Blue Asbestos, Amosite = Brown Asbestos, Chrysotile = White Asbestos. Anthophyllite, Actinolite and Tremolite are other forms of Asbestos. Samples are analysed by DETSC 1101 using polarised light microscopy in accordance with HSG248 and documented in-house methods. NAD = No Asbestos Detected. Where a sample is NAD, the result is based on analysis of at least 2 sub-samples and should be taken to mean 'no asbestos detected in sample'. Key: * - not included in laboratory scope of accreditation.

Information in Support of the Analytical Results

Our Ref 24-03214
 Client Ref PN244620
 Contract Corwen WwTW

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
2300246	BH02 0.50 SOIL		GJ 250ml x2, GJ 60ml	Sample date not supplied, Anions 2:1 (30 days), Aliphatics/Aromatics (14 days), Boron (365 days), BTEX / C5-C10 (14 days), Mercury (28 days), Total Sulphur ICP (7 days), Total Sulphate ICP (30 days), ICP WS Boron (182 days), Metals ICP (182 days), Metals ICP Prep (182 days), Naphthalene (14 days), PAH FID (14 days), pH + Conductivity (7 days), Cyanide/Mono pHoh (14 days)	

Key: G-Glass J-Jar

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

End of Report



Certificate of Analysis

Certificate Number 24-05154

Issued: 15-Mar-24

Client Geotechnics LTD
The Geotechnical Centre
Unit 1B Borders Ind. Park
River Lane
Saltney
Chester
CH4 8RJ

Our Reference 24-05154

Client Reference ~ PN244620

Order No ~ ON39710

Contract Title ~ CORWEN WWTW

Description 1 Soil sample, 1 Leachate prepared by DETS sample.

Date Received 11-Mar-24

Date Started 11-Mar-24

Date Completed 15-Mar-24

Test Procedures Identified by prefix DETSn (details on request).

Notes Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

A handwritten signature in black ink, appearing to read "Kirk Bridgewood".

Kirk Bridgewood
General Manager



2139

Normec DETS Limited

Unit 2, Park Road Industrial Estate South, Consett, Co Durham, DH8 5PY

Tel: 01207 582333 • email: info@dets.co.uk • www.dets.co.uk

Summary of Chemical Analysis

Leachate Samples

Our Ref 24-05154

Client Ref ~ PN244620

Contract Title ~ CORWEN WWTW

Lab No	2310599
Sample ID ~	BH02
Depth ~	0.20
Other ID ~	
Sample Type ~	LEACHATE
Sampling Date ~	n/s
Sampling Time ~	n/s

Test	Method	LOD	Units
Preparation			
BS EN 12457 10:1	DETSC 1009*		Y

WASTE ACCEPTANCE CRITERIA TESTING ANALYTICAL REPORT

Our Ref 24-05154
Client Ref PN244620
Contract Title CORWEN WWTW
Sample Id BH02 0.20

Sample Numbers 2310598 2310599
Date Analysed 15/03/2024

Test Results On Waste		
Determinand and Method Reference	Units	Result
DETSC 2084# Total Organic Carbon	%	2.5
DETSC 2003# Loss On Ignition	%	7.4
DETSC 3321# BTEX	mg/kg	< 0.04
DETSC 3401# PCBs (7 congeners)	mg/kg	< 0.01
DETSC 3311# TPH (C10 - C40)	mg/kg	< 10
DETSC 3301 PAHs	mg/kg	< 2.1
DETSC 2008# pH	pH Units	8.1
DETSC 2073* Acid Neutralisation Capacity (pH4)	mol/kg	< 1.0
DETSC 2073* Acid Neutralisation Capacity (pH7)	mol/kg	< 1.0

WAC Limit Values		
Inert Waste	SNRHW	Hazardous Waste
3	5	6
n/a	n/a	10
6	n/a	n/a
1	n/a	n/a
500	n/a	n/a
100	n/a	n/a
n/a	>6	n/a
n/a	TBE	TBE
n/a	TBE	TBE

Test Results On Leachate		
Determinand and Method Reference	Conc in Eluate ug/l	Amount Leached* mg/kg
	10:1	LS10
DETSC 2306 Arsenic as As	0.61	< 0.01
DETSC 2306 Barium as Ba	3.2	< 0.1
DETSC 2306 Cadmium as Cd	< 0.030	< 0.02
DETSC 2306 Chromium as Cr	< 0.25	< 0.1
DETSC 2306 Copper as Cu	0.72	< 0.02
DETSC 2306 Mercury as Hg	< 0.010	< 0.002
DETSC 2306 Molybdenum as Mo	< 1.1	< 0.1
DETSC 2306 Nickel as Ni	0.52	< 0.1
DETSC 2306 Lead as Pb	0.33	< 0.05
DETSC 2306 Antimony as Sb	< 0.17	< 0.05
DETSC 2306 Selenium as Se	< 0.25	< 0.03
DETSC 2306 Zinc as Zn	2.1	0.021
DETSC 2055 Chloride as Cl	360	< 100
DETSC 2055* Fluoride as F	< 100	< 0.1
DETSC 2055 Sulphate as SO4	1200	< 100
DETSC 2009* Total Dissolved Solids	16000	160
DETSC 2130 Phenol Index	< 100	< 1
DETSC 2085 Dissolved Organic Carbon	2300	< 50

WAC Limit Values		
Limit values for LS10 Leachate		
Inert Waste	SNRHW	Hazardous Waste
0.5	2	25
20	100	300
0.04	1	5
0.5	10	70
2	50	100
0.01	0.2	2
0.5	10	30
0.4	10	40
0.5	10	50
0.06	0.7	5
0.1	0.5	7
4	50	200
800	15,000	25,000
10	150	500
1000	20,000	50,000
4000	60,000	100,000
1	n/a	n/a
500	800	1000

Additional Information

DETSC 2008 pH	6.8
DETSC 2009 Conductivity uS/cm	23.3
* Temperature*	18.0

Mass of Sample Kg*	0.120
Mass of dry Sample Kg*	0.095

Stage 1

Volume of Leachant L2*	0.925
Volume of Eluate VE1*	0.87

TBE - To Be Evaluated
SNRHW - Stable Non-Reactive
Hazardous Waste

Disclaimer: The WAC limit values are provided for guidance only. DETS does not accept responsibility for errors or omissions. Values are correct at time of issue.

* DETS are accredited for the testing of leachates and not the leachate preparation stage which is unaccredited.

Summary of Asbestos Analysis Soil Samples

Our Ref 24-05154

Client Ref ~ PN244620

Contract Title ~ CORWEN WWTW

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
2310598	BH02 0.20	SOIL	NAD	none	Ben Barsby
Crocidolite = Blue Asbestos, Amosite = Brown Asbestos, Chrysotile = White Asbestos. Anthophyllite, Actinolite and Tremolite are other forms of Asbestos. Samples are analysed by DETSC 1101 using polarised light microscopy in accordance with HSG248 and documented in-house methods. NAD = No Asbestos Detected. Where a sample is NAD, the result is based on analysis of at least 2 sub-samples and should be taken to mean 'no asbestos detected in sample'. Key: * -not included in laboratory scope of accreditation.					

Information in Support of the Analytical Results

Our Ref 24-05154
 Client Ref ~ PN244620
 Contract ~ CORWEN WWTW

Containers Received & Deviating Samples

Lab No	Sample ID ~	Date Sampled ~	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
2310598	BH02 0.20 SOIL		GJ 250ml x2, GJ 60ml	Sample date not supplied, ANC (1095 days), BTEX / C5-C10 (14 days), Loss on Ignition (730 days), Naphthalene (14 days), Organic Matter (Auto) (28 days), PAH FID (14 days), PCB (30 days), pH +	
2310599	BH02 0.20 LEACHATE		GJ 250ml x2, GJ 60ml	Sample date not supplied	

Key: G-Glass J-Jar

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

End of Report



Certificate of Analysis

Certificate Number 24-05153

Issued: 14-Mar-24

Client Geotechnics LTD
The Geotechnical Centre
Unit 1B Borders Ind. Park
River Lane
Saltney
Chester
CH4 8RJ

Our Reference 24-05153

Client Reference ~ PN244620

Order No ~ (not supplied)

Contract Title ~ CORWEN WWTW

Description One Soil sample.

Date Received 11-Mar-24

Date Started 11-Mar-24

Date Completed 14-Mar-24

Test Procedures Identified by prefix DETSn (details on request).

Notes Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

Kirk Bridgewood
General Manager



Normec DETS Limited

Unit 2, Park Road Industrial Estate South, Consett, Co Durham, DH8 5PY

Tel: 01207 582333 • email: info@dets.co.uk • www.dets.co.uk

Summary of Asbestos Analysis Soil Samples

Our Ref 24-05153

Client Ref ~ PN244620

Contract Title ~ CORWEN WWTW

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
2310597	BH03 0.20	SOIL	NAD	none	Ben Barsby
Crocidolite = Blue Asbestos, Amosite = Brown Asbestos, Chrysotile = White Asbestos. Anthophyllite, Actinolite and Tremolite are other forms of Asbestos. Samples are analysed by DETSC 1101 using polarised light microscopy in accordance with HSG248 and documented in-house methods. NAD = No Asbestos Detected. Where a sample is NAD, the result is based on analysis of at least 2 sub-samples and should be taken to mean 'no asbestos detected in sample'. Key: * -not included in laboratory scope of accreditation.					

Information in Support of the Analytical Results

Our Ref 24-05153
 Client Ref ~ PN244620
 Contract ~ CORWEN WWTW

Containers Received & Deviating Samples

Lab No	Sample ID ~	Date Sampled ~	Containers Received	Hold time exceeded for tests	Inappropriate container for tests
2310597	BH03 0.20 SOIL		GJ 250ml x2, GJ 60ml		

Key: G-Glass J-Jar

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-
 Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

End of Report



Certificate of Analysis

Certificate Number 24-04058

Issued: 04-Mar-24

Client Geotechnics LTD
The Geotechnical Centre
Unit 1B Borders Ind. Park
River Lane
Saltney
Chester
CH4 8RJ

Our Reference 24-04058

Client Reference PN244620

Order No (not supplied)

Contract Title CORWEN WWTW

Description One Soil sample.

Date Received 26-Feb-24

Date Started 26-Feb-24

Date Completed 04-Mar-24

Test Procedures Identified by prefix DETSn (details on request).

Notes Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

A handwritten signature in black ink, appearing to read "K. Bridgewood".

Kirk Bridgewood
General Manager



Summary of Chemical Analysis

Soil Samples

Our Ref 24-04058

Client Ref PN244620

Contract Title CORWEN WWTW

Lab No	2304788
Sample ID	BH04
Depth	0.20
Other ID	
Sample Type	ES
Sampling Date	20/02/2024
Sampling Time	n/s

Test	Method	LOD	Units	
Metals				
Arsenic	DETSC 2301#	0.2	mg/kg	11
Boron, Water Soluble (2.5:1)	DETSC 2311#	0.2	mg/kg	0.7
Cadmium	DETSC 2301#	0.1	mg/kg	0.3
Chromium	DETSC 2301#	0.15	mg/kg	30
Copper	DETSC 2301#	0.2	mg/kg	22
Lead	DETSC 2301#	0.3	mg/kg	35
Mercury	DETSC 2325#	0.05	mg/kg	0.07
Nickel	DETSC 2301#	1	mg/kg	26
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5
Zinc	DETSC 2301#	1	mg/kg	180
Inorganics				
pH	DETSC 2008#		pH	9.6
Cyanide, Total	DETSC 2130#	0.1	mg/kg	0.3
Cyanide, Free	DETSC 2130#	0.1	mg/kg	< 0.1
Sulphate Aqueous Extract as SO4 (2:1)	DETSC 2076#	10	mg/l	1700
Sulphate as SO4, Total	DETSC 2321#	100	mg/kg	27900
Petroleum Hydrocarbons				
Aliphatic C5-C6	DETSC 3321*	0.01	mg/kg	< 0.01
Aliphatic C6-C8	DETSC 3321*	0.01	mg/kg	< 0.01
Aliphatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg	< 1.5
Aliphatic C12-C16	DETSC 3072#	1.2	mg/kg	< 1.2
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg	< 1.5
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg	< 3.4
Aliphatic C5-C35	DETSC 3072*	10	mg/kg	< 10
Aromatic C5-C7	DETSC 3321*	0.01	mg/kg	< 0.01
Aromatic C7-C8	DETSC 3321*	0.01	mg/kg	< 0.01
Aromatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01
Aromatic C10-C12	DETSC 3072#	0.9	mg/kg	< 0.9
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg	< 0.5
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg	< 0.6
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg	< 1.4
Aromatic C5-C35	DETSC 3072*	10	mg/kg	< 10
TPH Ali/Aro Total C5-C35	DETSC 3072*	10	mg/kg	< 10
PAHs				
Naphthalene	DETSC 3301	0.1	mg/kg	< 0.1
Acenaphthylene	DETSC 3301	0.1	mg/kg	< 0.1
Acenaphthene	DETSC 3301	0.1	mg/kg	< 0.1
Fluorene	DETSC 3301	0.1	mg/kg	< 0.1
Phenanthrene	DETSC 3301	0.1	mg/kg	< 0.1
Anthracene	DETSC 3301	0.1	mg/kg	< 0.1
Fluoranthene	DETSC 3301	0.1	mg/kg	< 0.1

Summary of Chemical Analysis Soil Samples

Our Ref 24-04058
Client Ref PN244620
Contract Title CORWEN WWTW

Lab No	2304788
Sample ID	BH04
Depth	0.20
Other ID	
Sample Type	ES
Sampling Date	20/02/2024
Sampling Time	n/s

Test	Method	LOD	Units	
Pyrene	DETSC 3301	0.1	mg/kg	< 0.1
Benzo(a)anthracene	DETSC 3301	0.1	mg/kg	< 0.1
Chrysene	DETSC 3301	0.1	mg/kg	< 0.1
Benzo(b)fluoranthene	DETSC 3301	0.1	mg/kg	< 0.1
Benzo(k)fluoranthene	DETSC 3301	0.1	mg/kg	< 0.1
Benzo(a)pyrene	DETSC 3301	0.1	mg/kg	< 0.1
Indeno(1,2,3-c,d)pyrene	DETSC 3301	0.1	mg/kg	< 0.1
Dibenzo(a,h)anthracene	DETSC 3301	0.1	mg/kg	< 0.1
Benzo(g,h,i)perylene	DETSC 3301	0.1	mg/kg	< 0.1
PAH 16 Total	DETSC 3301	1.6	mg/kg	< 1.6
Phenols				
Phenol - Monohydric	DETSC 2130#	0.3	mg/kg	< 0.3

Summary of Asbestos Analysis Soil Samples

Our Ref 24-04058

Client Ref PN244620

Contract Title CORWEN WWTW

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
2304788	BH04 0.20	SOIL	NAD	none	Michael Kay

Crocidolite = Blue Asbestos, Amosite = Brown Asbestos, Chrysotile = White Asbestos. Anthophyllite, Actinolite and Tremolite are other forms of Asbestos. Samples are analysed by DETSC 1101 using polarised light microscopy in accordance with HSG248 and documented in-house methods. NAD = No Asbestos Detected. Where a sample is NAD, the result is based on analysis of at least 2 sub-samples and should be taken to mean 'no asbestos detected in sample'. Key: * - not included in laboratory scope of accreditation.

Information in Support of the Analytical Results

Our Ref 24-04058
 Client Ref PN244620
 Contract CORWEN WWTW

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Hold time exceeded for tests	Inappropriate container for tests
2304788	BH04 0.20 SOIL	20/02/24	GJ 250ml x2, GJ 60ml		

Key: G-Glass J-Jar

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

End of Report



Certificate of Analysis

Certificate Number 24-05152

Issued: 13-Mar-24

Client Geotechnics LTD
The Geotechnical Centre
Unit 1B Borders Ind. Park
River Lane
Saltney
Chester
CH4 8RJ

Our Reference 24-05152

Client Reference ~ PN244620

Order No ~ (not supplied)

Contract Title ~ CORWEN WWTW

Description One Soil sample.

Date Received 11-Mar-24

Date Started 11-Mar-24

Date Completed 13-Mar-24

Test Procedures Identified by prefix DETSn (details on request).

Notes Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

Kirk Bridgewood
General Manager



Normec DETS Limited

Unit 2, Park Road Industrial Estate South, Consett, Co Durham, DH8 5PY

Tel: 01207 582333 • email: info@dets.co.uk • www.dets.co.uk

Page 1 of 3

Summary of Asbestos Analysis Soil Samples

Our Ref 24-05152

Client Ref ~ PN244620

Contract Title ~ CORWEN WWTW

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
2310596	BH04 0.50	SOIL	NAD	none	Vicky Convery
Crocidolite = Blue Asbestos, Amosite = Brown Asbestos, Chrysotile = White Asbestos. Anthophyllite, Actinolite and Tremolite are other forms of Asbestos. Samples are analysed by DETSC 1101 using polarised light microscopy in accordance with HSG248 and documented in-house methods. NAD = No Asbestos Detected. Where a sample is NAD, the result is based on analysis of at least 2 sub-samples and should be taken to mean 'no asbestos detected in sample'. Key: * -not included in laboratory scope of accreditation.					

Information in Support of the Analytical Results

Our Ref 24-05152
 Client Ref ~ PN244620
 Contract ~ CORWEN WWTW

Containers Received & Deviating Samples

Lab No	Sample ID ~	Date Sampled ~	Containers Received	Hold time exceeded for tests	Inappropriate container for tests
2310596	BH04 0.50 SOIL	20/02/24	GJ 250ml x2, GJ 60ml		
Key: G-Glass J-Jar DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.					

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :- Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

End of Report

Appendix E Dewatering Flow Estimates



Project:	24-451
Type of Calculation:	Radial & Planar Confined Aquifer Dewatering Flow Rate Estimates
Prepared by:	MAW
Checked by:	DW
Date:	13/01/2025

Calculation Details			
Ground level (mAOD)	0.0	0.0	0.0
Length of Excavation (m)	10.5	10.5	10.5
Width of Excavation (m)	10.5	10.5	10.5
Initial Groundwater Level (mAOD)	-0.7	-0.7	-0.7
Target Groundwater Level (mAOD)	-4.8	-4.8	-4.8
Drawdown (m)	4.10	4.10	4.10
Strata being Dewatered	Alluvium Sand & Gravel		
Permeability Range of Dewatered Strata (m/s)	7.38E-04	5.33E-03	6.80E-03
Top of Aquifer (mAOD)	-2.3	-2.3	-2.3
Base of Aquifer (mAOD)	-4.8	-4.8	-4.8
Thickness of Aquifer (m)	2.50	2.50	2.50

Partial penetration factors used in analyses	
Dewatering Well Penetration into Aquifer (P) (m)	2.80
P/H	0.68
P/D	1.12
Lambda	0.01
B	0.99

Planar Flow to the Excavation from Both Sides			
H (m)	4.10	4.10	4.10
hw	0	0	0
(H-hw)	4.10	4.10	4.10
Distance of Influence (Lo by Sichardt Formula)	194.92	523.82	591.67
Total Estimated Dewatering Flow Rate (l/s)	0.81	2.19	2.47
Total Estimated Dewatering Flow Rate (m3/day)	70	189	214

Radial Flow to The Excavation from Both Ends			
Radius of Equivalent Well re (m)	5.25	5.25	5.25
Distance of Influence (Ro by Sichardt Formula)	339.39	903.23	1019.53
Total Estimated Dewatering Flow Rate (l/s)	11.31	66.16	82.47
Total Estimated Dewatering Flow Rate (m3/day)	977	5716	7125

Estimated Required Dewatering Flow Rates			
Total Estimated Dewatering Flow Rate (l/s)	12.1	68.4	84.9
Total Estimated Dewatering Flow Rate (m3/day)	1047.7	5905.6	7339.0

NOTES ON CALCULATIONS:

Calculations are undertaken in accordance with CIRIA C750 Groundwater control: design and practice, second edition (2016).

Radial Confined calculations undertaken as per :

$$r_e = (a + b)/\pi$$

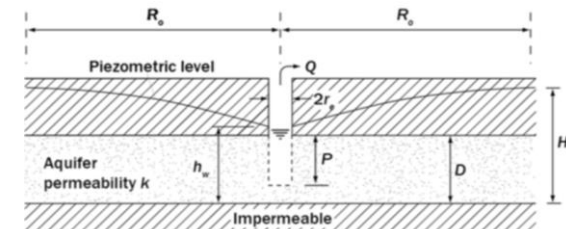
Radius of Equivalent Well (CIRIA C750 Equation 6.6)

$$\text{Confined conditions: } Q = \frac{2\pi kD(H - h_w)}{\ln[R_e/r_e]}$$

Partial Penetration Factor (CIRIA C750 6.7 and 6.10)

$$Q_{pp} = BQ_p$$

$$\text{Radial flow: } R_e = C(H - h_w)\sqrt{k}$$



Extracted from CIRIA C750 (Figure 6.8 A)

Appendix F Chemical Data Sheets

Material Safety Data Sheet

Page 1 of 5

Section 1: Identification of Substance/mixture and of the company undertaking

1.1: Product Identifier

Product Name AQUATREAT 2084

1.2: Relevant Identified use of substance/mixture and uses advised against

1.3: Details of the Supplier of the safety data sheet

Company Name: Aquatreat

Albany House
North Dock
Llanelli
Carmarthenshire
SA15 2LF

Telephone: 01554 775236

Fax: 01554 772253

E-mail: enquiries@aquatreat.co.uk

Website: www.aquatreat.co.uk

1.4: Emergency Telephone Numbers:

Emergency Telephone: 0333 333 9499

Section 2: Hazards Identification

2.1: Classification of substance/mixture according to Regulation (EC) No 1272/2008

Classification under CLP: NC Not Classified

Additional Information:

2.2: Label Elements: Labelling according to Regulation (EC) No 1272/2008 [CLP/GHS]

Label elements under CLP: NC Not Classified as Hazardous

Signal Words:

Hazard Pictograms:

Precautionary Statements

P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

P302+P352 IF ON SKIN: Wash with plenty of soap and water.

P301+P330+P331 IF SWALLOWED: rinse mouth. Do NOT induce vomiting.

2.3: Other Hazards

Section 3: Composition information on hazardous ingredients

Hydrocarbons, C12 - C15, isoalkanes, cyclics <2% aromatics

EINECS	CAS No	Classification according to Regulation (EC) 1272:2008	Percent
920-107-4		H302; ASP Tox.1	20 - 45

Isotridecanol, ethoxylated

EINECS	CAS No	Classification according to Regulation (EC) 1272:2008	Percent
Polymer		H318; Eye Dam.1, H302; Acute Tox.4	<5

Section 4: First Aid Measures**4.1: Description of First Aid measures**

- Skin Contact:** Wash off immediately with soap and plenty of water and remove any contaminated clothing. If persistent irritation occurs, seek medical advice
- Eye Contact:** Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Alternatively, rinse immediately with Diphoterine. Get prompt medical attention
- Ingestion:** Rinse mouth with water. DO NOT induce vomiting. Seek medical attention immediately
- Inhalation:** Move to fresh air. No special first aid measures required.

4.2: Most important symptoms and effects both acute and delayed

- Skin Contact:** None under normal use
- Eye Contact:** None under normal use
- Ingestion:** None under normal use
- Inhalation:** None under normal use

4.3: Indication of any immediate medical treatment and special treatment required

None reasonably foreseeable.

Section 5: Fire fighting measures**5.1: Extinguishing media**

Use fire extinguishers appropriate to the surrounding fire

Unsuitable Media

None

5.2: Special hazards arising from the substance/mixture

Oxides of Carbon and Nitrogen. Hydrogen cyanide may be produced as a result of combustion in an oxygen deficient atmosphere.

5.3: Advice for firefighters

Wear self contained breathing apparatus and protective clothing. Spills become extremely slippery when wet

Section 6: Accidental Release Measures**6.1: Personal precautions, protective equipment and emergency procedures**

Wear appropriate PPE - See section 8

6.2: Environmental precautions

Do not allow spills to enter surface water drains and watercourses

6.3: Methods and Materials for containment and clean up

Soak up with inert material. Sweep and shovel into suitable closed containers and arrange disposal

6.4: References to other sections**Section 7.0: Handling and Storage****7.1: Precautions for safe handling**

Avoid contact with skin and eyes. Renders surfaces extremely slippery when spilled. Do not eat, drink or smoke when using this product

7.2: Conditions for safe storage.

Keep away from heat and sources of ignition. Do not allow the product to freeze. Incompatible with oxidising agents

7.4: Specific End Use(s)**Section 8: Exposure controls/Personal Protection****8.1: Control Parameters**

None known

8 Hour TWA:

15MinSTEL:

8.2: Exposure Controls

Engineering Measures Use local exhaust ventilation if misting occurs

Respiratory Protection respiratory protective equipment is not normally required under normal conditions of use

Hand Protection PVC or other plastic material gloves

Eye Protection Safety glasses with side shields

Skin Protection Coveralls or chemical apron

Section 9.0: Physical and Chemical Properties**9.1: Information on basic physical and chemical properties**

State: Liquid

Colour: Milky

Odour: Aliphatic

Specific Gravity: 1.05

pH: 5 - 8 @5g/l

9.2: Other Information

Section 10: Stability and Reactivity

10.1: Reactivity

Stable under recommended conditions of storage and use

10.2: Chemical Stability

Stable under recommended conditions of storage and use

10.3: Possibility of Hazardous Reactions

None known

10.4: Conditions to Avoid

Heat, Sunlight and frost

10.5: Incompatible Materials

Oxidising Agents

10.6: Hazardous Decomposition Products

Oxides of Carbon and Nitrogen

Section 11: Toxicological Information

Aquatreat 2084

Dermal	Rat	LD50	>5000 mg/kg (estimated)
--------	-----	------	-------------------------

Aquatreat 2084

Oral	Rat	LD50	>5000 mg/kg (estimated)
------	-----	------	-------------------------

Section 12: Ecological Information

12.1: Toxicity

LC50/Oncorhynchus mykiss/ 96hours>100mg/l (estimated), EC50/Daphnia Magna/48 hours>100mg/l (estimated), IC50/Algae/72 hours>100mg/l(estimated)

12.2: Persistence and Biodegradable

Not readily biodegradable

12.3: Bioaccumulative Potential

This product is not expected to bioaccumulate

12.4: Mobility in Soil

No data available

12.5: Results of PBT and vPvB Assessment

Not according to the criteria of Annex XIII of REACH

12.6: Other adverse effects

None

Section 13: Disposal Information

Dispose of waste in accordance with local or national regulations

Section 14: Transport Information

UN Number	<input type="text"/>		
Shipping Name	<input type="text" value="Not classified as hazardous for transport"/>		
Transport Class	<input type="text"/>		
Packing Group	<input type="text"/>		
Environment Hazard	<input type="text"/>		
Special Precautions	<input type="text"/>		
Tunnel Code	<input type="text"/>	Transport Category	<input type="text"/>

Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code

Section 15: Regulatory Information

15.1: Safety, Health and Environmental regulations/legislation specific for the substance/mixture

15.2: Chemical safety assessment

Section 16: Other information

The above information is based on our present knowledge of the product at the time of publication. It is given in good faith, no warranty is implied as to the quality or specification of the product. Information contained in this data does not constitute an assessment of workplace risks. The user must satisfy himself that the product is entirely suitable for their purpose

SAFETY DATA SHEET according to Regulation (EC) No. 1907/2006**Polyaluminium chloride hydroxide sulphate (PAC)**

Version 5.0
Revision Date 2010/12/03

Print Date 2010/12/03
MSDS code: MPAC100

1. Identification of the substance/mixture and of the company/undertaking**1.1. Product identifier**

Trade name : Polyaluminium chloride hydroxide sulphate (PAC)
CAS-No. : 39290-78-3
EC-No. : 254-400-7

1.2. Relevant identified uses of the substance or mixture and uses advised against

Use of the Substance/Mixture : At this time we do not yet have information on identified uses.
They will be included in this safety data sheet when available.

Recommended restrictions on use : At that time we do not yet have information on use restrictions.
They will be included in this safety data sheet when available.

1.3. Details of the supplier of the safety data sheet

Company : Brenntag UK & Ireland
Albion House, Rawdon Park
GB LS19 7XX Leeds Yeadon
Telephone : 0113 3879 200
Telefax : 0113 3879 280
E-mail address : msds@brenntag.co.uk

1.4. Emergency telephone number

Emergency telephone number : Emergency only telephone number (open 24 hours):
01865 407333 (N.C.E.C. Culham)

2. Hazards identification**2.1. Classification of the substance or mixture**

Classification according to Regulation (EC) No 1272/2008

REGULATION (EC) No 1272/2008			
Hazard class	Hazard category	Target Organs	Hazard statements

SAFETY DATA SHEET according to Regulation (EC) No. 1907/2006**Polyaluminium chloride hydroxide sulphate (PAC)**

Version 5.0
Revision Date 2010/12/03

Print Date 2010/12/03
MSDS code: MPAC100

Hazard class	Hazard category	Target Organs	Hazard statements
Skin corrosion/irritation	Category 2		H315
Serious eye damage/eye irritation	Category 2		H319

For the full text of the H-Statements mentioned in this Section, see Section 16.

Classification according to EU Directives 67/548/EEC or 1999/45/EC

Directive 67/548/EEC or 1999/45/EC	
Hazard symbol / Category of danger	Risk phrases
Irritant (Xi)	R36/38

For the full text of the R-phrases mentioned in this Section, see Section 16.

Most important adverse effects

- Human Health : See section 11 for toxicological information.
No further information available.
- Physical and chemical hazards : See section 9 for physicochemical information.
No further information available.
- Potential environmental effects : See section 12 for environmental information.
No further information available.

2.2. Label elements**Labelling according to Regulation (EC) No 1272/2008**

Hazard symbols :



Signal word :

Warning

Hazard statements :

H315
H319

Causes skin irritation.
Causes serious eye irritation.

SAFETY DATA SHEET according to Regulation (EC) No. 1907/2006**Polyaluminium chloride hydroxide sulphate (PAC)**

Version 5.0
Revision Date 2010/12/03

Print Date 2010/12/03
MSDS code: MPAC100

Precautionary statements

General	:	P264 P280	Wash hands thoroughly after handling. Wear protective gloves/ protective clothing/ eye protection/ face protection.
		P302 + P352	IF ON SKIN: Wash with plenty of soap and water.
		P332 + P313	If skin irritation occurs: Get medical advice/ attention.
		P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
		P337 + P313	If eye irritation persists: Get medical advice/ attention.

Additional Labelling:

EUH210 Safety data sheet available on request.

Hazardous components which must be listed on the label:

II • Aluminum chloride hydroxide sulfate

2.3. Other hazards

No other information is available.

3. Composition/information on ingredients**3.1. Substances**

Chemical nature : Aqueous solution

Chemical Name	Identification Number	Amount [%]
Aluminum chloride hydroxide sulfate	CAS-No. : 39290-78-3	< 100
	EC-No. : 254-400-7	

*SAFETY DATA SHEET according to Regulation (EC) No. 1907/2006***Polyaluminium chloride hydroxide sulphate (PAC)**

Version 5.0
Revision Date 2010/12/03

Print Date 2010/12/03
MSDS code: **MPAC100**

4. First aid measures**4.1 Description of first aid measures**

- General advice : Take off all contaminated clothing immediately.
- In case of skin contact : Wash off immediately with soap and plenty of water. If skin irritation persists, call a physician.
- In case of eye contact : Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Call a physician immediately.
- If swallowed : Clean mouth with water and drink afterwards plenty of water.

4.2 Most important symptoms and effects, both acute and delayed

- Symptoms : No further information available.
- Effects : No further information available.

4.3 Indication of immediate medical attention and special treatment needed

- Treatment : Treat symptomatically.
No further information available.

5. Fire-fighting measures**5.1. Extinguishing media**

- Suitable extinguishing media : Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.
- Unsuitable extinguishing media : No information available.

5.2. Special hazards arising from the substance or mixture

- Specific hazards during fire : The product itself does not burn.

SAFETY DATA SHEET according to Regulation (EC) No. 1907/2006

Polyaluminium chloride hydroxide sulphate (PAC)

Version 5.0
Revision Date 2010/12/03

Print Date 2010/12/03
MSDS code: MPAC100

fighting

Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

5.3. Advice for firefighters

Special protective equipment for fire-fighters : Wear self contained breathing apparatus for fire fighting if necessary.

Further information : No further information available.

6. Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Personal precautions : Wear personal protective equipment. Avoid contact with skin and eyes.

6.2 Environmental precautions

Environmental precautions : No special precautions required.

6.3 Methods and materials for containment and cleaning up

Methods and materials for containment and cleaning up	: Absorb with liquid-binding material (sand, diatomite, acid binders, universal binders). Treat recovered material as described in the section "Disposal considerations". Flush away residuals with plenty of water.
---	--

6.4 Reference to other sections

For personal protection see section 8.

7. Handling and storage

7.1 Precautions for safe handling

*SAFETY DATA SHEET according to Regulation (EC) No. 1907/2006***Polyaluminium chloride hydroxide sulphate (PAC)**

Version 5.0
Revision Date 2010/12/03

Print Date 2010/12/03
MSDS code: MPAC100

Advice on safe handling : Avoid contact with skin, eyes and clothing. Handle in accordance with good industrial hygiene and safety practice.
Hygiene measures : Wash hands before breaks and immediately after handling the product. Keep away from food, drink and animal feedingstuffs. When using do not eat or drink.

7.2 Conditions for safe storage, including any incompatibilities

Requirements for storage areas and containers : Keep in an area equipped with acid resistant flooring. Use acid resistant materials only. Use chloride resistant materials only. Keep container tightly closed.

Advice on protection against fire and explosion : Normal measures for preventive fire protection.

Advice on common storage : Store separate from acidic- and chloride sensitive materials.

German storage class : 8B: Non-combustible substances, corrosive

Storage temperature : 0 - 30 °C

7.3 Specific end uses

Specific use(s) : No information available.

8. Exposure controls/personal protection**8.1. Control parameters**

Component: Aluminum chloride hydroxide sulfate

**CAS-No.
39290-78-3**

SAFETY DATA SHEET according to Regulation (EC) No. 1907/2006**Polyaluminium chloride hydroxide sulphate (PAC)**

Version 5.0
Revision Date 2010/12/03

Print Date 2010/12/03
MSDS code: MPAC100

Other OELs

Regulatory Basis	: UK. EH40 Workplace Exposure Limits (WELs)
Regulatory List	: EH40 WEL
Value type	: Time Weighted Average (TWA):
Value	: 2 mg/m ³

8.2. Exposure controls**Engineering measures**

Refer to protective measures listed in sections 7 and 8.

Personal protective equipment*Respiratory protection*

Advice : Breathing apparatus needed only when aerosol or mist is formed.

Hand protection

Advice : Neoprene gloves
Protective gloves should be replaced at first signs of wear.

Glove thickness : 0.75 mm

Eye protection

Advice : Tightly fitting safety goggles

Skin and body protection

Advice : Protective suit

Environmental exposure controls

General advice : No special precautions required.

9. Physical and chemical properties**9.1. Information on basic physical and chemical properties**

*SAFETY DATA SHEET according to Regulation (EC) No. 1907/2006****Polyaluminium chloride hydroxide sulphate (PAC)***

Version 5.0
Revision Date 2010/12/03

Print Date 2010/12/03
MSDS code: MPAC100

Form	: liquid
Colour	: clear to slight cloudy
Odour	: odourless
Odour Threshold	: Currently we do not have any Information from our supplier about this.
pH	: 2 - 3 20 °C
Freezing point	: -12 °C
Boiling point	: > 100 °C
Flash point	: not applicable
Evaporation rate	: Currently we do not have any Information from our supplier about this.
Flammability (solid, gas)	: Currently we do not have any Information from our supplier about this.
Upper explosion limit	: Currently we do not have any Information from our supplier about this.
Lower explosion limit	: Currently we do not have any Information from our supplier about this.
Vapour pressure	: Currently we do not have any Information from our supplier about this.
Relative vapour density	: Currently we do not have any Information from our supplier about this.
Density	: ca. 1.192 - 1.3 g/cm ³ 20 °C
Water solubility	: completely soluble
Partition coefficient: n-octanol/water	: Currently we do not have any Information from our supplier about this.
Ignition temperature	: Currently we do not have any Information from our supplier about this.
Thermal decomposition	: Currently we do not have any Information from our supplier about this.

*SAFETY DATA SHEET according to Regulation (EC) No. 1907/2006***Polyaluminium chloride hydroxide sulphate (PAC)**

Version 5.0
Revision Date 2010/12/03

Print Date 2010/12/03
MSDS code: MPAC100

Viscosity, kinematic	: Currently we do not have any Information from our supplier about this.
Explosive properties	: Currently we do not have any Information from our supplier about this.
Oxidizing properties	: Currently we do not have any Information from our supplier about this.

9.2 Other information

No further information available.

10. Stability and reactivity**10.1. Reactivity**

Advice : No information available.

10.2. Chemical stability

Advice : No decomposition if stored and applied as directed.
No further information available.

10.3. Possibility of hazardous reactions

Hazardous reactions : No information available.

10.4. Conditions to avoid

Conditions to avoid : Extremes of temperature and direct sunlight.

10.5. Incompatible materials

Materials to avoid : Oxidizing agents
Bases

10.6. Hazardous decomposition products

Hazardous decomposition products : Oxygen
hydrogen chloride

11. Toxicological information**11.1. Information on toxicological effects**

SAFETY DATA SHEET according to Regulation (EC) No. 1907/2006

Polyaluminium chloride hydroxide sulphate (PAC)Version 5.0
Revision Date 2010/12/03Print Date 2010/12/03
MSDS code: MPAC100

Product:	CAS-No. 39290-78-3
Acute toxicity	
Oral	
Value type	: LD50
Value	: > 5,000 mg/kg
Species	: rat
Irritation	
Skin	
Remarks	: Irritating to skin.
Eyes	
Remarks	: Irritating to eyes.
Sensitisation	
Remarks	: No sensitizing effect known.

12. Ecological information**12.1. Toxicity**

Component: Aluminum chloride hydroxide sulfate	CAS-No. 39290-78-3
Acute toxicity	
Fish	
Species	: Leuciscus idus (Golden orfe)
Exposure Time	: 48 h
Value type	: LC50

SAFETY DATA SHEET according to Regulation (EC) No. 1907/2006**Polyaluminium chloride hydroxide sulphate (PAC)**

Version 5.0
Revision Date 2010/12/03

Print Date 2010/12/03
MSDS code: MPAC100

||Value : ca. 1,500 mg/l

12.2. Persistence and degradability**12.3. Bioaccumulative potential****12.4. Mobility in soil****12.5. Results of PBT and vPvB assessment****12.6. Other adverse effects**

Product:	CAS-No. 39290-78-3
Additional ecological information	

Remarks : Solutions with low pH-value must be neutralized before discharge.
Ecological injuries are not known or expected under normal use.

13. Disposal considerations**13.1. Waste treatment methods**

Product : Can be disposed as waste water, when in compliance with local regulations.

Contaminated packaging : Empty remaining contents. Rinse with plenty of water. Store containers and offer for recycling of material when in accordance with the local regulations.

European Waste Catalogue Number : No waste code according to the European Waste Catalogue can be assigned for this product, as the intended use dictates the assignment. The waste code is established in consultation with the regional waste disposer.

14. Transport information**14.1. UN number**

SAFETY DATA SHEET according to Regulation (EC) No. 1907/2006**Polyaluminium chloride hydroxide sulphate (PAC)**

Version 5.0
Revision Date 2010/12/03

Print Date 2010/12/03
MSDS code: **MPAC100**

3264

14.2. UN proper shipping name

ADR : CORROSIVE LIQUID, ACIDIC, INORGANIC, N.O.S.
(Aluminum chloride hydroxide sulfate)

RID : CORROSIVE LIQUID, ACIDIC, INORGANIC, N.O.S.
(Aluminum chloride hydroxide sulfate)

IMDG : CORROSIVE LIQUID, ACIDIC, INORGANIC, N.O.S.
(Aluminum chloride hydroxide sulfate)

14.3. Transport hazard class(es)

ADR-Class : 8
(Labels; Classification Code; Hazard
identification No; Tunnel restriction code) 8; C1; 80; (E)

RID-Class : 8
(Labels; Classification Code; Hazard
identification No) 8; C1; 80

IMDG-Class : 8
(Labels; EmS) 8; F-A, S-B

14.4. Packaging group

ADR : III

RID : III

IMDG : III

14.5. Environmental hazards

Labeling according to 5.2.1.8 ADR : no

Labeling according to 5.2.1.8 RID : no

Labeling according to 5.2.1.6.3 IMDG : no

Classification as environmentally
hazardous according to 2.9.3 IMDG : no

*SAFETY DATA SHEET according to Regulation (EC) No. 1907/2006***Polyaluminium chloride hydroxide sulphate (PAC)**

Version 5.0
Revision Date 2010/12/03

Print Date 2010/12/03
MSDS code: **MPAC100**

14.6. Special precautions for user

Not applicable.

14.7. Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

IMDG : Not applicable.

15. Regulatory information**15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture****15.2. Chemical Safety Assessment**

Currently we do not have any Information from our supplier about this.

16. Other information**Full text of R-phrases referred to under sections 2 and 3.**

R36/38 Irritating to eyes and skin.

Full text of H-Statements referred to under sections 2 and 3.

H315 Causes skin irritation.

H319 Causes serious eye irritation.

Further information

Other information : The information provided in this Safety Data Sheet is correct to

*SAFETY DATA SHEET according to Regulation (EC) No. 1907/2006****Polyaluminium chloride hydroxide sulphate (PAC)***

Version 5.0
Revision Date 2010/12/03

Print Date 2010/12/03
MSDS code: MPAC100

the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text. Restricted to professional users. Attention - Avoid exposure - obtain special instructions before use.

|| Indicates updated section.