

Barry Landfill Restoration Capping Timber Pond Water Quality Assessment

Dow Silicones UK Ltd

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Quality information

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Executive Summary

AECOM Limited (AECOM) has been commissioned to undertake a surface water quality assessment of the Timber Pond adjacent to the landfill area located at Dow Silicones (Dow), Cardiff Road, Barry, South Glamorgan CF63 2YL.

The water quality assessment was requested by Natural Resources Wales (NRW) during a meeting on 1st March 2018. The meeting was held to present an updated Landfill Closure Report¹ to NRW, including proposals for the installation of a low permeability engineered cap and segregated surface water drainage system for the landfill area covered by Waste Management Licence No. 38.

The landfill restoration capping project forms part of Dow's long-term objective to surrender the Waste Management Licence for the landfill area and to remove the landfill from the site Environmental Permit. The conceptual design for the landfill capping and drainage installation was presented to NRW within the Landfill Closure Report and discussed during the 1st March 2018 meeting. The outline design for the capping and drainage works was submitted to Vale of Glamorgan Council in support of a Planning Application (2018/00515/FUL, as a variation of existing consent Ref.: 1986/00412/FUL) and granted consent on 10th October 2018.

The existing landfill surface forms an open area of flat ground, with no capping material over the waste mass and no provision for surface water drainage. The flat surface and absence of drainage provision makes the landfill surface prone to flooding from rainfall accumulation, with rainfall infiltration into the waste mass also contributing to the leaching of contaminants from the waste mass and potential migration of contaminants towards the Cadoxton Ponds via a shallow groundwater migration pathway.

The re-grading of the landfill surface, installation of low permeability capping layer and restoration soil cover, will promote clean surface water run-off from the capped landfill surface towards the adjacent Timber Pond. Water from the Timber Pond will then be routed to the Cadoxton Ponds via a new connector drain along the South Access Road and a new attenuation wetland within the nature reserve area. Water from the Cadoxton Ponds will continue to be pumped to Barry Docks using the existing collector sump and pump house in the nature reserve area.

To achieve the project objectives, AECOM proposed that existing Dow Site Protection and Monitoring Programme (SPMP) surface water quality data would be assessed to establish the water quality conditions within the respective ponds. As the SPMP samples are collected at, or close to, the water surface, AECOM also proposed that additional water quality samples should be collected at specified depths within the Timber Pond to ascertain whether the water body has become stratified on the basis of salinity or contaminant water quality parameters.

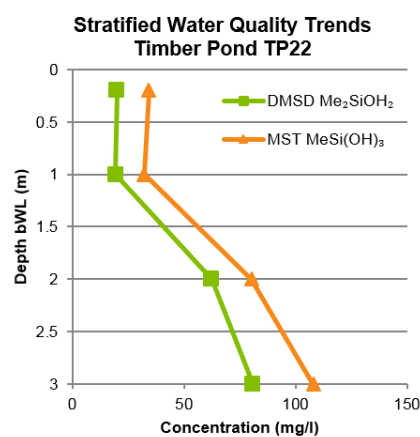
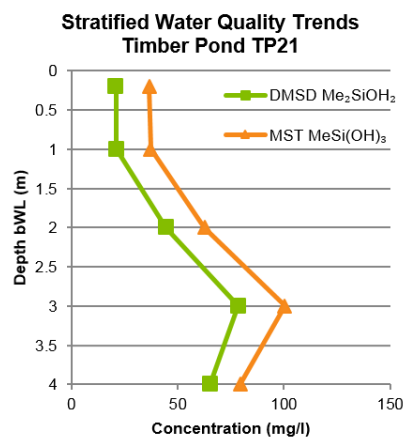
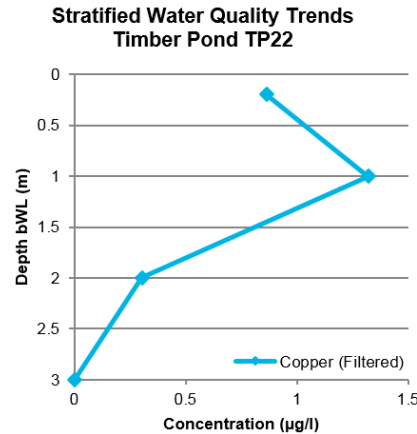
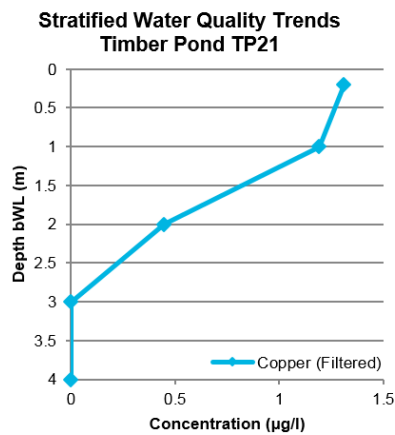
Based on the SPMP data review, Timber Pond water quality appears to be broadly similar to water quality in the Cadoxton Ponds.

Copper concentrations are higher in the Timber Pond than in the Cadoxton Ponds, although all three ponds record copper concentrations above the bioavailable EQS value of 1 µg/L. None of the recorded copper concentrations exceed the M-BAT based PNEC values previously established for the Cadoxton Ponds. Chloride concentrations exceed Environmental Quality Standards but are considered to reflect brackish conditions in proximity to the coast / Barry Docks complex. Silanol species have been detected across the pond network, although the distribution of species varies between ponds and no EQS values have been established.

The recorded contaminant concentrations do not suggest the presence of significant contamination which would prevent the connection of the two sets of water bodies.

Depth sampling indicates that the Timber Pond is stratified, with generally lower water quality recorded towards the base of the pond. The evidence from the depth sampling suggests limited mixing between the upper 1m of the pond water and the lower 3-4m, with the upper and lower layers exhibiting clear differences in water quality, including higher concentrations of copper in the surface layer and increasing silanols and organic concentrations within the deeper water layers, as shown in the water quality / water depth charts:

¹ Dow Silicones UK Limited. Landfill Closure Report. Repot Ref.: 60522560, AECOM Limited, February 2018.



A new outlet headwall and transfer drainage pipe will be installed to connect the Timber Pond with a newly constructed attenuation wetland and the Cadoxton Ponds. As the headwall will take flow from the Timber Pond surface layer, AECOM expects that the existing Dow water surface data and AECOM 1m depth water quality data provides the most likely indication of drainage quality and potential downstream impact when the ponds are connected.

Under the existing water quality conditions, a connection between the Timber Pond and the Cadoxton Ponds would allow the transfer of the generally higher quality upper water layer to the downstream ponds. This surface water layer includes copper concentrations which exceed the EQS value, but the existing data indicates that copper concentrations are broadly similar in all of the ponds and are below the M-BAT calculated PNEC values in all of the ponds.

The proposed landfill cap will significantly increase the Timber Pond catchment area and increase the volume of clean water flows into the Timber Pond. These additional water flows are expected to further improve the water quality within the upper 1m layer.

The design of the free draining landfill cap edge adjacent to the Timber Pond is expected to minimise run-off induced turbulence within the Timber Pond (reduced point discharges). Storm run-off has been assessed using 50mm and 100mm rainfall events, amounting to 4% and 9% of total pond volume, equivalent to increases in water level of 175mm and 350mm respectively (assuming no onward flow to the Cadoxton Ponds).

These factors all suggest that even under storm conditions, the additional water inputs to the Timber Pond are most likely to mix within the higher quality upper water layers of the pond, minimising the risk of mixing with the lower 3-4m depth water layers and flushing of potentially lower quality deep pond water.

The most likely long-term scenario (Scenario 2) would be that Timber Pond water quality would progressively improve, as a result of clean landfill cap run-off entering the pond and reduced rainfall infiltration and leaching of contaminants from the landfill waste mass

This assessment indicates that the construction of a direct drainage connection between the Timber Pond and the Cadoxton Ponds is unlikely to present an additional water quality risk to the Cadoxton Ponds.

1. Introduction

1.1 Terms of Reference

AECOM Limited (AECOM) has been commissioned to undertake a surface water quality assessment of the Timber Pond adjacent to the landfill area located at Dow Silicones UK Ltd (Dow), Cardiff Road, Barry, South Glamorgan CF63 2YL.

1.2 Background

Dow currently manufactures a range of silicone-based products and intermediates at its Barry facility. The site is understood to have been involved in the manufacture of silicone-based products since the 1950s, although the site was not acquired by Dow Corning (now Dow Silicones) until 1971.

Aerial photographs inspected in Dow offices show that a timber pond historically occupied the western part of the Dow Barry site area. The photographs, along with historical mapping, indicate that the timber pond was progressively in-filled from east to west, allowing the westerly expansion of the process plant area. Since acquisition of the site in 1971, it is understood that the remaining area of the former timber pond has been infilled with waste process materials (direct process residue, or "DPR" gel and filter bed material). The most westerly section of the former pond was formally licensed as a landfill for the disposal of process waste from the plant.

Waste Disposal Licence No. 22 was issued to Dow Corning by the predecessor organisation to Vale of Glamorgan Council, under the Control of Pollution Act 1974 (COPA). An extension to the licensed disposal area was agreed in 1986, and in 1991 Waste Management Licence No. 38 was issued to Dow Corning, with infilling of the former timber pond continuing until closure of the landfill in 2002. The licence permitted landfilling with five specific process wastes (silicone gel, spent silicone, calcium sulphate filter cake, limestone and carbon filter / molecular sieve kieselguhr).

A remaining body of water, known as the Timber Pond, is present between the western boundary of the licensed landfill area and the site perimeter boundary (D-shaped railway line curve). This water body represents the unfilled section of the former larger pond and is joined to a similar water body on the Barry Dock side of the railway line by an open lock gate. The water body is separated from the waste by a bund, of unknown construction detail, and is believed to extend to the same depth as the waste (having previously shared the same pond base / bed level).

Dow's long-term objective is to surrender the Waste Management Licence for the landfill area and to remove the landfill from the site Environmental Permit. In February 2018, Dow prepared and submitted a Landfill Closure Report² to Natural Resources Wales (NRW) to present environmental monitoring data, risk assessment and conceptual site model updates to support the landfill closure process and to present a proposed strategy for landfill capping, Waste Management Licence surrender and Environmental Permit variation.

A summary of the Landfill Closure Report and proposed capping strategy was presented to NRW on 1st March 2018. The objective of the meeting was to review the Landfill Closure Report, present the proposed landfill capping and closure strategy, receive NRW feedback and to seek agreement in principle for the proposed approach.

1.3 Landfill Capping Concept

The proposed landfill capping concept was presented to NRW within the Landfill Closure Report and summarised within a presentation delivered to NRW during the 1st March 2018 meeting.

The existing landfill surface forms an open area of flat ground, with no capping material over the waste mass and no provision for surface water drainage. Perimeter bunds have been constructed to prevent surface water run-off from the landfill area to the adjacent Timber Pond or to the site drainage system.

The flat surface and absence of drainage provision makes the landfill surface prone to flooding from rainfall accumulation. Rainfall, the accumulation of surface water and absence of a low permeability cap all contribute to rainfall infiltration into the waste mass and the leaching of contaminants from the waste mass. The conceptual

² Dow Silicones UK Limited. Landfill Closure Report. Repot Ref.: 60522560, AECOM Limited, February 2018.

model for the landfill area identifies vertical infiltration of rainfall and leaching of contaminants from the waste mass as one of the key components of the potential contaminant migration pathway towards the Cadoxton Ponds. The Cadoxton Ponds are two fishing lakes located within a nature reserve area to the north of the landfill and are identified as the key environmental receptors in respect of the landfill.

The installation of an engineered low permeability capping system has been agreed in principle with NRW and has been granted planning consent by Vale of Glamorgan Council.

The proposed capping concept is presented on Figure 1.1.

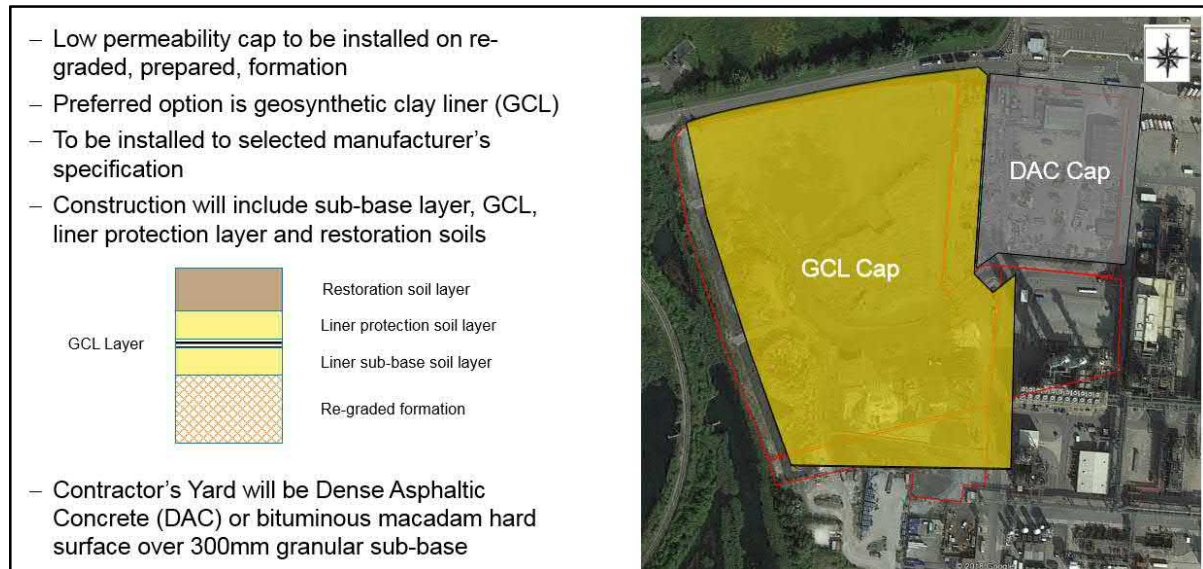


Figure 1.1 – Conceptual Landfill Capping Design – Low Permeability Cap
(Slide 16: Landfill Closure Summary Presentation, 1st March 2018)

The flat surface area of the landfill will be re-graded to provide a gradient of between 1:120 and 1:150 (vertical : horizontal) towards the south western boundary. The capping layers will be placed on the re-graded surface, with a bentonite-based geosynthetic clay liner (GCL) used as the low permeability component of the capping system. A liner protection layer and restoration soil layer will be installed above the GCL, with the restoration soil layer used to support a re-vegetated surface which will be hydro-seeded to provide erosion protection and enhanced future biodiversity.

A bituminous hard-standing surface will be installed within the section of former landfill now occupied by the Contractor's Yard.

1.4 Landfill Cap Drainage Concept

The capping system has been designed to reduce the current occurrence of surface water ponding, rainfall infiltration to the waste mass and contaminant leaching from the waste mass.

The combination of the re-graded surface profile and low permeability GCL layer will promote clean surface water run-off from the capped landfill surface towards the adjacent Timber Pond.

The flat nature of the site and the surrounding land limits the available hydraulic gradient for a formal collector drain system along the down gradient edge of the landfill. The proposed drainage concept is based on a slow percolation of clean surface water run-off from the landfill cap into the eastern margin of the Timber Pond. Water from the Timber Pond will then be routed to the Cadoxton Ponds via a new connector drain along the South Access Road and a new attenuation wetland within the nature reserve area. Water from the Cadoxton Ponds will continue to be pumped to Barry Docks using the existing collector sump and pump house in the nature reserve area.

The proposed drainage concept is presented on Figure 1.2.

Conceptual Landfill Capping Design – Drainage

1. Run-off from cap to Timber Pond
2. New outfall from Timber Pond
3. New drainage run to attenuation wetland in nature reserve area
4. Attenuation wetland, with overflow from wetland to Cadoxton Ponds
5. Pumped transfer to Barry Docks basin (as existing)



Figure 1.2 – Conceptual Landfill Capping Design – Drainage
(Amended from Slide 17: Landfill Closure Summary Presentation, 1st March 2018)

The Timber Pond has no identified inlet or outlet headwalls. Previous water level monitoring data indicates that the pond water level fluctuates between approximately 7.05mAOD and 7.35mAOD³. Water levels rise in response to rainfall and reduce with long-term periods of dry weather, with no fixed upper or lower control elevations identified during previous water level monitoring.

The landfill capping proposals include the installation of an outlet headwall and gravity drainage connection to a new attenuation wetland within the Nature area. A new outlet is proposed with the invert level of the outlet headwall set at 6.740mAOD. This will control the normal Timber Pond water level at 6.760m. The drainage design for the transfer pipeline between the Timber Pond and the new attenuation wetland has pipe sizes and drainage gradients specified to accommodate storm run-off from the low permeability landfill cap, within a maximum Timber Pond design water level of 7.340mAOD. This provides the Timber Pond with up to 600mm of freeboard for storm storage, without exceeding the maximum design water level (7.340mAOD) or the maximum recorded pond water level of 7.35mAOD. With a combined pond surface area of circa 18,380m² (Timber Pond west and east of railway), the 600mm freeboard provides circa 11,000m³ of additional storage volume.

A separate attenuation wetland has been constructed within the nature area as part of the Phase 1 drainage installation works. The drainage design has been specified to attenuate the cap run-off rates to the equivalent of greenfield run off rates. The attenuation wetland has been designed and built to incorporate an existing pond and wetland vegetation within the nature area (believed to be a remnant of a former Cadoxton River channel). The overflow from the attenuation wetland will discharge into the Cadoxton Ponds during periods of high-water levels / storm run-off attenuation.

These pond areas are identified as sensitive environmental receptors and NRW has requested that a water quality assessment should be undertaken for the Timber Pond. Clean surface water run-off from the landfill will increase the water flow into the Timber Pond and may result in the flushing of any contaminants within the pond and allow subsequent transfer to the Cadoxton Ponds nature area. Dow currently monitor surface water quality as part of the Environmental Permit Site Protection and Monitoring Programme (SPMP). The Timber Pond and Cadoxton Ponds are included within the SPMP.

³ Landfill Groundwater Data Assessment, Report Ref.: 47065177/CRRP0001, URS Infrastructure & Environment Limited, November 2013

1.5 Objectives

AECOM understands that Dow's long-term objective is to surrender the Waste Management Licence for the landfill area and remove the landfill from the site's Environmental Permit. In order to achieve this objective, the landfill is to be capped and a formal drainage system implemented to allow clean surface runoff from the landfill cap to enter the Timber Pond located immediately south west of the landfill area, and then be discharged into the Cadoxton Ponds via a new attenuation wetland, as described in Sections 1.3 and 1.4.

Following the Landfill Closure Report review meeting on 1st March 2018, NRW requested that a Timber Pond Water Quality Technical Note should be prepared as an addendum to the Landfill Closure Report.

The objectives of this Technical Note include the assessment of the existing water quality conditions within the Timber Pond and Cadoxton Ponds, and the evaluation of potential impacts that might arise from connecting the ponds with the proposed landfill capping drainage system and providing a potential contaminant migration pathway between the Timber Pond and the Cadoxton Ponds.

This report details the investigation into the existing surface water quality of the Timber Pond, to determine the suitability of the proposed over flow system between the Timber Pond and the Cadoxton Ponds. The potential for adverse ecological impacts associated with the transfer of Invasive Non-Native Species (INNS) between the ponds is addressed in a separate report prepared for submission to Vale of Glamorgan Council in relation to the discharge of planning conditions.

1.6 Scope of Works

To achieve the project objectives, AECOM proposed that existing Dow SPMP surface water quality data would be assessed to establish the water quality conditions within the respective ponds.

As the SPMP samples are collected at, or close to, the water surface, AECOM also proposed that additional water quality samples should be collected at specified depths within the Timber Pond to ascertain whether the water body has become stratified on the basis of salinity or contaminant water quality parameters. The formation of the Timber Pond through the infilling of a former dock basin (potential saline / brackish water), long period of isolation of the pond from water inflows and outflows and the potential for density separation of denser than water contaminants are all factors that could contribute to stratified water quality conditions within the pond. AECOM therefore aimed to access multiple locations around the Timber Pond to collect stratified surface water samples. These are to determine the water quality of the Timber Pond and to monitor any concentration fluctuations with depth.

The scope of work undertaken included:

- Data review to establish the exiting water quality conditions, based on recent Dow SPMP water quality data for the Timber Pond and Cadoxton Ponds.
- AECOM site walkover to determine safe access and sampling points for additional water quality sampling, including the production of a site-specific health and safety plan.
- AECOM sampling of the Timber Pond, including collection of field water quality measurements and water samples from the full depth profile of the Timber Pond and submission of samples for laboratory analysis.
- Review of the laboratory analytical data and preparation of this Technical Note.

2. Review of Dow Surface Water Monitoring Data

Shallow surface water samples have been collected by Dow as part of the SPMP, as required under the site Environmental Permit. Surface water samples have been collected from the Timber Pond and from other locations across the site including the Cadoxton River (upstream and downstream of the permitted effluent discharge), South Pond (Freshwater Pond), Cadoxton North Pond and Cadoxton South Pond between 2007 and 2019 (ongoing).

The potential contaminants of concern (PCOC) that are considered to be characteristic of the landfill area have previously been identified as copper and trimethylsilanol (TMS). Other compounds have been detected during previous groundwater monitoring, but copper and TMS remain the primary indicators of leaching and contamination arising from the landfill waste mass.

Copper is classified as a non-hazardous pollutant and has an environmental quality standard (EQS) value of $1\mu\text{g/L}$. This EQS is based on bioavailable copper. Previous surface water sampling and M-BAT⁴ assessment has derived an M-BAT based probable no-effect concentrations (PNECs) of $31.89\mu\text{g/L}$ copper for the Cadoxton South Pond and $39.43\mu\text{g/L}$ copper for the Cadoxton North Pond⁵. These concentrations are broadly comparable to the now superseded hardness-based copper EQS value of $28\mu\text{g/L}$ which was used in assessments prior to 2015.

TMS has historically been used as an indicator compound for silanols and other siloxane breakdown products. No UK or EU based EQS or generic assessment criteria (GAC) are available for TMS as an aquatic contaminant. Previous groundwater studies and the existing conceptual site model has focused on TMS (trimethylsilanol) as this substance was readily identifiable and has been monitored and tracked for over 10 years.

In 2017 the analytical capability was improved, and site effluent and borehole testing indicated that other silanol species can be present in addition to TMS, namely dimethylsilanediol (DMSD) and methylsilanetriol (MST). The improvements in analytical techniques have allowed Dow to add a number of additional species to their environmental analytical suite, including methylsilanetriol (MST), dimethylsilanediol (DMSD) and silicic acid. Sampling and analysis of these species has now been extended to the site surface water monitoring locations and the depth samples collected from the Timber Pond as part of this water quality assessment. No UK or EU based EQS or GAC were available for TMS or other silanol species as aquatic contaminants.

Dow has completed an assessment of whether selected silanols, including TMS, DMSD and MST, are likely to be classified as hazardous substances in the context of the Water Framework Directive (WFD) and Groundwater Daughter Directive (GDD), using the approach outlined by JAGDAG⁶. The Water Framework Directive defines a hazardous substance as one which is toxic, persistent and liable to bioaccumulate, so a substance must meet all three criteria to be determined as hazardous. Alternatively, a substance must be very persistent and very bio-accumulative to be considered hazardous in groundwater.

The hazardous substances assessment demonstrates that TMS, DMSD and MST are regarded as non-hazardous pollutants in respect of groundwater. The Dow Groundwater Directive Assessment Sheets for TMS, DMSD and MST are included as **Appendix A**.

Physico-chemical data indicates a range of specific densities for the silanol species, from marginally less dense than fresh water (TMS) to marginally denser than fresh water (MST). The specific density largely reflects the degree of methylation associated with each molecule (with the CH_3 methyl unit having a lower molecular mass than the OH hydroxyl unit that is replaced).

- | | | |
|----------------------|------|--|
| • Trimethylsilanol | TMS | specific density 0.900 g/cm^3 |
| • Dimethylsilanediol | DMSD | specific density 0.998 g/cm^3 |
| • Methylsilanetriol | MST | specific density 1.284 g/cm^3 |

The density contrast between these species and with fresh water (nominally 1 g/cm^3) was one factor that indicated the potential for water quality stratification to occur within the Timber Pond.

⁴ Metals Bioavailability Assessment Tool - <https://www.wfduk.org/resources/rivers-lakes-metal-bioavailability-assessment-tool-m-bat>

⁵ Dow Corning Barry Landfill Site Investigation Report, Ref.: 60469588 (47065177), AECOM Infrastructure & Environment UK Limited, May 2016

⁶ Joint Agencies Groundwater Directive Advisory Group

Sections 2.1 to 2.4 present the data review findings for the Dow SPMP sampling, which is understood to be based on samples collected from, at, or near to the surface of the water body. A summary of these results is detailed below, taken from AECOM Landfill Closure Report dated January 2018. Additional silanols results from Q1-2018 have also been included. Historical data tables are found in **Appendix B**.

Section 3 presents the methodology and findings from the depth profiling water quality survey undertaken at the Timber Pond during August 2018.

2.1 Copper

Copper is the primary metal contaminant of potential concern, based on its relative environmental mobility and low bioavailable EQS value of 1µg/L. **Table 2.1** presents the detections of copper in surface water samples for the six monitoring rounds 2015-Q1 to 2017-Q3.

Table 2.1 – Copper Detections in Surface Waters

Monitoring Round	Location					
	Timber Pond	Cadoxton Pond N	Cadoxton Pond S	South Pond	SW2 Cadoxton River (upstream)	SW3 Cadoxton River (downstream)
2015-Q1	10.9	<MDL	<MDL	5.19	2.96	16
2015-Q3	7.56	<MDL	<MDL	2.41	<MDL	<MDL
2016-Q1	14.9	5.82	5.32	6.16	7.01	10.2
2016-Q3	4.85	3.46	2.58	14.5	3.83	17.8
2017-Q1	10.4	12.3	3.69	3.24	2.70	5.60
2017-Q3	18.7	<MDL	<MDL	3.31	3.16	18.5

Note: All results in µg/L.

EQS exceedances in **bold**.

<MDL – Less than the Method Detection Limit.

Cadoxton Pond N = Cadoxton North Cadoxton. Pond S = Cadoxton South Pond.

Copper was reported at a maximum surface water concentration of 18.7µg/l in the samples from the Timber Pond and 18.5µg/l in the Cadoxton River SW3 location in 2017-Q3. These concentrations are higher than the maximum reported concentration recorded during AECOM sampling, of 3.31µg/L from the Timber Pond, sampled as part of the 2015 site investigation.

Timber Pond copper concentrations are recorded at concentrations above the bioavailable EQS value of 1 µg/L, but are below the 2015 M-BAT assessed PNEC values for the Cadoxton Ponds of 31.89µg/L and 39.43µg/L.

Copper is also detected within the Cadoxton Ponds, at concentrations of between 2.58 µg/L in the Cadoxton South Pond in 2016-Q3 and 12.3 µg/L in the Cadoxton North Pond in 2017-Q1, lower than the M-BAT assessed PNEC values.

All detected values in the Cadoxton Ponds exceed the bioavailable EQS of 1 µg/L. In general, copper concentrations are higher in the Timber Pond than in the Cadoxton Ponds, although are of the same order of magnitude. In 2017-Q1 a higher copper concentration was detected in the Cadoxton North Pond than in the Timber Pond.

Although the Timber Pond copper concentrations are broadly similar to those in the Cadoxton Ponds, there is no known direct drainage connection between the Timber Pond and the other surface water bodies.

2.2 Trimethylsilanol (TMS), Methylsilanetriol (MST), Dimethylsilanediol (DMSD) and Silicic Acid in Surface Waters

Since 2017, analysis of silanol species has been expanded from TMS only, to a broader suite including TMS, MST, DMSD and silicic acid. Table 2.2 presents the silanol detections in surface water samples from the Cadoxton Ponds and the Timber Pond from 2017-8.

Table 2.2 – Silanol Detections in Surface Waters

Location	Monitoring Round	Analyte			
		TMS	MST	Silicic Acid	DMSD
Timber Pond	2017-Q1	<MDL	38.3	5.3	19.8
	2017-Q3	<MDL	36	3.3	20.4
	2018-Q1	<MDL	33.4	2.3	18.1
Cadoxton N Pond	2017-Q3	<MDL	1.5	6.8	2.2
	2018-Q1	<MDL	17.4	23.3	12.6
Cadoxton S Pond	2018-Q1	0.15	7	25.8	5.3
South Pond	2017-Q3	<MDL	17.4	3	9.3
	2018-Q1	<MDL	13.5	3.2	7.3
SW2 Cadoxton River (upstream)	2017-Q1	-	0.1	12.9	-
	2017-Q3	-	0.1	9.7	-
SW3 Cadoxton River (downstream)	2017-Q1	-	6	12.7	-
	2017-Q3	-	9.6	11.6	-

Note: All results in mg/L.
No EQS values available
<MDL – Less than the Method Detection Limit.
A '-' indicates where a sample was not tested for an analyte.

TMS was only detected in the 2018 Quarter 1 monitoring round, and only in the Cadoxton South Pond. No TMS is recorded for the Timber Pond water samples for the 2017-2018 monitoring data.

MST was reported in the 2017 rounds for the Timber Pond and Cadoxton North Pond (2017-Q3 only). During the 2018 Quarter 1 round, MST was reported in the Timber Pond, Cadoxton North Pond and Cadoxton South Pond. The maximum reported concentration was 38.3 mg/l in the sample from the Timber Pond in 2017-Q1 (36.0mg/l in 2017-Q3). MST concentrations in the Timber Pond are elevated compared to other locations.

Silicic acid was reported at all locations and across all 2017 – 2018 monitoring rounds, with a maximum recorded concentration of 25.8mg/l in the sample from Cadoxton South Pond (2018-Q1) and a minimum detection of 2.3mg/l was recorded at the Timber Pond (2018-Q1).

DMSD was reported above the laboratory limit of detection in all collected samples in both 2017 and 2018.

TMS was identified as a useful marker compound based on the previous groundwater assessments, but the surface water data review indicates that TMS is not widely recorded across the Dow SPMP surface water sampling locations for 2017-2018.

MST and DMSD concentrations are consistently higher in the Timber Pond, compared to the Cadoxton Ponds, but for silicic acid the pattern is reversed with higher concentration reported in the Cadoxton Ponds (although the dataset is currently limited to a small number of sampling events).

2.3 Benzene, Toluene, Ethylbenzene & Xylenes (BTEX)

All available results for the period Q4-2007 to Q3-2017 were reported as less than the Method Detection Limit (<MDL) for the surface water sampled.

2.4 Inorganics

Table 2.3 presents a summary of results for selected inorganic determinands in surface waters, for the period 2015 – 2017.

Table 2.3 - Inorganics in Surface Waters

Monitoring Round	Location	COD	Chloride (ppm)	Total Alkalinity	Alkalinity (as Carbonates)	pH	Sulphates	Hardness (mg equ. CaCO ₃ /L)
2015-Q1	Timber Pond	108	120	82	<MDL	7.8	<MDL	1,368
	Cadoxton Pond N	30	483	208	<MDL	8.07	<MDL	605
	Cadoxton Pond S	22	211	258	<MDL	8.07	<MDL	370
	South Pond	103	647	95	<MDL	7.66	<MDL	792
	Cadoxton River SW2	36	31	272	<MDL	7.98	<MDL	298
	Cadoxton River SW3	40	429	272	<MDL	7.95	<MDL	781
2015-Q3	Timber Pond	84	118	86	<MDL	6.89	<MDL	1,403
	Cadoxton Pond N	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
	Cadoxton Pond S	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
	South Pond	<MDL	<MDL	90	<MDL	<MDL	<MDL	781
	Cadoxton River SW2	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
	Cadoxton River SW3	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
2016-Q1	Timber Pond	<MDL	ND	84	<MDL	7.78	<MDL	1,052
	Cadoxton Pond N	26	ND	188	<MDL	8.42	<MDL	410
	Cadoxton Pond S	25	ND	214	<MDL	8.64	<MDL	400
	South Pond	45	ND	98	<MDL	8.1	<MDL	608
	Cadoxton River SW2	16	40	280	<MDL	8.18	<MDL	274
	Cadoxton River SW3	35	388	252	<MDL	8.1	<MDL	660
2016-Q3	Timber Pond	75	187	78	<MDL	7.24	<MDL	1,129
	Cadoxton Pond N	30	83	176	<MDL	8.03	<MDL	<MDL
	Cadoxton Pond S	31	327	234	<MDL	7.93	<MDL	<MDL
	South Pond	93	285	78	<MDL	7.32	<MDL	713
	Cadoxton River SW2	18	21	195	<MDL	7.98	<MDL	<MDL
	Cadoxton	76	473	174	<MDL	7.77	<MDL	<MDL

Monitoring Round	Location	COD	Chloride (ppm)	Total Alkalinity	Alkalinity (as Carbonates)	pH	Sulphates	Hardness (mg equ. CaCO ₃ /L)
River SW3								
2017-Q1	Timber Pond	69	77	98	<MDL	7.67	<MDL	792
	Cadoxton Pond N	29	230	195	22	8.17	<MDL	252
	Cadoxton Pond S	25	211	249	<MDL	8.06	<MDL	274
	South Pond	38	420	106	<MDL	7.99	<MDL	428
	Cadoxton River SW2	17	29	253	<MDL	7.97	<MDL	214
	Cadoxton River SW3	32	29	243	<MDL	8.2	<MDL	449
2017-Q3	Timber Pond	88	92	73	<MDL	7.06	<MDL	1,023
	Cadoxton Pond N	32	286	238	<MDL	8.21	<MDL	331
	Cadoxton Pond S	33	362	188	<MDL	7.99	<MDL	327
	South Pond	38	231	73	<MDL	7.56	<MDL	543
	Cadoxton River SW2	<MDL	24	220	<MDL	8.16	<MDL	245
	Cadoxton River SW3	80	125	161	<MDL	7.91	44	1,649

Note: All results in mg/L.
Bold exceeds EQS value
 <MDL – Less than the Method Detection Limit.

The inorganic water quality data exhibits some variability, particularly with the pattern of non-detects / < limit of detection reports between the various monitoring rounds.

The two Cadoxton Ponds show very similar water quality data. There are some variations in maximum reported concentrations between Cadoxton North Pond and Cadoxton South Pond, especially for chloride and hardness, but the average values are closely grouped across all of the inorganic determinands.

Inorganic water quality in the Timber Pond shows some significant differences compared to the Cadoxton Ponds. Chemical Oxygen Demand (COD) and calcium carbonate hardness are consistently higher in the Timber Pond compared to the Cadoxton Ponds. Minimum, mean and maximum COD figures are 69, 84.8 and 108 mg/L for the Timber Pond, compared with 26, 29.4 and 32 mg/L for Cadoxton North Pond and 22, 27.2 and 33 mg/L for Cadoxton South Pond. Likewise, the minimum, mean and maximum calcium carbonate hardness concentrations are 792, 1128 and 1403 mg/L for the Timber Pond, compared with 252, 399 and 605 mg/L for Cadoxton North Pond and 274, 343 and 400 mg/L for Cadoxton South Pond.

The chloride concentrations provide an unexpected finding, especially given the concerns expressed by the wildlife trust that the Timber Pond water might be brackish, based on the former timber pond / dock basin being an isolated enclosure from Barry Docks. Chloride concentrations recorded in the Timber Pond are generally lower than for the Cadoxton Ponds.

Minimum, mean and maximum chloride concentrations are 77, 119 and 187 mg/L for the Timber Pond, compared with 83, 270 and 483 mg/L for Cadoxton North Pond and 211, 229 and 258 mg/L for Cadoxton South Pond. The Cadoxton Ponds are close to or marginally exceed the non-statutory chloride EQS values of 250mg/L, whereas the data for the Timber Pond show that chloride concentrations are consistently less than the EQS value.

2.5 SPMP Data Review Summary

Based on the review of the Dow SPMP data, the water quality conditions in the Timber Pond are broadly similar to the Cadoxton Ponds, in that neither shows significant signs of contamination which would prevent the connection of the two sets of water bodies.

There are some detail differences in the distribution and concentration data for specific contaminant species.

In particular, copper concentrations are higher in the Timber Pond than in the Cadoxton Ponds, although all locations exceed the bioavailable EQS value of 1 µg/L and no locations exceed the M-BAT based PNEC values previously established for the Cadoxton Ponds.

Conversely, chloride concentrations within the Cadoxton Ponds appear to marginally exceed the non-statutory chloride EQS value, whereas chloride concentrations in the Timber Pond do not.

Silanol species have been detected across the pond network, although the distribution of species varies between ponds and no EQS values have been established.

Based on the Dow SPMP data, installing a connection between the ponds appears unlikely to provide a pathway for the flushing of contaminants from the Timber Pond to the Cadoxton Ponds. Note however, that this is based on samples collected from the surface layers of the ponds and takes no account of any water quality stratification that may have occurred within the Timber Pond. Water quality stratification is assessed in Section 3.

3. AECOM Stratified Water Quality Survey

3.1 Methodology

AECOM first attended the site on 13 August 2018 to complete a site walkover to assess safe access to the Timber Pond and to identify suitable sample locations. AECOM engineers returned to the site on 6 September 2018 to undertake the stratified surface water sampling at two locations from the Timber Pond.

These sampling points were located in the area between the railway line and the landfill fence. TP21 was located off of the railway bridge and TP22 was located off of a concrete jetty into the Timber Pond, north of TP21. A plan showing the locations of these sampling points is included as **Figure 1**.

The sampling locations were accessed through a gate west of the sampling locations where the railway line crosses the road. For safety reasons, sampling work was timed to avoid trains running along this line, and high visibility clothing was worn during work. Life jackets were worn by staff during sampling, and when sampling location TP22 off of the jetty, one AECOM engineer remained on the railway bridge with a throw line.

Samples were collected using a peristaltic pump and dedicated LDPE tubing, to allow sample collection from specified depths. The tubing was lowered to the correct depth using rigid HDPE tubing marked with the required sampling intervals. Field parameters including water temperature, pH, conductivity, dissolved oxygen and oxidation/reduction potential (ORP or Redox) were monitored and recorded from two depths (0.5m and 2.0m) at each location.

A total of nine surface water samples were collected from two locations (see **Figure 1**). Five surface water samples were collected from TP21 at depths of 0.2m, 1.0m, 2.0m, 3.0m and 4.0m. Four samples were collected from TP22 from depths of 0.2m, 1.0m, 2.0m and 3.0m.

For each of these nine samples, an additional two bottles were filled and returned to Dow on the day of sampling for analysis of Dow specific determinands (silanol species). The remainder of the samples were collected in laboratory supplied containers, labelled and stored in temperature-controlled conditions for transfer to the analytical laboratory.

Excepting the bottles returned to Dow, all of the remaining bottles for each of the nine samples were submitted for analysis at the laboratory ALS Hawarden and were analysed for the following:

- Total Petroleum Hydrocarbons (TPH)
- Benzene, Toluene, Ethyl benzene and Xylenes (BTEX)
- Oxygenates - Methyl Tertiary-Butyl Ether (MTBE) and Tert Amyl Methyl Ether (TAME)
- Volatile Organic Compounds (VOCs) including Chlorinated Hydrocarbons, Halogenated Benzenes, Hydrocarbons and Phenols and Solvents (Carbon Disulphide and Isophorone)
- Semi Volatile Organic Compounds (SVOCs) including Phthalates
- Polycyclic Aromatic Hydrocarbons (PAHs)
- Phenols
- Anilines
- Metals (filtered) – arsenic, barium, beryllium, boron, cadmium, chromium, copper, iron, lead, nickel, mercury, selenium, vanadium and zinc
- Total Organic Carbon (TOC)
- Inorganics - total alkalinity, bicarbonate alkalinity and acidity, ammoniacal nitrogen, nitrate, nitrite, phosphate, chloride, bromide, sulphate (soluble), sulphide, biological oxygen demand (BOD) and chemical oxygen demand (COD), total suspended solids, pH, calcium, magnesium, potassium and sodium

Dow Silicones undertook analysis on all samples for silanols which included trimethylsilanol (TMS), dimethylsilanediol (DMSD), methylsilanetriol (MST) and silicic acid.

3.2 Findings (factual results)

The following sections present a summary of the results of laboratory analysis completed on the surface water samples collected from the Timber Pond. Laboratory analytical results are presented in **Appendix C**.

Certificates of analysis (including mCERTS and ISO17025 accreditation) are presented in **Appendix D**.

A graphical representation of marker analytes at each sample location can be found in in section 3.12 below.

3.3 Metals

Table 3.1 summarises the detected concentrations of metals in surface water samples taken from the Timber Pond. For clarity, the concentrations of analytes that were below the method detection limit (MDL) are not reported in Table 3.1.

A full table of results can be found in **Appendix C**.

Table 3.1 - Summary of Detected Metals – Timber Pond depth sampling

Analyte	Number of samples above MDL	Minimum Detection (µg/l)	Maximum Detection (µg/l)	Number of EQS GAC Exceedances	Location of Maximum Concentration	Depth of Maximum Concentration
Arsenic	9	2.37	11.3	0	TP21	4.0m
Barium	9	302	1,420	N/A	TP21	4.0m
Boron	9	185	357	0	TP21	4.0m
Copper	6	0.304	1.32	3	TP22	1.0m
Iron	9	24	166,000	3	TP21	4.0m
Nickel	9	0.431	2.01	0	TP21	4.0m
Zinc	8	1	3.32	0	TP21	4.0m

Note: All results in µg/L.
EQS exceedances in **bold**.

The collection of water quality samples from multiple depths within the Timber Pond water column has identified that metals are generally detected at higher concentrations with an increasing depth, with the exception of copper and zinc. The maximum concentrations of arsenic, barium, boron, iron and nickel were all from the 4m deep samples, believed to be at / close to the base of the Timber Pond.

Copper was detected at higher concentrations in the top one metre of the pond and was not detected in samples below 2m depth, as shown in Figure 3.1.

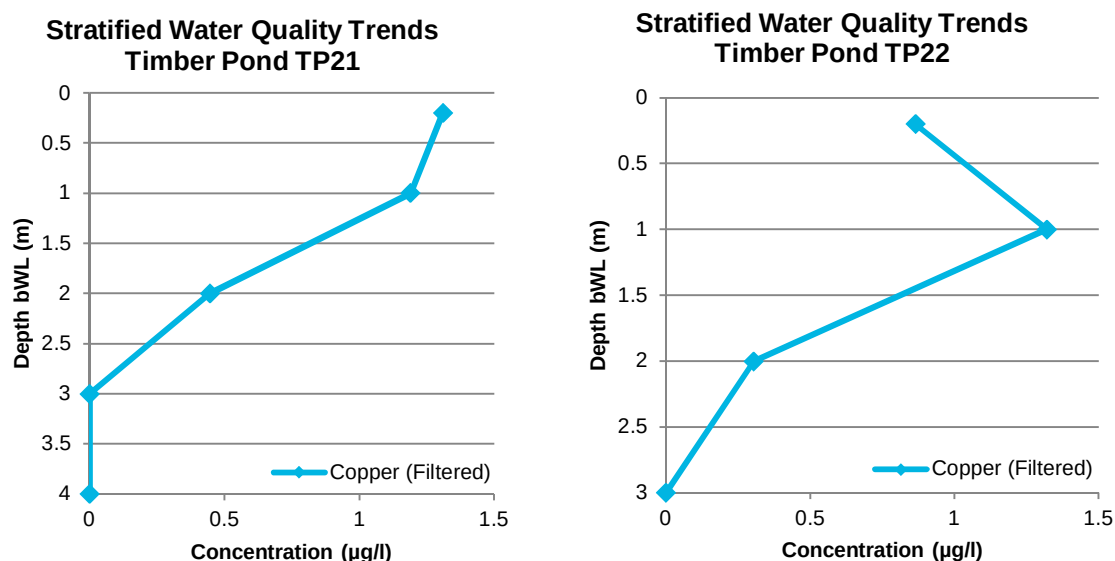


Figure 3.1 – Stratified Water Quality Trends for Copper, Timber Pond, 6th September 2018.

Copper was found to marginally exceed the bioavailable EQS of 1.0µg/l within the top metre of the Timber Pond only (EQS derived from the water framework directive 2015 freshwater standards). Copper was not detected at concentrations above of the previously calculated Cadoxton Ponds PNEC values of 31.89µg/L / 39.43µg/L

Zinc was found to be less consistent, reporting no apparent trend in concentration in samples collected from TP21. Concentrations of zinc in samples collected from TP22 appear to decrease with depth.

3.4 Silanols

Table 3.2 summarises the detected concentrations of silanols in nine surface water samples taken from the Timber Pond.

For clarity, the concentrations of analytes that were reported as below the method detection limit (MDL) are not shown. A full table of results can be found in **Appendix C**.

Table 3.2 - Summary of Detected Silanols – Timber Pond depth sampling

Analyte	Number of samples above MDL	Minimum Detection (mg/l)	Maximum Detection (mg/l)	Number of EQS GAC Exceedances	Location of Maximum Concentration	Depth of Maximum Concentration
MST	9	32.2	108	N/A	TP22	3.0m
DMSD	9	19.4	81	N/A	TP22	3.0m
Silicic acid	9	1.2	12.1	N/A	TP22	3.0m
TMS	5	0.5	1.4	N/A	TP22	3.0m

Note: All results in mg/L.
No EQS values available

DMSD, MST and silicic acid were detected in all samples from both locations.

The concentrations of each analyte were generally seen to increase with depth. The highest concentrations from TP21 were seen at 3m below surface level with a slight decrease noted for each analyte at 4m. The highest concentrations from TP22 were also seen at 3m below surface level however a 4m sample was not collected.

TMS was not detected in the first metre at either location. Concentrations of TMS were then noted to increase with depth in samples collected from both locations.

Depth / concentration trends are shown for MST and DMSD on Figure 3.2 and for TMS and silicic acid on Figure 3.3.

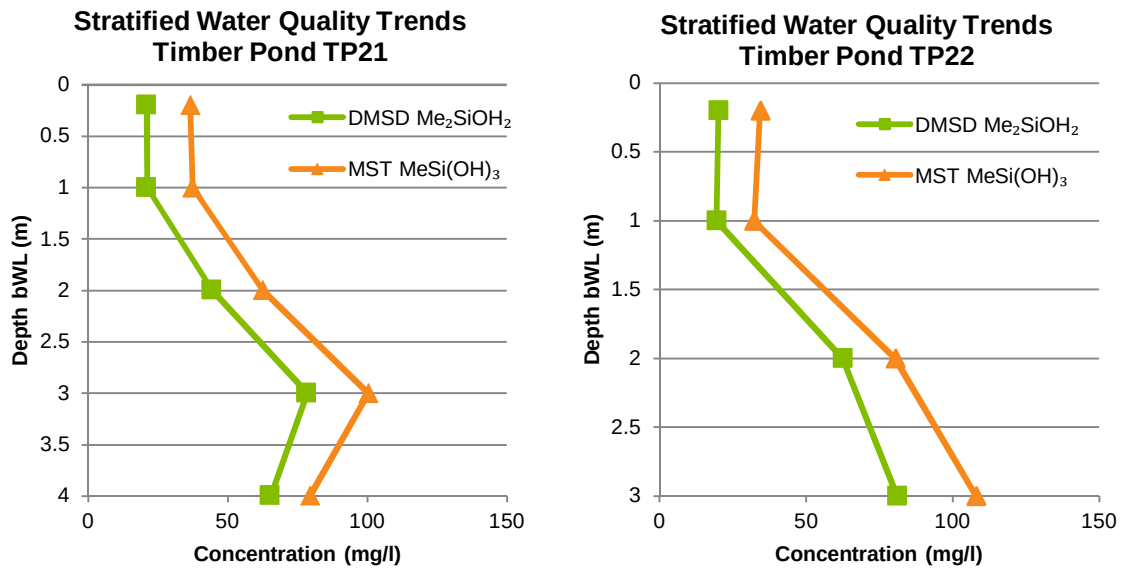


Figure 3.2 – Stratified Water Quality Trends for DMSD and MST, Timber Pond, 6th September 2018.

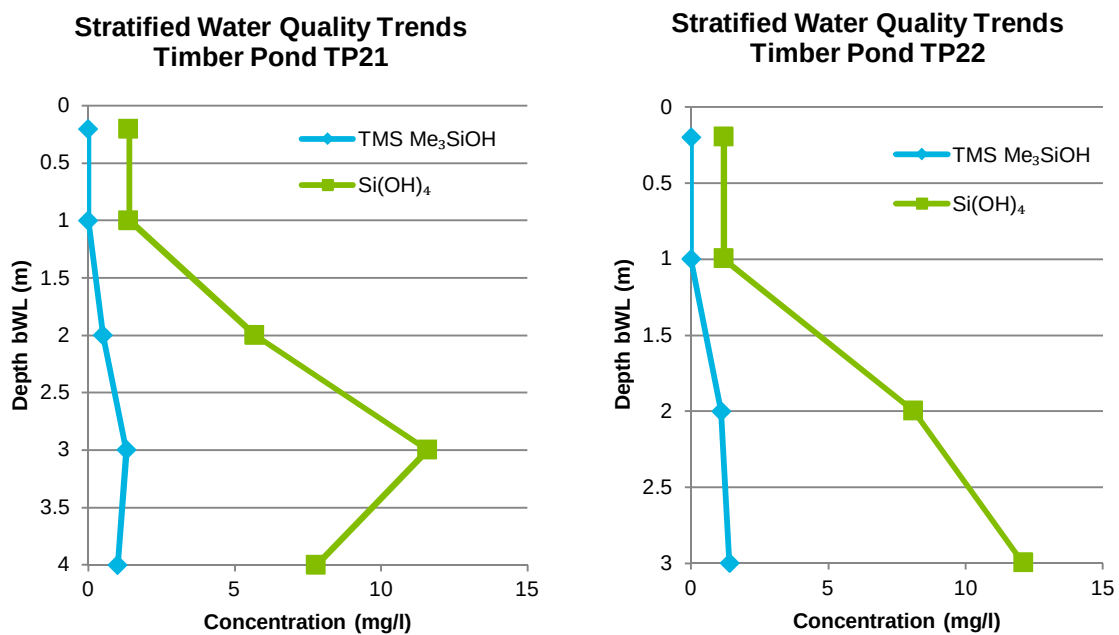


Figure 3.3 – Stratified Water Quality Trends for TMS and silicic acid, Timber Pond, 6th September 2018.

3.5 Benzene, Toluene, Ethylbenzene and Xylene Compounds

Table 3.3 summarises the detected concentrations of benzene, toluene, ethylbenzene and xylene (BTEX) compounds in surface water samples taken from the Timber Pond.

Concentrations of analytes that were below the method detection limit (MDL) are not reported in Table 3.3. A full table of results can be found in **Appendix C**.

Table 3.3 - Summary of Detected BTEX

Analyte	Number of samples above MDL	Minimum Detection (µg/l)	Maximum Detection (µg/l)	Number of EQS GAC Exceedances	Location of Maximum Concentration	Depth of Maximum Concentration
Benzene	3	1.44	13.6	1	TP21	4.0m
Toluene	3	1.24	2.27	0	TP21	4.0m
Ethylbenzene	1	1.45	1.45	0	TP21	4.0m
Xylene	3	3.54	5.90	0	TP21	4.0m

Note: All results in µg/L.
EQS exceedances in **bold**.

Benzene, toluene, ethylbenzene and xylene were not detected in the first 2m bWL (below water level) at either location.

All BTEX compound detections, with the exception of ethylbenzene were detected above the MDL in the samples collected from 3m bWL. All BTEX were detected in the sample collected from 4m bWL at TP21.

The recorded concentration of benzene exceeded the EQS GAC in the 4.0m sample from TP21. No other GAC exceedances were reported for BTEX compounds.

Depth / concentration trends for are shown on Figure 3.4 with other selected organic contaminants

3.6 Total Petroleum Hydrocarbons

Table 3.4 summarises the detected concentrations of TPH in surface water samples taken from the Timber Pond. Concentrations of analytes that were below the method detection limit (MDL) are not reported in Table 3.4. A full table of results can be found in **Appendix C**.

Table 3.4 - Summary of Detected TPH

Analyte	Number of samples above MDL	Minimum Detection (µg/l)	Maximum Detection (µg/l)	Number of EQS GAC Exceedances	Location of Maximum Concentration	Depth of Maximum Concentration
>C5-C6 Aliphatics	5	161	506	0	TP22	3.0m
>C6-C8 Aliphatics	5	72	235	0	TP22	3.0m
>C8-C10 Aliphatics	5	53	164	0	TP22	3.0m
>C10-C12 Aliphatics	5	15	131	0	TP21	4.0m
>C12-C16 Aliphatics	1	11	11	0	TP21	4.0m
>C16-C21 Aliphatics	1	12	12	0	TP21	4.0m
>C16-C35 Aliphatics	1	12	12	0	TP21	4.0m
>C5-C7 Aromatics	1	11	11	1	TP21	4.0m
>C8-C10 Aromatics	5	36	117	0	TP22	3.0m
>C10-C12 Aromatics	5	10	87	0	TP21	4.0m
>C12-C16 Aromatics	2	28	148	0	TP21	4.0m

Analyte	Number of samples above MDL	Minimum Detection (µg/l)	Maximum Detection (µg/l)	Number of EQS GAC Exceedances	Location of Maximum Concentration	Depth of Maximum Concentration
>C16-C21 Aromatics	1	31	31	0	TP21	4.0m
>C12-C35 Aromatics	2	28	179	0	TP21	4.0m

Note: All results in µg/L.
EQS exceedances in **bold**.

TPH was not detected in the first metre below the water level. Primarily only lower molecular weight aromatic and aliphatic fractions (<C12) were detected in samples collected from 3.0m bWL with most tested TPH fractions being detected in the sample collected from 4.0m bWL at TP21.

Only TPH >C5-C7 Aromatics exceeded the EQS GAC of 10 µg/L, corresponding with the occurrence of benzene exceedance discussed in section 4.3 above.

Depth / concentration trends for are shown on Figure 3.4 with other selected organic contaminants

3.7 Semi-Volatile Organic Compounds including Polycyclic Aromatic Hydrocarbons

Table 3.5 summarises the detected concentrations of semi-volatile organic compounds (SVOC) in surface water samples taken from the Timber Pond. Analytical data include polycyclic aromatic hydrocarbons (PAH).

Concentrations of analytes that were below the method detection limit (MDL) are not reported in Table 3.5. A full table of results can be found in **Appendix C**.

Table 3.5 - Summary of Detected SVOCs

Analyte	Number of samples above MDL	Minimum Detection (µg/l)	Maximum Detection (µg/l)	Number of EQS GAC Exceedances	Location of Maximum Concentration	Depth of Maximum Concentration
Naphthalene	1	137	137	1	TP21	4.0m
Acenaphthene	1	5.64	5.64	0	TP21	4.0m
Fluorene	1	3.56	3.56	0	TP21	4.0m
Phenanthrene	1	2.5	2.5	0	TP21	4.0m
2-methylnaphthalene	1	5.03	5.03	0	TP21	4.0m
Carbazole	1	5.14	5.14	0	TP21	4.0m
Dibenzofuran	1	3.13	3.13	0	TP21	4.0m

Note: All results in µg/L.
EQS exceedances in **bold**.

SVOCs were only detected in the 4.0m bWL sample collected from TP21.

Seven compounds were detected above the MDL including naphthalene which exceeded the EQS GAC of 2 µg/L. The other detected analytes are acenaphthene, fluorene, phenanthrene, 2-methylnaphthalene, carbazole and dibenzofuran, for which EQS GAC are not available.

Depth / concentration trends for are shown on Figure 3.4 with other selected organic contaminants

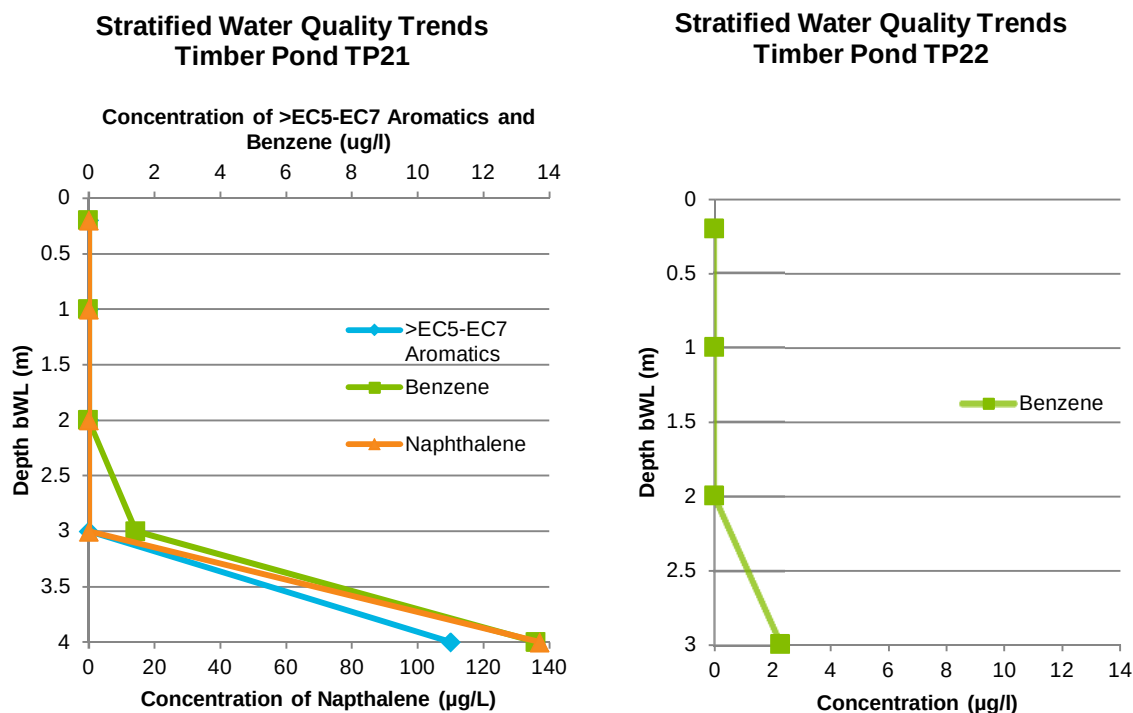


**Figure 3.4 – Stratified Water Quality Trends for selected organic compounds
Timber Pond, 6th September 2018.**

3.8 Volatile Organic Compounds including Chlorinated Hydrocarbons

Table 3.6 summarises the detected concentrations of volatile organic compounds (VOC) in surface water samples taken from the Timber Pond. Concentrations of analytes that were below the method detection limit (MDL) are not reported in Table 3.6.

A full table of results can be found in **Appendix C**.

Table 3.6 - Summary of Detected VOCs

Analyte	Number of samples above MDL	Minimum Detection (ug/l)	Maximum Detection (ug/l)	Number of EQS GAC Exceedances	Location of Maximum Concentration	Depth of Maximum Concentration
1,3,5-trimethylbenzene	3	1.2	1.82	0	TP22 4.0m	TP22 4.0m
1,2,4-trimethylbenzene	3	2.74	4.07	0	TP22 4.0m	TP22 4.0m
Chloroethane	4	1.08	2.07	0	TP22 3.0m	TP22 3.0m

Note: All results in ug/L.
EQS exceedances in **bold**.

Two VOCs, 1,3,5-trimethylbenzene and 1,2,4-trimethylbenzene, were detected above the method detection limit in samples collected from 3.0m bWL at both locations and at 4.0m bWL from TP21.

Chloroethane was recorded in the 3.0m and 4.0m bWL samples collected from TP21 and the 2.0m and 3.0m bWL samples collected from TP22. The highest concentrations of chloroethane at each location were recorded in the samples collected from 3.0m bWL.

No other VOCs were detected above the MDL.

3.9 Phenols

Table 3.7 summarises the detected concentrations of phenols in surface water samples taken from the Timber Pond. Concentrations of analytes that were below the method detection limit (MDL) are not reported in Table 3.7.

A full table of results can be found in **Appendix C**.

Table 3.7 - Summary of Detected Phenols

Analyte	Number of samples above MDL	Minimum Detection (µg/l)	Maximum Detection (µg/l)	Number of EQS GAC Exceedances	Location of Maximum Concentration	Depth of Maximum Concentration
2,4-dimethylphenol	2	2.47	24.9	0	TP21	4.0m

Note: All results in µg/L.
EQS not available.

2,4-dimethylphenol was reported above the MDL in TP21 at 4.0m bWL and TP22 at 3.0m bWL. No other phenols were reported above the MDL.

3.10 Inorganics

Table 3.8 summarises the detected concentrations of inorganics in surface water samples taken from the Timber Pond. Concentrations of analytes that were below the method detection limit (MDL) are not reported in Table 3.8.

A full table of results can be found in **Appendix C**.

Table 3.8 - Summary of Detected Inorganics

Analyte	Number of samples above MDL	Minimum Detection (mg/l)	Maximum Detection (mg/l)	Number of EQS GAC Exceedances	Location of Maximum Concentration	Depth of Maximum Concentration
Acidity	8	5.48	106	0	TP21	4.0m
BOD	4	2.33	11.4	0	TP22	2.0m
Sodium	9	63.3	110	0	TP21	4.0m
Bromide	4	0.355	0.912	0	TP21	4.0m
Chloride	9	855	4,480	9	TP21	4.0m
Sulphide	3	0.0548	0.155	0	TP21	3.0m
Alkalinity (total) as CaCO ₃	9	57.6	90.8	0	TP21	4.0m
Alkalinity (bicarbonate as CaCO ₃)	9	57.6	90.8	0	TP21	4.0m
Ammoniacal Nitrogen	3	3.1	21	0	TP21	4.0m
Sulphate	8	4.2	6.7	0	TP22	1.0m
COD	9	97.8	415	0	TP22	3.0m
pH (lab) – reported in pH units	9	6.18	7.56	0	TP22	2.0m
Total Suspended Solids	7	3.6	233	0	TP21	4.0m
Calcium	9	417	2,280	N/A	TP21	4.0m

Magnesium	9	16	35.6	0	TP21	4.0m
Potassium	9	12.6	20.9	N/A	TP21	4.0m

Note: All results in mg/L.
EQS exceedances in **bold**.

Chloride was reported above the freshwater EQS GAC of 250 mg/L at all locations / depths. Concentrations of chloride are seen to increase with depth in samples from both locations, as shown in Figure 3.5.

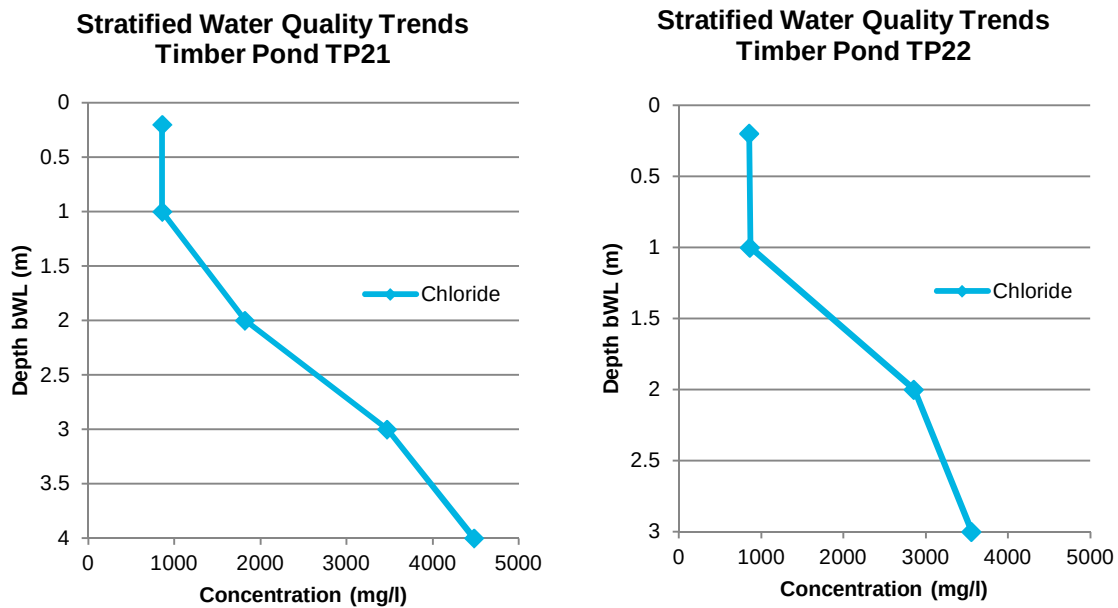


Figure 3.5 – Stratified Water Quality Trends for chloride, Timber Pond, 6th September 2018.

Sodium, calcium, magnesium and potassium concentrations follow the same trend as chloride with higher concentrations found at depth.

Bromide results are not consistent with chloride, sodium, calcium, magnesium and potassium and do not show a clear trend.

The recorded maximum and minimum concentrations of chloride given in Table 3.8 are >1 order of magnitude larger than those reported for sodium, possibly suggesting that a residual brackish water component (from the original docks basin / tidal water) may not fully explain the observed chloride concentrations and water quality stratification.

4. Water Quality Review Summary

This report aims to investigate the existing surface water quality of the Timber Pond, to determine the suitability of the proposed over flow system between the Timber Pond and the Cadoxton Ponds. A water quality summary for both the Timber Pond and the Cadoxton Ponds can be found below.

4.1 Timber Pond Water Quality Summary

AECOM has reviewed Dow SPMP surface monitoring data for the Timber Pond and Cadoxton Ponds, as well as a single round of depth sampling to obtain spot water quality data to assess water quality stratification within the Timber Pond.

Both data sets useful for the assessment of the Timber Pond water quality and assessment of the likelihood of causing pollution of the Cadoxton Ponds by providing a drainage link.

The depth sampling clearly indicates that there is some stratification within the circa 4m deep Timber Pond, and the observed stratification accounts for some of the differences between the AECOM and Dow data sets (Dow samples are collected at the water surface).

The water quality at surface or near surface is likely to be the most important indicator for assessing the suitability of a drainage connection. A new outlet headwall is proposed at the northern corner of the Timber Pond, providing a drainage pathway between the Timber Pond and the Cadoxton Ponds.

The evidence from the depth sampling suggests limited mixing between the upper 1m of the pond water and the lower 3-4m, with the upper and lower layers exhibiting clear differences in water quality. As the new outlet headwall takes flow from the Timber Pond surface layer, AECOM expects that the existing Dow water surface data and AECOM 1m depth data provide the most likely indication of drainage quality and potential downstream impact when the ponds are connected.

The additional catchment area provided by the proposed landfill cap will increase the volume of clean water flows through the Timber Pond. These additional water flows are expected to further improve the water quality within the upper 1m layer, providing storm run-off flows do not promote water mixing with the lower water layers of the Timber Pond.

Table 4.1 presents the contaminants of Potential Concern (COPC) identified for the Timber Pond and the proposed connection to the Cadoxton Ponds.

Table 4.1 – Timber Pond COPC, based on Dow surface water and AECOM depth sampling data

Analyte	Comments and significance
<i>COPC - upper pond layer (could be conveyed by drainage connection)</i>	
Copper. (>EQS)	Copper concentrations in the Timber Pond vary between <1µg/L and 18.7µg/L. Data indicates that copper is present above EQS value in the upper 1m of the Timber Pond water body. Copper would therefore be expected to be present in the transfer drainage between the Timber Pond and Cadoxton Ponds. Timber Pond copper concentrations exceed the bioavailable EQS value of 1µg/L (Cadoxton Pond copper concentrations also exceed the EQS value). No Timber Pond samples exceed the Cadoxton Ponds PNEC values of 31.89µg/L and 39.43µg/L. Copper concentrations decrease with depth and are <EQS for samples below 1m depth and <MDL below 2m depth
Chloride (>EQS*)	AECOM data indicates that chloride exceeds non-statutory EQS value in upper 1m layer. *Dow data reports lower values <EQS, potentially due to surface sample collection influenced by rainfall. Concentrations increase with depth: from 855 mg/L at 1.0m, to 4,480mg/l at 4.0m. Non-statutory EQS value is 250mg/L.
MST (No EQS)	No EQS available Present in surface / upper layer of Timber Pond at higher concentrations than Cadoxton Ponds Concentrations increase with depth

DMSD (No EQS)	No EQS available Present in surface / upper layer of Timber Pond at higher concentrations than Cadoxton Ponds Concentrations increase with depth
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COPC - lower pond layers (unlikely to be conveyed by drainage connection unless mixed with surface layer)

Chloride (>EQS)	AECOM data indicates that chloride exceeds non-statutory EQS value of 250 mg/L for all depth samples. Concentrations increase with depth: from 855 mg/L at 1.0m, to 4,480mg/l at 4.0m. Higher concentrations from deeper layers unlikely to be conveyed by drainage connection unless mixed with upper water body layers, which would provide dilution Non-statutory EQS value is 250mg/L
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Iron (>EQS)	Highest concentrations recorded at deepest sampling depths Higher concentrations from deeper layers unlikely to be conveyed by drainage connection unless mixed with upper water body layers, which would provide dilution
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MST (No EQS)	No EQS available Concentrations increase with depth Higher concentrations from deeper layers unlikely to be conveyed by drainage connection unless mixed with upper water body layers, which would provide dilution
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DMSD (No EQS)	No EQS available Concentrations increase with depth Higher concentrations from deeper layers unlikely to be conveyed by drainage connection unless mixed with upper water body layers, which would provide dilution
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Silicic acid (No EQS)	No EQS available Concentrations increase with depth, but remain similar or lower than Cadoxton Pond silicic acid concentrations Higher concentrations from deeper layers unlikely to be conveyed by drainage connection unless mixed with upper water body layers, which would provide dilution
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Benzene / TPH EC5-EC8 (>EQS)	Benzene and aromatic TPH EC5-EC7 detections considered to be the same result Detected at one location only, which exceeds EQS value Detected at deepest sample only (4m depth) High concentration from pond base is unlikely to be conveyed by drainage connection unless mixed with upper water body layers, which would provide dilution
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Naphthalene (>EQS)	Detected at one location only, which exceeds EQS value Detected at deepest sample only (4m depth) High concentration from pond base is unlikely to be conveyed by drainage connection unless mixed with upper water body layers, which would provide dilution
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Chloroethane (No EQS)	Detected in four samples. All four detections exceed EQS value Highest concentrations recorded for deepest samples No chloroethane detected above 2.0m Higher concentrations from deeper layers unlikely to be conveyed by drainage connection unless mixed with upper water body layers, which would provide dilution
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4.2 Cadoxton Pond Water Quality Summary

The 2017 monitoring rounds assessed samples from the Cadoxton Ponds for BTEX, metals, silanols and inorganics. Data from the 2018 quarter 1 monitoring round has been provided for silanols only. Of the 2017 results, only some metals were found in excess of the Freshwater EQS GAC. Some exceedances of the EQS were reported for aluminium, cadmium, copper, lead, manganese, mercury and zinc from both the Cadoxton North and South Ponds.

Silanols were assessed in the 2017 Quarter 3 monitoring round in Cadoxton Pond North and in both the Cadoxton North and South Ponds in Quarter 1 2018. MST, DMSD and silicic acid were detected in all samples. An increase in concentrations was noted at the Cadoxton North Pond between quarter 3 2017 and quarter 1 2018. TMS was only detected in the Cadoxton South Pond (Q1 2018).

4.3 Water quality comparison

For the proposed development to be successful, water in both water bodies will need to be of similar quality to avoid the transport of any potential contamination from the Timber Pond to the Cadoxton Ponds. As described in Section 3, there is a clear trend for increased concentrations of the marker analytes with depth. Samples collected from the top metre of the Timber Pond appear to be within the same order of magnitude to recent (2017 and 2018) water quality samples from the Cadoxton Ponds with the exception of chloride, sulphate and silanol concentrations.

Chloride levels are approximately 2-4 times greater in the first metre of the Timber Pond than in the Cadoxton Ponds. MST concentrations in the Timber Ponds are up to over two times higher than the levels in the Cadoxton North Pond and over five times greater than those found in the Cadoxton South Pond (TP21 1.0m sample compared to 2018 Quarter 1 results). DMSD was found to be between 1.5 and almost 4 times higher in samples collected from the Timber Pond (TP21 1.0m) and the latest Cadoxton Pond results. Sulphate was not detected in the 2017 data collected from the Cadoxton Ponds but was reported at a maximum of 6.7mg/l in the Timber Pond.

It was not possible to compare results for calcium, nickel, potassium or sodium as they were not reported for the Cadoxton Ponds.

5. Conceptual Model for Landfill – Timber Pond Boundary

5.1 Conceptual Model – Existing Conditions

The full conceptual model for the existing landfill conditions is presented in Section 5 of the 2018 Landfill Closure Report.

The existing conceptual model for the landfill is illustrated on the relevant conceptual model figures from the Landfill Closure Report, which are included as **Appendix E** and summarised below:

- Wastes were progressively deposited in a former Barry Docks basin / timber pond.
- No engineered basal or side slope containment was provided for the waste mass (consistent with contemporary regulatory requirements). The base of the deposited wastes is therefore understood to be at / close to the base of the former docks basin / timber pond.
- A remaining body of water known as the “Timber Pond” is adjacent to the western boundary of the landfill. The Timber Pond is separated from the waste mass by a perimeter bund of unknown construction and material. The bund is not understood to provide any hydraulic containment.
- The circa 4m deep Timber Pond is believed to extend to a similar depth as the base of the adjacent waste mass, consistent with the original dock basin / timber pond having a continuous base prior to infilling. Based on a pond footprint of 18,380m² and an assumed depth of 4m, the pond volume is estimated as approximately 73,520m³. However, pond water levels are known to vary between 7.05 and 7.35mAOD, representing approximately 5,500m³ of additional storage (1,838m³/100mm freeboard).
- The pond and the waste mass are both believed to be in contact with permeable alluvial sand strata unit.
- The landfill is uncapped, with a largely level and planar top surface and no provision for gravity drainage. Incident rainfall accumulates on the landfill surface causing localised ponding. Perimeter bunds prevent direct run-off of contaminated water to the Timber Pond. Or other surface water receptors. When surface water management is necessary, Dow are able to pump excess surface water to the site effluent treatment system.
- Groundwater level data and water quality data from the waste mass / landfill perimeter indicates that surface water infiltration occurs into the waste mass and that vertical downward migration and leaching of contaminants occurs.
- Deeper wells within the waste and perimeter bunds indicate seasonally higher piezometric pressures towards the base of the waste mass. These data are interpreted as vertical groundwater recharge from the alluvial sand unit and / or deep lateral recharge from the Timber Pond, driven by the 4-5m hydrostatic head of water within the Timber Pond. Water / leachate flows across the Timber pond / landfill boundary are expected to vary seasonally and with depth / head pressure.
- There are no known surface water inflows or outflows to / from the Timber Pond. Timber Pond water levels therefore fluctuate as the equilibrium between rainfall derived inflows and evaporation and groundwater recharge outflows changes. Groundwater / leachate flows across the Timber pond / landfill boundary are expected to vary as the head of water within the pond and groundwater head within the landfill vary.
- The current surface water quality data review and water quality depth sampling has identified modest concentrations of COPC within the Timber Pond. Stratification of the pond water quality has been recorded, with generally increasing concentrations of COPC with increasing depth.
- Ecological eDNA sampling has identified six species of freshwater fish within the Timber Pond, compared to six species in Cadoxton North Pond and eight species in Cadoxton South Pond, suggesting no / limited biodiversity impairment within the Timber Pond:
 - Timber Pond - carp, dace, perch, roach, rudd, three-spined stickleback.

- o Cadoxton North Pond - carp, bream, eel, perch, roach, rudd.
- o Cadoxton South Pond - carp, bream, dace, eel, pike, perch, roach, rudd.
- o Cadoxton Remnant Pond - eel, nine-spined stickleback, three-spined stickleback.

5.2 Conceptual Model – Proposed Restoration Capping

The proposed landfill restoration capping is intended to reduce rainfall infiltration into the waste mass and therefore reduce contaminant leaching and transport to surface water receptors.

The design and construction of the cap will directly reduce rainfall infiltration through the provision of a modest drainage gradient across the re-profiled and restored surface and through the installation of a low permeability capping layer. These features will create a new, segregated clean water drainage flow, derived from the cap surface water run-off.

The low elevation differences across site and to receiving surface waters has dictated that the restored landfill surface drains to the adjacent Timber Pond and then via a new drainage pipeline to an attenuation wetland in the Nature Area, the Cadoxton Ponds, and with final pumping to Barry Docks.

Construction of these features will revise the conceptual model for the Landfill / Timber Pond boundary, as discussed below.

- The low permeability landfill capping will reduce rainfall infiltration to the waste mass to circa 100mm/annum and provide a greatly extended Timber Pond rainfall / surface water catchment.
- The Timber Pond will be provided with a fixed outlet which will control maximum pond water levels and control outflow rates to the attenuation wetland and Cadoxton Ponds.
- The increased flux of water, derived from the cap area, will provide additional clean water inflow into the Timber Pond, reducing the overall concentrations of contaminants within the water body. However, the provision of the drainage connection to the attenuation wetland and Cadoxton Ponds may provide a pathway for flushing of existing contaminants from the Timber Pond.

The water quality at surface or near surface is likely to be the most important indicator for assessing the suitability of a drainage connection between the ponds.

A new outlet headwall is proposed at the northern corner of the Timber Pond, providing a fixed discharge elevation of 6.740m AOD. Previous studies indicate that the pond naturally fluctuates between 7.05 – 7.35m AOD, but with no fixed outlet the fluctuations are interpreted as reflecting rain water-based increases in water level versus evaporation / groundwater recharge-based decreases in water level. There is very limited additional catchment area for the pond, so rainfall on the 18,380m² pond footprint provides the sole clean water input to the pond.

The clean rainwater input to surface is expected to be a major factor influencing the observed water quality stratification under the existing drainage conditions, which suggest limited mixing occurs between the upper 1m of pond water and the deeper waters below 3m.

The new outlet will provide a pathway for the upper surface water from the Timber Pond to drain to the Cadoxton Ponds. Additionally, the newly installed cap will provide over 45,000m² (45,660m² based on GCL area) of newly connected drainage catchment for the Timber Pond. As this area will be drained from entirely above the capping layer, the net clean water input to the Timber Pond should be increased from 18,380m² to circa 64,010m².

The 2013 Landfill Groundwater Data Assessment Report used St Athan Long-Term Average (LTA) rainfall of 998.9 mm/annum. For estimation purposes this has been used as 1,000 mm rainfall per annum for the Timber Pond and the uncapped landfill. For the capped landfill, 100mm/annum infiltration is assumed, with the balance of 900mm conservatively assessed as potential clean run-off to the Timber Pond⁷.

⁷ This is a conservative assumption with no evapo-transpiration / evaporation figures available for the existing landfill area

Four scenarios have been assessed to test the potential impact of the landfill capping on Timber Pond water quality conditions:

- Scenario 1: Existing condition, prior to capping the landfill. Stratified water body with higher quality water within the upper 1m layer, most likely reflecting rainfall mixing with the surface of the pond. Catchment area for rainfall recharge is limited to the pond water surface area, therefore the Timber Pond is only influenced by direct rainfall which mixes with the top metre of water only. Ongoing rainfall dilution is considered in this scenario as this process is suspected to be a key driver for the observed water quality stratification. The reviewed water quality data will already reflect the Scenario 1 "current condition", including any dilution effects from rainfall. Contaminant concentrations are therefore assumed to be as defined by this water quality data review. However, the ongoing rainfall dilution is also considered in this scenario as this process is suspected to be a key driver for the observed water quality stratification and water quality variation.
- Scenario 2: Post landfill capping, annual average condition. The Timber pond catchment is expanded to include clean water run-off from the landfill cap. The additional clean water input to the Timber Pond is based on the long-term average rainfall rate on the cap only, reduced by 100mm to allow for the assumed 100mm/annum cap infiltration. Mixing is assumed to take place in the top metre of the Timber Pond only.
- Scenario 3A: Post landfill capping 50mm storm event. The scenario determines the effect of a 50mm storm with rainfall entering the Timber Pond through direct rainfall and runoff over the capped landfill. The scenario is again based on mixing of rain/runoff in the first metre below water level only.
- Scenario 3B: Post landfill capping 100mm storm event. Scenario 3B assesses the effect of a 100mm storm with rain/runoff water penetrating deeper into the Timber Pond and mixing occurring throughout the full depth of the pond.

A simple contaminant mass balance estimate has been completed for each of the four scenarios. For each scenario, the current concentrations of the key marker analytes / COPC have been assessed in relation to future rainfall and runoff rates. The COPC assessed are copper, chloride, DMSD, MST, silicic acid, benzene (TPH EC₅-EC₇), naphthalene and iron.

The results of the four scenarios are presented below.

5.2.1 Scenario 1 – existing condition

The baseline condition for Scenario 1 is the water quality data review presented in this report.

For the assessment of potential risks for a Cadoxton Ponds drainage connection, this means that the recorded copper and chloride EQS exceedances in the upper 1m layer must be considered as potentially increasing the concentrations of these contaminants within the Cadoxton Ponds. Existing MST and DMSD concentrations in the upper 1m of the Timber Pond are interpreted as posing similar risks, but there is no current EQS for these contaminants.

However, the Dow SPMP monitoring indicates that the data for pond water quality shows considerable variation between sampling rounds.

If annual average rainfall dilution is considered, over the upper 1m of the Timber Pond, the resulting mass balance estimate indicates that copper concentrations would be below the EQS GAC; and iron, chloride, DMSD, MST and silicic acid would be below or within the same order or magnitude as those found in 2017 samples from the Cadoxton ponds.

Table 5.1 presents key parameters for the mass balance estimate.

Table 5.1 – Scenario 1 mass balance estimate

Scenario 1		Existing Condition	
Rainfall Estimate	998 mm/annum	St Athan LTA. 1m surface layer mixing	
Pond Catchment Area	18,380 m ²		
Additional Water Volume	18,360 m ³	Assumed added to existing upper pond water layer	
COPC	EQS Value µg/L	Baseline Concentration µg/L	Revised Concentration µg/L
Copper	1	1.32	0.66
Chloride	250,000	865,000	432,738
MST	-	37,300	18,660
DMSD	-	21,100	10556
Silicic acid	-	1,400	700
Iron	1,000	30.3	15.6

5.2.2 Scenario 2 – landfill capping, annual average condition

Annual direct rainfall and runoff from the landfill cap have been assessed to determine dilution of the marker analytes in the top metre of the Timber Pond.

This mixing in the top metre would cause all marker analytes to be below or within the same order of magnitude as those in the Cadoxton Ponds (2017 data).

Table 5.2 presents key parameters for the Scenario 2 mass balance estimate.

Table 5.2 – Scenario 2 mass balance estimate

Scenario 2		Landfill cap - Annual Average Condition	
Rainfall Estimate	998 mm/annum	St Athan LTA. 1m surface layer mixing	
Pond Catchment Area	18,380 m ²		
Landfill cap catchment area	45,560 m ²		
Additional cap run-off	40,913 m ³		
Additional Water Volume	59,273 m ³	Assumed added to existing upper pond water layer	
COPC	EQS Value µg/L	Baseline Concentration µg/L	Revised Concentration µg/L
Copper	1	1.32	0.29
Chloride	250,000	865,000	187,951
MST	-	37,300	8105
DMSD	-	21,100	4,585
Silicic acid	-	1,400	304
Iron	1,000	30.3	6.58

5.2.3 Scenario 3A – landfill capping, 50mm storm event

In the event of a 50mm storm it was determined that an additional 919,000 litres of water would enter the Timber Pond via direct rainfall and a further 2.3 million litres via landfill runoff. Following mixing of the storm water and

top metre of the Timber Pond, concentrations of the key contaminants of concern are lowered by approximately 14%.

In this scenario copper concentrations will remain marginally above the EQS GAC (1.1ug/l) but within the same order of magnitude of recently recorded levels within the Cadoxton Ponds. MST and DMSD concentrations remain higher than those found within the Cadoxton Ponds.

Scenario 3A assumes that the 50mm storm event occurs immediately after cap construction, as it is based on the flushing of contaminants at the existing water quality. Over time, the establishment of drainage conditions represented by Scenario 2 would be expected to reduce contaminant concentrations within the Timber Pond.

Additionally, the storm run-off represents only 4% of the total pond storage volume and would increase the pond depth by only 175mm (assuming no outlet drainage to the attenuation pond). This small increase is considered unlikely to cause significant mixing of pond waters and flushing of deeper level contaminants, especially as the pond water level rises in response to rainfall, the additional water volume will flow to the attenuation pond via the proposed outlet headwall and transfer drain.

Table 5.3 presents key parameters for the Scenario 3A mass balance estimate.

Table 5.3 – Scenario 3A mass balance estimate

Scenario 3A		Landfill cap - 50mm storm event	
Rainfall Estimate	50 mm/annum	4 hour storm event. 1m surface layer mixing	
Pond Catchment Area	18,380 m ²		
Landfill cap catchment area	45,560 m ²		
Additional cap run-off	2,278 m ³		
Additional Water Volume	3,197 m ³	Assumed added to existing upper pond water layer (pond + run off)	
COPC	EQS Value µg/L	Baseline Concentration µg/L	Revised Concentration µg/L
Copper	1	1.32	1.1
Chloride	250,000	865,000	736,836
MST	-	37,300	31,773
DMSD	-	21,100	17,974
Silicic acid	-	1,400	1,193
Iron	1,000	30.3	25.8

5.2.4 Scenario 3B – landfill capping, 100mm storm event

The occurrence of a 100mm storm would produce 1.8million litres of direct rainfall and 4.35 million litres of cap runoff. For this quantity of water entering the Timber Pond in a storm event it has been assumed that the storm water would mix with deeper water in the pond.

An average of the recorded concentrations for each chemical of concern at each depth interval has been used to reflect overall water quality for the full depth of the pond. Following the mixing and dilution it can be concluded that all marker analytes are below the EQS GAC with the exception of chloride, iron and naphthalene.

MST concentrations are between 3 and 9 times higher than the most recent results from the Cadoxton Ponds. DMSD results are between 8 and 12 times greater than the most recent results from the Cadoxton Ponds.

Scenario 3B assumes that the 100mm storm event occurs immediately after cap construction, as it is based on the flushing of contaminants at the existing water quality. Over time, the establishment of drainage conditions represented by Scenario 2 would be expected to reduce contaminant concentrations within the Timber Pond.

Table 5.4 presents key parameters for the Scenario 3B mass balance estimate.

The full-depth mixing scenario is considered to be a very conservative worst-case, and would not be expected to be realised in practice. The 100mm storm run-off represents <9% of the total pond storage volume and would

increase the pond depth by approximately 350mm. This small increase is considered unlikely to cause complete mixing of pond waters layers and flushing of deeper level contaminants.

The landfill cap drainage has been designed to allow slow permeation of cap drainage into the Timber Pond – the surface has a free draining edge, with piped discharges limited to the perimeter drain for the short east and south facing internal slopes. This drainage design should minimise turbulent discharge to the Timber Pond and reduce the potential for mixing of cap run-off water with the deeper stratified pond water layers.

Table 5.4 – Scenario 3B mass balance estimate

Scenario 3B		Landfill cap - 100mm storm event	
Rainfall Estimate	100 mm/annum	4 hour storm event. Full depth 4m mixing	
Pond Catchment Area	18,380 m ²		
Landfill cap catchment area	45,560 m ²		
Additional cap run-off	4,556 m ³		
Additional Water Volume	6,394 m ³	Assumed added to existing upper pond water layer (pond + run off)	
COPC	EQS Value µg/L	Baseline Maximum Concentration* µg/L	Revised Concentration** µg/L
Copper	1	1.32	0.66
Chloride	250,000	4,480,000	2,322,236
MST	-	108,000	62,854
DMSD	-	81,000	46,165
Silicic acid	-	12,100	5,667
Iron	1,000	166,000	35,759
Benzene	10	13.6	3.5
Naphthalene	2	137	25.9

Note *Baseline Maximum concentration is the maximum recorded at any depth layer – for example 13.6 µg/L benzene was recorded at 4m depth, but was not recorded at shallower depths.

**The revised concentrations are based on contaminant concentrations averaged across the Timber Pond depth profile

6. Conclusions

AECOM has reviewed recent Dow SPMP data for the Timber Pond and Cadoxton Ponds and has undertaken additional depth sampling of the Timber pond to assess water quality stratification.

Based on the SPMP data review, Timber Pond water quality appears to be broadly similar to water quality in the Cadoxton Ponds. Some exceedances of Environmental Quality Standards are reported, especially for copper and chloride, but the recorded contaminant concentrations do not suggest the presence of significant contamination which would prevent the connection of the two sets of water bodies.

Copper concentrations are higher in the Timber Pond than in the Cadoxton Ponds, although all locations exceed the bioavailable EQS value of 1 µg/L. None of the recorded copper concentrations exceed the M-BAT based PNEC values previously established for the Cadoxton Ponds. Chloride concentrations exceed Environmental Quality Standards but are considered to reflect brackish conditions in proximity to the coast / Barry Docks complex and do not appear to restrict the diversity of fish species recorded during ecological sampling. Silanol species have been detected across the pond network, although the distribution of species varies between ponds and no EQS values have been established.

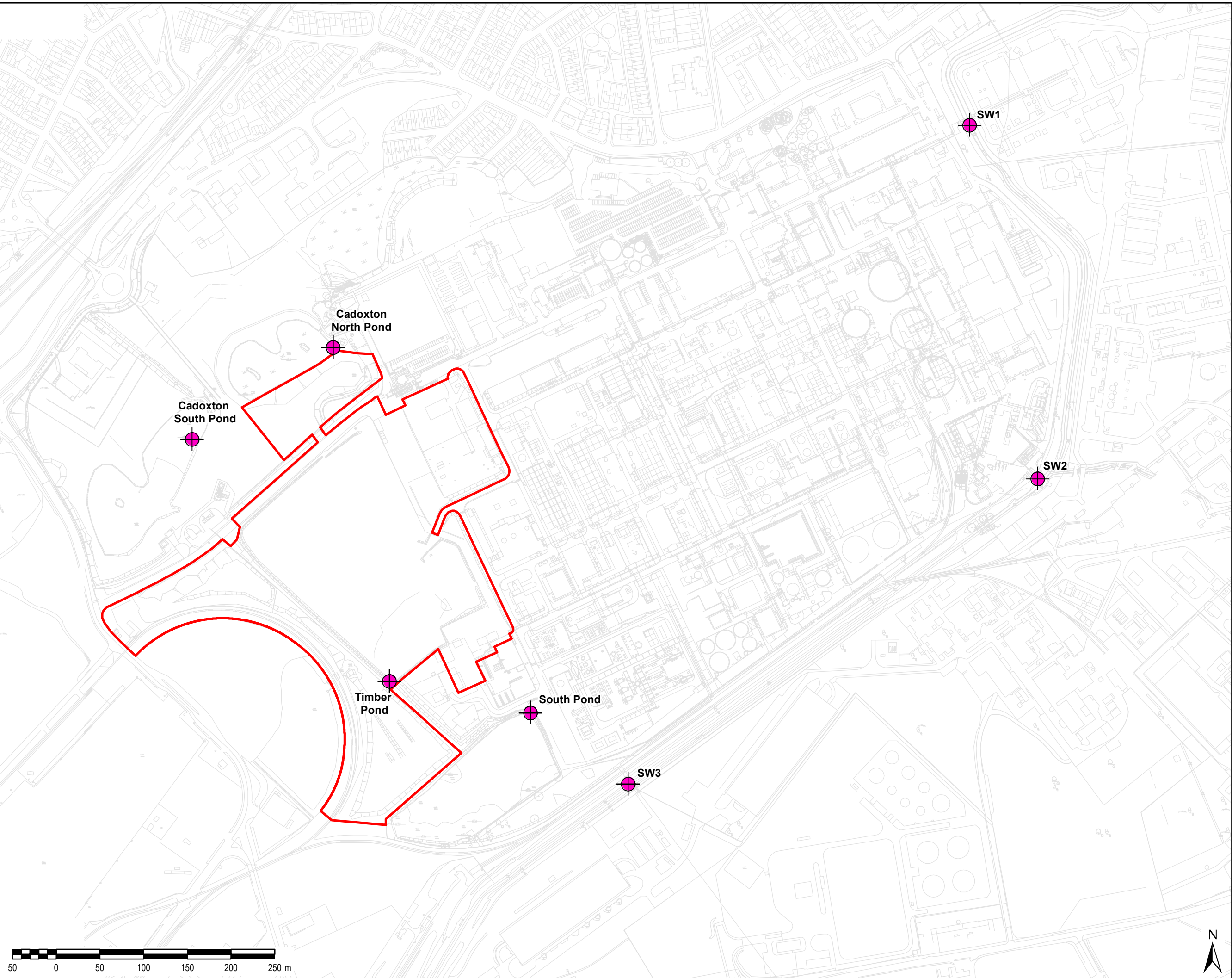
Depth sampling indicates that the Timber Pond is stratified, with generally lower water quality recorded towards the base of the pond. The evidence from the depth sampling suggests limited mixing between the upper 1m of the pond water and the lower 3-4m, with the upper and lower layers exhibiting clear differences in water quality, including higher concentrations of silanols and organic species. Copper concentrations are highest in the surface layer and decrease with depth.

As the new outlet headwall takes flow from the Timber Pond surface layer, AECOM expects that the existing Dow water surface data and AECOM 1m depth water quality data provides the most likely indication of drainage quality and potential downstream impact when the ponds are connected. Under the existing water quality conditions, a connection between the Timber Pond and the Cadoxton Ponds would allow the transfer of the generally higher quality upper water layer to the downstream ponds. Although this includes copper concentrations which exceed the EQS value, the copper concentrations are broadly similar in all of the ponds and are below the M-BAT calculated PNEC value in all of the ponds.

Additionally, the significantly expanded Timber Pond catchment area provided by the proposed landfill cap will increase the volume of clean water flows through the Timber Pond. These additional water flows are expected to further improve the water quality within the upper 1m layer, providing storm run-off flows do not promote water mixing with the lower water layers of the Timber Pond. The design of the free draining landfill cap edge adjacent to the Timber Pond is expected to minimise run-off induced turbulence within the Timber Pond (reduced point discharges). Storm run-off has been assessed using 50mm and 100mm rainfall events, amounting to 4% and 9% of total pond volume and 175mm and 350mm of additional freeboard requirement (worst case - assuming no onward flow to the Cadoxton Ponds).

These factors all suggest that additional water inputs to the Timber Pond are most likely to mix within the higher quality upper water layers of the pond, minimising the risk of mixing with the lower 3-4m depth water layers and flushing of potentially lower quality deep pond water.

The most likely long-term scenario (Scenario 2) would be that Timber Pond water quality would progressively improve, as a result of clean landfill cap run-off entering the pond and reduced rainfall infiltration and leaching of contaminants from the landfill waste mass.



Project Title:

Barry Landfill Restoration
Capping - Timber Pond
Water Quality Assessment

Client:

Dow Silicones UK Ltd

LEGEND

-  Surface Water Samples
-  Site Boundary

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Ordnance Survey 0100031673

AECOM Internal Project No:

60585570

Drawing Title:

**SITE PLAN WITH
DOW SAMPLING LOCATIONS**

Scale at A3: 1:4,000

Drawing No:

FIGURE 2.1

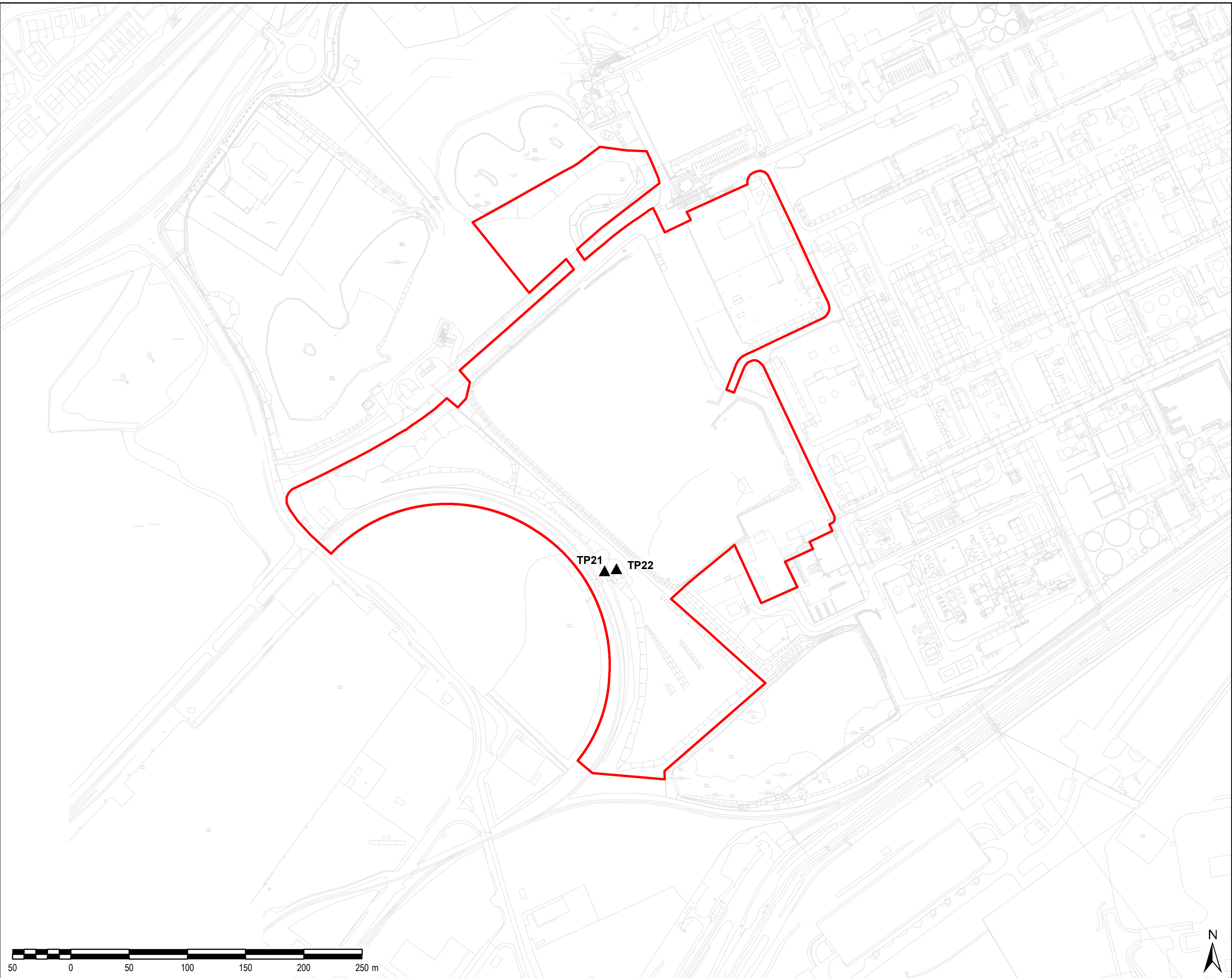
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Project Title:

Barry Landfill Restoration
Capping - Timber Pond
Water Quality Assessment

Client:

Dow Silicones UK Ltd.

LEGEND

- Site Boundary
- September 2018 Surface
Water Sampling Locations

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SITE PLAN WITH AECOM
SEPTEMBER 2018 SAMPLING
LOCATIONS

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FIGURE 3.1

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- 26/11/18

Appendix A Groundwater Directive Assessment Sheets for selected Silanols



Seek Together™

Assessment of Trimethylsilanol per Methodology for the determination of hazardous substances for the purposes of the Groundwater Directive (2006/118/EC)

Trimethylsilanol, CAS 1066-40-6

	Yes / No / Insufficient data / Borderline / assume yes or no?	Value	Reference
Is substance persistent, bioaccumulative and toxic?			
Persistence			
Passes ready biodegradation test	No	0% (OECD 301B)	Clarke, N. Trimethylsilanol (CAS No. 1066-40-6): Assessment of Ready Biodegradability; CO2 in Sealed Vessels (CO2 Headspace Test). DC Internal Report 2008-I0000-59826 Hydroxytrimethylsilane (CAS 1066-40-6) ECHA Dossier, https://echa.europa.eu/registration-dossier/-/registered-dossier/23873/1
Passes inherent biodegradation test	No data available	NA	NA

*If answer to either question is YES,
substance is not persistent*

*If answer to both questions is NO, additional
data on Half-life is required*

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Half-life marine water $\geq$ 60 days	Borderline	Volatilization from water is significant for this substance, under certain conditions abiotic degradation rate could be significantly below 60 days but under other conditions it may be greater than 60 days	SIAP, 1066-40-6, 03Oct2014
Half-life fresh or estuarine water $\geq$ 40 days	Borderline	Volatilization from water is significant for this substance, under certain conditions abiotic degradation rate could be significantly below 40 days but under other conditions it may be greater than 40 days	SIAP, 1066-40-6, 03Oct2014
Half-life marine sediment $\geq$ 180 days	Not applicable	Very water soluble, Koc = 9.75, preferentially partitions to water over sediment	SIAP, 1066-40-6, 03Oct2014 KOCWIN (EPA EPI Suite v 4.1)
Half-life fresh or estuarine sediment $\geq$ 120 days	Not applicable	Very water soluble, Koc = 9.75, preferentially partitions to water over sediment	SIAP, 1066-40-6, 03Oct2014 KOCWIN (EPA EPI Suite v 4.1)

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Half-life in soil $\geq$ 120 days	Borderline	Read across to DMSD, Biodegradation half-life of DMSD in soil > 120 days according to Lehmann et al. (1998), Sabourin et al. (1996). Other mechanisms of removal for DMSD include volatilization in drying process of soil or lost through plant transpiration (Xu, 2016, 2017). In addition, TMS can be volatilized directly from water and therefore, removal of TMS from soil would be expected to be significantly greater even without the drying process (Xu and Kropscott, 2014).	Lehmann, R G; Miller, J R; Collins, H P. 1998. Microbial degradation of dimethylsilanediol in soil. WATER AIR AND SOIL POLLUTION Sabourin, C., Carpenter, J., Leib, T., Spivack, J., 1996. Biodegradation of dimethylsilanediol in soils. Applied and environmental microbiology 62, 4352-4360. Xu, Shihe. Non-Regulated Study: Fate of Dimethylsilanediol (DMSD) in Soils. Part 2. Evaporation from Bare Surface Soils. DC Internal Report No. 2016-I0000-77564 Xu S. Fate of Dimethylsilanediol (DMSD) in Soils. Part 3. Volatilization from Soil with Corn Plant Under Irrigation (Dow Corning HES Study No 12573-108), 2017. Xu, S.; Kropscott, B. 2014. Evaluation of a three-phase equilibrium method for measuring temperature dependence of internally consistent partition coefficients (KOW, KOA and KAW) for volatile methylsiloxanes and trimethylsilanol. Environ. Toxicol. Chem. 2014. 33, 2702-2710.
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If answer to any question is YES, substance is persistent

If answer to all questions is NO, substance is not persistent

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Is sufficient data available? (if not assume substance is persistent)	Yes		
Is substance persistent?	Borderline		
Bioaccumulation			
Bioconcentration factor (BCF) for aquatic species (wet weight) ≥ 2000	No	Based on log Kow of 1.22 at 25.0 °C	Xu, S.; Kropscott, B.E. Non-Regulated: Temperature Dependence of Air/Water, 1-Octanol/Air, and 1-Octanol/Water Partitioning Coefficients of Trimethylsilanol (TMS) (CAS No. 1066-40-6). DC Internal Report No. 2011-I0000-64295
Does field data show evidence for biomagnification?	NA		
<i>If answer to either question is YES, substance is bioaccumulative</i>			
If no BCF data, is log Kow ≥ 4.5 ?	No	log Kow = 1.22 at 25.0 °C	Xu, S.; Kropscott, B.E. Non-Regulated: Temperature Dependence of Air/Water, 1-Octanol/Air, and 1-Octanol/Water Partitioning Coefficients of Trimethylsilanol (TMS) (CAS No. 1066-40-6). DC Internal Report No. 2011-I0000-64295
<i>If answer is YES, substance is bioaccumulative</i>			
Does the weight of evidence from the following criteria indicate bioaccumulation unlikely?	Yes		

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Substance is chronically non-toxic in mammals	Yes	NOAEL $\geq$ 600 mg/L	Hydroxytrimethylsilane (CAS 1066-40-6) ECHA Dossier, https://echa.europa.eu/registration-dossier/-/registered-dossier/23873/1
Molecular size $\geq$ 4.3nm	No	0.492 nm	Advances in electronic structure theory: GAMESS a decade later" M.S.Gordon, M.W.Schmidt pp. 1167-1189, in "Theory and Applications of Computational Chemistry: the first forty years" C.E.Dykstra, G.Frenking, K.S.Kim, G.E.Scuseria (editors), Elsevier, Amsterdam, 2005
Molecular weight $\geq$ 1100g/mol	No	90.20	EPA EPI Suite v 4.1
Octanol solubility $\leq$ 0.002mmol/l	No	miscible	SPARC, ARChem Physicochemical calculator, 2010

If weight of evidence indicates bioaccumulation unlikely (i.e. YES answers) substance is not bioaccumulative

If weight of evidence indicates bioaccumulation a possibility (i.e. NO answers), BCF data should be obtained

Is sufficient data available? (if not assume substance bioaccumulates)	Yes		
Is substance bioaccumulative?	No	Based on log Kow 1.22 at 25.0 °C	Xu, S.; Kropscott, B.E. Non-Regulated: Temperature Dependence of Air/Water, 1-Octanol/Air, and 1-Octanol/Water Partitioning Coefficients of Trimethylsilanol (TMS) (CAS No. 1066-40-6). DC Internal Report No. 2011-I0000-64295

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Toxicity

Is the lowest chronic NOEC for freshwater or marine organisms $\leq 0.01\text{mg/l}$	The only chronic data available at this time is an algal growth rate NOECr. However, a chronic daphnid study report will be completed by mid-May 2019. Acute data and MOA WoE available	
	Algal 72-h ErC50 > 1053 mg/L, NOECr = 70 mg/L	Hydroxytrimethylsilane (CAS 1066-40-6) ECHA Dossier, https://echa.europa.eu/registration-dossier/-/registered-dossier/23873/1
	Rainbow trout 96-h LC50 = 271 mg/L	Hydroxytrimethylsilane (CAS 1066-40-6) ECHA Dossier, https://echa.europa.eu/registration-dossier/-/registered-dossier/23873/1
	Daphnia magna 48-h EC50 = 124 mg/L	Hydroxytrimethylsilane (CAS 1066-40-6) ECHA Dossier, https://echa.europa.eu/registration-dossier/-/registered-dossier/23873/1
	The work of Redman et al. (2012) and Mackay et al. (2015) both found the pelagic and benthic data on cyclic siloxanes consistent with a narcotic mode of action (MOA). Mackay et al. (2015) also suggested that with these materials, most aquatic organisms will fail to achieve an effect-level critical body burden under standard test durations, even when tested at the solubility limit; he attributed this absence of an effect to uptake/elimination kinetics and poor assimilation Fairbrother, A; Woodburn, K. 2016. Assessing the aquatic risks of the cyclic volatile methyl siloxane D4. Environ. Sci. Technol. Letters. 10: 359-363. Gobas F, Xu S, Kozerski G, Powell D, Woodburn K, Mackay D, Fairbrother A. 2015. Fugacity and activity analysis of the bioaccumulation and environmental risks of decamethylcyclopentasiloxane (D5). Environ. Toxicol. Chem. 34: 2723-2731. Mackay D, Powell DE, Woodburn KB. 2015. Bioconcentration and aquatic toxicity of superhydrophobic chemicals: A modeling case study of cyclic volatile methyl siloxanes. Environ. Sci. Technol. 49: 11913-11922.	

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		efficiency. This theory is consistent with experimental findings, both for pelagic and benthic exposures, and it suggests that other silicone-containing molecules such as the silanols will likely be active via a narcotic MOA (Fairbrother and Woodburn, 2016; Gobas et al., 2015).	Redman AD, Mihaich E, Woodburn K, Paquin P, Powell D, McGrath JA, Di Toro DM. 2012. Tissue-based risk assessment of cyclic volatile methyl siloxanes. Environ. Toxicol. Chem. 31: 1911-1919.
Is there substantial evidence of long term toxicity (STOT RE1 or STOT RE2)	No	No effects observed	Hydroxytrimethylsilane (CAS 1066-40-6) ECHA Dossier, https://echa.europa.eu/registration-dossier/-/registered-dossier/23873/1
Is substance carcinogenic (Carc 1A,1B), mutagenic (Muta 1A, 1B) or toxic for reproduction (Repr 1A, 1B, 2)	No	No effects observed	Hydroxytrimethylsilane (CAS 1066-40-6) ECHA Dossier, https://echa.europa.eu/registration-dossier/-/registered-dossier/23873/1

If answer to any question is YES, substance is toxic

If answer to all questions is NO, substance is not toxic

Is sufficient data available? (if not assume substance is toxic)	Yes
Is substance toxic?	No

IS SUBSTANCE PERSISTENT, BIOACCUMULATIVE AND TOXIC?

Does substance pose an equivalent level of concern?

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Very persistent and very bioaccumulative?

Half-life in marine, fresh or estuarine water ≥ 60 days	Borderline	Volatilization from water is significant for this substance, under certain conditions abiotic degradation rate could be significantly below 40 days but under other conditions it may be greater than 40 days	SIAP, 1066-40-6, 03Oct2014
Half-life in marine, fresh or estuarine sediment ≥ 180 days	Not applicable	Very water soluble, Koc = 9.75, preferentially partitions to water over sediment	SIAP, 1066-40-6, 03Oct2014 KOCWIN (EPA EPI Suite v 4.1)
Half-life in soil ≥ 180 days	Borderline	Read across to DMSD, Biodegradation half-life of DMSD in soil > 180 days according to Lehmann et al. (1998), Sabourin et al. (1996). Other mechanisms of removal for DMSD include volatilization in drying process of soil or lost through plant transpiration (Xu, 2016, 2017). In addition, TMS can be volatilized directly from water and therefore, removal of TMS from soil would be expected to be significantly greater even without the drying process (Xu and Kropscott, 2014).	Lehmann, R G; Miller, J R; Collins, H P. 1998. Microbial degradation of dimethylsilanediol in soil. WATER AIR AND SOIL POLLUTION Sabourin, C., Carpenter, J., Leib, T., Spivack, J., 1996. Biodegradation of dimethylsilanediol in soils. Applied and environmental microbiology 62, 4352-4360. Xu, Shihe. Non-Regulated Study: Fate of Dimethylsilanediol (DMSD) in Soils. Part 2. Evaporation from Bare Surface Soils. DC Internal Report No. 2016-I0000-77564 Xu S. Fate of Dimethylsilanediol (DMSD) in Soils. Part 3. Volatilization from Soil with Corn Plant Under Irrigation (Dow Corning HES Study No 12573-108), 2017.

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Xu, S.; Kropscott, B. 2014. Evaluation of a three-phase equilibrium method for measuring temperature dependence of internally consistent partition coefficients (KOW, KOA and KAW) for volatile methylsiloxanes and trimethylsilanol. Environ. Toxicol. Chem. 2014. 33, 2702-2710.

If answer to any question is YES, substance is very persistent

Is bioconcentration factor ≥ 5000	No	Based on log Kow 1.22 at 25.0 °C	Xu, S.; Kropscott, B.E. Non-Regulated: Temperature Dependence of Air/Water, 1-Octanol/Air, and 1-Octanol/Water Partitioning Coefficients of Trimethylsilanol (TMS) (CAS No. 1066-40-6). DC Internal Report No. 2011-I0000-64295
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If answer is yes, substance is very bioaccumulative

Is substance very persistent and very bioaccumulative?	Borderline for vP; No for vB		
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Does substance pose a specific risk to groundwater?

Does groundwater monitoring data show Half-life in groundwater ≥ 1 year	No data available	NA	NA
Do $\geq 5\%$ of groundwater samples show levels of the substance greater than the LOQ?	No data available	NA	NA

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Do $\geq$ 15% of sites have at least one sample where the substance is detected above the LOQ?	No data available	NA	NA
<i>If answer to any question is YES, substance is persistent in groundwater</i>			
Is substance persistent in groundwater?	No data available	NA	NA
<i>If substance is persistent in groundwater, bioaccumulative AND toxic, substance is hazardous</i>			
Does substance pose a specific risk to groundwater?	No data available	NA	NA
Is substance very toxic?			
Is substance mutagenic (Muta 1A, 1B,2) or have no determinable threshold for adverse effects on human health	No	No effects observed	Hydroxytrimethylsilane (CAS 1066-40-6) ECHA Dossier, https://echa.europa.eu/registration-dossier/-/registered-dossier/23873/1
<i>If answer to any question is YES, substance is very toxic and hazardous</i>			
Is sufficient data available? (if not assume substance is very toxic)	Yes		
Is substance very toxic?	No		

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Is substance hazardous to groundwater?	No	Substance is not considered hazardous to groundwater. Considered persistent but not expected to bioaccumulate or be hazardous to the aquatic environment; substance is not considered to be toxic to human health
Is substance hazardous, if so, state on what basis	NA	
Does substance have breakdown products of concern?	No	This substance is expected to have final breakdown products of CO ₂ , silicic acid, silica

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Seek Together™

Assessment of Dimethylsilanediol per Methodology for the determination of hazardous substances for the purposes of the Groundwater Directive (2006/118/EC)

Dimethylsilanediol (DMSD), CAS 1066-42-8

	Yes / No / Insufficient data / Borderline / assume yes or no?	Value	Reference
Is substance persistent, bioaccumulative and toxic?			
Persistence			
Passes ready biodegradation test	No	Not readily biodegradable	BIOWIN (EPA EPI Suite v 4.1) Xu, Shihe. Fate of silanols in various aquatic / soil environments: Investigation of dimethylsilanediol (bio)degradation in microcosms. DC Internal Report No. 2017-10000-78562
Passes inherent biodegradation test	No	Xu 2017 - no evidence of significant degradation or conversion in aquatic or soil conditions	Xu, Shihe. Fate of silanols in various aquatic / soil environments: Investigation of dimethylsilanediol (bio)degradation in microcosms. DC Internal Report No. 2017-10000-78562
<i>If answer to either question is YES, substance is not persistent</i> <i>If answer to both questions is NO, additional data on half life is required</i>			

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Half-life marine water $\geq$ 60 days	Borderline	Under certain conditions abiotic degradation rate could be significantly below 60 days but under other conditions it may be greater than 60 days	Buch, R.R., Lane, T.H., Annelin, R.B., Frye, C.L., 1984. Photolytic oxidative demethylation of aqueous dimethylsiloxanols. Environmental Toxicology and Chemistry 3, 215-222. Jaeshin Kim - study underway
Half-life fresh or estuarine water $\geq$ 40 days	Borderline	Under certain conditions abiotic degradation rate could be significantly below 40 days but under other conditions it may be greater than 40 days	Buch, R.R., Lane, T.H., Annelin, R.B., Frye, C.L., 1984. Photolytic oxidative demethylation of aqueous dimethylsiloxanols. Environmental Toxicology and Chemistry 3, 215-222. Jaeshin Kim - study underway
Half-life marine sediment $\geq$ 180 days	Not applicable	Very water soluble, Koc = 0.2 to 1.2, preferentially partitions to water over sediment	Kim, J., Miller, J.A. Sorption Behavior of 14C-Dimethylsilanediol (14C-DMSD)(CAS Number 1066-42-8) on Different Soil Types Using a Batch Equilibrium Method. DC Internal Report No. 2014-I0000-71298
Half-life fresh or estuarine sediment $\geq$ 120 days	Not applicable	Very water soluble, Koc = 0.2 to 1.2, preferentially partitions to water over sediment	Kim, J., Miller, J.A. Sorption Behavior of 14C-Dimethylsilanediol (14C-DMSD)(CAS Number 1066-42-8) on Different Soil Types Using a Batch Equilibrium Method. DC Internal Report No. 2014-I0000-71298

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Half-life in soil $\geq$ 120 days	Borderline	Biodegradation half-life of DMSD in soil > 120 days according to Lehmann et al. (1998), Sabourin et al. (1996). Other mechanisms of removal for DMSD include volatilization in drying process of soil or lost through plant transpiration (Xu, 2016, 2017)	Lehmann, R G; Miller, J R; Collins, H P. 1998. Microbial degradation of dimethylsilanediol in soil. WATER AIR AND SOIL POLLUTION Sabourin, C., Carpenter, J., Leib, T., Spivack, J., 1996. Biodegradation of dimethylsilanediol in soils. Applied and environmental microbiology 62, 4352-4360. Xu, Shihe. Non-Regulated Study: Fate of Dimethylsilanediol (DMSD) in Soils. Part 2. Evaporation from Bare Surface Soils. DC Internal Report No. 2016-I0000-77564 Xu S. Fate of Dimethylsilanediol (DMSD) in Soils. Part 3. Volatilization from Soil with Corn Plant Under Irrigation (Dow Corning HES Study No 12573-108), 2017.
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If answer to any question is YES, substance is persistent

If answer to all questions is NO, substance is not persistent

Is sufficient data available? (if not assume substance is persistent)	Yes
Is substance persistent?	Borderline

Bioaccumulation

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Bioconcentration factor (BCF) for aquatic species (wet weight) ≥ 2000	No	Based on log Kow of -0.38 at 20.2 °C	Xu, S.; Kropscott, B.E. Non-Regulated: Temperature Dependence of Air/Water, 1-Octanol/Air, and 1-Octanol/Water Partitioning Coefficients of Dimethylsilanediol (DMSD) (CAS No. 1066-42-8). DC Internal Report No. 2011-I0000-64293 Xu S, Kropscott B. Method for Simultaneous Determination of Partition Coefficients for Cyclic Volatile Methylsiloxanes and Dimethylsilanediol. Analytical Chemistry 2012; 84: 1948-1955.
Does field data show evidence for biomagnification?	NA	NA	NA
<i>If answer to either question is YES, substance is bioaccumulative</i>			
If no BCF data, is log Kow ≥ 4.5 ?	No	log Kow = -0.38 at 20.2 °C	Xu, S.; Kropscott, B.E. Non-Regulated: Temperature Dependence of Air/Water, 1-Octanol/Air, and 1-Octanol/Water Partitioning Coefficients of Dimethylsilanediol (DMSD) (CAS No. 1066-42-8). DC Internal Report No. 2011-I0000-64293
<i>If answer is YES, substance is bioaccumulative</i>			
Does the weight of evidence from the following criteria indicate bioaccumulation unlikely?	Yes		

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Substance is chronically non-toxic in mammals	Yes	A risk assessment was conducted to evaluate general population exposure to DMSD via drinking water. This resulted in a margin of safety of about 400 based on estimated water concentrations in the chemical safety reports for the DMSD-generators. The combined exposure to DMSD from drinking water (i.e. adding all the contributions from the different DMSD generators) results in a margin of safety of around 300. The German drinking water limit of 10 ppm was also considered, and it was determined that this exposure would be associated with a margin of safety of about 350.	Domoradzki, J.Y. et al. Combined Repeated Dose Toxicity Study with the Reproductive/Developmental Toxicity Screening Test for Dimethylsilanediol (DMSD), ZMAT 4065555, in Sprague-Dawley Rats via Oral Gavage. DC Internal Report No. 2009-I0000-61060
Molecular size $\geq 4.3\text{nm}$	No	0.492 nm	Advances in electronic structure theory: GAMESS a decade later" M.S.Gordon, M.W.Schmidt pp. 1167-1189, in "Theory and Applications of Computational Chemistry: the first forty years" C.E.Dykstra, G.Frenking, K.S.Kim, G.E.Scuseria (editors), Elsevier, Amsterdam, 2005
Molecular weight $\geq 1100\text{g/mol}$	No	92.17	EPA EPI Suite v 4.1

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Octanol solubility $\leq 0.002\text{mmol/l}$	No	miscible	SPARC, ARChem Physicochemical calculator, 2010
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If weight of evidence indicates bioaccumulation unlikely (i.e. YES answers) substance is not bioaccumulative

If weight of evidence indicates bioaccumulation a possibility (i.e. NO answers), BCF data should be obtained

Is sufficient data available? (if not assume substance bioaccumulates)	Yes		
Is substance bioaccumulative?	No	Based on log Kow of -0.38 at 20.2 °C	Xu, S.; Kropscott, B.E. Non-Regulated: Temperature Dependence of Air/Water, 1-Octanol/Air, and 1-Octanol/Water Partitioning Coefficients of Dimethylsilanediol (DMSD) (CAS No. 1066-42-8). DC Internal Report No. 2011-I0000-64293

Toxicity

Is the lowest chronic NOEC for freshwater or marine organisms $\leq 0.01\text{mg/l}$	No, chronic DM, acute 3-pk, and MOA WoE included	Daphnia magna 21-d Chronic Reproduction and Growth: LOEC, MATC > 12.6 mg/L NOEC = 12.6 mg/L Limit test, no effect	Louch, D.W., et al. Dimethylsilanediol: A 21-Day Chronic Toxicity Study with the Freshwater Cladoceran, Daphnia magna. DC Internal Report No. 2017-I0000-81096
		Algal 72-h ErC50 > 118 mg/L, NOECr $\geq 118\text{ mg/L}$	Jezowski, R.L.; Miller, J.A. Dimethylsilanediol (CAS Number 1066-42-8): Freshwater Alga Pseudokirchneriella subcapitata Growth Inhibition Test. DC Internal Report No. 2009-I0000-60224

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	Rainbow Trout 96-h LC50 > 126 mg/L	Drottar, K.; Miller, J.A. Dimethylsilanediol (CAS Number 1066-42-8): Acute Toxicity to the Rainbow Trout (<i>Oncorhynchus mykiss</i>) Under Static Test Conditions. DC Internal Report No. 2009-I0000-60282
	Daphnia magna 48-h EC50 > 117 mg/L	Drottar, K.; Miller, J.A. Dimethylsilanediol (CAS Number 1066-42-8): Acute Toxicity to the Cladoceran (<i>Daphnia magna</i>) Under Static Test Conditions. DC Internal Report No. 2009-I0000-60283
	The work of Redman et al. (2012) and Mackay et al. (2015) both found the pelagic and benthic data on cyclic siloxanes consistent with a narcotic mode of action (MOA). Mackay et al. (2015) also suggested that with these materials, most aquatic organisms will fail to achieve an effect-level critical body burden under standard test durations, even when tested at the solubility limit; he attributed this absence of an effect to uptake/elimination kinetics and poor assimilation efficiency. This theory is consistent with experimental findings, both for pelagic and benthic exposures, and it suggests that other silicone-containing molecules such as the silanols will likely be active via a narcotic MOA (Fairbrother and Woodburn, 2016; Gobas et al., 2015).	Fairbrother, A; Woodburn, K. 2016. Assessing the aquatic risks of the cyclic volatile methyl siloxane D4. <i>Environ. Sci. Technol. Letters</i>. 10: 359-363. Gobas F, Xu S, Kozerski G, Powell D, Woodburn K, Mackay D, Fairbrother A. 2015. Fugacity and activity analysis of the bioaccumulation and environmental risks of decamethylcyclopentasiloxane (D5). <i>Environ. Toxicol. Chem.</i> 34: 2723-2731. Mackay D, Powell DE, Woodburn KB. 2015. Bioconcentration and aquatic toxicity of superhydrophobic chemicals: A modeling case study of cyclic volatile methyl siloxanes. <i>Environ. Sci. Technol.</i> 49: 11913-11922. Redman AD, Mihaich E, Woodburn K, Paquin P, Powell D, McGrath JA, Di Toro DM. 2012. Tissue-based risk assessment of cyclic volatile methyl siloxanes. <i>Environ. Toxicol. Chem.</i> 31: 1911-1919.

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Is there substantial evidence of long term toxicity (STOT RE1 or STOT RE2)	No	> 500 mg/Kg/day for 28-days	Domoradzki, J.Y. et al. Combined Repeated Dose Toxicity Study with the Reproductive/Developmental Toxicity Screening Test for Dimethylsilanediol (DMSD), ZMAT 4065555, in Sprague-Dawley Rats via Oral Gavage. DC Internal Report No. 2009-I0000-61060
Is substance carcinogenic (Carc 1A,1B), mutagenic (Muta 1A, 1B) or toxic for reproduction (Repr 1A, 1B, 2)	Yes	NOAEL < 250 mg/kg bw/day	Kappeler, C., Seidel, S. An Oral (Gavage) Prenatal Developmental Toxicity Study of Dimethylsilanediol in Rats. DC Internal Report No. 2014-I0000-71595

If answer to any question is YES, substance is toxic

If answer to all questions is NO, substance is not toxic

Is sufficient data available? (if not assume substance is toxic)	Yes		
Is substance toxic?	No	Substance is classified under GHS as a Category 2 reproductive toxin; however, effects were seen at the highest dose (1000 mg/kg/day), which significantly exceeds any potential human exposure.	

IS SUBSTANCE PERSISTENT, BIOACCUMULATIVE AND TOXIC?

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Does substance pose an equivalent level of concern?			
Very persistent and very bioaccumulative?			
Half-life in marine, fresh or estuarine water ≥ 60 days	Borderline	Under certain conditions abiotic degradation rate could be significantly below 60 days but under other conditions it may be greater than 60 days	Buch, R.R., Lane, T.H., Annelin, R.B., Frye, C.L., 1984. Photolytic oxidative demethylation of aqueous dimethylsiloxanols. Environmental Toxicology and Chemistry 3, 215-222. Jaeshin Kim - study underway
Half-life in marine, fresh or estuarine sediment ≥ 180 days	Not applicable	Very water soluble, Koc = 0.2 to 1.2, preferentially partitions to water over sediment	Kim, J., Miller, J.A. Sorption Behavior of 14C-Dimethylsilanediol (14C-DMSD)(CAS Number 1066-42-8) on Different Soil Types Using a Batch Equilibrium Method. DC Internal Report No. 2014-I0000-71298
Half-life in soil ≥ 180 days	Borderline	Biodegradation half-life of DMSD in soil > 180 days according to Lehmann et al. (1998), Sabourin et al. (1996). Other mechanisms of removal for DMSD include volatilization in drying process of soil or lost through plant transpiration (Xu, 2016, 2017)	Lehmann, R G; Miller, J R; Collins, H P. 1998. Microbial degradation of dimethylsilanediol in soil. Water, Air, and Soil Pollution 16, 111-122. Sabourin, C., Carpenter, J., Leib, T., Spivack, J., 1996. Biodegradation of dimethylsilanediol in soils. Applied and environmental microbiology 62, 4352-4360. Xu, S. Non-Regulated Study: Fate of Dimethylsilanediol (DMSD) in Soils. Part 2. Evaporation from Bare Surface Soils. DC Internal Report No. 2016-I0000-77564 Xu S. Fate of Dimethylsilanediol (DMSD) in Soils. Part 3. Volatilization from Soil with

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Corn Plant Under Irrigation (Dow Corning HES Study No 12573-108), 2017.

If answer to any question is YES, substance is very persistent

Is bioconcentration factor ≥ 5000	No	log Kow -0.38 at 20.2 °C	Xu, S.; Kropscott, B.E. 2011. Non-Regulated: Temperature Dependence of Air/Water, 1-Octanol/Air, and 1-Octanol/Water Partitioning Coefficients of Dimethylsilanediol (DMSD) (CAS No. 1066-42-8). DC Internal Report No. 2011-I0000-64293
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If answer is yes, substance is very bioaccumulative

Is substance very persistent and very bioaccumulative?	Borderline for vP; No for vB
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Does substance pose a specific risk to groundwater?

Does groundwater monitoring data show half life in groundwater ≥ 1 year	No data available	NA	NA
Do $\geq 5\%$ of groundwater samples show levels of the substance greater than the LOQ?	No data available	NA	NA
Do $\geq 15\%$ of sites have at least one sample where the substance is detected above the LOQ?	No data available	NA	NA

If answer to any question is YES, substance is persistent in groundwater

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Is substance persistent in groundwater?	No data available	NA	NA
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If substance is persistent in groundwater, bioaccumulative AND toxic, substance is hazardous

Does substance pose a specific risk to groundwater?	No, does not pose a risk based on all data	NA	NA
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Is substance very toxic?

Is substance mutagenic (Muta 1A, 1B,2) or have no determinable threshold for adverse effects on human health	No	Substance was negative in both a Bacterial Reverse Mutation Assay and an In Vitro Mammalian Chromosome Aberration Test as well as QSAR analysis	Wagner III, V., VanDyke, M., Mudgett, S.L. Bacterial Reverse Mutation Assay with Dimethylsilanediol (DMSD). DC Internal Report No. 2009-I0000-60446 Gudi, R., Rao, M., Mudgett, S.L. In Vitro Mammalian Chromosome Aberration Test with Dimethylsilanediol (DMSD). DC Internal Report No. 2009-I0000-60447 QSAR analysis predicted negative for mutagenicity
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If answer to any question is YES, substance is very toxic and hazardous

Is sufficient data available? (if not assume substance is very toxic)	Yes
Is substance very toxic?	No

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Is substance hazardous to groundwater?	No	Substance is not considered hazardous to groundwater. Considered persistent but not expected to bioaccumulate or be hazardous to the aquatic environment; substance is not considered to be toxic to human health
Is substance hazardous, if so, state on what basis	NA	
Does substance have breakdown products of concern?	No	This substance is expected to have final breakdown products of CO ₂ , silicic acid, silica

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Seek Together™

Assessment of Methylsilanetriol per Methodology for the determination of hazardous substances for the purposes of the Groundwater Directive (2006/118/EC)

Methylsilanetriol, CAS 2445-53-6

	Yes / No / Insufficient data / Borderline / assume yes or no?	Value	Reference
Is substance persistent, bioaccumulative and toxic?			
Persistence			
Passes ready biodegradation test	No	Not readily biodegradable	based on read across to TMS biodegradation test and prediction by BIOWIN (EPA EPI Suite v 4.1)
Passes inherent biodegradation test	No data available	NA	NA
<i>If answer to either question is YES, substance is not persistent</i> <i>If answer to both questions is NO, additional data on Half-life is required</i>			
Half-life marine water $\geq$ 60 days	Borderline	Read across to DMSD, under certain conditions abiotic degradation rate could be significantly below 60 days but under other conditions it may be greater than 60 days	Buch, R.R., Lane, T.H., Annelin, R.B., Frye, C.L., 1984. Photolytic oxidative demethylation of aqueous dimethylsiloxanols. Environmental Toxicology and Chemistry 3, 215-222. Jaeshin Kim - study underway

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Half-life fresh or estuarine water $\geq$ 40 days	Borderline	Read across to DMSD, under certain conditions abiotic degradation rate could be significantly below 40 days but under other conditions it may be greater than 40 days	Buch, R.R., Lane, T.H., Annelin, R.B., Frye, C.L., 1984. Photolytic oxidative demethylation of aqueous dimethylsiloxanols. Environmental Toxicology and Chemistry 3, 215-222. Jaeshin Kim - study underway
Half-life marine sediment $\geq$ 180 days	Not applicable	Very water soluble, Koc < 0.2, preferentially partitions to water over sediment	Read across to DMSD; Kim, J., Miller, J.A. Sorption Behavior of 14C-Dimethylsilanediol (14C-DMSD)(CAS Number 1066-42-8) on Different Soil Types Using a Batch Equilibrium Method. DC Internal Report No. 2014-I0000-71298
Half-life fresh or estuarine sediment $\geq$ 120 days	Not applicable	Very water soluble, Koc < 0.2, preferentially partitions to water over sediment	Read across to DMSD; Kim, J., Miller, J.A. Sorption Behavior of 14C-Dimethylsilanediol (14C-DMSD)(CAS Number 1066-42-8) on Different Soil Types Using a Batch Equilibrium Method. DC Internal Report No. 2014-I0000-71298
Half-life in soil $\geq$ 120 days	No data available	NA	NA
<i>If answer to any question is YES, substance is persistent</i> <i>If answer to all questions is NO, substance is not persistent</i>			
Is sufficient data available? (if not assume substance is persistent)	Yes		
Is substance persistent?	Borderline		

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Bioaccumulation

Bioconcentration factor (BCF) for aquatic species (wet weight) ≥ 2000	No	based on log Kow of -2.36	KOWWIN (EPA EPI Suite v 4.1)
Does field data show evidence for biomagnification?	NA	NA	NA
<i>If answer to either question is YES, substance is bioaccumulative</i>			
If no BCF data, is log Kow ≥ 4.5 ?	No	log Kow = -2.36	KOWWIN (EPA EPI Suite v 4.1)
<i>If answer is YES, substance is bioaccumulative</i>			
Does the weight of evidence from the following criteria indicate bioaccumulation unlikely?	Yes		
Substance is chronically non-toxic in mammals	Yes	Reviewed as a food additive and considered safe, conc should be below conc of concern	http://onlinelibrary.wiley.com/doi/10.2903/j.efsa.2016.4436/epdf
Molecular size $\geq 4.3\text{nm}$	No	0.494 nm	Advances in electronic structure theory: GAMESS a decade later" M.S.Gordon, M.W.Schmidt pp. 1167-1189, in "Theory and Applications of Computational Chemistry: the first forty years" C.E.Dykstra, G.Frenking, K.S.Kim, G.E.Scuseria (editors), Elsevier, Amsterdam, 2005
Molecular weight $\geq 1100\text{g/mol}$	No	94.14	EPA EPI Suite v 4.1
Octanol solubility $\leq 0.002\text{mmol/l}$	No	0.22 mol/L (or $2.2 \times 10^5 \mu\text{mol/L}$)	SPARC, ARCHem Physicochemical calculator, 2010

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*If weight of evidence indicates
bioaccumulation unlikely (i.e. YES answers)
substance is not bioaccumulative*

*If weight of evidence indicates
bioaccumulation a possibility (i.e. NO
answers), BCF data should be obtained*

Is sufficient data available? (if not assume substance bioaccumulates)	Yes		
Is substance bioaccumulative?	No	based on log Kow of -2.36	KOWWIN (EPA EPI Suite v 4.1)

Toxicity

Is the lowest chronic NOEC for freshwater or marine organisms $\leq 0.01\text{mg/l}$	No, chronic DM, acute 3-pk, and MOA WoE included	Daphnia magna 21-d Chronic Reproduction and Growth: LOEC, MATC > 10.0 mg/L NOEC = 10.0 mg/L Limit test, no effect	Louch, D.W., et al. Methylsilanetriol (derived from Methyltrimethoxysilane): A 21-day Chronic Toxicity Study with the Freshwater Cladoceran, Daphnia magna. Dow Report No. K-006040-005
		Algal 72-h ErC50 > 120 mg/L, NOECr ≥ 120 mg/L	Drottar, K. R. Methyltrimethoxysilane: Freshwater Alga, Pseudokirchneriella subcapitata, Growth Inhibition Test. DC Internal Report No. 2007-I0000-58130
		Daphnia magna 48-h EC50 > 122 mg/L	Drottar, K. R. Methyltrimethoxysilane: Acute Toxicity to the Cladoceran, Daphnia magna, Under Flow-Through Test Conditions. DC Internal Report No. 2007-I0000-58362
		Rainbow trout 96-h LC50 > 110 mg/L	Drottar, K. R. Methyltrimethoxysilane: Acute Toxicity to the Rainbow Trout (Oncorhynchus mykiss) Under Flow-Through Test Conditions. DC Internal Report No. 2007-I0000-58364

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The work of Redman et al. (2012) and Mackay et al. (2015) both found the pelagic and benthic data on cyclic siloxanes consistent with a narcotic mode of action (MOA). Mackay et al. (2015) also suggested that with these materials, most aquatic organisms will fail to achieve an effect-level critical body burden under standard test durations, even when tested at the solubility limit; he attributed this absence of an effect to uptake/elimination kinetics and poor assimilation efficiency. This theory is consistent with experimental findings, both for pelagic and benthic exposures, and it suggests that other silicone-containing molecules such as the silanols will likely be active via a narcotic MOA (Fairbrother and Woodburn, 2016; Gobas et al., 2015).	Fairbrother, A; Woodburn, K. 2016. Assessing the aquatic risks of the cyclic volatile methyl siloxane D4. Environ. Sci. Technol. Letters. 10: 359-363. Gobas F, Xu S, Kozerski G, Powell D, Woodburn K, Mackay D, Fairbrother A. 2015. Fugacity and activity analysis of the bioaccumulation and environmental risks of decamethylcyclopentasiloxane (D5). Environ. Toxicol. Chem. 34: 2723-2731. Mackay D, Powell DE, Woodburn KB. 2015. Bioconcentration and aquatic toxicity of superhydrophobic chemicals: A modeling case study of cyclic volatile methyl siloxanes. Environ. Sci. Technol. 49: 11913-11922. Redman AD, Mihaich E, Woodburn K, Paquin P, Powell D, McGrath JA, Di Toro DM. 2012. Tissue-based risk assessment of cyclic volatile methyl siloxanes. Environ. Toxicol. Chem. 31: 1911-1919.
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Is there substantial evidence of long term toxicity (STOT RE1 or STOT RE2)	No	Safe as food additives	http://onlinelibrary.wiley.com/doi/10.2903/j.efsa.2016.4436/epdf
Is substance carcinogenic (Carc 1A,1B), mutagenic (Muta 1A, 1B) or toxic for reproduction (Repr 1A, 1B, 2)	No	Safe as food additives	http://onlinelibrary.wiley.com/doi/10.2903/j.efsa.2016.4436/epdf

If answer to any question is YES, substance is toxic

If answer to all questions is NO, substance is not toxic

Is sufficient data available? (if not assume substance is toxic)	Yes
Is substance toxic?	No

IS SUBSTANCE PERSISTENT, BIOACCUMULATIVE AND TOXIC?

Does substance pose an equivalent level of concern?

Very persistent and very bioaccumulative?

Half-life in marine, fresh or estuarine water $\geq$ 60 days	Borderline	Read across to DMSD, under certain conditions abiotic degradation rate could be significantly below 60 days but under other conditions it may be greater than 60 days	Buch, R.R., Lane, T.H., Annelin, R.B., Frye, C.L., 1984. Photolytic oxidative demethylation of aqueous dimethylsiloxanols. Environmental Toxicology and Chemistry 3, 215-222. Jaeshin Kim - study underway
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Half-life in marine, fresh or estuarine sediment ≥ 180 days	Not applicable	Very water soluble, $K_{oc} < 0.2$, preferentially partitions to water over sediment	Read across to DMSD; Kim, J., Miller, J.A. Sorption Behavior of 14C-Dimethylsilanediol (14C-DMSD)(CAS Number 1066-42-8) on Different Soil Types Using a Batch Equilibrium Method. DC Internal Report No. 2014-I0000-71298
Half-life in soil ≥ 180 days	No data available	NA	NA

If answer to any question is YES, substance is very persistent

Is bioconcentration factor ≥ 5000	No	Based on log Kow of -2.36	KOWWIN (EPA EPI Suite v 4.1)
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If answer is yes, substance is very bioaccumulative

Is substance very persistent and very bioaccumulative?	Borderline for vP; No for vB		
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Does substance pose a specific risk to groundwater?

Does groundwater monitoring data show Half-life in groundwater ≥ 1 year	No data available	NA	NA
Do $\geq 5\%$ of groundwater samples show levels of the substance greater than the LOQ?	No data available	NA	NA
Do $\geq 15\%$ of sites have at least one sample where the substance is detected above the LOQ?	No data available	NA	NA

If answer to any question is YES, substance is persistent in groundwater

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Is substance persistent in groundwater?	No data available	NA	NA
<i>If substance is persistent in groundwater, bioaccumulative AND toxic, substance is hazardous</i>			
Does substance pose a specific risk to groundwater?	No data available	NA	NA
Is substance very toxic?			
Is substance mutagenic (Muta 1A, 1B,2) or have no determinable threshold for adverse effects on human health	No	Negative in in vitro and in vivo tests (cited by EFSA): http://onlinelibrary.wiley.com/doi/10.2903/j.efsa.2016.4436/epdf	QSAR predicted negative for mutagenicity; In addition, substance has been used for decades as an oral silicon supplement for bone and connective tissue health. Ravin Jugdaohsingh et al (2013) conclude that it is safe, is absorbed and undergoes sufficient metabolism in vivo to raise fasting serum silicon levels, consistent with other well absorbed forms of dietary silicon (e.g. orthosilicic acid). It thus appears to be a suitable silicon supplement. European Food Safety organization (EFSA) considers methylsilanetriol suitable for use as a nutritional supplement based on available safety data. http://onlinelibrary.wiley.com/doi/10.2903/j.efsa.2016.4436/epdf
<i>If answer to any question is YES, substance is very toxic and hazardous</i>			

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Is sufficient data available? (if not assume substance is very toxic)	Yes	
Is substance very toxic?	No	
Is substance hazardous to groundwater?	No	Substance is not considered hazardous to groundwater. Considered persistent but not expected to bioaccumulate or be hazardous to the aquatic environment; substance is not considered to be toxic to human health
Is substance hazardous, if so, state on what basis	NA	
Does substance have breakdown products of concern?	No	This substance is expected to have final breakdown products of CO ₂ , silicic acid, silica

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Appendix B Historical Data Tables

Table A1 – MST and Silicic Acid in Surface Waters

Analyte (ug/l)	Cadoxton North Pond			Cadoxton South Pond			Timber Pond		
	2017-Q1	2017-Q3	2018-Q1	2017-Q1	2017-Q3	2018-Q1	2017-Q1	2017-Q3	2018-Q1
MST	-	1,500	17,400	-	-	7,000	38,300	36,000	33,400
DMSD	-	2,200	12,600	-	-	5,300	19,800	20,400	18,100
Silicic Acid	-	6,800	23,300	-	-	25,800	5,300	3,300	2,300
TMS	-	-	<0.1	-	-	150	-	-	<0.1

Table A2 – Metal Detections in Surface Waters

Monitoring Round		Aluminium	Arsenic	Boron	Cadmium	Calcium (mg/L)	Chromium (III+VI)	Copper	Iron	Lead	Magnesium (mg/l)	Manganese	Mercury	Nickel	Selenium	Zinc
		EQS (µg/L)	15	50	2000	0.08	-	-	1	1000	1.2	-	123	0.07	4	-
2015-Q1	Cadoxton Pond N	112	<MDL	145	<MDL	200	<MDL	<MDL	337	<MDL	25	434	<MDL	<MDL	<MDL	3.35
	Cadoxton Pond S	432	<MDL	197	<MDL	109	<MDL	<MDL	422	<MDL	23	130	1.97	<MDL	<MDL	5.56
	Timber Pond	9.25	<MDL	190	<MDL	518	<MDL	11	147	<MDL	18	207	6.50	<MDL	<MDL	2.16
2015-Q3	Cadoxton Pond N	0	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
	Cadoxton Pond S	0	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
	Timber Pond	0	<MDL	216	<MDL	530	<MDL	7.56	140	6.29	20	179	<MDL	<MDL	<MDL	5.71
2016-Q1	Cadoxton Pond N	47	<MDL	139	<MDL	131	4.49	5.82	648	<MDL	20	161	<MDL	<MDL	<MDL	11.1
	Cadoxton Pond S	36	<MDL	175	<MDL	127	<MDL	5.32	169	<MDL	20	87	<MDL	<MDL	<MDL	6.75
	Timber Pond	0	<MDL	<MDL	<MDL	397	<MDL	15	<MDL	<MDL	15	<MDL	<MDL	<MDL	<MDL	7.95
2016-Q3	Cadoxton Pond N	87	<MDL	220	<MDL	<MDL	<MDL	3.46	506	<MDL	26	287	<MDL	<MDL	<MDL	4.99
	Cadoxton Pond S	109	<MDL	287	<MDL	<MDL	<MDL	2.58	513	<MDL	27	255	<MDL	<MDL	<MDL	6.94
	Timber Pond	0	<MDL	221	<MDL	425	<MDL	4.85	139	7.00	17	179	<MDL	<MDL	<MDL	2.77
2017-Q1	Cadoxton Pond N	42	<MDL	118	1.27	74	<MDL	12	752	5.18	16	115	15	<MDL	<MDL	13
	Cadoxton Pond S	59	<MDL	179	0.51	79	<MDL	3.69	193	5.42	19	78	13	<MDL	<MDL	14
	Timber Pond	3.21	<MDL	155	0.59	297	<MDL	10	50	9.27	12	36	16	<MDL	<MDL	5.50
2017-Q3	Cadoxton Pond N	90	4.94	261	<MDL	94	<MDL	<MDL	397	5.00	24	181	17	<MDL	<MDL	6.29
	Cadoxton Pond S	75	4.91	197	<MDL	92	<MDL	<MDL	579	<MDL	24	344	9.37	<MDL	<MDL	2.24
	Timber Pond	16	<MDL	186	<MDL	386	<MDL	19	275	<MDL	14	365	<MDL	<MDL	<MDL	8.19

EQS exceedances in bold.

<MDL – Less than the Method Detection Limit

Cadoxton Pond N = North

Cadoxton Pond S = South

Table A3 - Inorganics in Surface Waters

Monitoring Round	Well	COD	Chloride (ppm)	Total Alkalinity	Alkalinity (as Carbonates)	pH	Sulphates	Hardness (mg equ. CaCO ₃ /L)
2015-Q1	Cadoxton Pond N	30	483	208	<MDL	8.07	<MDL	605
	Cadoxton Pond S	22	211	258	<MDL	8.07	<MDL	370
	Timber Pond	108	120	82	<MDL	7.8	<MDL	1,368
2015-Q3	Cadoxton Pond N	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
	Cadoxton Pond S	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
	Timber Pond	84	118	86	<MDL	6.89	<MDL	1,403
2016-Q1	Cadoxton Pond N	26	ND	188	<MDL	8.42	<MDL	410
	Cadoxton Pond S	25	ND	214	<MDL	8.64	<MDL	400
	Timber Pond	<MDL	ND	84	<MDL	7.78	<MDL	1,052
2016-Q3	Cadoxton Pond N	30	83	176	<MDL	8.03	<MDL	<MDL
	Cadoxton Pond S	31	327	234	<MDL	7.93	<MDL	<MDL
	Timber Pond	75	187	78	<MDL	7.24	<MDL	1,129
2017-Q1	Cadoxton Pond N	29	230	195	22	8.17	<MDL	252
	Cadoxton Pond S	25	211	249	<MDL	8.06	<MDL	274
	Timber Pond	69	77	98	<MDL	7.67	<MDL	792
2017-Q3	Cadoxton Pond N	32	286	238	<MDL	8.21	<MDL	331
	Cadoxton Pond S	33	362	188	<MDL	7.99	<MDL	327
	Timber Pond	88	92	73	<MDL	7.06	<MDL	1,023

<MDL – Less than the Method Detection Limit

Cadoxton Pond N = North Cadoxton Pond S = South

Appendix C Laboratory Analysis Tables

Table 1
Stratified Water Analytical Results
Landfill Assessment
Dow Corning Ltd

[illegible]

Table 1
Stratified Water Analytical Results
Landfill Assessment
Dow Corning Ltd

	Units	Method Detection Limit	GAC_WTV_EN /WA_EQS- Fresh	WL_DowComi ng_Barry_EQS _Fresh	Location Date Screen Depth	TP21					TP22			
						06/09/2018					06/09/2018			
						0.2	1	2	3	4	0.2	1	2	3
Halogenated Hydrocarbons														
Dichlorodifluoromethane	µg/L	1				<1	<1	<1	<1	<1	<1	<1	<1	<1
Bromomethane	µg/L	1				<1	<1	<1	<1	<1	<1	<1	<1	<1
Trichlorofluoromethane	µg/L	1				<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dibromoethane	µg/L	1				<1	<1	<1	<1	<1	<1	<1	<1	<1
Halogenated Phenols														
2-chlorophenol	µg/L	1	50 ^{#6}			<1	<1	<1	<1	<1	<1	<1	<1	<1
2,4-dichlorophenol	µg/L	1	4.2 ^{#2}			<1	<1	<1	<1	<1	<1	<1	<1	<1
2,4,5-trichlorophenol	µg/L	1				<1	<1	<1	<1	<1	<1	<1	<1	<1
2,4,6-trichlorophenol	µg/L	1				<1	<1	<1	<1	<1	<1	<1	<1	<1
Pentachlorophenol	µg/L	1	0.4 ^{#3}			<1	<1	<1	<1	<1	<1	<1	<1	<1
Phthalates														
Bis(2-ethylhexyl) phthalate	µg/L	2	1.3 ^{#3}			<2	<2	<2	<2	<2	<2	<2	<2	<2
Butyl benzyl phthalate	µg/L	1	7.5 ^{#2}			<1	<1	<1	<1	<1	<1	<1	<1	<1
Di-n-butyl phthalate	µg/L	1	8 ^{#6}			<1	<1	<1	<1	<1	<1	<1	<1	<1
Di-n-octyl phthalate	µg/L	5	20 ^{#6}			<5	<5	<5	<5	<5	<5	<5	<5	<5
Diethylphthalate	µg/L	1	200 ^{#6}			<1	<1	<1	<1	<1	<1	<1	<1	<1
Dimethyl phthalate	µg/L	1	800 ^{#6}			<1	<1	<1	<1	<1	<1	<1	<1	<1
Solvents														
Carbon disulfide	µg/L	1				<1	<1	<1	<1	<1	<1	<1	<1	<1
Isophorone	µg/L	1				<1	<1	<1	<1	<1	<1	<1	<1	<1
Metals														
Arsenic (Filtered)	µg/L	0.5	50 ^{#2}			2.44	2.52	3.95	8.32	11.3	2.6	2.37	6.01	9.12
Barium (Filtered)	µg/L	0.2				304	303	629	878	1,420	302	312	833	907
Beryllium (Filtered)	µg/L	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Boron (Filtered)	µg/L	10	2,000 ^{#8}			186	185	243	320	357	193	192	286	327
Cadmium (Filtered)	µg/L	0.08	0.08 ^{#3}			<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Calcium (Filtered)	mg/L	2.27				525	525	1,250	2,200	2,280	417	517	1,840	2,170
Chromium (III+VI) (Filtered)	µg/L	1				<1	<1	<1	<1	<1	<1	<1	<1	<1
Copper (Filtered)	µg/L	0.3	1 ^{#2}	6 ^{#9}		1.31	1.19	0.447	<0.3	<0.3	0.865	1.32	0.304	<0.3
Iron (Filtered)	µg/L	19	1,000 ^{#2}			25.7	30.3	26	21,500	166,000	32.4	24	180	28,100
Lead (Filtered)	µg/L	0.2	1.2 ^{#3}			<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Magnesium (Filtered)	mg/L	0.036				16.3	16	21.2	26.4	35.6	16.2	16.6	23.1	27
Mercury (Filtered)	µg/L	0.01	0.07 ^{#1}			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel (Filtered)	µg/L	0.4	4 ^{#3}			0.431	0.531	1.2	1.73	2.01	0.716	0.701	1.68	1.61
Selenium (Filtered)	µg/L	1				<1	<1	<1	<1	<1	<1	<1	<1	<1
Vanadium (Filtered)	µg/L	1	20 ^{#6}			<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc (Filtered)	µg/L	1	10.9 ^{#2}			1.64	2.32	1.64	1.01	3.32	2.05	1.98	1	<1
Potassium (Filtered)	mg/L	0.2				12.6	12.6	15.1	18.2	20.9	12.7	12.8	16.9	18.4
Organics														
TOC	mg/L	3				18	18.8	34	53.4	59.1	19.3	19.9	48.1	55.9
Inorganics														
Acidity	mg/L	4				9.13	5.48	5.48	18.3	106	<4	5.48	5.48	9.13
BOD	mg/L	1				<1	2.33	11.2	<1.5	<25	2.42	<1	11.4	<1.67
Sodium (Filtered)	mg/L	0.76				63.3	63.3	78.3	98.5	110	75.2	63.5	90.5	94.9
Bromide	µg/L	60				<60	355	<60	<60	912	361	413	<60	<60
Chloride	mg/L	10	250 ^{#6}			856	859	1,820	3,470	4,480	855	865	2,860	3,560
Nitrate (as NO3-)	mg/L	0.3				<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Nitrite (as NO2-)	mg/L	0.05				<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ortho Phosphate as PO4	mg/L	0.05				<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Sulphide	mg/L	0.01				<0.01	<0.01	<0.01	0.155	0.0566	<0.01	<0.01	<0.01	0.0548
Alkalinity (total) as CaCO3	mg/L	2				79.6	80	71.6	69.8	90.8	77.9	79.8	57.6	72.1
Alkalinity (Bicarbonate as CaCO3)	mg/L	2				79.6	80	71.6	69.8	90.8	77.9	79.8	57.6	72.1
Ammoniacal Nitrogen as N	mg/L	0.2	300 (total ammonia as nitrogen) ^{#2}			<0.2	<0.2	<0.2	3.1	21	<0.2	<0.2	<0.2	4.26
Sulphate (soluble)	mg/L	2				6.6	6.3	6	5	<2	6.4	6.7	6.4	4.2
COD	mg/L	14				98.2	108	209	413	397	97.8	108	332	415
pH (Lab)	pH Units	1				7.35	7.39	7.41	6.72	6.18	7.48	7.4	7.56	6.81
TSS	mg/L	2				<6	<6	22.2	71.7	233	3.6	5.9	32.7	71.3
Other														
methylsilanetriol	µg/L					36500	37300	62600	100300	79400	34300	32200	80400	108000
Dimethyl Silanediol	µg/L					21,000	21,100	44,500	78,400	65,300	20,100	19,400	62,500	81,000
Silicic Acid	µg/L					1400	1400	5700	11600	7800	1200	1200	8100	12100
Trimethylsilanol	µg/L			124 ^{#8}		<100	<100	500	1,300	1,000	<100	<100	1,100	1,400

Comments
#1 WFD England/Wales . 2015 - MAC-EQS Inland
#2 WFD England/Wales . 2015 - Freshwater Standards
#3 WFD England/Wales . 2015 - AA-EQS Inland
#4 Water Env't Regs (Scotland) 2015. AA-EQS Inland
#5 SEPA WAT-SG-53 Fresh EQS - MAC - 2015
#6 SEPA WAT-SG-53 Fresh EQS - AA - 2015
#7 PNEC (EU REACH) - Freshwater
#8 PNEC - data provided by Dow Corning
#9 Hardness - assumed value - data required.
GAC: Generic Assessment Criteria
SSAC: Site Specific Assessment Criteria
(blank): No assessment criteria available
- : Not analysed
EQS: Environmental Quality Standard

Key
XXX Exceedance of CW/WE Water. Aquatic Toxicity - England/Wales - Freshwater
XXX Exceedance of WL_DowCorning_Barry_EQS_Fresh

Appendix D Laboratory Certificates



Unit 7-8 Hawarden Business Park
Manor Road (off Manor Lane)
Hawarden
Deeside
CH5 3US

Tel: (01244) 528700

Fax: (01244) 528701

email: hawardencustomerservices@alsglobal.com

Website: www.alsenvironmental.co.uk

Aecom
1 Callaghan Square
Cardiff
CF10 5BT

Attention: Marika Gates

CERTIFICATE OF ANALYSIS

Date: 20 September 2018
Customer: H_AECOM_CDF
Sample Delivery Group (SDG): 180907-35
Your Reference: Dow
Location: Barry
Report No: 473276

This report has been revised and directly supersedes 472223 in its entirety.

We received 9 samples on Friday September 07, 2018 and 9 of these samples were scheduled for analysis which was completed on Thursday September 20, 2018. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

Chemical testing (unless subcontracted) performed at ALS Environmental Hawarden (Method codes TM) or ALS Environmental Aberdeen (Method codes S).

Approved By:

Sonia McWhan

Operations Manager





CERTIFICATE OF ANALYSIS

Validated

SDG:	180907-35	Client Reference:	Dow	Report Number:	473276
Location:	Barry	Order Number:	60585570	Superseded Report:	472223

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
18277672	TP21		0.20	06/09/2018
18277673	TP21		1.00	06/09/2018
18277674	TP21		2.00	06/09/2018
18277675	TP21		3.00	06/09/2018
18277676	TP21		4.00	06/09/2018
18277677	TP22		0.20	06/09/2018
18277678	TP22		1.00	06/09/2018
18277679	TP22		2.00	06/09/2018
18277680	TP22		3.00	06/09/2018

Maximum Sample/Coolbox Temperature (°C) : 10.2

ISO5667-3 Water quality - Sampling - Part3 -

During Transportation samples shall be stored in a cooling device capable of maintaining a temperature of (5±3)°C.

ALS have data which show that a cool box with 4 frozen icepacks is capable of maintaining pre-chilled samples at a temperature of (5±3)°C for a period of up to 24hrs.

Only received samples which have had analysis scheduled will be shown on the following pages.



CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: Barry

Client Reference: Dow
Order Number: 60585570

Report Number: 473276
Superseded Report: 472223

Results Legend

X Test
N No Determination Possible

Sample Types -

S - Soil/Solid
UNS - Unspecified Solid
GW - Ground Water
SW - Surface Water
LE - Land Leachate
PL - Prepared Leachate
PR - Process Water
SA - Saline Water
TE - Trade Effluent
TS - Treated Sewage
US - Untreated Sewage
RE - Recreational Water
DW - Drinking Water Non-regulatory
UNL - Unspecified Liquid
SL - Sludge
G - Gas
OTH - Other

	Lab Sample No(s)		18277672		18277673		18277674	
	Customer Sample Reference		TP21		TP21		TP21	
	AGS Reference							
	Depth (m)		0.20		1.00		2.00	
	Container		H2SO4 (ALE244)		H2SO4 (ALE244)		H2SO4 (ALE244)	
	Sample Type		SW		SW		SW	
Acidity as HCl	All	NDPs: 0 Tests: 9		X		X		X
Alkalinity as CaCO3	All	NDPs: 0 Tests: 9		X		X		X
Ammoniacal Nitrogen	All	NDPs: 0 Tests: 9			X			X
Anions by ion Chromatography	All	NDPs: 0 Tests: 9		X		X		X
Anions by Kone (w)	All	NDPs: 0 Tests: 9		X		X		X
BOD True Total	All	NDPs: 0 Tests: 9	X		X		X	
COD Unfiltered	All	NDPs: 0 Tests: 9	X		X		X	
Dissolved Metals by ICP-MS	All	NDPs: 0 Tests: 9						
EPH CWG (Aliphatic) Aqueous GC (W)	All	NDPs: 0 Tests: 9	X		X		X	
EPH CWG (Aromatic) Aqueous GC (W)	All	NDPs: 0 Tests: 9	X		X		X	
GRO by GC-FID (W)	All	NDPs: 0 Tests: 9						
Mercury Dissolved	All	NDPs: 0 Tests: 9						
Nitrite by Kone (w)	All	NDPs: 0 Tests: 9						
pH Value	All	NDPs: 0 Tests: 9		X		X		X
Phosphate by Kone (w)	All	NDPs: 0 Tests: 9		X		X		X



CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: Barry

Client Reference: Dow
Order Number: 60585570

Report Number: 473276
Superseded Report: 472223

Results Legend



Test



No Determination Possible

Sample Types -

S - Soil/Solid
UNS - Unspecified Solid
GW - Ground Water
SW - Surface Water
LE - Land Leachate
PL - Prepared Leachate
PR - Process Water
SA - Saline Water
TE - Trade Effluent
TS - Treated Sewage
US - Untreated Sewage
RE - Recreational Water
DW - Drinking Water Non-regulatory
UNL - Unspecified Liquid
SL - Sludge
G - Gas
OTH - Other

	Lab Sample No(s)		18277677		18277678		18277679	
	Customer Sample Reference		TP22		TP22		TP22	
	AGS Reference							
	Depth (m)		0.20		1.00		2.00	
	Container		H2SO4 (ALE244)		H2SO4 (ALE244)		H2SO4 (ALE244)	
	Sample Type		SW		SW		SW	
Acidity as HCl	All	NDPs: 0 Tests: 9		X		X		X
Alkalinity as CaCO3	All	NDPs: 0 Tests: 9		X		X		X
Ammoniacal Nitrogen	All	NDPs: 0 Tests: 9			X			X
Anions by ion Chromatography	All	NDPs: 0 Tests: 9		X		X		X
Anions by Kone (w)	All	NDPs: 0 Tests: 9		X		X		X
BOD True Total	All	NDPs: 0 Tests: 9	X		X		X	
COD Unfiltered	All	NDPs: 0 Tests: 9	X		X		X	
Dissolved Metals by ICP-MS	All	NDPs: 0 Tests: 9						
EPH CWG (Aliphatic) Aqueous GC (W)	All	NDPs: 0 Tests: 9	X		X		X	
EPH CWG (Aromatic) Aqueous GC (W)	All	NDPs: 0 Tests: 9	X		X		X	
GRO by GC-FID (W)	All	NDPs: 0 Tests: 9						
Mercury Dissolved	All	NDPs: 0 Tests: 9						
Nitrite by Kone (w)	All	NDPs: 0 Tests: 9						
pH Value	All	NDPs: 0 Tests: 9		X		X		X
Phosphate by Kone (w)	All	NDPs: 0 Tests: 9		X		X		X



CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: Barry

Client Reference: Dow
Order Number: 60585570

Report Number: 473276
Superseded Report: 472223

Results Legend			Customer Sample Ref.		TP21	TP21	TP21	TP21	TP21	TP22
#	ISO17025 accredited.		Depth (m) Sample Type Date Sampled Sampled Time Date Received SDG Ref Lab Sample No.(s) AGS Reference		0.20	1.00	2.00	3.00	4.00	0.20
M	mCERTS accredited.				Surface Water (SW)	Surface Water (SW)	Surface Water (SW)	Surface Water (SW)	Surface Water (SW)	Surface Water (SW)
aq	Aqueous / settled sample.				06/09/2018	06/09/2018	06/09/2018	06/09/2018	06/09/2018	06/09/2018
diss.filt	Dissolved / filtered sample.									
tot.unfilt	Total / unfiltered sample.				07/09/2018	07/09/2018	07/09/2018	07/09/2018	07/09/2018	07/09/2018
*	Subcontracted test.				180907-35	180907-35	180907-35	180907-35	180907-35	180907-35
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery				18277672	18277673	18277674	18277675	18277676	18277677
(F)	Trigger breach confirmed									
1-5&*\$@	Sample deviation (see appendix)									
Component	LOD/Units	Method								
Suspended solids, Total	<2 mg/l	TM022	<6	#	<6	#	22.2	#	233	#
Alkalinity, Total as CaCO3	<2 mg/l	TM043	79.6	#	80	#	71.6	#	90.8	#
Alkalinity, Bicarbonate as CaCO3	<2 mg/l	TM043	79.6	#	80	#	71.6	#	90.8	#
BOD, unfiltered	<1 mg/l	TM045	<1	#	2.33	#	11.2	#	<25	#
Organic Carbon, Total	<3 mg/l	TM090	18	#	18.8	#	34	#	59.1	#
Acidity as HCl	<4 mg/l	TM094	9.13	#	5.48	#	5.48	#	106	#
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099	<0.2	#	<0.2	#	<0.2	#	21	#
Sulphide	<0.01 mg/l	TM101	<0.01	#	<0.01	#	<0.01	#	0.0566	#
COD, unfiltered	<7 mg/l	TM107	98.2	#	108	#	209	#	397	#
Arsenic (diss.filt)	<0.5 µg/l	TM152	2.44	#	2.52	#	3.95	#	11.3	#
Barium (diss.filt)	<0.2 µg/l	TM152	304	#	303	#	629	#	1420	#
Beryllium (diss.filt)	<0.1 µg/l	TM152	<0.1	#	<0.1	#	<0.1	#	<0.1	#
Boron (diss.filt)	<10 µg/l	TM152	186	#	185	#	243	#	357	#
Cadmium (diss.filt)	<0.08 µg/l	TM152	<0.08	#	<0.08	#	<0.08	#	<0.08	#
Chromium (diss.filt)	<1 µg/l	TM152	<1	#	<1	#	<1	#	<1	#
Copper (diss.filt)	<0.3 µg/l	TM152	1.31	#	1.19	#	0.447	#	<0.3	#
Lead (diss.filt)	<0.2 µg/l	TM152	<0.2	#	<0.2	#	<0.2	#	<0.2	#
Nickel (diss.filt)	<0.4 µg/l	TM152	0.431	#	0.531	#	1.2	#	2.01	#
Selenium (diss.filt)	<1 µg/l	TM152	<1	#	<1	#	<1	#	<1	#
Vanadium (diss.filt)	<1 µg/l	TM152	<1	#	<1	#	<1	#	<1	#
Zinc (diss.filt)	<1 µg/l	TM152	1.64	#	2.32	#	1.64	#	3.32	#
Sodium (Dis.Filt)	<0.076 mg/l	TM152	63.3	#	63.3	#	78.3	#	110	#
Magnesium (Dis.Filt)	<0.036 mg/l	TM152	16.3	#	16	#	21.2	#	35.6	#
Potassium (Dis.Filt)	<0.2 mg/l	TM152	12.6	#	12.6	#	15.1	#	20.9	#
Calcium (Dis.Filt)	<0.2 mg/l	TM152	525	#	525	#	1250	#	2280	#
Iron (Dis.Filt)	<0.019 mg/l	TM152	0.0257	#	0.0303	#	0.026	#	166	#
Mercury (diss.filt)	<0.01 µg/l	TM183	<0.01	#	<0.01	#	<0.01	#	<0.01	#
Nitrite as NO2	<0.05 mg/l	TM184	<0.05	#	<0.05	#	<0.05	#	<0.05	#
Phosphate (Ortho as PO4)	<0.05 mg/l	TM184	<0.05	#	<0.05	#	<0.05	#	<0.05	#
Sulphate	<2 mg/l	TM184	6.6	#	6.3	#	6	#	<2	#
Chloride	<2 mg/l	TM184	856	#	859	#	1820	#	4480	#
Nitrate as NO3	<0.3 mg/l	TM184	<0.3	#	<0.3	#	<0.3	#	<0.3	#



CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: Barry

Client Reference: Dow
Order Number: 60585570

Report Number: 473276
Superseded Report: 472223

Results Legend			Customer Sample Ref.			TP22			TP22			TP22					
#	ISO17025 accredited.		Depth (m) Sample Type Date Sampled Sampled Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	1.00 Surface Water (SW) 06/09/2018 07/09/2018 180907-35 18277678	2.00 Surface Water (SW) 06/09/2018 07/09/2018 180907-35 18277679	3.00 Surface Water (SW) 06/09/2018 07/09/2018 180907-35 18277680											
M	mCERTS accredited.																
aq	Aqueous / settled sample.																
diss.filt	Dissolved / filtered sample.																
tot.unfilt	Total / unfiltered sample.																
*	Subcontracted test.																
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery																
(F)	Trigger breach confirmed																
1-5&	Sample deviation (see appendix)																
Component	LOD/Units	Method															
Suspended solids, Total	<2 mg/l	TM022	5.9	#		32.7	#		71.3	#							
Alkalinity, Total as CaCO3	<2 mg/l	TM043	79.8	#		57.6	#		72.1	#							
Alkalinity, Bicarbonate as CaCO3	<2 mg/l	TM043	79.8	#		57.6	#		72.1	#							
BOD, unfiltered	<1 mg/l	TM045	<1	#		11.4	#		<1.67	#							
Organic Carbon, Total	<3 mg/l	TM090	19.9	#		48.1	#		55.9	#							
Acidity as HCl	<4 mg/l	TM094	5.48	#		5.48	#		9.13	#							
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099	<0.2	#		<0.2	#		4.26	#							
Sulphide	<0.01 mg/l	TM101	<0.01	#		<0.01	#		0.0548	#							
COD, unfiltered	<7 mg/l	TM107	108	#		332	#		415	#							
Arsenic (diss.filt)	<0.5 µg/l	TM152	2.37	#		6.01	#		9.12	#							
Barium (diss.filt)	<0.2 µg/l	TM152	312	#		833	#		907	#							
Beryllium (diss.filt)	<0.1 µg/l	TM152	<0.1	#		<0.1	#		<0.1	#							
Boron (diss.filt)	<10 µg/l	TM152	192	#		286	#		327	#							
Cadmium (diss.filt)	<0.08 µg/l	TM152	<0.08	#		<0.08	#		<0.08	#							
Chromium (diss.filt)	<1 µg/l	TM152	<1	#		<1	#		<1	#							
Copper (diss.filt)	<0.3 µg/l	TM152	1.32	#		0.304	#		<0.3	#							
Lead (diss.filt)	<0.2 µg/l	TM152	<0.2	#		<0.2	#		<0.2	#							
Nickel (diss.filt)	<0.4 µg/l	TM152	0.701	#		1.68	#		1.61	#							
Selenium (diss.filt)	<1 µg/l	TM152	<1	#		<1	#		<1	#							
Vanadium (diss.filt)	<1 µg/l	TM152	<1	#		<1	#		<1	#							
Zinc (diss.filt)	<1 µg/l	TM152	1.98	#		1	#		<1	#							
Sodium (Dis.Filt)	<0.076 mg/l	TM152	63.5	#		90.5	#		94.9	#							
Magnesium (Dis.Filt)	<0.036 mg/l	TM152	16.6	#		23.1	#		27	#							
Potassium (Dis.Filt)	<0.2 mg/l	TM152	12.8	#		16.9	#		18.4	#							
Calcium (Dis.Filt)	<0.2 mg/l	TM152	517	#		1840	#		2170	#							
Iron (Dis.Filt)	<0.019 mg/l	TM152	0.024	#		0.18	#		28.1	#							
Mercury (diss.filt)	<0.01 µg/l	TM183	<0.01	#		<0.01	#		<0.01	#							
Nitrite as NO2	<0.05 mg/l	TM184	<0.05	#		<0.05	#		<0.05	#							
Phosphate (Ortho as PO4)	<0.05 mg/l	TM184	<0.05	#		<0.05	#		<0.05	#							
Sulphate	<2 mg/l	TM184	6.7	#		6.4	#		4.2	#							
Chloride	<2 mg/l	TM184	865	#		2860	#		3560	#							
Nitrate as NO3	<0.3 mg/l	TM184	<0.3	#		<0.3	#		<0.3	#							



CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: BarryClient Reference: Dow
Order Number: 60585570Report Number: 473276
Superseded Report: 472223

SVOC MS (W) - Aqueous

Results Legend			Customer Sample Ref.	TP21	TP21	TP21	TP21	TP21	TP22
#	ISO17025 accredited.		Depth (m) Sample Type Date Sampled Sampled Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	0.20	1.00	2.00	3.00	4.00	0.20
M	mCERTS accredited.			Surface Water (SW)	Surface Water (SW)	Surface Water (SW)	Surface Water (SW)	Surface Water (SW)	Surface Water (SW)
aq	Aqueous / settled sample.			06/09/2018	06/09/2018	06/09/2018	06/09/2018	06/09/2018	06/09/2018
diss.filt	Dissolved / filtered sample.								
tot.unfilt	Total / unfiltered sample.								
*	Subcontracted test.								
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery			07/09/2018	07/09/2018	07/09/2018	07/09/2018	07/09/2018	07/09/2018
(F)	Trigger breach confirmed			180907-35	180907-35	180907-35	180907-35	180907-35	180907-35
1-5&*\$@	Sample deviation (see appendix)			18277672	18277673	18277674	18277675	18277676	18277677
Component	LOD/Units	Method							
1,2,4-Trichlorobenzene (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
1,2-Dichlorobenzene (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
1,3-Dichlorobenzene (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
1,4-Dichlorobenzene (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
2,4,5-Trichlorophenol (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
2,4,6-Trichlorophenol (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
2,4-Dichlorophenol (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
2,4-Dimethylphenol (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #	24.9 #	<1 #	<1 #
2,4-Dinitrotoluene (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
2,6-Dinitrotoluene (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
2-Chloronaphthalene (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
2-Chlorophenol (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
2-Methylnaphthalene (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #	5.03 #	<1 #	<1 #
2-Methylphenol (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
2-Nitroaniline (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
2-Nitrophenol (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
3-Nitroaniline (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
4-Bromophenylphenylether (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
4-Chloro-3-methylphenol (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
4-Chloroaniline (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
4-Chlorophenylphenylether (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
4-Methylphenol (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
4-Nitroaniline (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
4-Nitrophenol (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
Azobenzene (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
Acenaphthylene (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
Acenaphthene (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #	5.64 #	<1 #	<1 #
Anthracene (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
bis(2-Chloroethyl)ether (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
bis(2-Chloroethoxy)methane (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
bis(2-Ethylhexyl) phthalate (aq)	<2 µg/l	TM176		<2 #	<2 #	<2 #	<2 #	<2 #	<2 #
Butylbenzyl phthalate (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #



CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: Barry

Client Reference: Dow
Order Number: 60585570

Report Number: 473276
Superseded Report: 472223

SVOC MS (W) - Aqueous

Results Legend			Customer Sample Ref.	TP21	TP21	TP21	TP21	TP21	TP22
#	ISO17025 accredited.	Depth (m) Sample Type Date Sampled Sampled Time Date Received SDG Ref Lab Sample No.(s) AGS Reference		0.20	1.00	2.00	3.00	4.00	0.20
M	mCERTS accredited.			Surface Water (SW)	Surface Water (SW)	Surface Water (SW)	Surface Water (SW)	Surface Water (SW)	Surface Water (SW)
aq	Aqueous / settled sample.			06/09/2018	06/09/2018	06/09/2018	06/09/2018	06/09/2018	06/09/2018
diss.filt	Dissolved / filtered sample.			.	.	.	.	.	.
tot.unfilt	Total / unfiltered sample.			07/09/2018	07/09/2018	07/09/2018	07/09/2018	07/09/2018	07/09/2018
*	Subcontracted test.			180907-35	180907-35	180907-35	180907-35	180907-35	180907-35
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery			18277672	18277673	18277674	18277675	18277676	18277677
(F)	Trigger breach confirmed								
1-5&*\$@	Sample deviation (see appendix)								
Component	LOD/Units	Method							
Benzo(a)anthracene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #	
Benzo(b)fluoranthene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #	
Benzo(k)fluoranthene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #	
Benzo(a)pyrene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #	
Benzo(g,h,i)perylene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #	
Carbazole (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #	<1 #	5.14 #	<1 #	
Chrysene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #	
Dibenzofuran (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #	<1 #	3.13 #	<1 #	
n-Dibutyl phthalate (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #	
Diethyl phthalate (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #	
Dibenzo(a,h)anthracene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #	
Dimethyl phthalate (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #	
n-Dioctyl phthalate (aq)	<5 µg/l	TM176	<5 #	<5 #	<5 #	<5 #	<5 #	<5 #	
Fluoranthene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #	
Fluorene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #	<1 #	3.56 #	<1 #	
Hexachlorobenzene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #	
Hexachlorobutadiene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #	
Pentachlorophenol (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #	
Phenol (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #	
n-Nitroso-n-dipropylamine (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #	
Hexachloroethane (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #	
Nitrobenzene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #	
Naphthalene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #	<1 #	23.6 #	<1 #	
Isophorone (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #	
Hexachlorocyclopentadiene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #	
Phenanthrene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #	<1 #	2.5 #	<1 #	
Indeno(1,2,3-cd)pyrene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #	
Pyrene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #	
SVOC TIC (aq)		TM176	Not Detected	Not Detected	Detected	Detected	Detected	Not Detected	
Total SVOC TIC	<10 µg/l	TM176	<10	<10	36.8	144	208	<10	
Dimethylphenol	µg/l	TM176					25.3		
Ethylmethylphenol	µg/l	TM176					25.6		



CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: BarryClient Reference: Dow
Order Number: 60585570Report Number: 473276
Superseded Report: 472223

SVOC MS (W) - Aqueous

Results Legend			Customer Sample Ref.	TP22	TP22	TP22			
#	ISO17025 accredited.		Depth (m) Sample Type Date Sampled Sampled Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	1.00	2.00	3.00			
M	mCERTS accredited.			Surface Water (SW)	Surface Water (SW)	Surface Water (SW)			
aq	Aqueous / settled sample.			06/09/2018	06/09/2018	06/09/2018			
diss.filt	Dissolved / filtered sample.								
tot.unfilt	Total / unfiltered sample.								
*	Subcontracted test.								
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery								
(F)	Trigger breach confirmed			07/09/2018	07/09/2018	07/09/2018			
1-5&*\$@	Sample deviation (see appendix)			180907-35	180907-35	180907-35			
				18277678	18277679	18277680			
Component	LOD/Units	Method							
1,2,4-Trichlorobenzene (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #			
1,2-Dichlorobenzene (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #			
1,3-Dichlorobenzene (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #			
1,4-Dichlorobenzene (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #			
2,4,5-Trichlorophenol (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #			
2,4,6-Trichlorophenol (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #			
2,4-Dichlorophenol (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #			
2,4-Dimethylphenol (aq)	<1 µg/l	TM176		<1 #	<1 #	2.47 #			
2,4-Dinitrotoluene (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #			
2,6-Dinitrotoluene (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #			
2-Chloronaphthalene (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #			
2-Chlorophenol (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #			
2-Methylnaphthalene (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #			
2-Methylphenol (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #			
2-Nitroaniline (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #			
2-Nitrophenol (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #			
3-Nitroaniline (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #			
4-Bromophenylphenylether (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #			
4-Chloro-3-methylphenol (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #			
4-Chloroaniline (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #			
4-Chlorophenylphenylether (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #			
4-Methylphenol (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #			
4-Nitroaniline (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #			
4-Nitrophenol (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #			
Azobenzene (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #			
Acenaphthylene (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #			
Acenaphthene (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #			
Anthracene (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #			
bis(2-Chloroethyl)ether (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #			
bis(2-Chloroethoxy)methane (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #			
bis(2-Ethylhexyl) phthalate (aq)	<2 µg/l	TM176		<2 #	<2 #	<2 #			
Butylbenzyl phthalate (aq)	<1 µg/l	TM176		<1 #	<1 #	<1 #			



CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: Barry

Client Reference: Dow
Order Number: 60585570

Report Number: 473276
Superseded Report: 472223

SVOC MS (W) - Aqueous

Results Legend			Customer Sample Ref.					
#	ISO17025 accredited.		Depth (m) Sample Type Date Sampled Sampled Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	TP22 1.00 Surface Water (SW) 06/09/2018 07/09/2018 180907-35 18277678	TP22 2.00 Surface Water (SW) 06/09/2018 07/09/2018 180907-35 18277679	TP22 3.00 Surface Water (SW) 06/09/2018 07/09/2018 180907-35 18277680		
M	mCERTS accredited.							
aq	Aqueous / settled sample.							
diss.filt	Dissolved / filtered sample.							
tot.unfilt	Total / unfiltered sample.							
*	Subcontracted test.							
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery							
(F)	Trigger breach confirmed							
1-5&*\$@	Sample deviation (see appendix)							
Component	LOD/Units	Method						
Benzo(a)anthracene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #			
Benzo(b)fluoranthene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #			
Benzo(k)fluoranthene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #			
Benzo(a)pyrene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #			
Benzo(g,h,i)perylene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #			
Carbazole (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #			
Chrysene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #			
Dibenzofuran (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #			
n-Dibutyl phthalate (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #			
Diethyl phthalate (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #			
Dibenzo(a,h)anthracene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #			
Dimethyl phthalate (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #			
n-Dioctyl phthalate (aq)	<5 µg/l	TM176	<5 #	<5 #	<5 #			
Fluoranthene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #			
Fluorene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #			
Hexachlorobenzene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #			
Hexachlorobutadiene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #			
Pentachlorophenol (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #			
Phenol (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #			
n-Nitroso-n-dipropylamine (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #			
Hexachloroethane (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #			
Nitrobenzene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #			
Naphthalene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #			
Isophorone (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #			
Hexachlorocyclopentadiene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #			
Phenanthrene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #			
Indeno(1,2,3-cd)pyrene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #			
Pyrene (aq)	<1 µg/l	TM176	<1 #	<1 #	<1 #			
SVOC TIC (aq)		TM176	Not Detected	Detected	Detected			
Total SVOC TIC	<10 µg/l	TM176	<10	103	117			
Mixed Hydrocarbons	µg/l	TM176		87.4	97.8			
Pentamethylbenzoic acid	µg/l	TM176		15.8	19.3			



CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: Barry

Client Reference: Dow
Order Number: 60585570

Report Number: 473276
Superseded Report: 472223

TPH CWG (W)

Results Legend			Customer Sample Ref.	TP21	TP21	TP21	TP21	TP21	TP22
#	ISO17025 accredited.	Depth (m) Sample Type Date Sampled Sampled Time Date Received SDG Ref Lab Sample No.(s) AGS Reference		0.20 Surface Water (SW) 06/09/2018 07/09/2018 180907-35 18277672	1.00 Surface Water (SW) 06/09/2018 07/09/2018 180907-35 18277673	2.00 Surface Water (SW) 06/09/2018 07/09/2018 180907-35 18277674	3.00 Surface Water (SW) 06/09/2018 07/09/2018 180907-35 18277675	4.00 Surface Water (SW) 06/09/2018 07/09/2018 180907-35 18277676	0.20 Surface Water (SW) 06/09/2018 07/09/2018 180907-35 18277677
M	mCERTS accredited.								
aq	Aqueous / settled sample.								
diss.filt	Dissolved / filtered sample.								
tot.unfilt	Total / unfiltered sample.								
*	Subcontracted test.								
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery								
(F)	Trigger breach confirmed								
1-5&\$@	Sample deviation (see appendix)								
Component	LOD/Units	Method							
GRO Surrogate % recovery**	%	TM245	91	95	95	105	92	95	
GRO >C5-C12	<50 µg/l	TM245	<50 #	<50 #	347 #	1020 #	943 #	<50 #	
Methyl tertiary butyl ether (MTBE)	<3 µg/l	TM245	<3 #	<3 #	<3 #	<3 #	<3 #	<3 #	
Benzene	<7 µg/l	TM245	<7 #	<7 #	<7 #	<7 #	11 #	<7 #	
Toluene	<4 µg/l	TM245	<4 #	<4 #	<4 #	<4 #	<4 #	<4 #	
Ethylbenzene	<5 µg/l	TM245	<5 #	<5 #	<5 #	<5 #	<5 #	<5 #	
m,p-Xylene	<8 µg/l	TM245	<8 #	<8 #	<8 #	<8 #	<8 #	<8 #	
o-Xylene	<3 µg/l	TM245	<3 #	<3 #	<3 #	<3 #	3 #	<3 #	
Sum of detected Xylenes	<11 µg/l	TM245	<11	<11	<11	<11	<11	<11	
Sum of detected BTEX	<28 µg/l	TM245	<28	<28	<28	<28	<28	<28	
Aliphatics >C5-C6	<10 µg/l	TM245	<10	<10	161	455	346	<10	
Aliphatics >C6-C8	<10 µg/l	TM245	<10	<10	72	213	120	<10	
Aliphatics >C8-C10	<10 µg/l	TM245	<10	<10	53	148	113	<10	
Aliphatics >C10-C12	<10 µg/l	TM245	<10	<10	15	57	131	<10	
Aliphatics >C12-C16 (aq)	<10 µg/l	TM174	<10	<10	<10	<10	11	<10	
Aliphatics >C16-C21 (aq)	<10 µg/l	TM174	<10	<10	<10	<10	12	<10	
Aliphatics >C21-C35 (aq)	<10 µg/l	TM174	<10	<10	<10	<10	<10	<10	
Total Aliphatics >C12-C35 (aq)	<10 µg/l	TM174	<10	<10	<10	<10	23	<10	
Aromatics >EC5-EC7	<10 µg/l	TM245	<10	<10	<10	<10	11	<10	
Aromatics >EC7-EC8	<10 µg/l	TM245	<10	<10	<10	<10	<10	<10	
Aromatics >EC8-EC10	<10 µg/l	TM245	<10	<10	36	107	85	<10	
Aromatics >EC10-EC12	<10 µg/l	TM245	<10	<10	10	38	87	<10	
Aromatics >EC12-EC16 (aq)	<10 µg/l	TM174	<10	<10	<10	<10	148	<10	
Aromatics >EC16-EC21 (aq)	<10 µg/l	TM174	<10	<10	<10	<10	31	<10	
Aromatics >EC21-EC35 (aq)	<10 µg/l	TM174	<10	<10	<10	<10	<10	<10	
Total Aromatics >EC12-EC35 (aq)	<10 µg/l	TM174	<10	<10	<10	<10	179	<10	
Total Aliphatics & Aromatics >C5-35 (aq)	<10 µg/l	TM174	<10	<10	348	1020	1100	<10	
Aliphatics >C16-C35 Aqueous	<10 µg/l	TM174	<10	<10	<10	<10	12	<10	



CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: BarryClient Reference: Dow
Order Number: 60585570Report Number: 473276
Superseded Report: 472223

TPH CWG (W)

Results Legend			Customer Sample Ref.	TP22	TP22	TP22			
#	ISO17025 accredited.		Depth (m) Sample Type Date Sampled Sampled Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	1.00	2.00	3.00			
M	mCERTS accredited.			Surface Water (SW)	Surface Water (SW)	Surface Water (SW)			
aq	Aqueous / settled sample.			06/09/2018	06/09/2018	06/09/2018			
diss.filt	Dissolved / filtered sample.								
tot.unfilt	Total / unfiltered sample.								
*	Subcontracted test.								
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery			07/09/2018	07/09/2018	07/09/2018			
(F)	Trigger breach confirmed			180907-35	180907-35	180907-35			
1-5&	Sample deviation (see appendix)			18277678	18277679	18277680			
Component	LOD/Units	Method							
GRO Surrogate % recovery**	%	TM245		105	103	94			
GRO >C5-C12	<50 µg/l	TM245		<50 #	805 #	1130 #			
Methyl tertiary butyl ether (MTBE)	<3 µg/l	TM245		<3 #	<3 #	<3 #			
Benzene	<7 µg/l	TM245		<7 #	<7 #	<7 #			
Toluene	<4 µg/l	TM245		<4 #	<4 #	<4 #			
Ethylbenzene	<5 µg/l	TM245		<5 #	<5 #	<5 #			
m,p-Xylene	<8 µg/l	TM245		<8 #	<8 #	<8 #			
o-Xylene	<3 µg/l	TM245		<3 #	<3 #	<3 #			
Sum of detected Xylenes	<11 µg/l	TM245		<11	<11	<11			
Sum of detected BTEX	<28 µg/l	TM245		<28	<28	<28			
Aliphatics >C5-C6	<10 µg/l	TM245		<10	372	506			
Aliphatics >C6-C8	<10 µg/l	TM245		<10	164	235			
Aliphatics >C8-C10	<10 µg/l	TM245		<10	116	164			
Aliphatics >C10-C12	<10 µg/l	TM245		<10	44	64			
Aliphatics >C12-C16 (aq)	<10 µg/l	TM174		<10	<10	<10			
Aliphatics >C16-C21 (aq)	<10 µg/l	TM174		<10	<10	<10			
Aliphatics >C21-C35 (aq)	<10 µg/l	TM174		<10	<10	<10			
Total Aliphatics >C12-C35 (aq)	<10 µg/l	TM174		<10	<10	<10			
Aromatics >EC5-EC7	<10 µg/l	TM245		<10	<10	<10			
Aromatics >EC7-EC8	<10 µg/l	TM245		<10	<10	<10			
Aromatics >EC8-EC10	<10 µg/l	TM245		<10	80	117			
Aromatics >EC10-EC12	<10 µg/l	TM245		<10	29	43			
Aromatics >EC12-EC16 (aq)	<10 µg/l	TM174		<10	<10	28			
Aromatics >EC16-EC21 (aq)	<10 µg/l	TM174		<10	<10	<10			
Aromatics >EC21-EC35 (aq)	<10 µg/l	TM174		<10	<10	<10			
Total Aromatics >EC12-EC35 (aq)	<10 µg/l	TM174		<10	<10	28			
Total Aliphatics & Aromatics >C5-35 (aq)	<10 µg/l	TM174		<10	805	1160			
Aliphatics >C16-C35 Aqueous	<10 µg/l	TM174		<10	<10	<10			



CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: BarryClient Reference: Dow
Order Number: 60585570Report Number: 473276
Superseded Report: 472223

VOC MS (W)

Results Legend			Customer Sample Ref.		TP21	TP21	TP21	TP21	TP21	TP22
#	ISO17025 accredited.		Depth (m) Sample Type Date Sampled Sampled Time Date Received SDG Ref Lab Sample No.(s) AGS Reference		0.20	1.00	2.00	3.00	4.00	0.20
M	mCERTS accredited.				Surface Water (SW)	Surface Water (SW)	Surface Water (SW)	Surface Water (SW)	Surface Water (SW)	Surface Water (SW)
aq	Aqueous / settled sample.				06/09/2018	06/09/2018	06/09/2018	06/09/2018	06/09/2018	06/09/2018
diss.filt	Dissolved / filtered sample.									
tot.unfilt	Total / unfiltered sample.				07/09/2018	07/09/2018	07/09/2018	07/09/2018	07/09/2018	07/09/2018
*	Subcontracted test.				180907-35	180907-35	180907-35	180907-35	180907-35	180907-35
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery				18277672	18277673	18277674	18277675	18277676	18277677
(F)	Trigger breach confirmed									
1-5&*\$@	Sample deviation (see appendix)									
Component	LOD/Units	Method								
Dibromofluoromethane**	%	TM208			106	108	107	106	105	106
Toluene-d8**	%	TM208			99.4	99.9	99.9	98.9	99.2	99.2
4-Bromofluorobenzene**	%	TM208			99.7	99.6	101	100	101	100
Dichlorodifluoromethane	<1 µg/l	TM208			<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
Chloromethane	<1 µg/l	TM208			<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
Vinyl chloride	<1 µg/l	TM208			<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
Bromomethane	<1 µg/l	TM208			<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
Chloroethane	<1 µg/l	TM208			<1 #	<1 #	<1 #	1.82 #	1.08 #	<1 #
Trichlorofluoromethane	<1 µg/l	TM208			<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
1,1-Dichloroethene	<1 µg/l	TM208			<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
Carbon disulphide	<1 µg/l	TM208			<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
Dichloromethane	<3 µg/l	TM208			<3 #	<3 #	<3 #	<3 #	<3 #	<3 #
Methyl tertiary butyl ether (MTBE)	<1 µg/l	TM208			<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
trans-1,2-Dichloroethene	<1 µg/l	TM208			<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
1,1-Dichloroethane	<1 µg/l	TM208			<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
cis-1,2-Dichloroethene	<1 µg/l	TM208			<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
2,2-Dichloropropane	<1 µg/l	TM208			<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
Bromochloromethane	<1 µg/l	TM208			<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
Chloroform	<1 µg/l	TM208			<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
1,1,1-Trichloroethane	<1 µg/l	TM208			<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
1,1-Dichloropropene	<1 µg/l	TM208			<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
Carbontetrachloride	<1 µg/l	TM208			<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
1,2-Dichloroethane	<1 µg/l	TM208			<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
Benzene	<1 µg/l	TM208			<1 #	<1 #	<1 #	1.44 #	13.6 #	<1 #
Trichloroethene	<1 µg/l	TM208			<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
1,2-Dichloropropane	<1 µg/l	TM208			<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
Dibromomethane	<1 µg/l	TM208			<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
Bromodichloromethane	<1 µg/l	TM208			<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
cis-1,3-Dichloropropene	<1 µg/l	TM208			<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
Toluene	<1 µg/l	TM208			<1 #	<1 #	<1 #	1.24 #	2.27 #	<1 #
trans-1,3-Dichloropropene	<1 µg/l	TM208			<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
1,1,2-Trichloroethane	<1 µg/l	TM208			<1 #	<1 #	<1 #	<1 #	<1 #	<1 #



CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: Barry

Client Reference: Dow
Order Number: 60585570

Report Number: 473276
Superseded Report: 472223

VOC MS (W)

Results Legend			Customer Sample Ref.		TP21	TP21	TP21	TP21	TP21	TP22
#	ISO17025 accredited.	Depth (m) Sample Type Date Sampled Sampled Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	0.20 Surface Water (SW) 06/09/2018 07/09/2018 180907-35 18277672	1.00 Surface Water (SW) 06/09/2018 07/09/2018 180907-35 18277673	2.00 Surface Water (SW) 06/09/2018 07/09/2018 180907-35 18277674	3.00 Surface Water (SW) 06/09/2018 07/09/2018 180907-35 18277675	4.00 Surface Water (SW) 06/09/2018 07/09/2018 180907-35 18277676	0.20 Surface Water (SW) 06/09/2018 07/09/2018 180907-35 18277677		
M	mCERTS accredited.									
aq	Aqueous / settled sample.									
diss.filt	Dissolved / filtered sample.									
tot.unfilt	Total / unfiltered sample.									
*	Subcontracted test.									
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery									
(F)	Trigger breach confirmed									
1-5&	Sample deviation (see appendix)									
Component	LOD/Units	Method								
1,3-Dichloropropane	<1 µg/l	TM208	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #		
Tetrachloroethene	<1 µg/l	TM208	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #		
Dibromochloromethane	<1 µg/l	TM208	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #		
1,2-Dibromoethane	<1 µg/l	TM208	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #		
Chlorobenzene	<1 µg/l	TM208	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #		
1,1,1,2-Tetrachloroethane	<1 µg/l	TM208	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #		
Ethylbenzene	<1 µg/l	TM208	<1 #	<1 #	<1 #	<1 #	1.45 #	<1 #		
m,p-Xylene	<1 µg/l	TM208	<1 #	<1 #	<1 #	2.25 #	3.86 #	<1 #		
o-Xylene	<1 µg/l	TM208	<1 #	<1 #	<1 #	1.29 #	2.04 #	<1 #		
Styrene	<1 µg/l	TM208	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #		
Bromoform	<1 µg/l	TM208	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #		
Isopropylbenzene	<1 µg/l	TM208	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #		
1,1,2,2-Tetrachloroethane	<1 µg/l	TM208	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #		
1,2,3-Trichloropropane	<1 µg/l	TM208	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #		
Bromobenzene	<1 µg/l	TM208	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #		
Propylbenzene	<1 µg/l	TM208	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #		
2-Chlorotoluene	<1 µg/l	TM208	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #		
1,3,5-Trimethylbenzene	<1 µg/l	TM208	<1 #	<1 #	<1 #	1.51 #	1.2 #	<1 #		
4-Chlorotoluene	<1 µg/l	TM208	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #		
tert-Butylbenzene	<1 µg/l	TM208	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #		
1,2,4-Trimethylbenzene	<1 µg/l	TM208	<1 #	<1 #	<1 #	2.74 #	3.01 #	<1 #		
sec-Butylbenzene	<1 µg/l	TM208	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #		
4-iso-Propyltoluene	<1 µg/l	TM208	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #		
1,3-Dichlorobenzene	<1 µg/l	TM208	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #		
1,4-Dichlorobenzene	<1 µg/l	TM208	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #		
n-Butylbenzene	<1 µg/l	TM208	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #		
1,2-Dichlorobenzene	<1 µg/l	TM208	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #		
1,2-Dibromo-3-chloropropane	<1 µg/l	TM208	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #		
1,2,4-Trichlorobenzene	<1 µg/l	TM208	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #		
Hexachlorobutadiene	<1 µg/l	TM208	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #		
tert-Amyl methyl ether (TAME)	<1 µg/l	TM208	<1 #	<1 #	<1 #	<1 #	<1 #	<1 #		
Naphthalene	<1 µg/l	TM208	<1 #	<1 #	<1 #	<1 #	137 #	<1 #		



CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: BarryClient Reference: Dow
Order Number: 60585570Report Number: 473276
Superseded Report: 472223

VOC MS (W)

Results Legend		Customer Sample Ref.	TP22	TP22	TP22			
#	ISO17025 accredited.	Depth (m) Sample Type Date Sampled Sampled Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	TP22	TP22	TP22			
M	mCERTS accredited.		1.00	2.00	3.00			
aq	Aqueous / settled sample.		Surface Water (SW)	Surface Water (SW)	Surface Water (SW)			
diss.filt	Dissolved / filtered sample.		06/09/2018	06/09/2018	06/09/2018			
tot.unfilt	Total / unfiltered sample.							
*	Subcontracted test.		07/09/2018	07/09/2018	07/09/2018			
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery		180907-35	180907-35	180907-35			
(F)	Trigger breach confirmed		18277678	18277679	18277680			
1-5&*\$@	Sample deviation (see appendix)							
Component	LOD/Units	Method						
Dibromofluoromethane**	%	TM208	107	109	107			
Toluene-d8**	%	TM208	99	99.6	100			
4-Bromofluorobenzene**	%	TM208	101	102	103			
Dichlorodifluoromethane	<1 µg/l	TM208	<1 #	<1 #	<1 #			
Chloromethane	<1 µg/l	TM208	<1 #	<1 #	<1 #			
Vinyl chloride	<1 µg/l	TM208	<1 #	<1 #	<1 #			
Bromomethane	<1 µg/l	TM208	<1 #	<1 #	<1 #			
Chloroethane	<1 µg/l	TM208	<1 #	1.31 #	2.07 #			
Trichlorofluoromethane	<1 µg/l	TM208	<1 #	<1 #	<1 #			
1,1-Dichloroethene	<1 µg/l	TM208	<1 #	<1 #	<1 #			
Carbon disulphide	<1 µg/l	TM208	<1 #	<1 #	<1 #			
Dichloromethane	<3 µg/l	TM208	<3 #	<3 #	<3 #			
Methyl tertiary butyl ether (MTBE)	<1 µg/l	TM208	<1 #	<1 #	<1 #			
trans-1,2-Dichloroethene	<1 µg/l	TM208	<1 #	<1 #	<1 #			
1,1-Dichloroethane	<1 µg/l	TM208	<1 #	<1 #	<1 #			
cis-1,2-Dichloroethene	<1 µg/l	TM208	<1 #	<1 #	<1 #			
2,2-Dichloropropane	<1 µg/l	TM208	<1 #	<1 #	<1 #			
Bromochloromethane	<1 µg/l	TM208	<1 #	<1 #	<1 #			
Chloroform	<1 µg/l	TM208	<1 #	<1 #	<1 #			
1,1,1-Trichloroethane	<1 µg/l	TM208	<1 #	<1 #	<1 #			
1,1-Dichloropropene	<1 µg/l	TM208	<1 #	<1 #	<1 #			
Carbontetrachloride	<1 µg/l	TM208	<1 #	<1 #	<1 #			
1,2-Dichloroethane	<1 µg/l	TM208	<1 #	<1 #	<1 #			
Benzene	<1 µg/l	TM208	<1 #	<1 #	2.27 #			
Trichloroethene	<1 µg/l	TM208	<1 #	<1 #	<1 #			
1,2-Dichloropropane	<1 µg/l	TM208	<1 #	<1 #	<1 #			
Dibromomethane	<1 µg/l	TM208	<1 #	<1 #	<1 #			
Bromodichloromethane	<1 µg/l	TM208	<1 #	<1 #	<1 #			
cis-1,3-Dichloropropene	<1 µg/l	TM208	<1 #	<1 #	<1 #			
Toluene	<1 µg/l	TM208	<1 #	<1 #	1.96 #			
trans-1,3-Dichloropropene	<1 µg/l	TM208	<1 #	<1 #	<1 #			
1,1,2-Trichloroethane	<1 µg/l	TM208	<1 #	<1 #	<1 #			



CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: Barry

Client Reference: Dow
Order Number: 60585570

Report Number: 473276
Superseded Report: 472223

VOC MS (W)

Results Legend		Customer Sample Ref.	TP22	TP22	TP22			
#	ISO17025 accredited.	Depth (m) Sample Type Date Sampled Sampled Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	TP22	TP22	TP22			
M	mCERTS accredited.		1.00	2.00	3.00			
aq	Aqueous / settled sample.		Surface Water (SW)	Surface Water (SW)	Surface Water (SW)			
diss.filt	Dissolved / filtered sample.		06/09/2018	06/09/2018	06/09/2018			
tot.unfilt	Total / unfiltered sample.		07/09/2018	07/09/2018	07/09/2018			
*	Subcontracted test.		180907-35	180907-35	180907-35			
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery		18277678	18277679	18277680			
(F)	Trigger breach confirmed							
1-5&#pound;	Sample deviation (see appendix)							
Component	LOD/Units	Method						
1,3-Dichloropropane	<1 µg/l	TM208	<1 #	<1 #	<1 #			
Tetrachloroethene	<1 µg/l	TM208	<1 #	<1 #	<1 #			
Dibromochloromethane	<1 µg/l	TM208	<1 #	<1 #	<1 #			
1,2-Dibromoethane	<1 µg/l	TM208	<1 #	<1 #	<1 #			
Chlorobenzene	<1 µg/l	TM208	<1 #	<1 #	<1 #			
1,1,1,2-Tetrachloroethane	<1 µg/l	TM208	<1 #	<1 #	<1 #			
Ethylbenzene	<1 µg/l	TM208	<1 #	<1 #	<1 #			
m,p-Xylene	<1 µg/l	TM208	<1 #	<1 #	3.65 #			
o-Xylene	<1 µg/l	TM208	<1 #	<1 #	1.98 #			
Styrene	<1 µg/l	TM208	<1 #	<1 #	<1 #			
Bromoform	<1 µg/l	TM208	<1 #	<1 #	<1 #			
Isopropylbenzene	<1 µg/l	TM208	<1 #	<1 #	<1 #			
1,1,2,2-Tetrachloroethane	<1 µg/l	TM208	<1 #	<1 #	<1 #			
1,2,3-Trichloropropane	<1 µg/l	TM208	<1 #	<1 #	<1 #			
Bromobenzene	<1 µg/l	TM208	<1 #	<1 #	<1 #			
Propylbenzene	<1 µg/l	TM208	<1 #	<1 #	<1 #			
2-Chlorotoluene	<1 µg/l	TM208	<1 #	<1 #	<1 #			
1,3,5-Trimethylbenzene	<1 µg/l	TM208	<1 #	<1 #	1.82 #			
4-Chlorotoluene	<1 µg/l	TM208	<1 #	<1 #	<1 #			
tert-Butylbenzene	<1 µg/l	TM208	<1 #	<1 #	<1 #			
1,2,4-Trimethylbenzene	<1 µg/l	TM208	<1 #	<1 #	4.07 #			
sec-Butylbenzene	<1 µg/l	TM208	<1 #	<1 #	<1 #			
4-iso-Propyltoluene	<1 µg/l	TM208	<1 #	<1 #	<1 #			
1,3-Dichlorobenzene	<1 µg/l	TM208	<1 #	<1 #	<1 #			
1,4-Dichlorobenzene	<1 µg/l	TM208	<1 #	<1 #	<1 #			
n-Butylbenzene	<1 µg/l	TM208	<1 #	<1 #	<1 #			
1,2-Dichlorobenzene	<1 µg/l	TM208	<1 #	<1 #	<1 #			
1,2-Dibromo-3-chloropropane	<1 µg/l	TM208	<1 #	<1 #	<1 #			
1,2,4-Trichlorobenzene	<1 µg/l	TM208	<1 #	<1 #	<1 #			
Hexachlorobutadiene	<1 µg/l	TM208	<1 #	<1 #	<1 #			
tert-Amyl methyl ether (TAME)	<1 µg/l	TM208	<1 #	<1 #	<1 #			
Naphthalene	<1 µg/l	TM208	<1 #	<1 #	<1 #			



CERTIFICATE OF ANALYSIS

Validated

SDG:	180907-35	Client Reference:	Dow	Report Number:	473276
Location:	Barry	Order Number:	60585570	Superseded Report:	472223

Table of Results - Appendix

Method No	Reference	Description
TM022	Method 2540D, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part120 1981;BS EN 872	Determination of total suspended solids in waters
TM043	Method 2320B, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part109 1984	Determination of alkalinity in aqueous samples
TM045	MEWAM BOD5 2nd Ed.HMSO 1988 / Method 5210B, AWWA/APHA, 20th Ed., 1999; SCA Blue Book 130	Determination of BOD5 (ATU) Filtered by Oxygen Meter on liquids
TM061	Method for the Determination of EPH,Massachusetts Dept.of EP, 1998	Determination of Extractable Petroleum Hydrocarbons by GC-FID (C10-C40)
TM090	Method 5310, AWWA/APHA, 20th Ed., 1999 / Modified: US EPA Method 415.1 & 9060	Determination of Total Organic Carbon/Total Inorganic Carbon in Water and Waste Water
TM094	Method 2310B, AWWA/APHA, 19th Ed., 1981	Determination of Acidity by titration
TM099	BS 2690: Part 7:1968 / BS 6068: Part2.11:1984	Determination of Ammonium in Water Samples using the Kone Analyser
TM101	Method 4500B & C, AWWA/APHA, 20th Ed., 1999	Determination of Sulphide in soil and water samples using the Kone Analyser
TM107	ISO 6060-1989	Determination of Chemical Oxygen Demand using COD Dr Lange Kit
TM152	Method 3125B, AWWA/APHA, 20th Ed., 1999	Analysis of Aqueous Samples by ICP-MS
TM174	Analysis of Petroleum Hydrocarbons in Environmental Media – Total Petroleum Hydrocarbon Criteria	Determination of Speciated Extractable Petroleum Hydrocarbons in Waters by GC-FID
TM176	EPA 8270D Semi-Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)	Determination of SVOCs in Water by GCMS
TM183	BS EN 23506:2002, (BS 6068-2.74:2002) ISBN 0 580 38924 3	Determination of Trace Level Mercury in Waters and Leachates by PSA Cold Vapour Atomic Fluorescence Spectrometry
TM184	EPA Methods 325.1 & 325.2,	The Determination of Anions in Aqueous Matrices using the Kone Spectrophotometric Analysers
TM208	Modified: US EPA Method 8260b & 624	Determination of Volatile Organic Compounds by Headspace / GC-MS in Waters
TM226	In-House Method	Determination of Anions in Waters using Ion Chromatography
TM245	By GC-FID	Determination of GRO by Headspace in waters
TM256	The measurement of Electrical Conductivity and the Laboratory determination of pH Value of Natural, Treated and Wastewaters. HMSO, 1978. ISBN 011 751428 4.	Determination of pH in Water and Leachate using the GLpH pH Meter

NA = not applicable.

Chemical testing (unless subcontracted) performed at ALS Environmental Hawarden (Method codes TM) or ALS Environmental Aberdeen (Method codes S).



CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: BarryClient Reference: Dow
Order Number: 60585570Report Number: 473276
Superseded Report: 472223

Test Completion Dates

Lab Sample No(s)	18277672	18277673	18277674	18277675	18277676	18277677	18277678	18277679	18277680
Customer Sample Ref.	TP21	TP21	TP21	TP21	TP21	TP22	TP22	TP22	TP22
AGS Ref.									
Depth	0.20	1.00	2.00	3.00	4.00	0.20	1.00	2.00	3.00
Type	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
Acidity as HCl	14-Sep-2018	14-Sep-2018	14-Sep-2018	14-Sep-2018	14-Sep-2018	14-Sep-2018	14-Sep-2018	14-Sep-2018	14-Sep-2018
Alkalinity as CaCO ₃	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018
Ammoniacal Nitrogen	12-Sep-2018	14-Sep-2018	14-Sep-2018	14-Sep-2018	14-Sep-2018	14-Sep-2018	12-Sep-2018	14-Sep-2018	14-Sep-2018
Anions by ion Chromatography	14-Sep-2018	14-Sep-2018	14-Sep-2018	14-Sep-2018	20-Sep-2018	19-Sep-2018	19-Sep-2018	14-Sep-2018	14-Sep-2018
Anions by Kone (w)	12-Sep-2018	12-Sep-2018	12-Sep-2018	12-Sep-2018	12-Sep-2018	12-Sep-2018	12-Sep-2018	12-Sep-2018	12-Sep-2018
BOD True Total	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018
COD Unfiltered	14-Sep-2018	14-Sep-2018	14-Sep-2018	14-Sep-2018	13-Sep-2018	14-Sep-2018	13-Sep-2018	14-Sep-2018	13-Sep-2018
Dissolved Metals by ICP-MS	17-Sep-2018	17-Sep-2018	17-Sep-2018	17-Sep-2018	14-Sep-2018	14-Sep-2018	14-Sep-2018	17-Sep-2018	17-Sep-2018
EPH CWG (Aliphatic) Aqueous GC (W)	14-Sep-2018	11-Sep-2018	11-Sep-2018	14-Sep-2018	17-Sep-2018	14-Sep-2018	14-Sep-2018	14-Sep-2018	18-Sep-2018
EPH CWG (Aromatic) Aqueous GC (W)	14-Sep-2018	11-Sep-2018	11-Sep-2018	14-Sep-2018	17-Sep-2018	14-Sep-2018	14-Sep-2018	14-Sep-2018	18-Sep-2018
GRO by GC-FID (W)	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018
Mercury Dissolved	12-Sep-2018	12-Sep-2018	12-Sep-2018	12-Sep-2018	12-Sep-2018	12-Sep-2018	13-Sep-2018	12-Sep-2018	13-Sep-2018
Nitrite by Kone (w)	12-Sep-2018	12-Sep-2018	12-Sep-2018	12-Sep-2018	12-Sep-2018	12-Sep-2018	12-Sep-2018	12-Sep-2018	12-Sep-2018
pH Value	10-Sep-2018	10-Sep-2018	10-Sep-2018	10-Sep-2018	13-Sep-2018	10-Sep-2018	10-Sep-2018	10-Sep-2018	10-Sep-2018
Phosphate by Kone (w)	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018
Sulphide	15-Sep-2018	15-Sep-2018	15-Sep-2018	15-Sep-2018	15-Sep-2018	15-Sep-2018	15-Sep-2018	15-Sep-2018	15-Sep-2018
Suspended Solids	11-Sep-2018	11-Sep-2018	12-Sep-2018	11-Sep-2018	12-Sep-2018	12-Sep-2018	11-Sep-2018	11-Sep-2018	12-Sep-2018
SVOC MS (W) - Aqueous	12-Sep-2018	11-Sep-2018	11-Sep-2018	12-Sep-2018	12-Sep-2018	11-Sep-2018	12-Sep-2018	12-Sep-2018	11-Sep-2018
Total Organic and Inorganic Carbon	11-Sep-2018	11-Sep-2018	11-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018
TPH CWG (W)	14-Sep-2018	13-Sep-2018	13-Sep-2018	14-Sep-2018	17-Sep-2018	14-Sep-2018	14-Sep-2018	14-Sep-2018	18-Sep-2018
VOC MS (W)	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018	13-Sep-2018



CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: Barry

Client Reference: Dow
Order Number: 60585570

Report Number: 473276
Superseded Report: 472223

Chromatogram

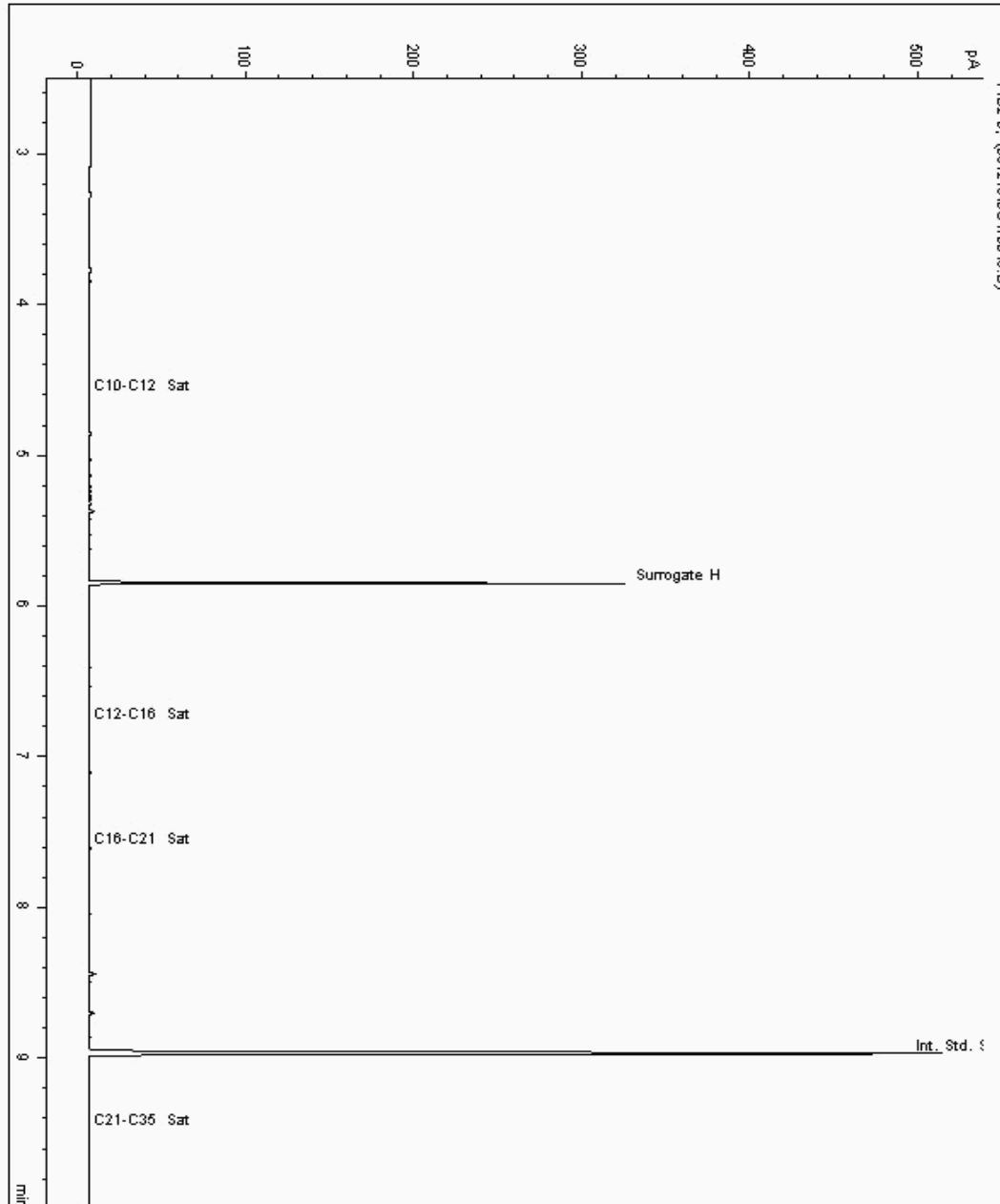
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 18281791
Sample ID : TP21

Depth : 3.00

Speciated TPH - SATs (C12 - C40)

Sample Identity: 17173485-
Date Acquired : 14/09/18 00:25:37 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.050





CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: Barry

Client Reference: Dow
Order Number: 60585570

Report Number: 473276
Superseded Report: 472223

Chromatogram

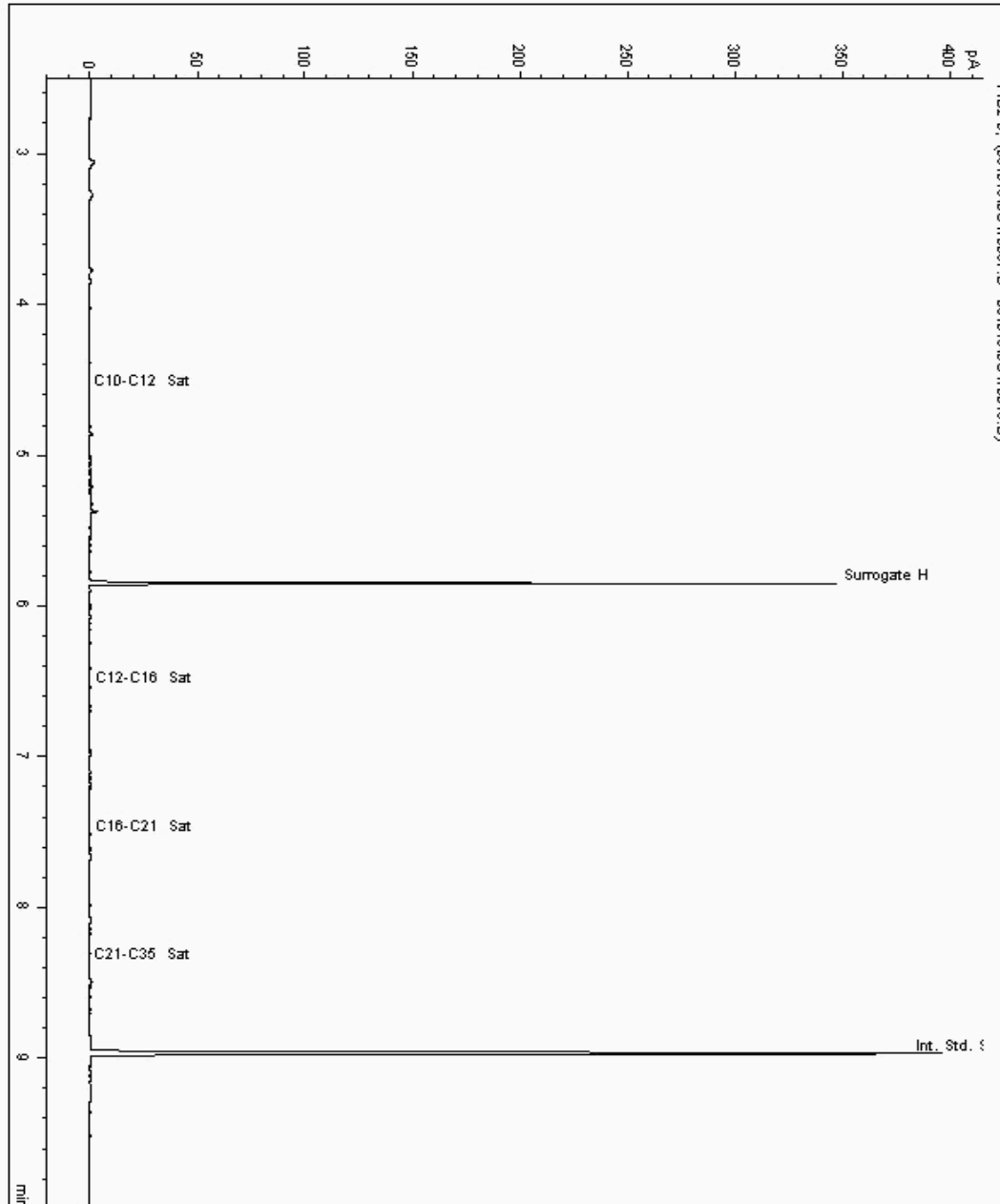
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 18281863
Sample ID : TP21

Depth : 2.00

Speciated TPH - SATS (C12 - C40)

Sample Identity: 17173433-
Date Acquired : 11/09/18 04:06:39 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.025





CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: Barry

Client Reference: Dow
Order Number: 60585570

Report Number: 473276
Superseded Report: 472223

Chromatogram

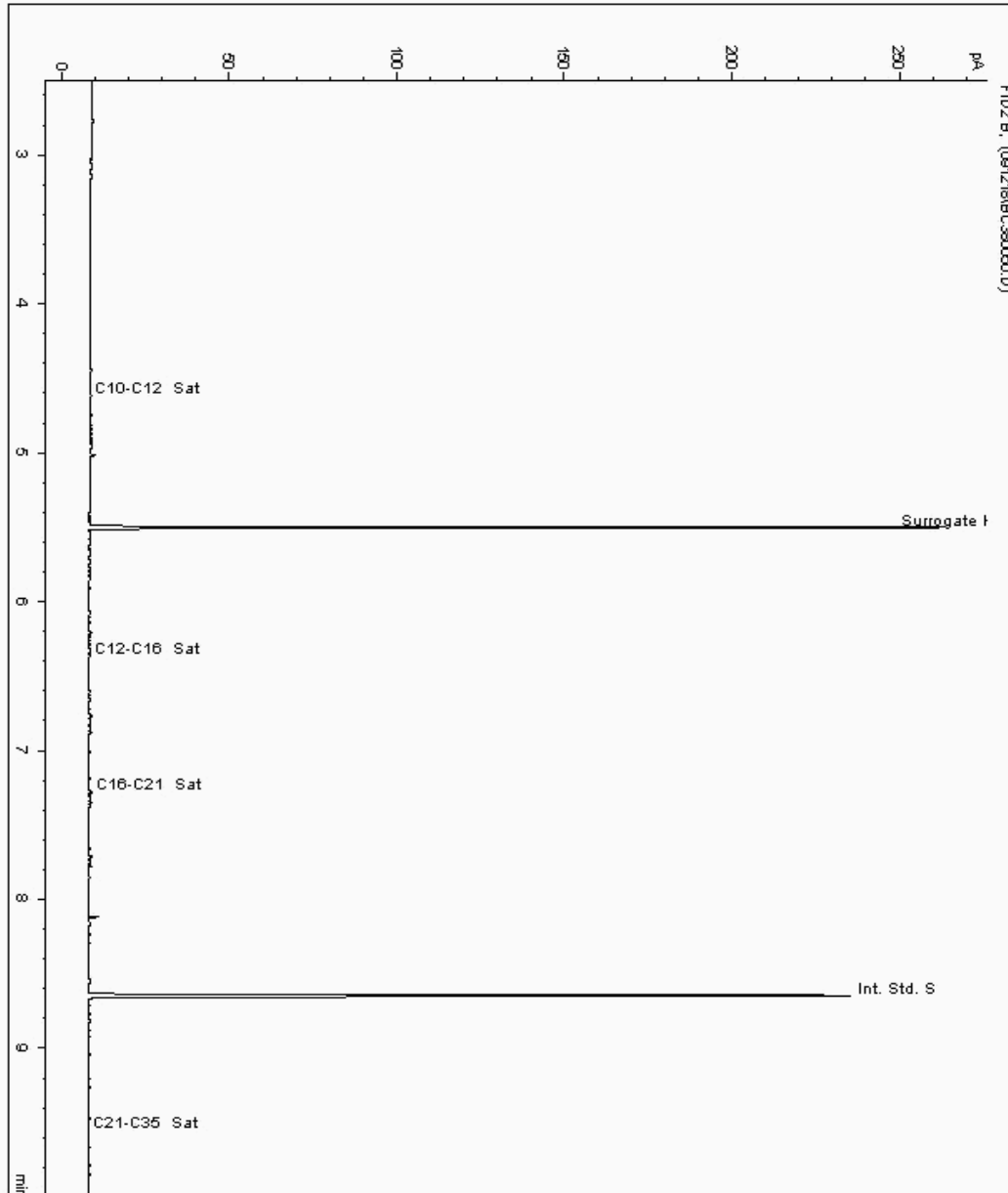
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 18281893
Sample ID : TP21

Depth : 0.20

Speciated TPH - SATS (C12 - C40)

Sample Identity: 17173320-
Date Acquired : 13/09/18 19:37:55 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.025





CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: Barry

Client Reference: Dow
Order Number: 60585570

Report Number: 473276
Superseded Report: 472223

Chromatogram

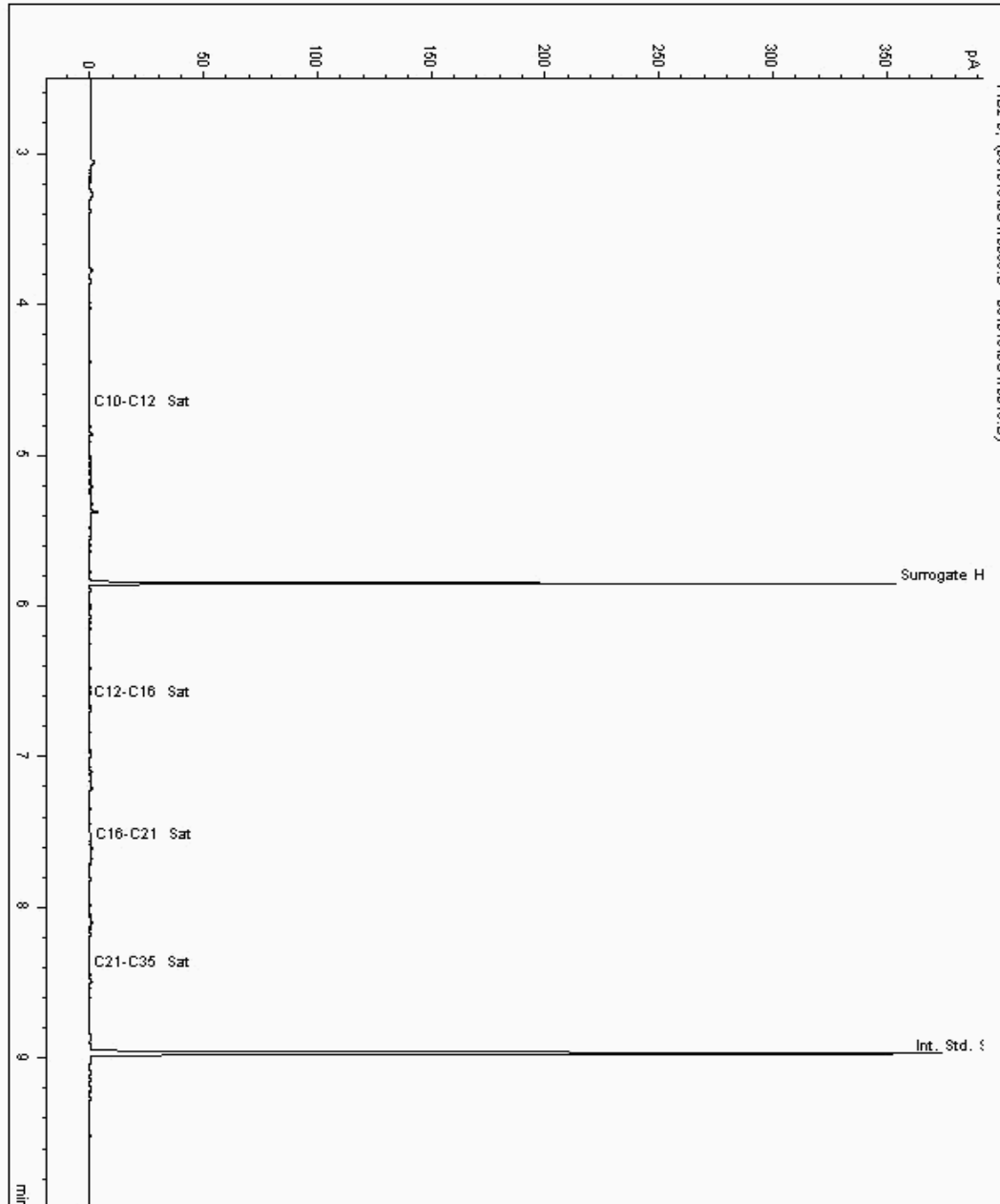
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 18281899
Sample ID : TP21

Depth : 1.00

Speciated TPH - SATS (C12 - C40)

Sample Identity: 17173388-
Date Acquired : 11/09/18 04:53:46 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.025





CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: Barry

Client Reference: Dow
Order Number: 60585570

Report Number: 473276
Superseded Report: 472223

Chromatogram

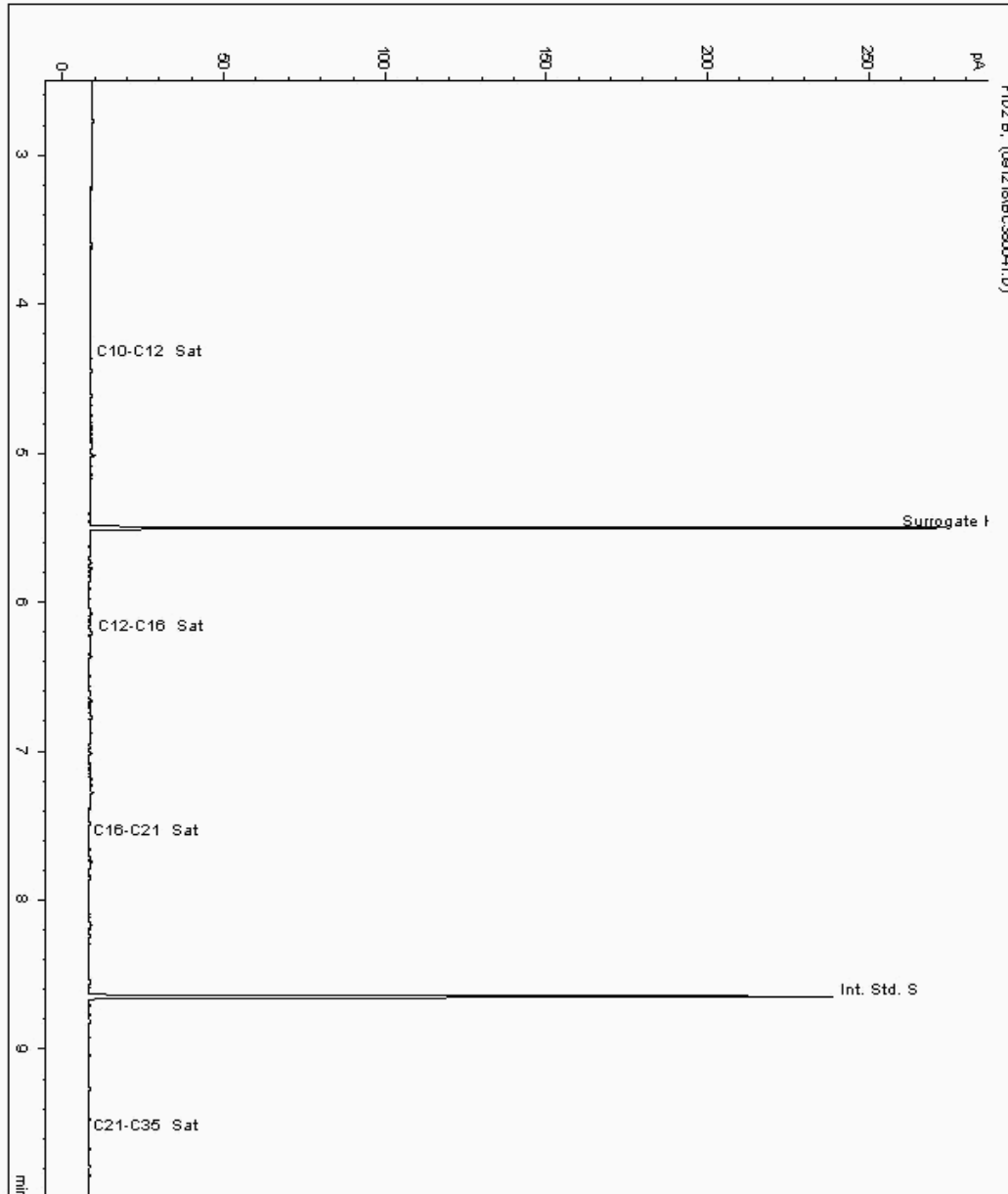
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 18282174
Sample ID : TP22

Depth : 2.00

Speciated TPH - SATS (C12 - C40)

Sample Identity: 17173742-
Date Acquired : 13/09/18 16:08:59 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.025





CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: Barry

Client Reference: Dow
Order Number: 60585570

Report Number: 473276
Superseded Report: 472223

Chromatogram

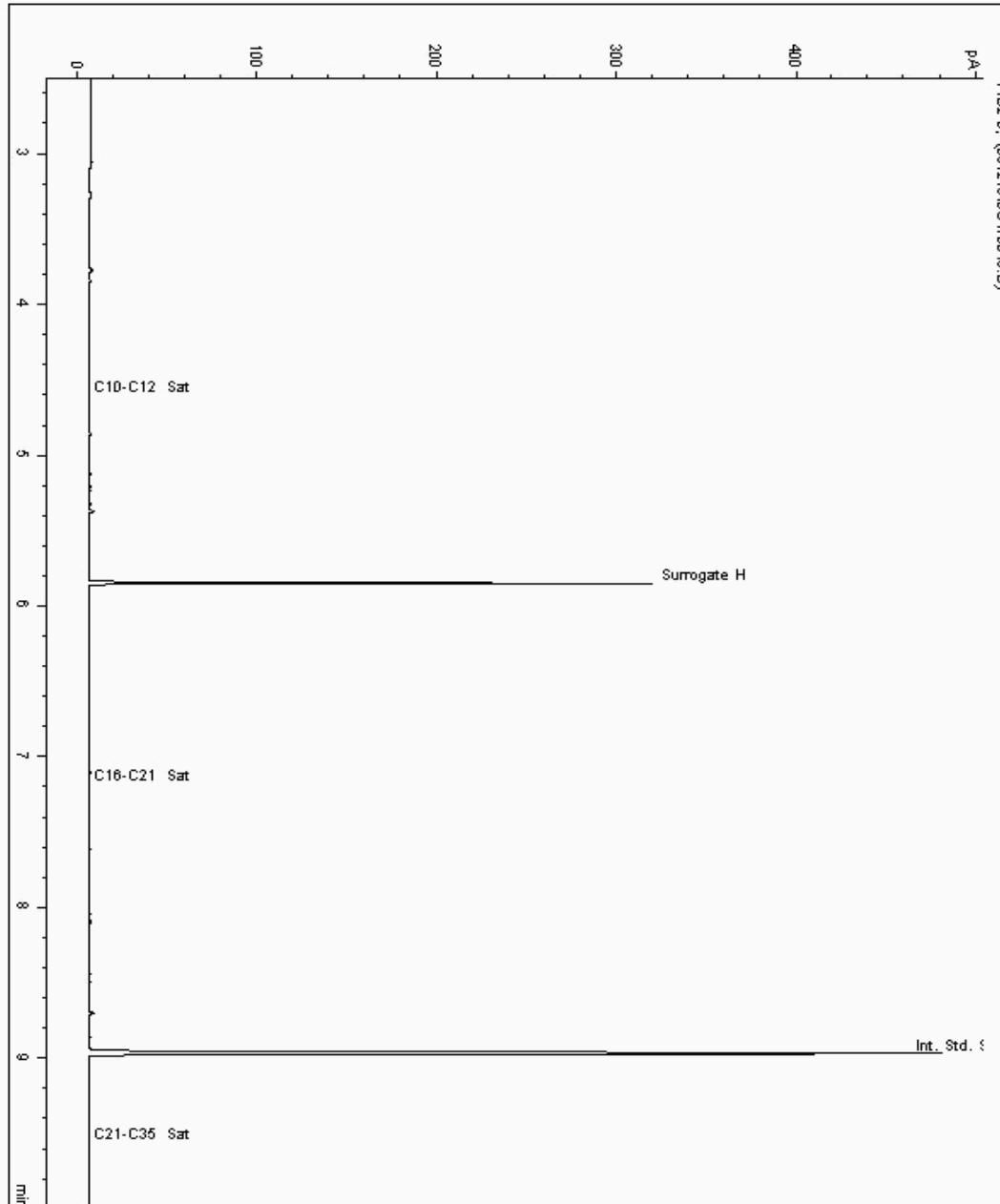
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 18282221
Sample ID : TP22

Depth : 1.00

Speciated TPH - SATS (C12 - C40)

Sample Identity: 17173656-
Date Acquired : 14/09/18 00:48:48 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.050





CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: Barry

Client Reference: Dow
Order Number: 60585570

Report Number: 473276
Superseded Report: 472223

Chromatogram

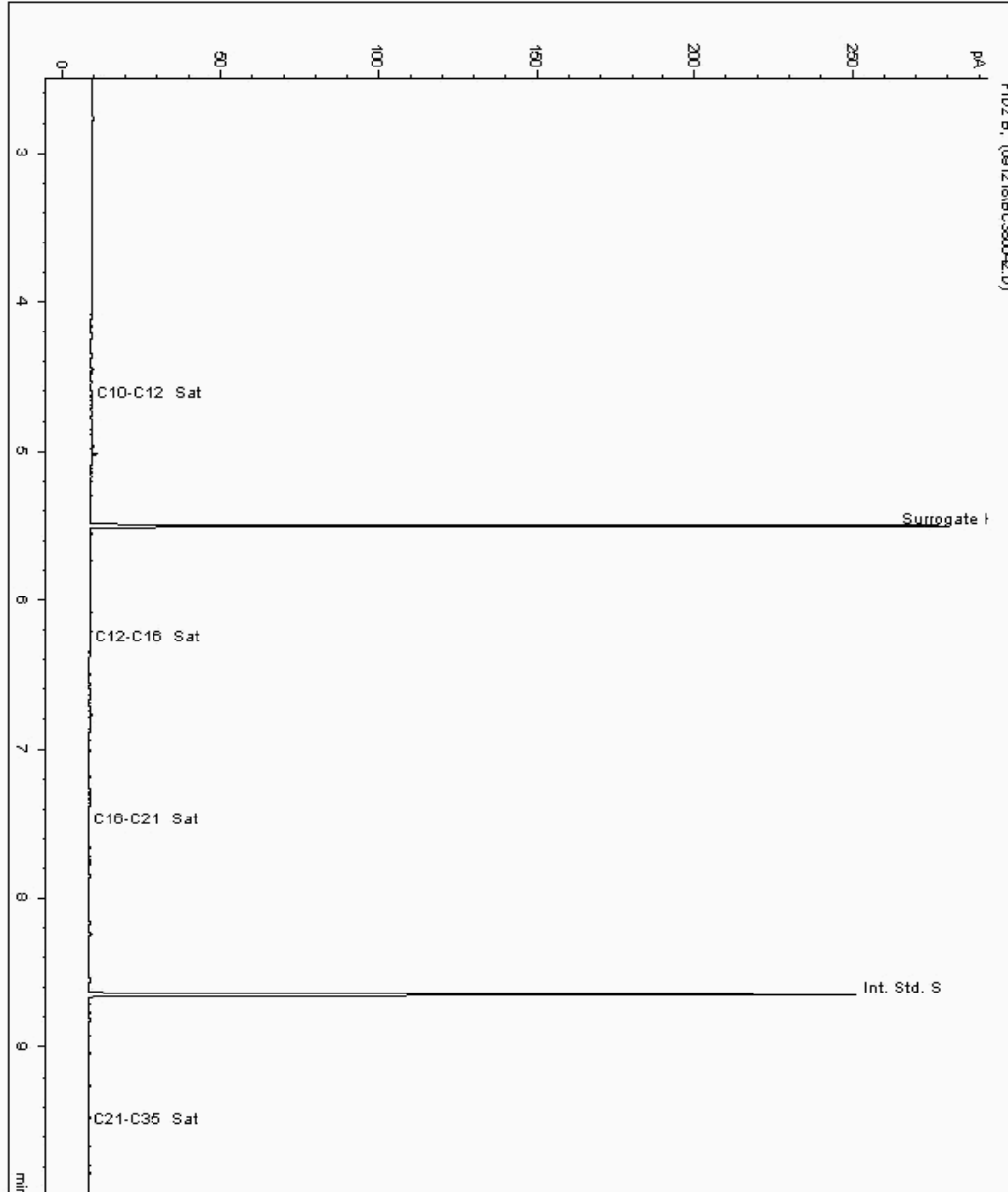
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 18282244
Sample ID : TP22

Depth : 0.20

Speciated TPH - SATS (C12 - C40)

Sample Identity: 17173581-
Date Acquired : 13/09/18 16:32:07 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.025





CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: Barry

Client Reference: Dow
Order Number: 60585570

Report Number: 473276
Superseded Report: 472223

Chromatogram

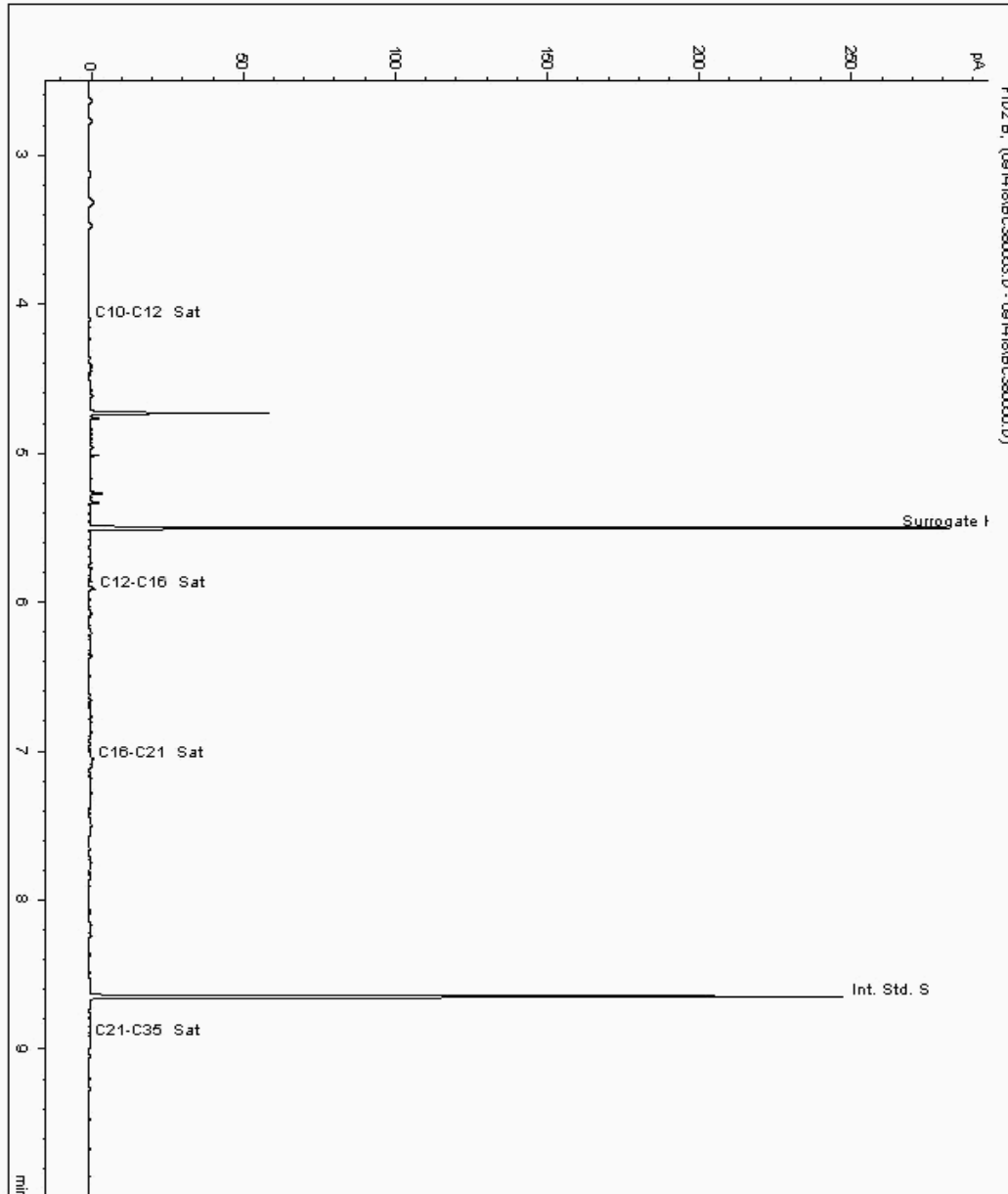
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 18328608
Sample ID : TP21

Depth : 4.00

Speciated TPH - SATS (C12 - C40)

Sample Identity: 17219415-
Date Acquired : 17/09/18 11:09:49 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.025





CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: Barry

Client Reference: Dow
Order Number: 60585570

Report Number: 473276
Superseded Report: 472223

Chromatogram

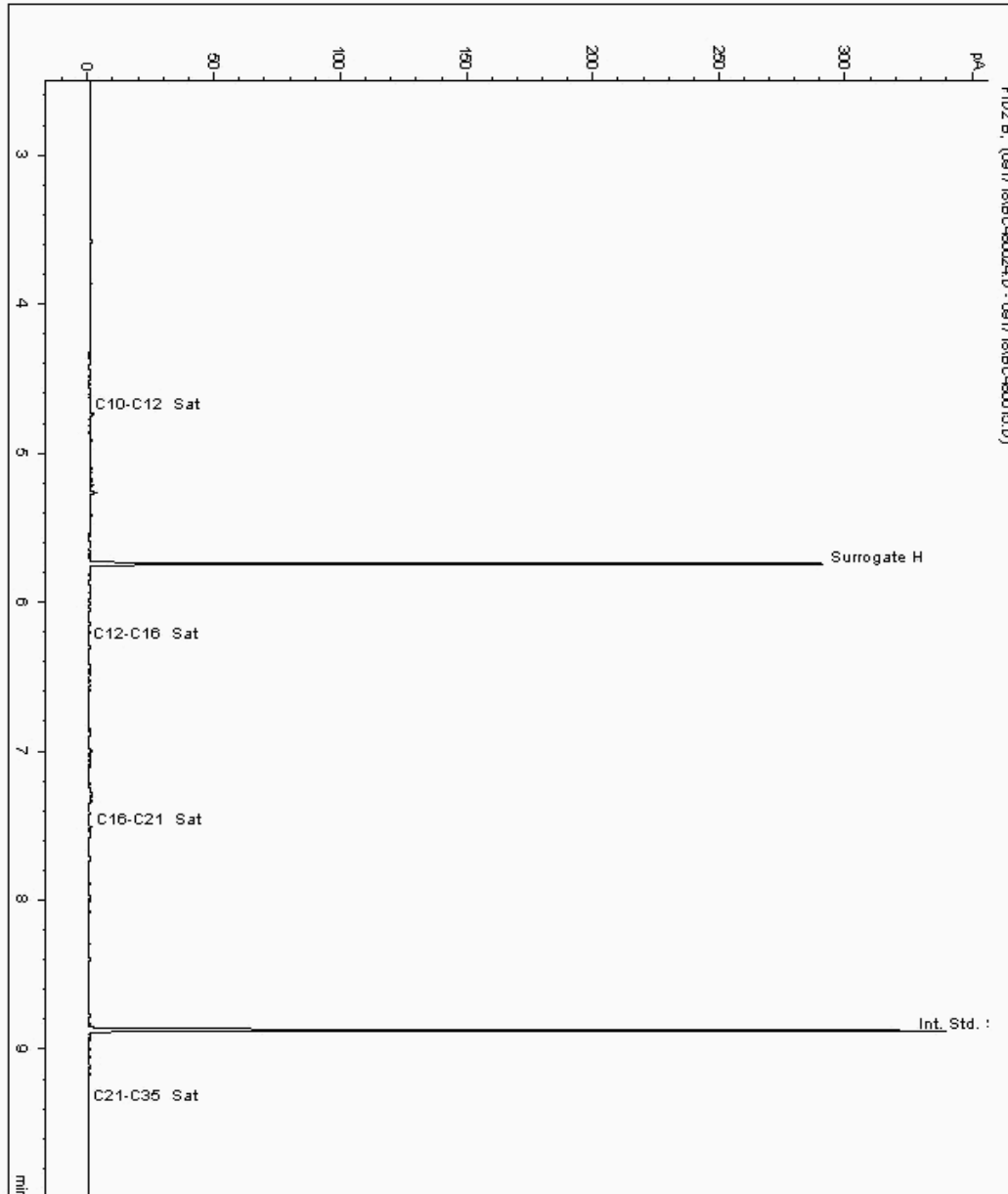
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 18338430
Sample ID : TP22

Depth : 3.00

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 17219615-
Date Acquired : 18/09/2018 02:14:37 PM
Units : ppb
Dilution : SE TP22[3.00] ->
CF : 1
Multiplier : 0.025





CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: Barry

Client Reference: Dow
Order Number: 60585570

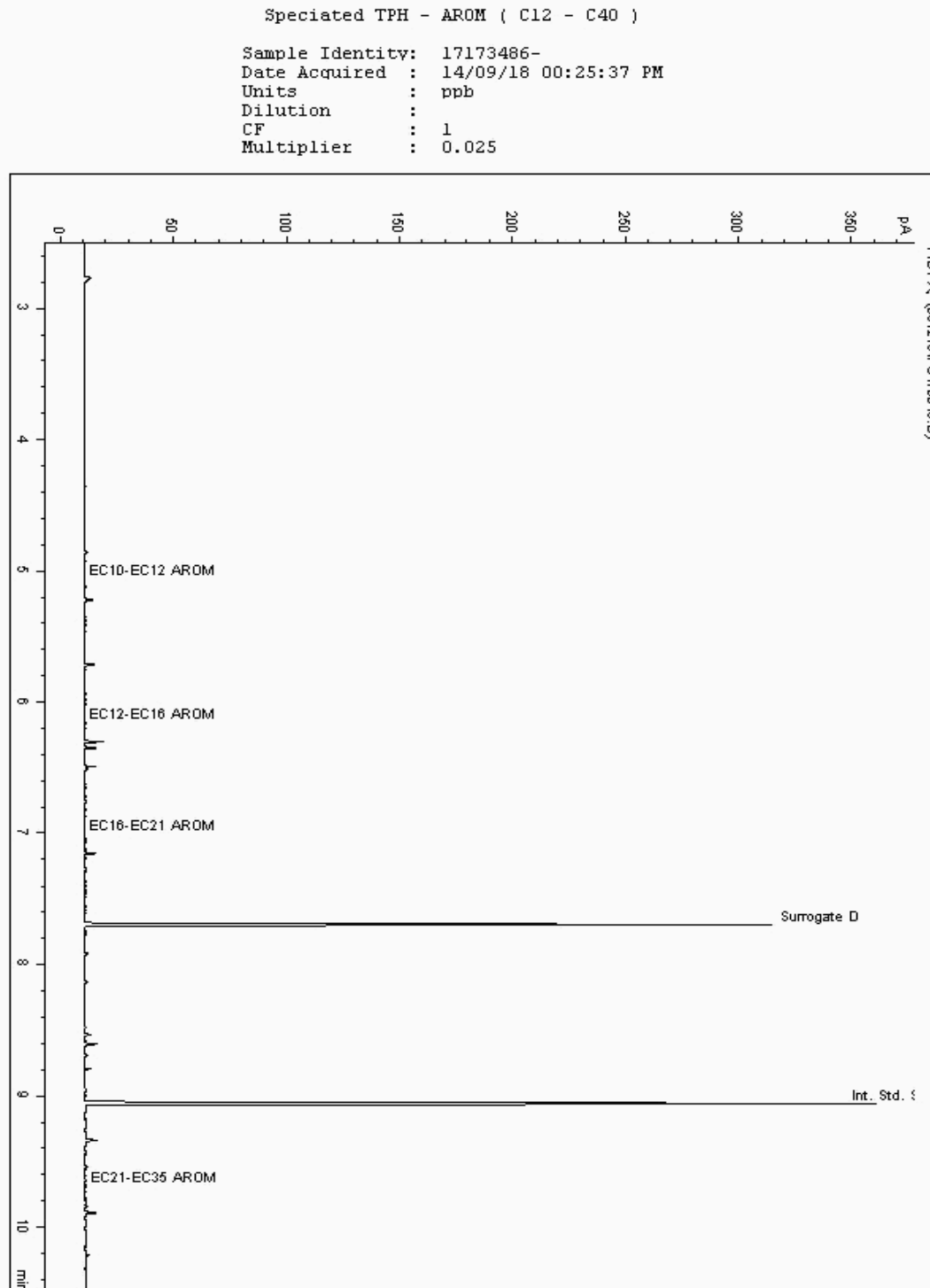
Report Number: 473276
Superseded Report: 472223

Chromatogram

Analysis: EPH CWG (Aromatic) Aqueous GC (W)

Sample No : 18281791
Sample ID : TP21

Depth : 3.00





CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: Barry

Client Reference: Dow
Order Number: 60585570

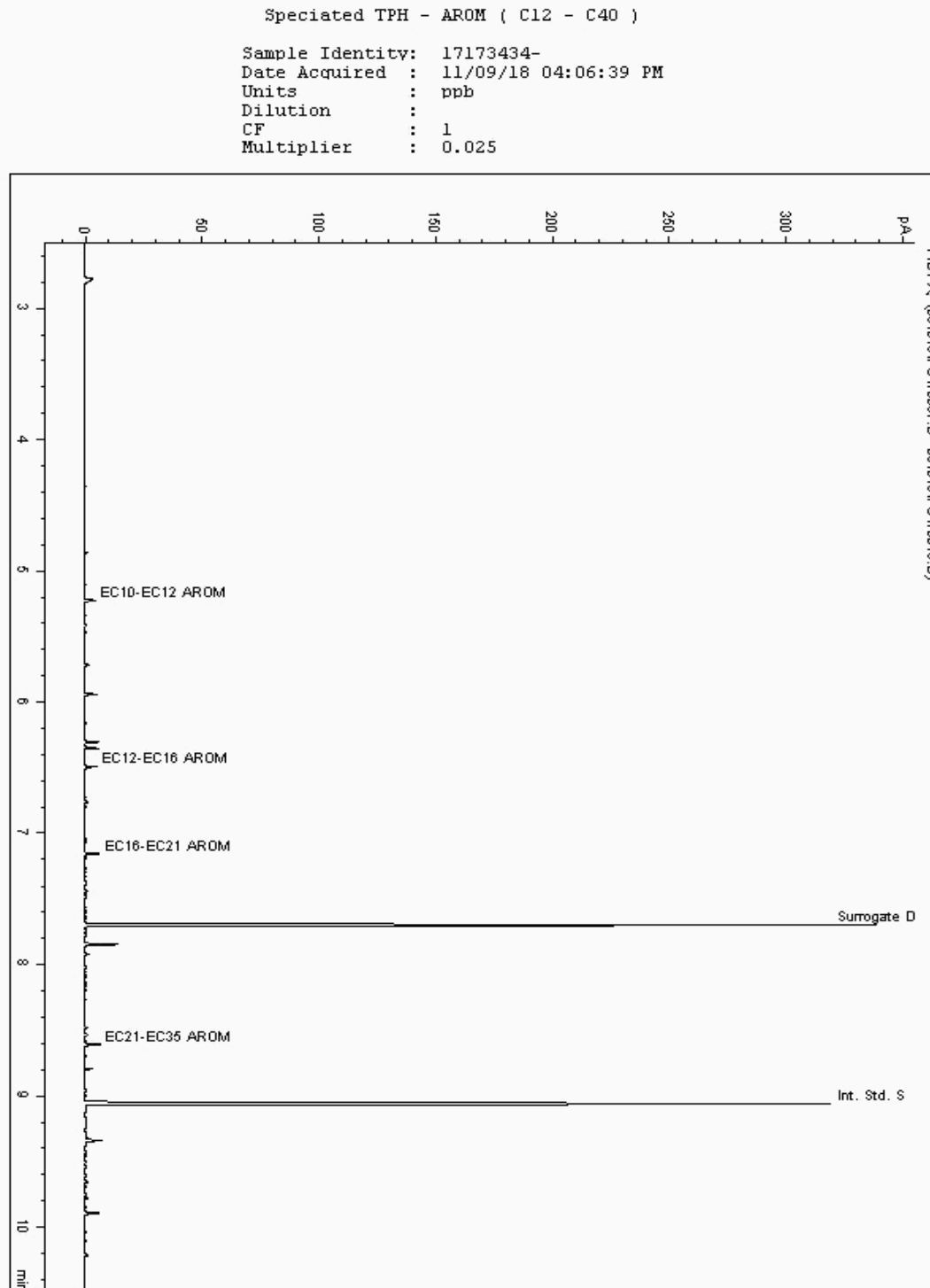
Report Number: 473276
Superseded Report: 472223

Chromatogram

Analysis: EPH CWG (Aromatic) Aqueous GC (W)

Sample No : 18281863
Sample ID : TP21

Depth : 2.00





CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: Barry

Client Reference: Dow
Order Number: 60585570

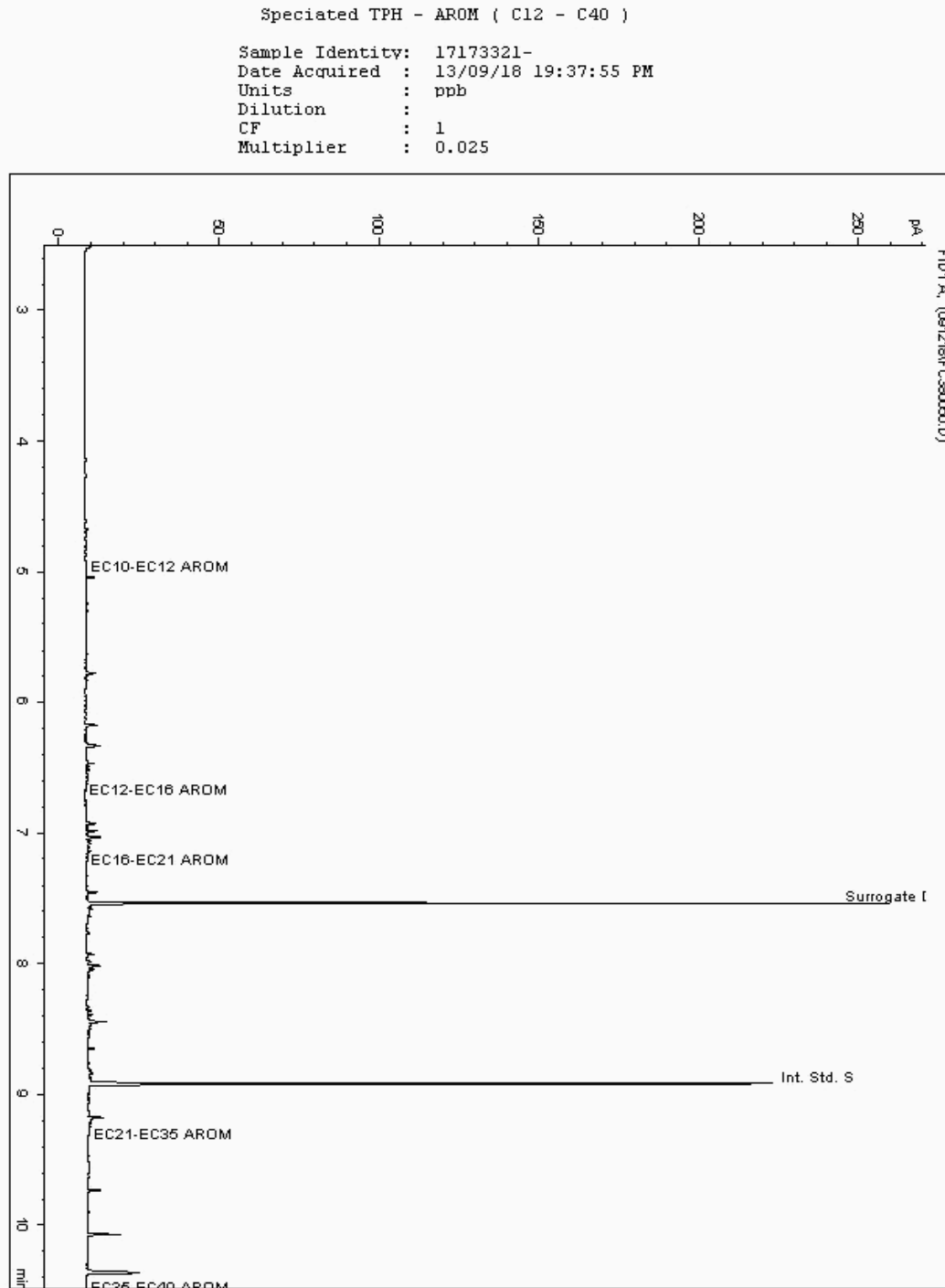
Report Number: 473276
Superseded Report: 472223

Chromatogram

Analysis: EPH CWG (Aromatic) Aqueous GC (W)

Sample No : 18281893
Sample ID : TP21

Depth : 0.20





CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: Barry

Client Reference: Dow
Order Number: 60585570

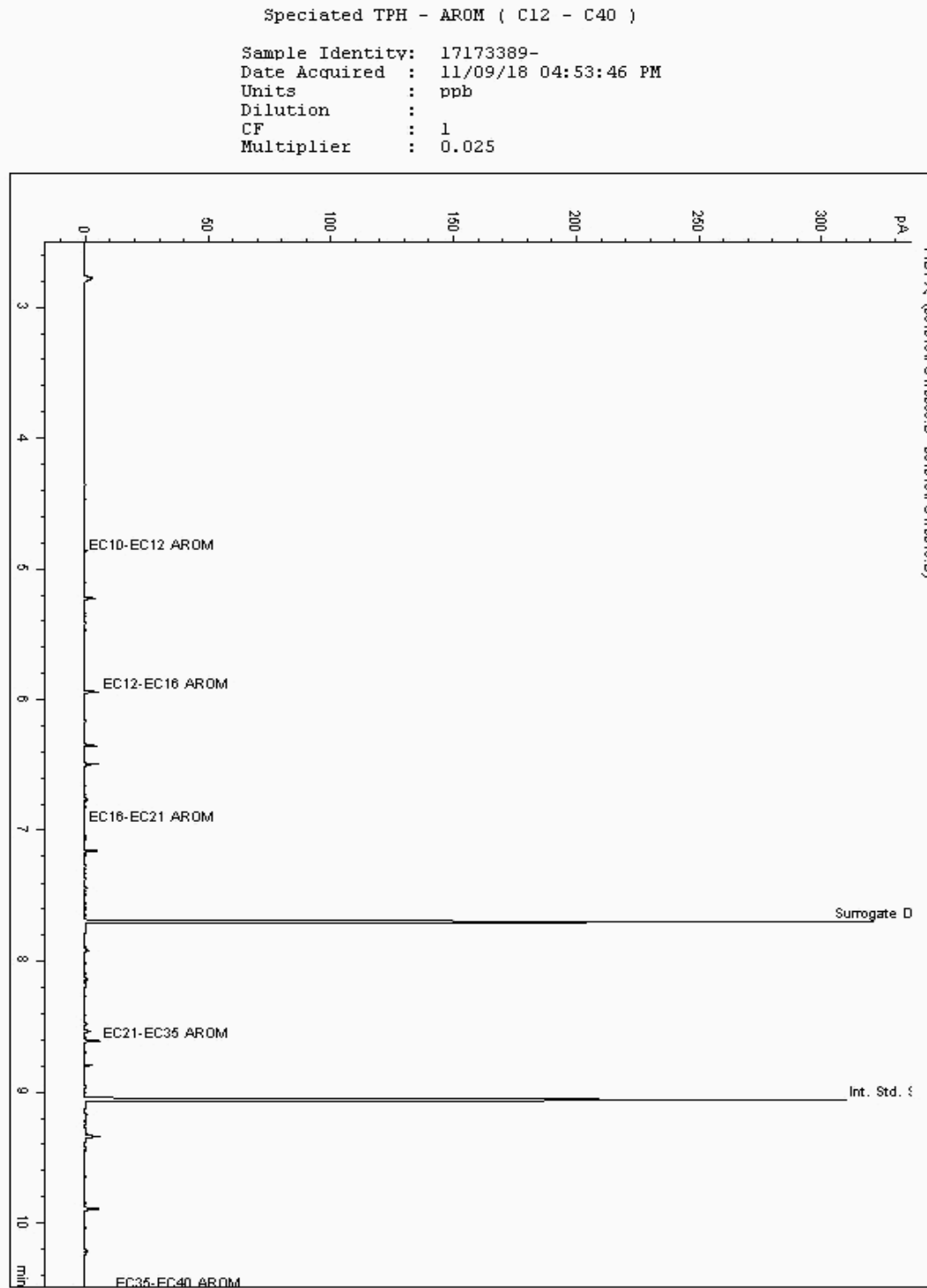
Report Number: 473276
Superseded Report: 472223

Chromatogram

Analysis: EPH CWG (Aromatic) Aqueous GC (W)

Sample No : 18281899
Sample ID : TP21

Depth : 1.00





CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: Barry

Client Reference: Dow
Order Number: 60585570

Report Number: 473276
Superseded Report: 472223

Chromatogram

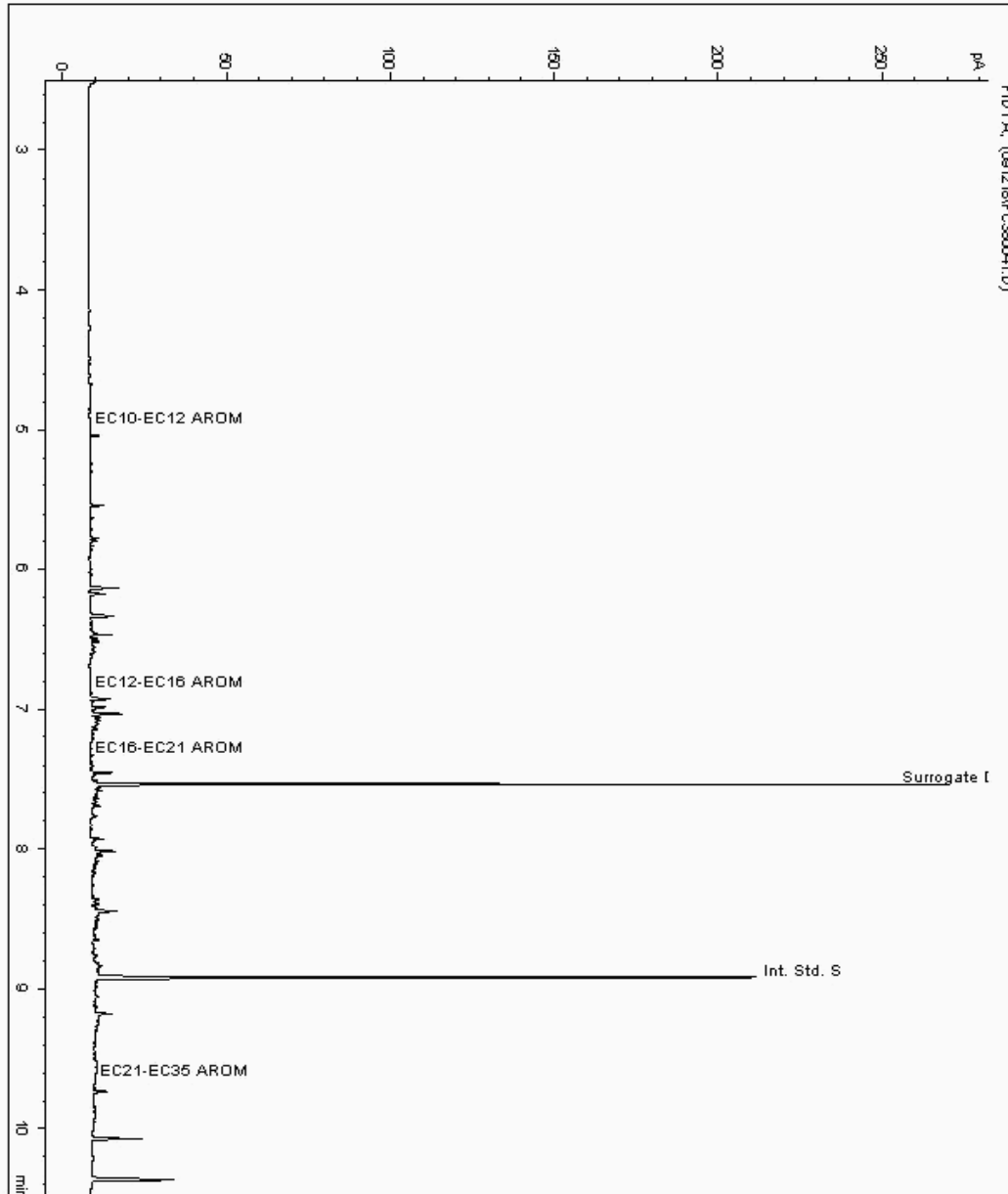
Analysis: EPH CWG (Aromatic) Aqueous GC (W)

Sample No : 18282174
Sample ID : TP22

Depth : 2.00

Speciated TPH - AROM (C12 - C40)

Sample Identity: 17173743-
Date Acquired : 13/09/18 16:08:59 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.025





CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: Barry

Client Reference: Dow
Order Number: 60585570

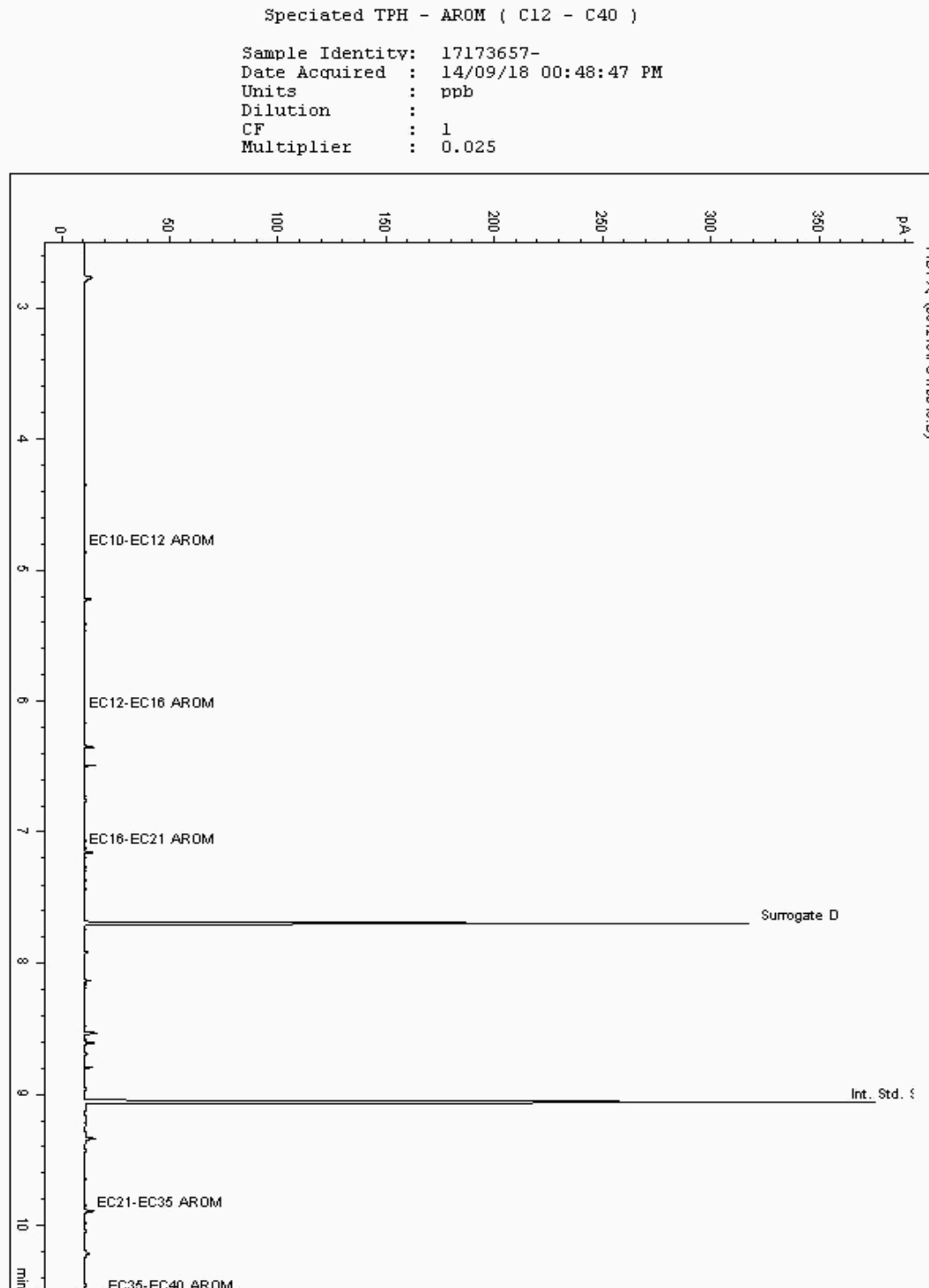
Report Number: 473276
Superseded Report: 472223

Chromatogram

Analysis: EPH CWG (Aromatic) Aqueous GC (W)

Sample No : 18282221
Sample ID : TP22

Depth : 1.00





CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: Barry

Client Reference: Dow
Order Number: 60585570

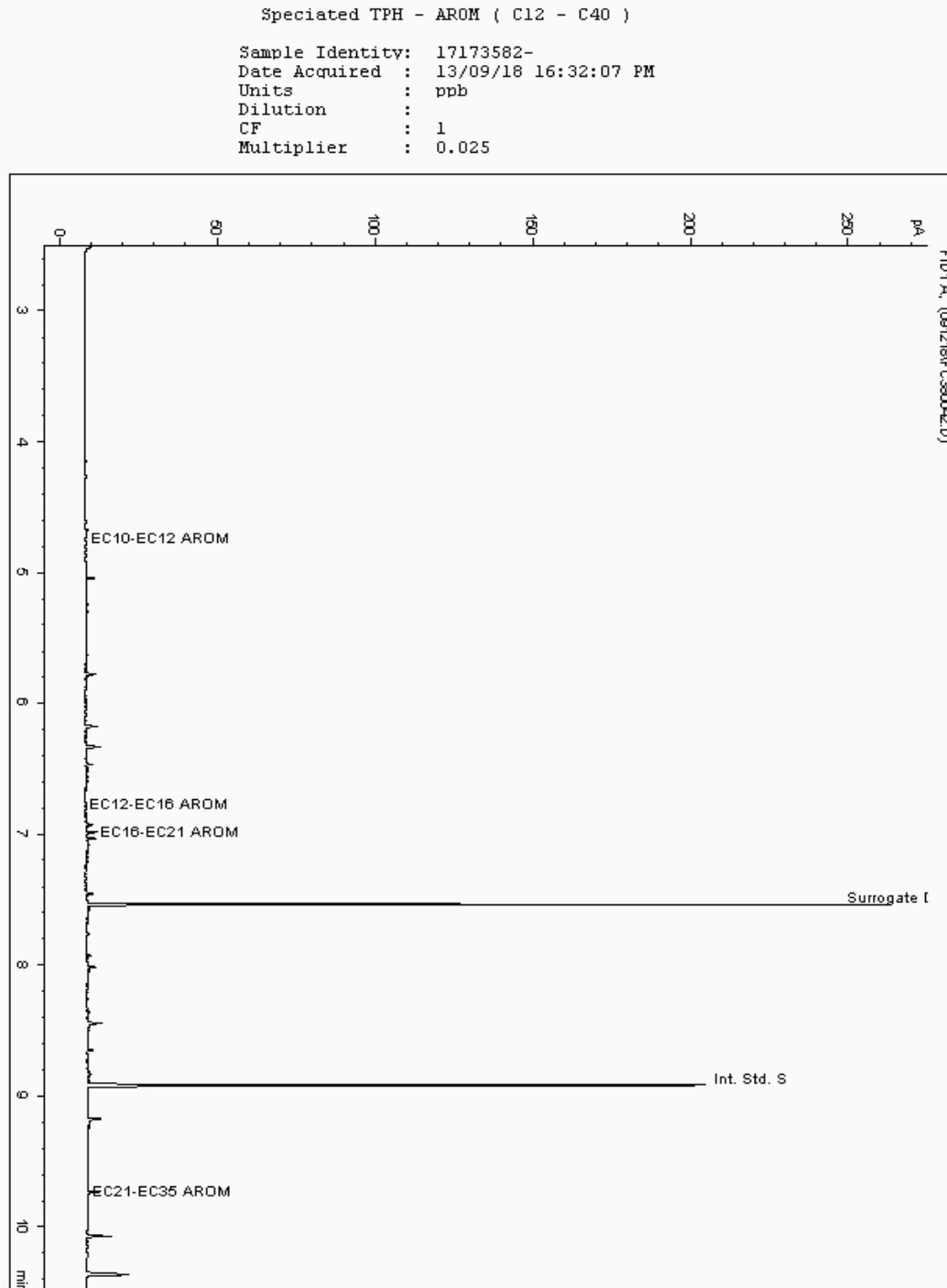
Report Number: 473276
Superseded Report: 472223

Chromatogram

Analysis: EPH CWG (Aromatic) Aqueous GC (W)

Sample No : 18282244
Sample ID : TP22

Depth : 0.20





CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: Barry

Client Reference: Dow
Order Number: 60585570

Report Number: 473276
Superseded Report: 472223

Chromatogram

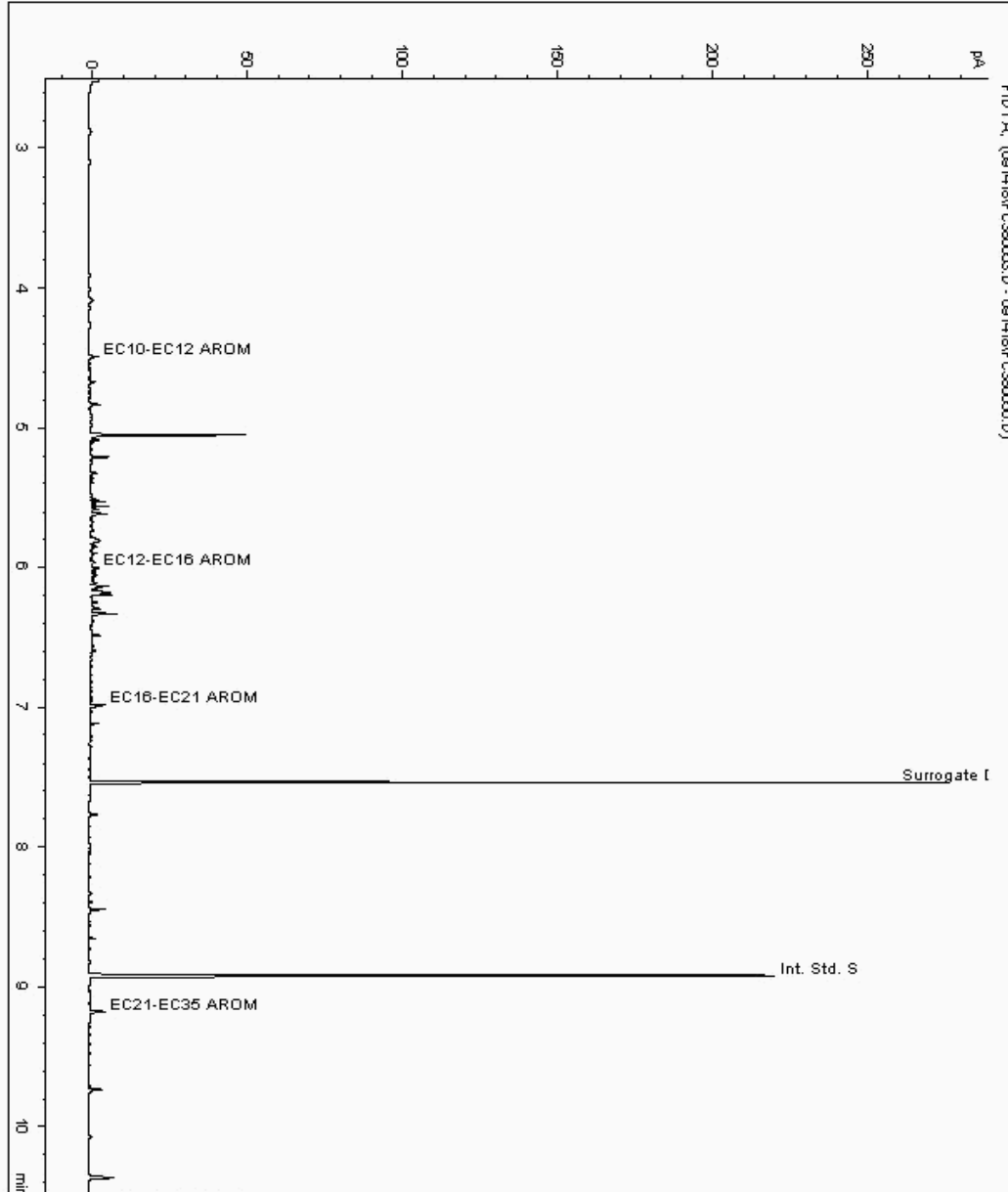
Analysis: EPH CWG (Aromatic) Aqueous GC (W)

Sample No : 18328608
Sample ID : TP21

Depth : 4.00

Speciated TPH - AROM (C12 - C40)

Sample Identity: 17219414-
Date Acquired : 17/09/18 11:09:49 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.025





CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: Barry

Client Reference: Dow
Order Number: 60585570

Report Number: 473276
Superseded Report: 472223

Chromatogram

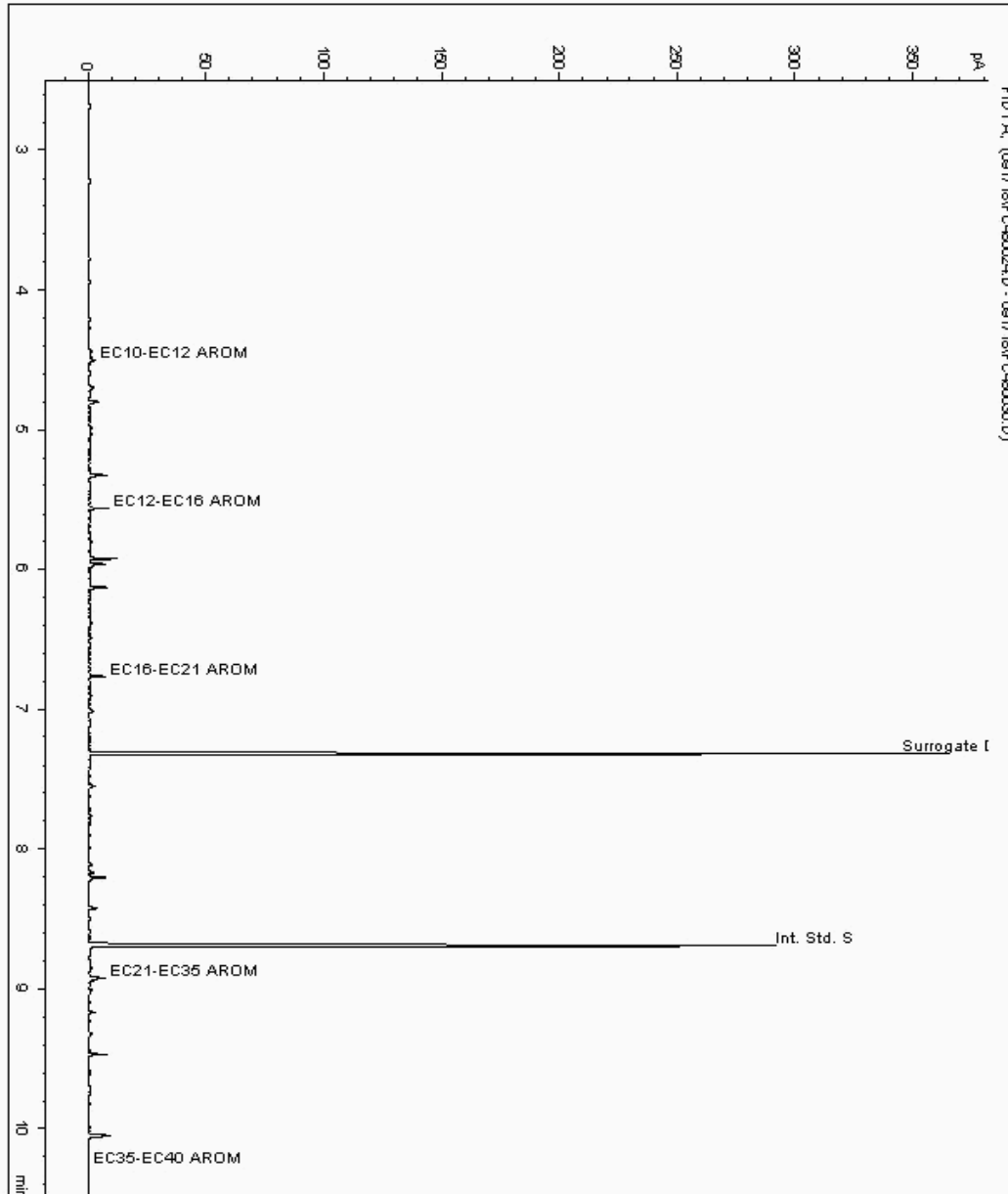
Analysis: EPH CWG (Aromatic) Aqueous GC (W)

Sample No : 18338430
Sample ID : TP22

Depth : 3.00

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 17219614-
Date Acquired : 18/09/2018 02:14:37 PM
Units : ppb
Dilution : SE TP22[3.00] ->
CF : 1
Multiplier : 0.025





CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: Barry

Client Reference: Dow
Order Number: 60585570

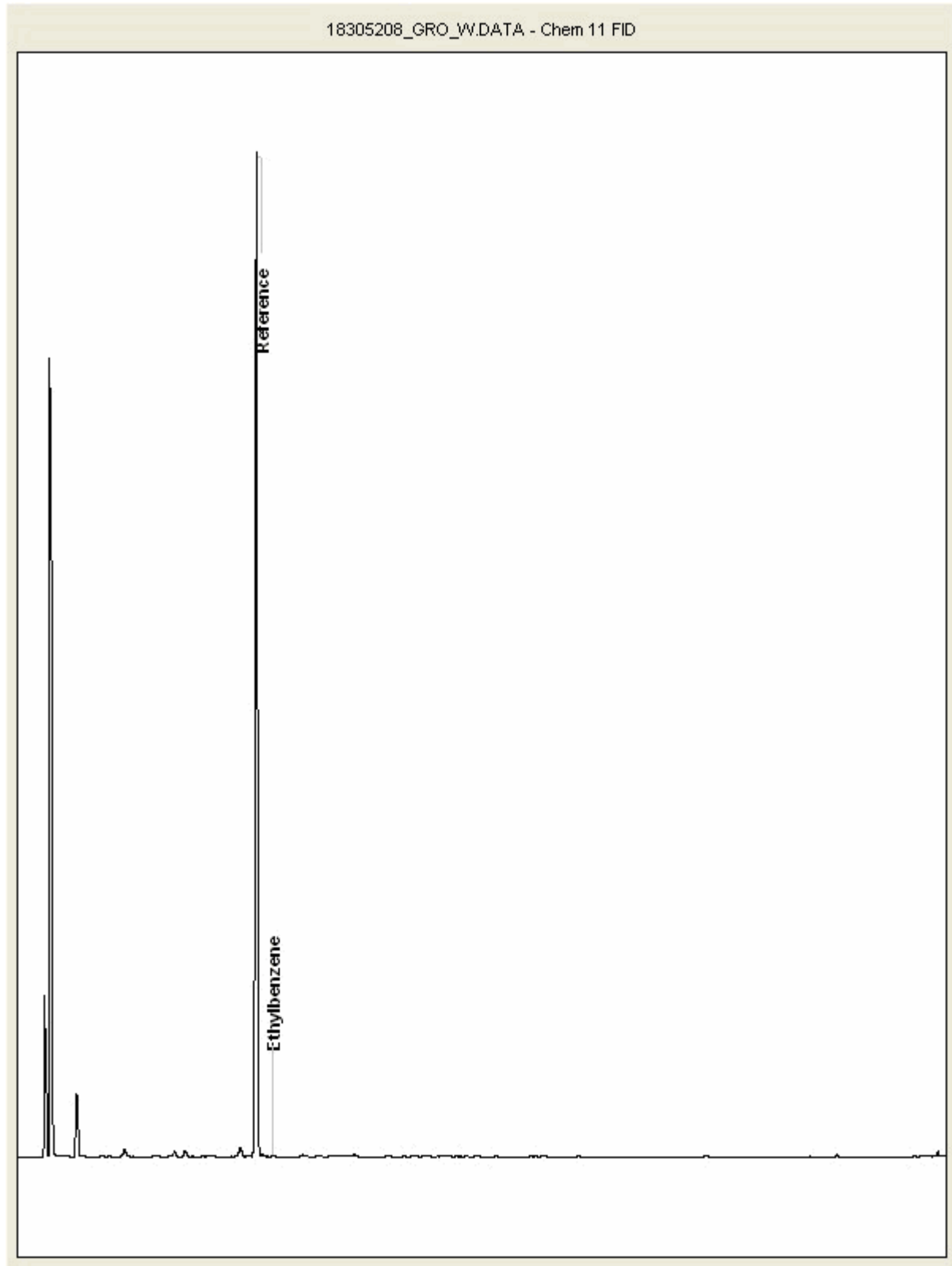
Report Number: 473276
Superseded Report: 472223

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 18305208
Sample ID : TP22

Depth : 2.00





CERTIFICATE OF ANALYSIS

Validated

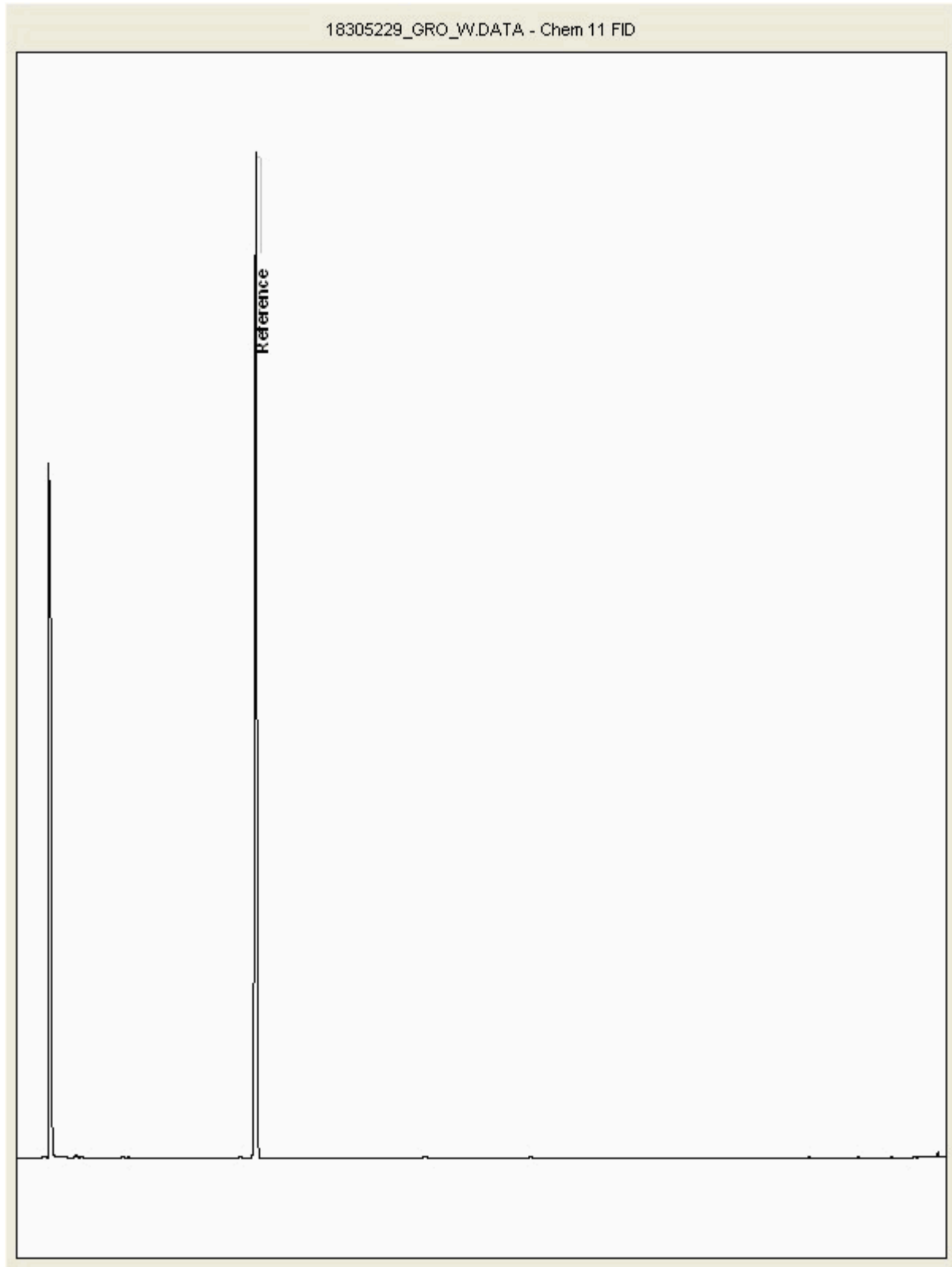
SDG:	180907-35	Client Reference:	Dow	Report Number:	473276
Location:	Barry	Order Number:	60585570	Superseded Report:	472223

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 18305229
Sample ID : TP22

Depth : 1.00





CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: Barry

Client Reference: Dow
Order Number: 60585570

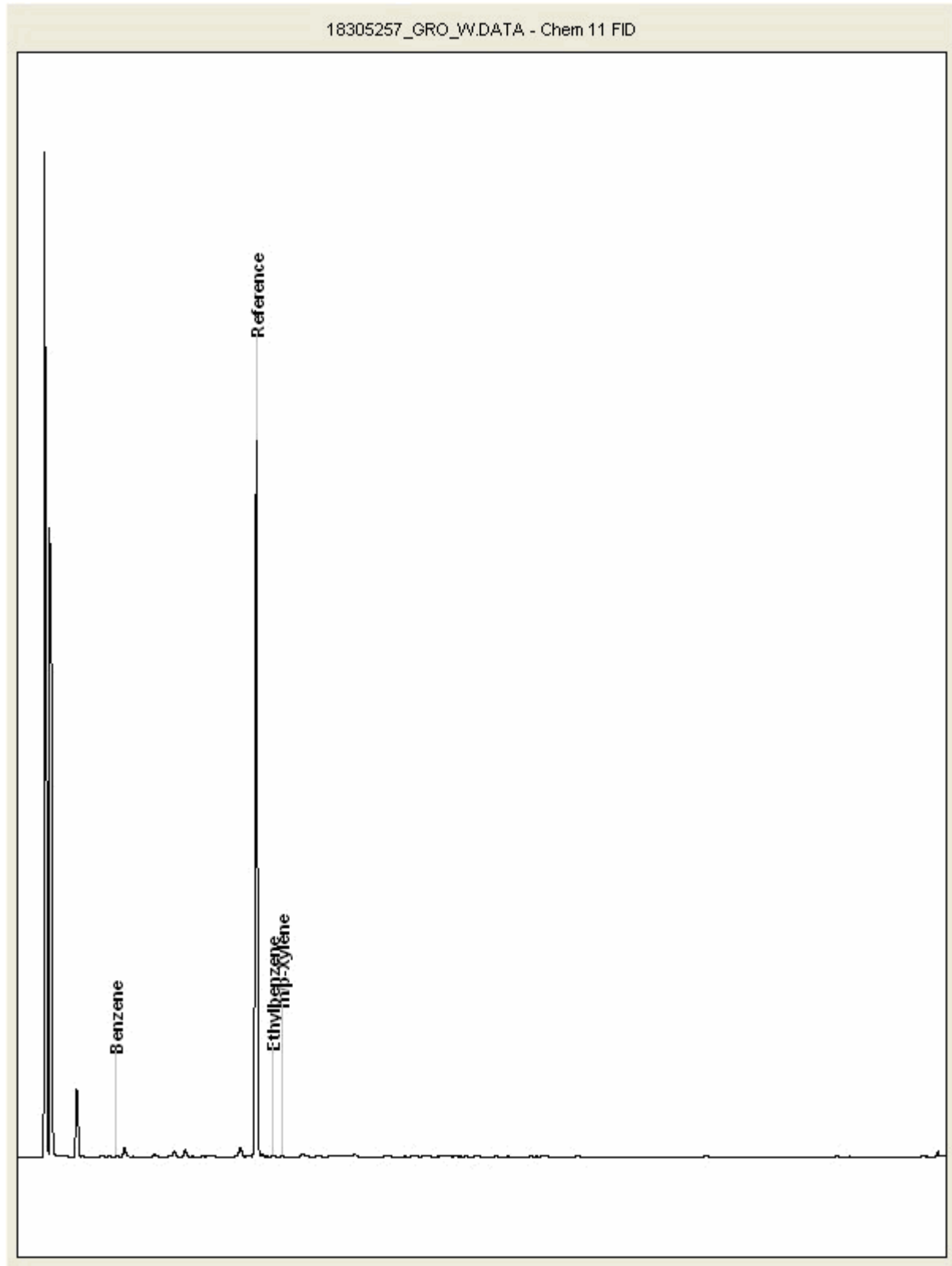
Report Number: 473276
Superseded Report: 472223

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 18305257
Sample ID : TP22

Depth : 3.00





CERTIFICATE OF ANALYSIS

Validated

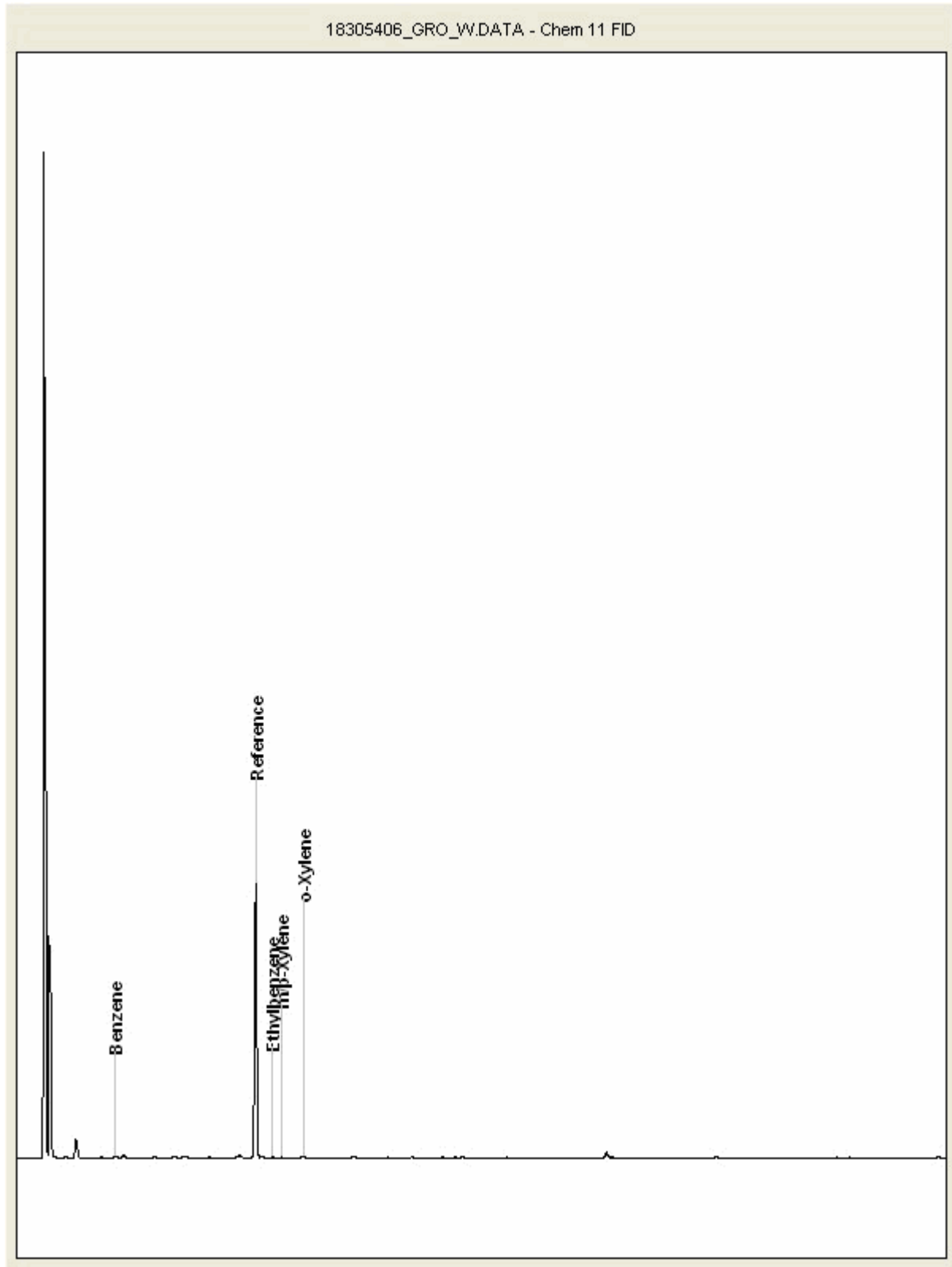
SDG:	180907-35	Client Reference:	Dow	Report Number:	473276
Location:	Barry	Order Number:	60585570	Superseded Report:	472223

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 18305406
Sample ID : TP21

Depth : 4.00





CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: Barry

Client Reference: Dow
Order Number: 60585570

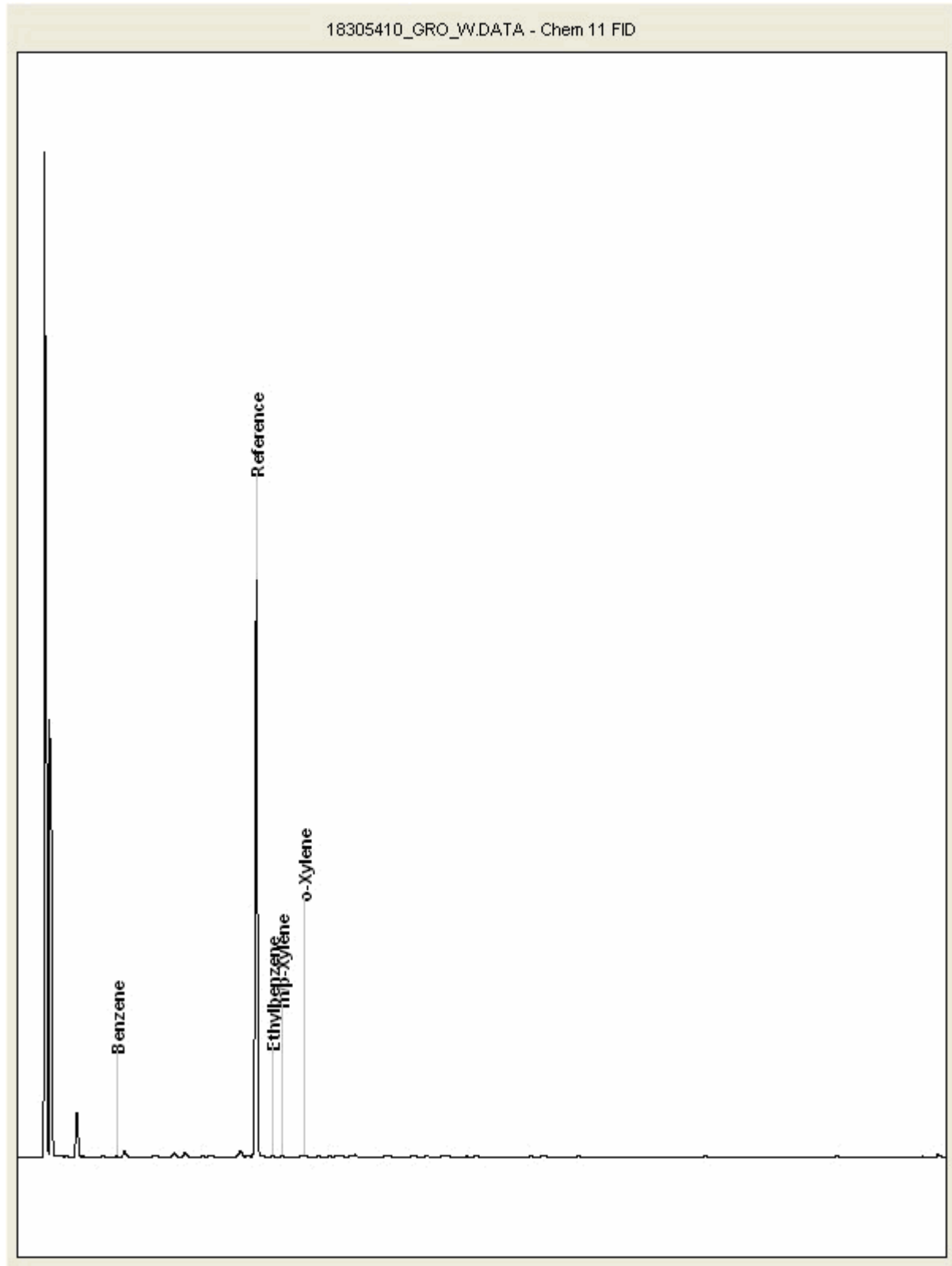
Report Number: 473276
Superseded Report: 472223

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 18305410
Sample ID : TP21

Depth : 3.00





CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: Barry

Client Reference: Dow
Order Number: 60585570

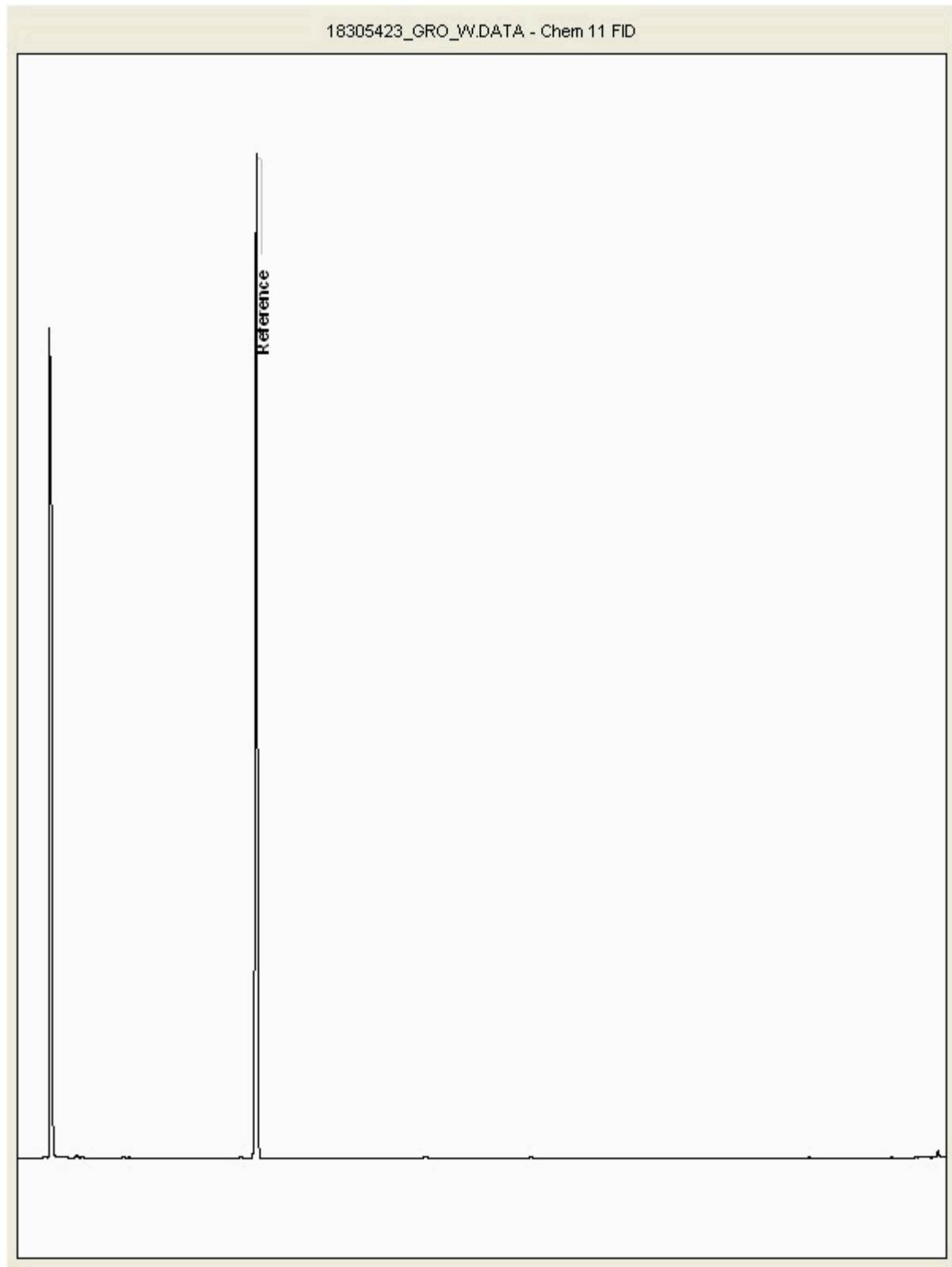
Report Number: 473276
Superseded Report: 472223

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 18305423
Sample ID : TP22

Depth : 0.20





CERTIFICATE OF ANALYSIS

Validated

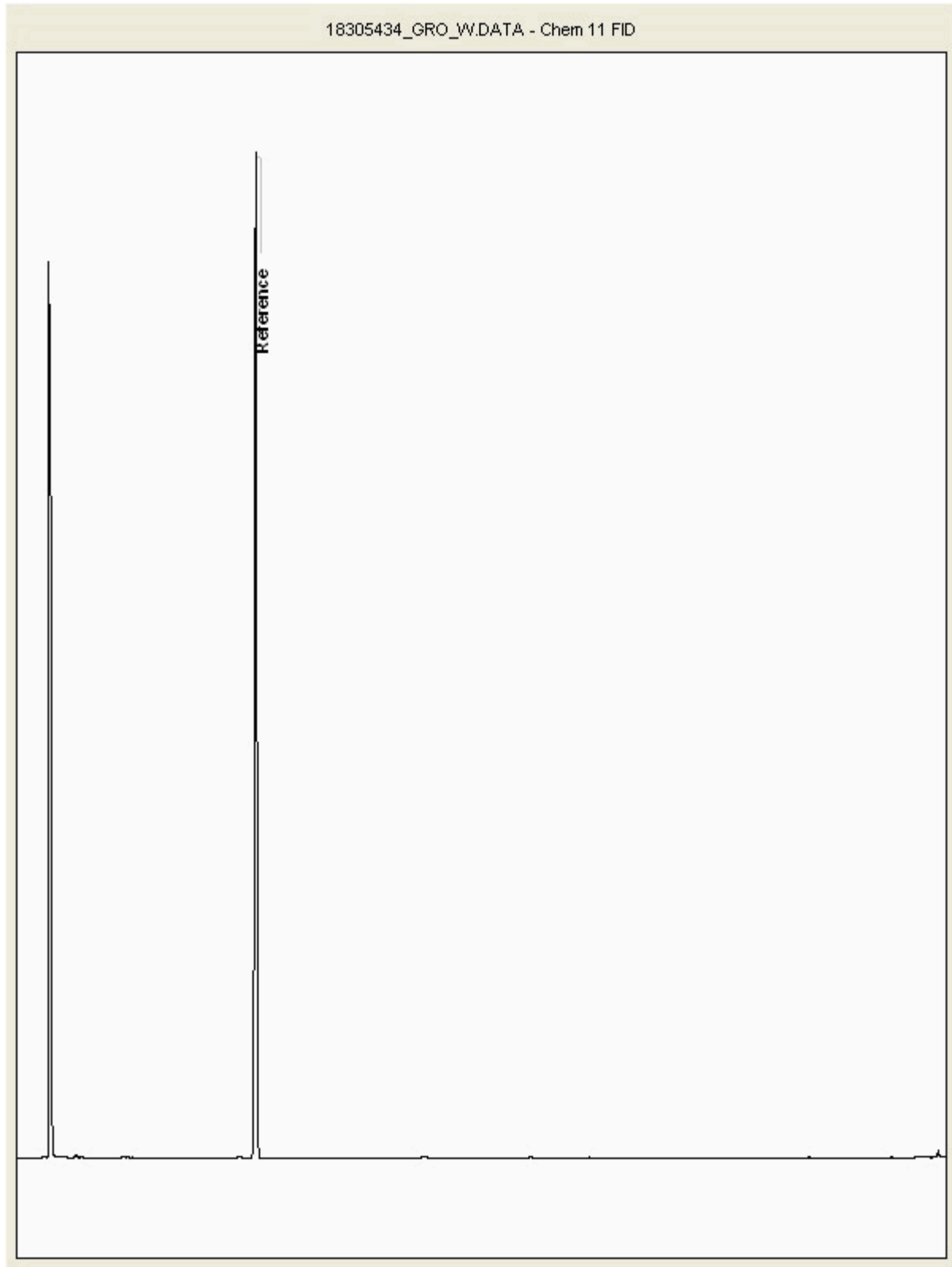
SDG:	180907-35	Client Reference:	Dow	Report Number:	473276
Location:	Barry	Order Number:	60585570	Superseded Report:	472223

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 18305434
Sample ID : TP21

Depth : 1.00





CERTIFICATE OF ANALYSIS

Validated

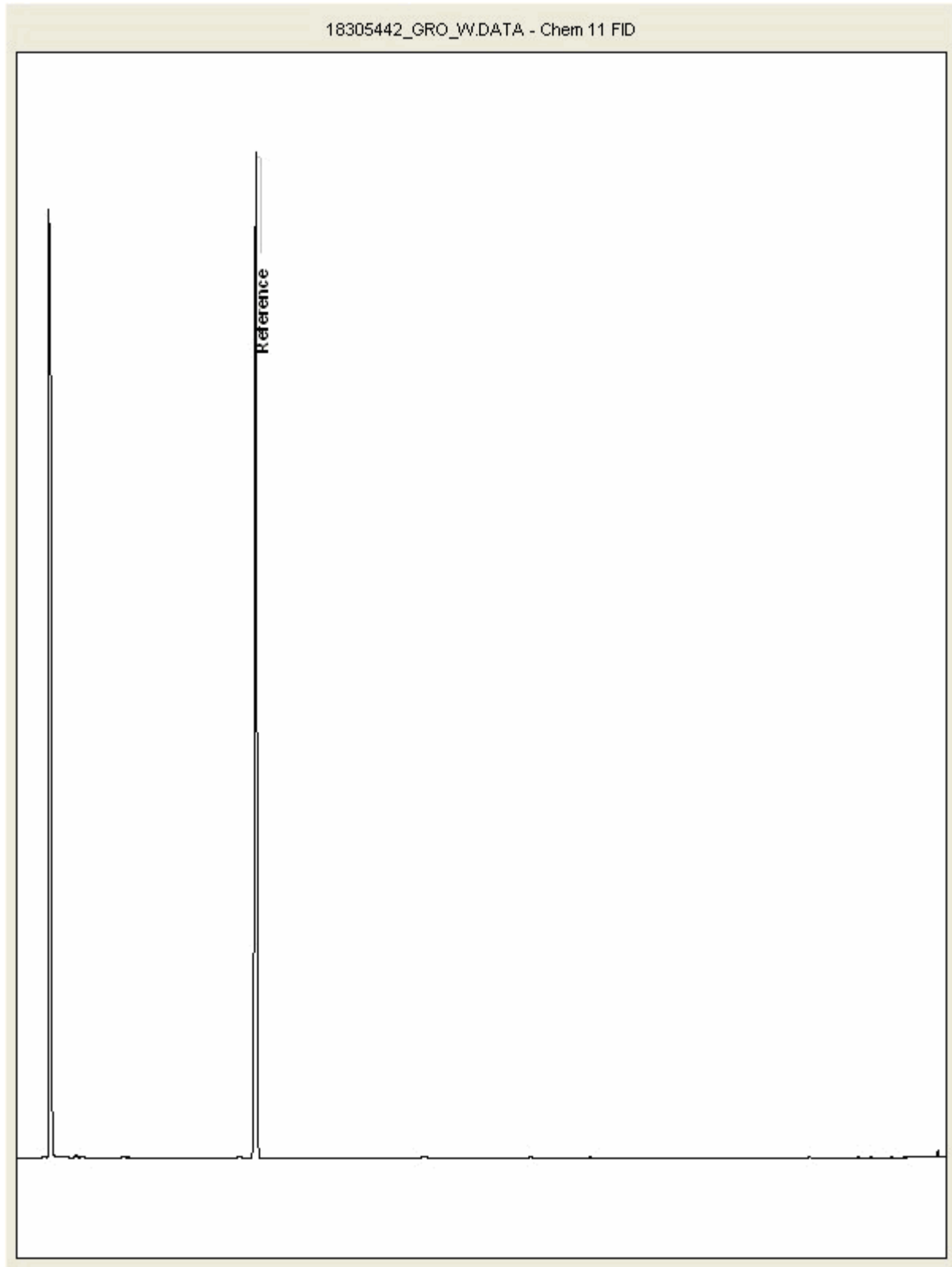
SDG:	180907-35	Client Reference:	Dow	Report Number:	473276
Location:	Barry	Order Number:	60585570	Superseded Report:	472223

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 18305442
Sample ID : TP21

Depth : 0.20





CERTIFICATE OF ANALYSIS

Validated

SDG: 180907-35
Location: Barry

Client Reference: Dow
Order Number: 60585570

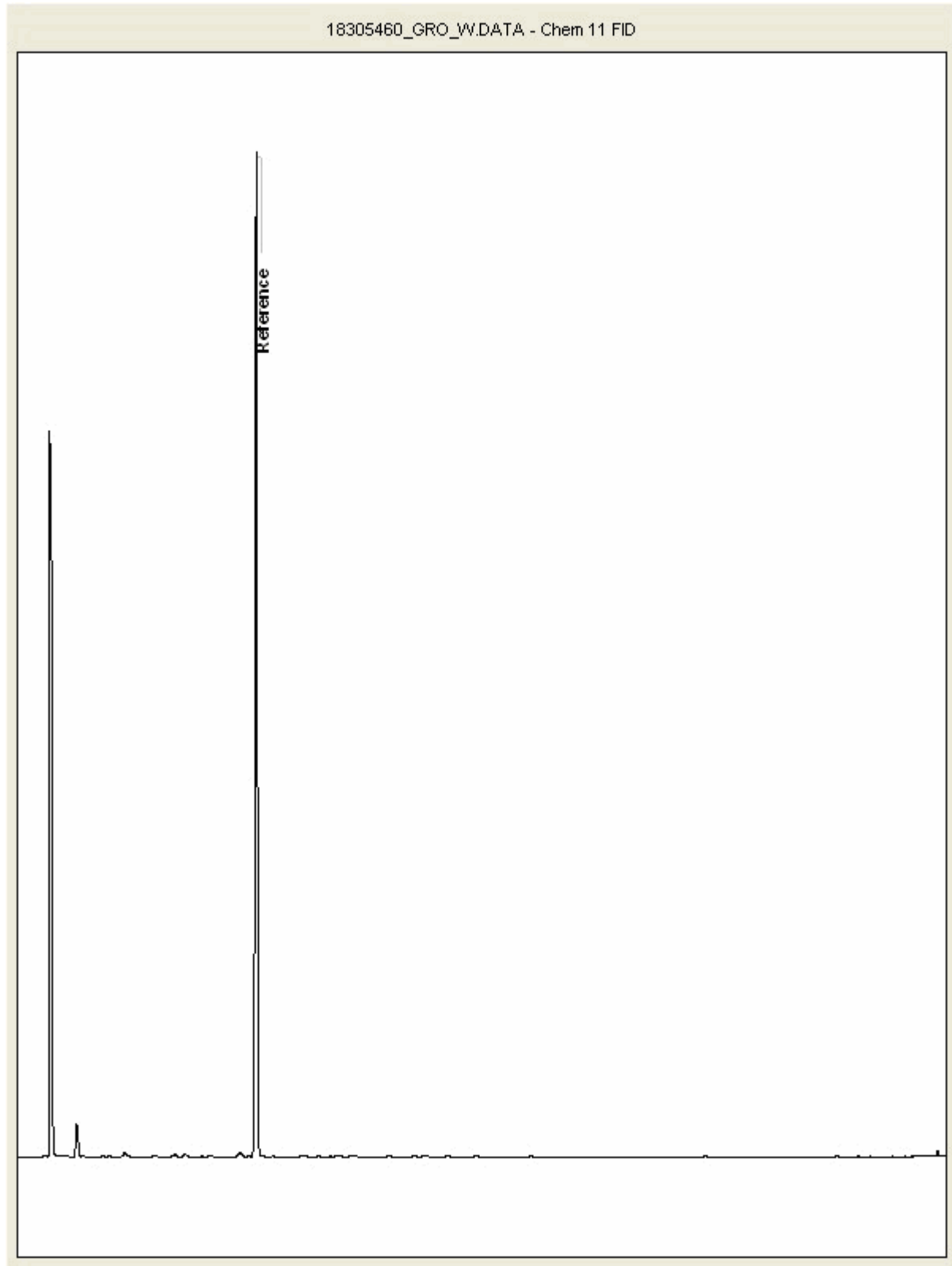
Report Number: 473276
Superseded Report: 472223

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 18305460
Sample ID : TP21

Depth : 2.00





CERTIFICATE OF ANALYSIS

SDG:	180907-35	Client Reference:	Dow	Report Number:	473276
Location:	Barry	Order Number:	60585570	Superseded Report:	472223

Appendix

1. Results are expressed on a dry weight basis (dried at 35°C) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH₄ by the BRE method, VOC TICs and SVOC TICs.

2. Samples will be run in duplicate upon request, but an additional charge may be incurred.

3. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALS reserve the right to charge for samples received and stored but not analysed.

4. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

5. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

6. When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as "Not detected". If no asbestos fibre types are found all will be reported as "Not detected" and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of asbestos present is not determined unless specifically requested.

7. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

8. If appropriate preserved bottles are not received preservation will take place on receipt. However, the integrity of the data may be compromised.

9. NDP - No determination possible due to insufficient/unsuitable sample.

10. Metals in water are performed on a filtered sample, and therefore represent dissolved metals - total metals must be requested separately.

11. Results relate only to the items tested.

12. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

13. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

14. **Product analyses** - Organic analyses on products can only be semi-quantitative due to the matrix effects and high dilution factors employed.

15. Phenols monohydric by HPLC include phenol, cresols (2-Methylphenol, 3-Methylphenol and 4-Methylphenol) and Xylenols (2,3 Dimethylphenol, 2,4 Dimethylphenol, 2,5 Dimethylphenol, 2,6 Dimethylphenol, 3,4 Dimethylphenol, 3,5 Dimethylphenol).

16. Total of 5 speciated phenols by HPLC includes Phenol, 2,3,5-Trimethyl Phenol, 2-Isopropylphenol, Cresols and Xylenols (as detailed in 15).

17. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

18. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

19. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

20. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

General

21. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

22. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

23. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

24. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as "mixed hydrocarbons". Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

Sample Deviations

If a sample is classed as deviated then the associated results may be compromised.

1	Container with Headspace provided for volatiles analysis
2	Incorrect container received
3	Deviation from method
4	Holding time exceeded before sample received
5	Samples exceeded holding time before preservation was performed
§	Sampled on date not provided
◆	Sample holding time exceeded in laboratory
@	Sample holding time exceeded due to sampled on date
&	Sample Holding Time exceeded - Late arrival of instructions.

Asbestos

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

Astos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

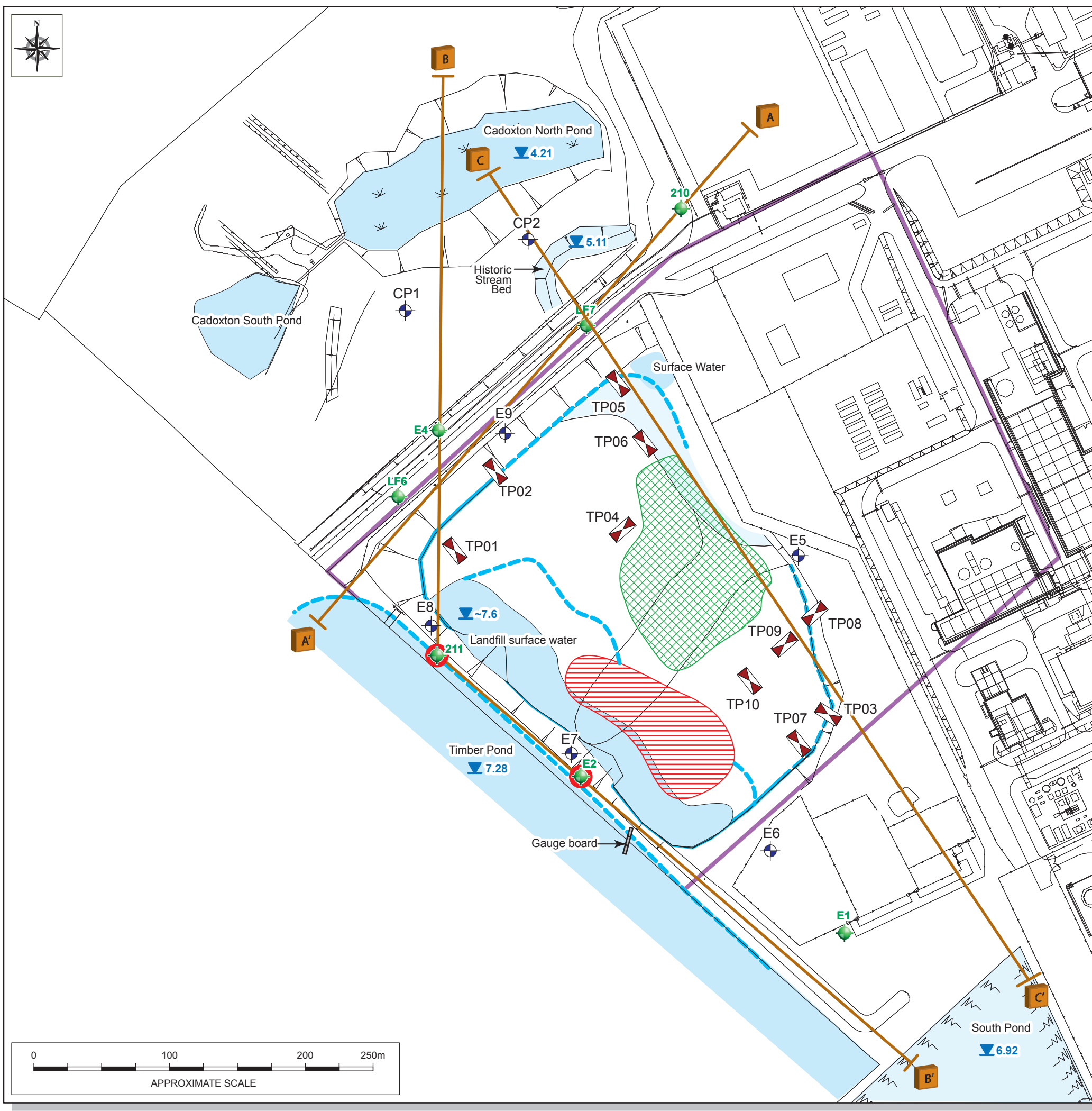
Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than: - Trace - Where only one or two asbestos fibres were identified.

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

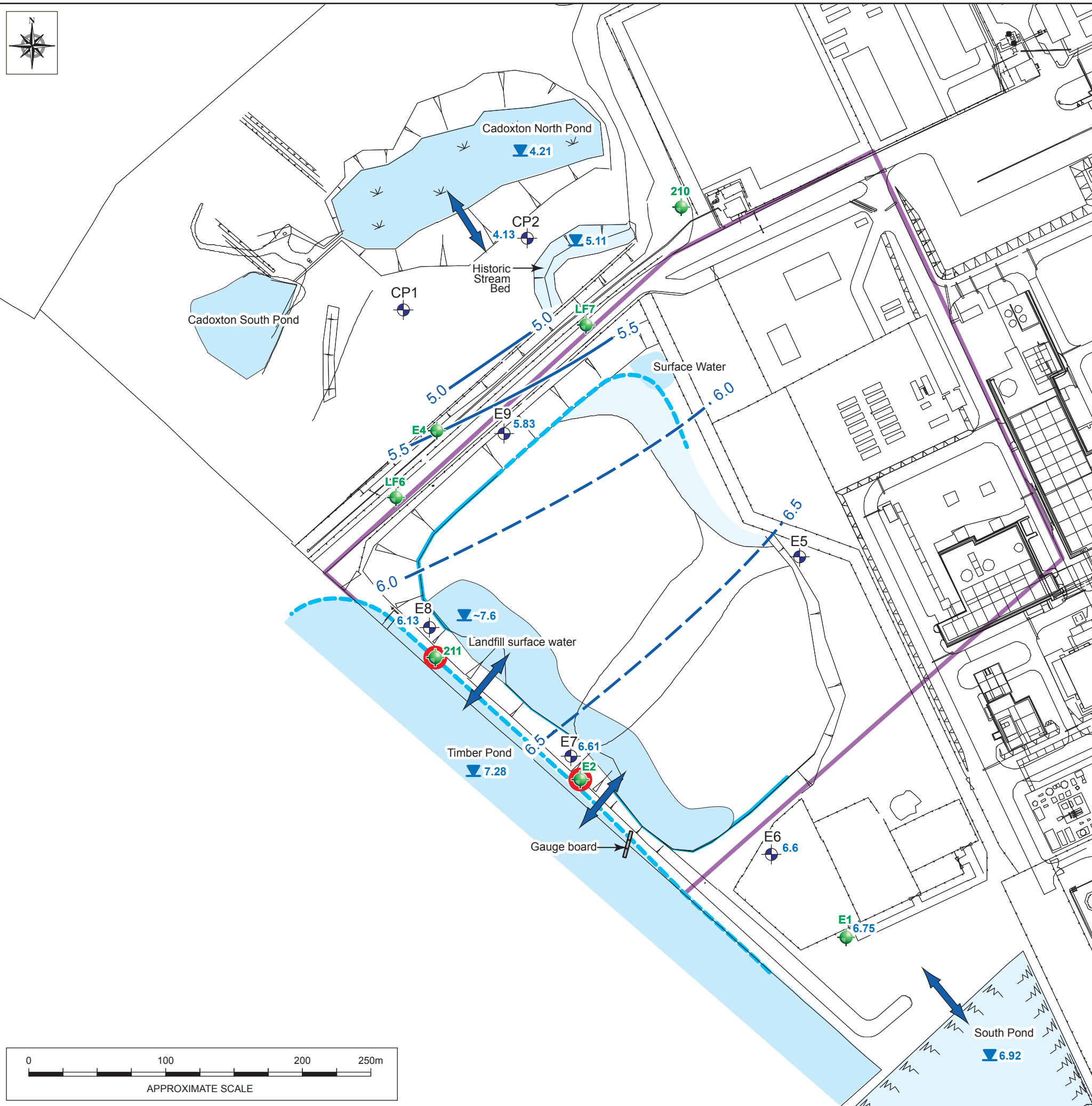
The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.

Appendix E Conceptual Model Figures



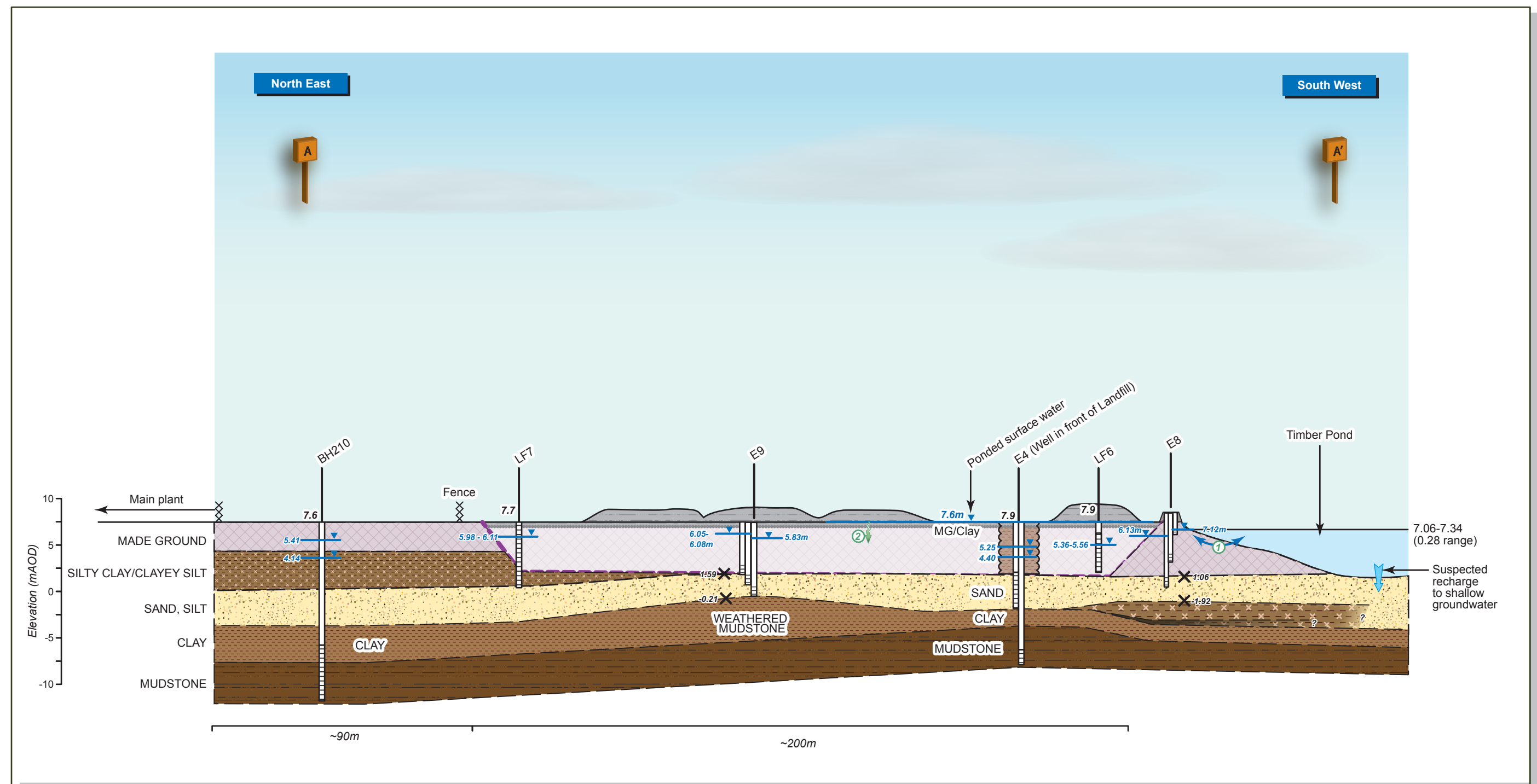
- KEY:
- Approximate area landfilled (1991)
 - Surface water feature
 - Line of section
 - Surface water levels (mAOD) 26/11/12
 - Existing monitoring wells
 - CMT well 2015
 - Lost Well
 - Approximate area of process waste material surface storage (December 2015)
 - Approximate area of rubble storage

Title	SITE FEATURES PLAN		
Location	DOW CORNING, BARRY, SOUTH WALES		
Client	DOW CORNING LTD		
	App'd: JC	Drawn: SQ/LCS	Date: FEB 2016
	Status: DRAFT	Ref: JC/CAR/SQ/MCH	
	Scale: AS SHOWN	Job No: 60469588	
	Drg. Size: A3	FIGURE 1	



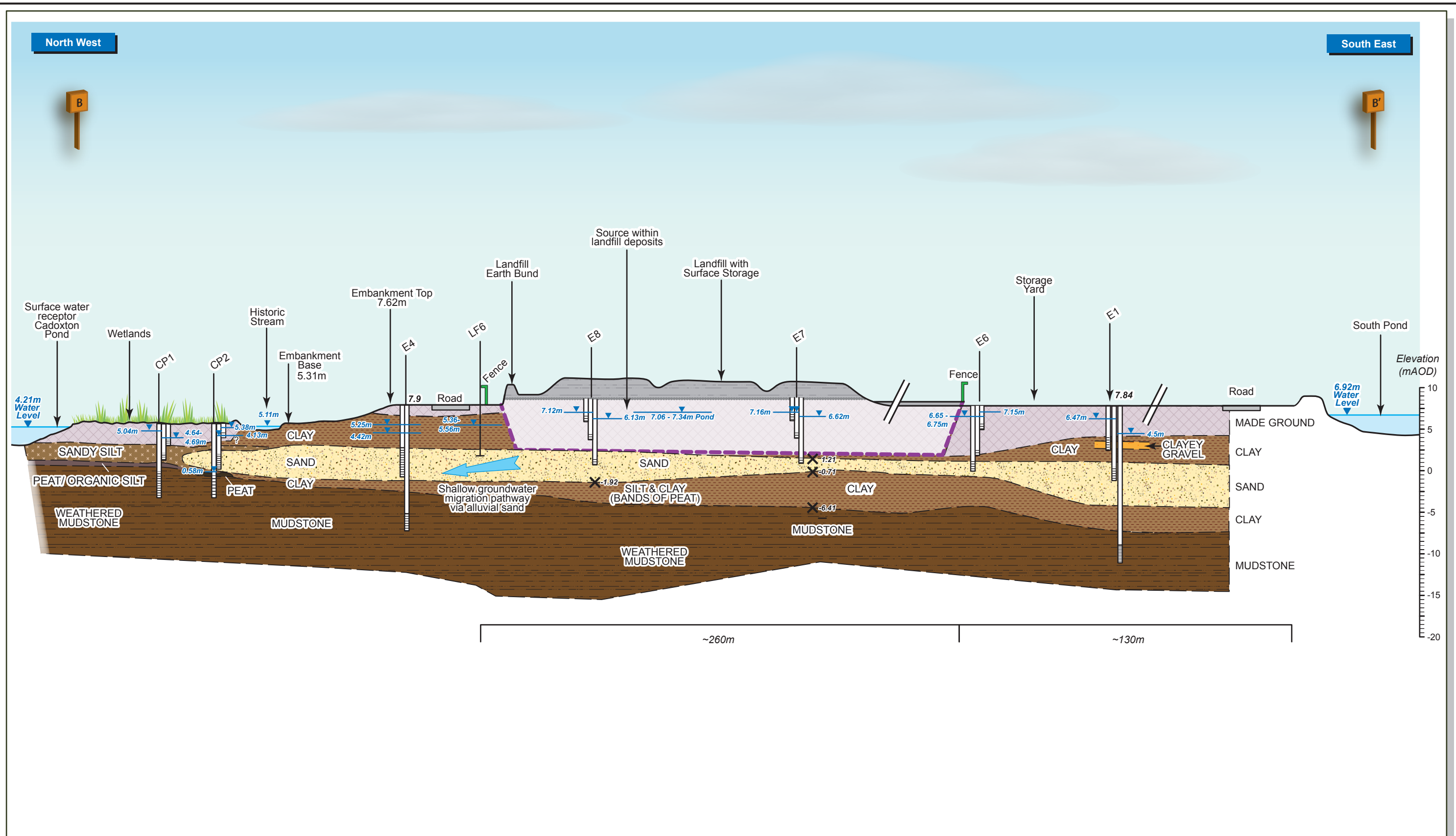
- KEY:
- Approximate area landfilled (1991)
 - Surface water feature
 - Surface water levels (mAOD) 26/11/12
 - Existing monitoring wells
 - CMT well 2015
 - Lost Well
 - Potential Hydraulic Connection Via Deep Made Ground/Sand
 - Groundwater Contour in Sand (mAOD)

Title	GROUNDWATER CONTOUR PLOT - SAND		
Location	DOW CORNING, BARRY, SOUTH WALES		
Client	DOW CORNING LTD		
	App'd:	Drawn:	Date:
	JC	SO/LCS	FEB 2016
	Status:	Ref:	
	DRAFT	LCH/BRIS/JC/CDF	
Scale:	AS SHOWN		Job No:
			60469588
Drg. Size:	A3		FIGURE 2



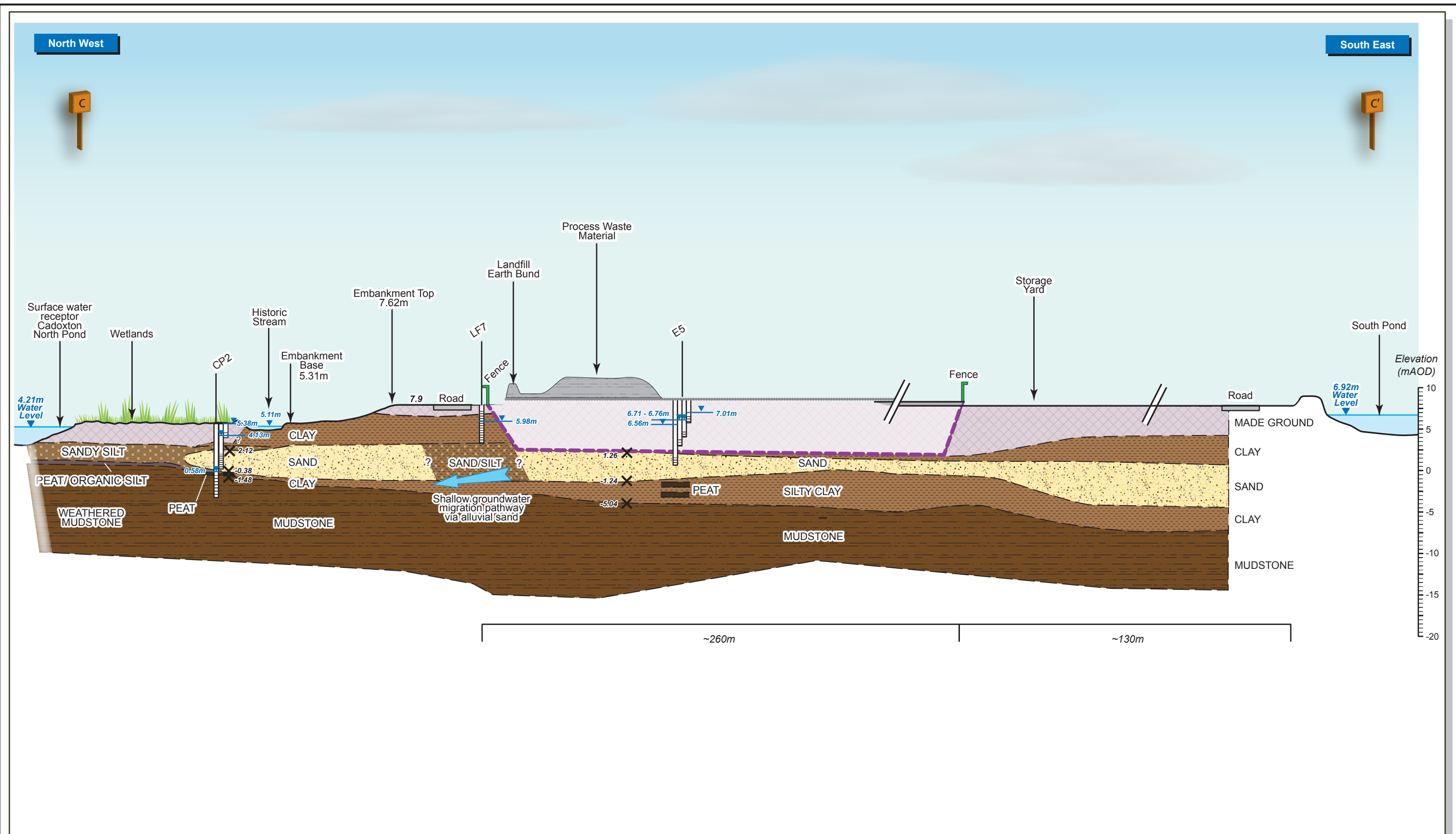
Key:			
	Surface stored materials		Clayey Silt/ Silty Clay
	Made Ground		Potential depth of Landfill mass to 7mbgl
	Silt Clay		Water Levels of surface water 26/11/12
	Sand		Spot Heights
	Peat		Lateral migration to/from Timber Pond
	Mudstone		Vertical infiltration to landfill

Title	CROSS SECTION A-A'		
Location	DOW CORNING, BARRY, SOUTH WALES		
Client	DOW CORNING LTD		
	App'd: JC	Drawn: RH/LCS	Date: FEB 2016
	DRAFT		Ref: JC/CDF/LCS/BRS
	Scale: AS SHOWN		Job No: 60469588
	Drg. Size: A3		FIGURE 3



Key:			
	Surface stored materials		Peat
	Made Ground		Mudstone
	Silt Clay		Sandy Silt
	Sand		Potential depth of Landfill mass to 7mbgl
	Gravel		Water Levels of surface water 26/11/12
	Peat/Organic Silt		Spot Heights

Title	CROSS SECTION B-B'		
Location	DOW CORNING, BARRY, SOUTH WALES		
Client	DOW CORNING LTD		
	App'd:	Drawn:	Date:
	JC	RH/LCS	FEB 2016
	DRAFT		Ref: JC/CDF/LCS/BRS
	Scale: AS SHOWN		Job No: 60469588
	Drg. Size: A3		FIGURE 4



Key:			
	Surface stored materials		Mudstone
	Made Ground		Sandy Silt
	Silt Clay		Potential depth of Landfill mass to 7mbgl
	Sand		Water Levels of surface water 26/11/12
	Peat/Organic Silt		Spot Heights
	Peat		

Title CROSS SECTION C-C'			
Location DOW CORNING, BARRY, SOUTH WALES			
Client DOW CORNING LTD			
	App'd:	Drawn:	Date:
	JC	RH/LCS	FEB 2016
	DRAFT		Ref: JC/CDF/LCS/BRS
	Scale: AS SHOWN		Job No: 60469588
	Drg. Size: A3		FIGURE 5

