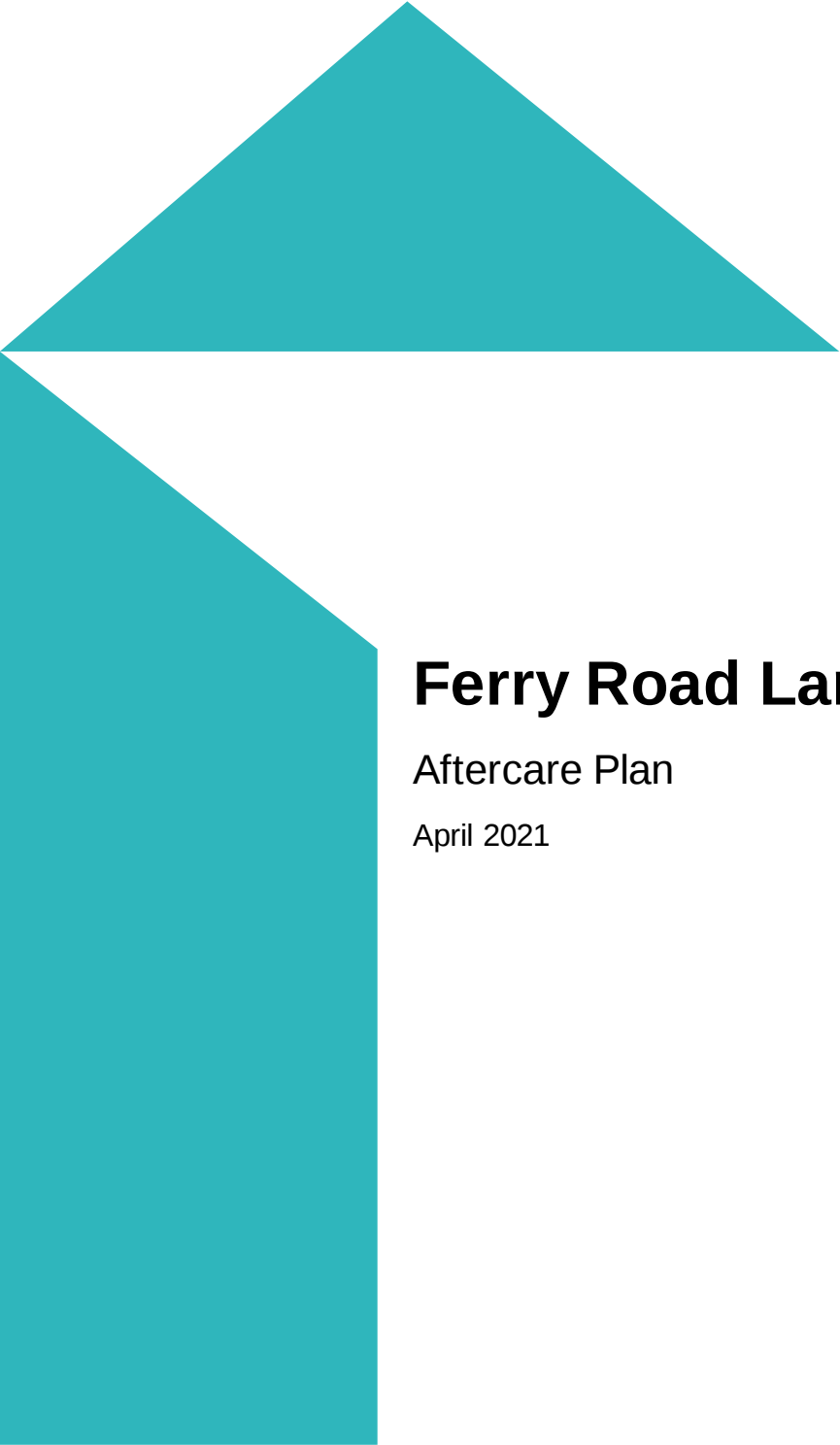




Ferry Road Landfill

Aftercare Plan

April 2021

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Aftercare Plan

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Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Description
A	26/04/21	D Dray	E C Probert	E C Probert	First issue
B	29/04/21	D Dray	E C Probert	E C Probert	Second issue – minor changes to gas monitoring and topographic survey information

Document reference: 100103133 | 1 | B

Information class: Standard

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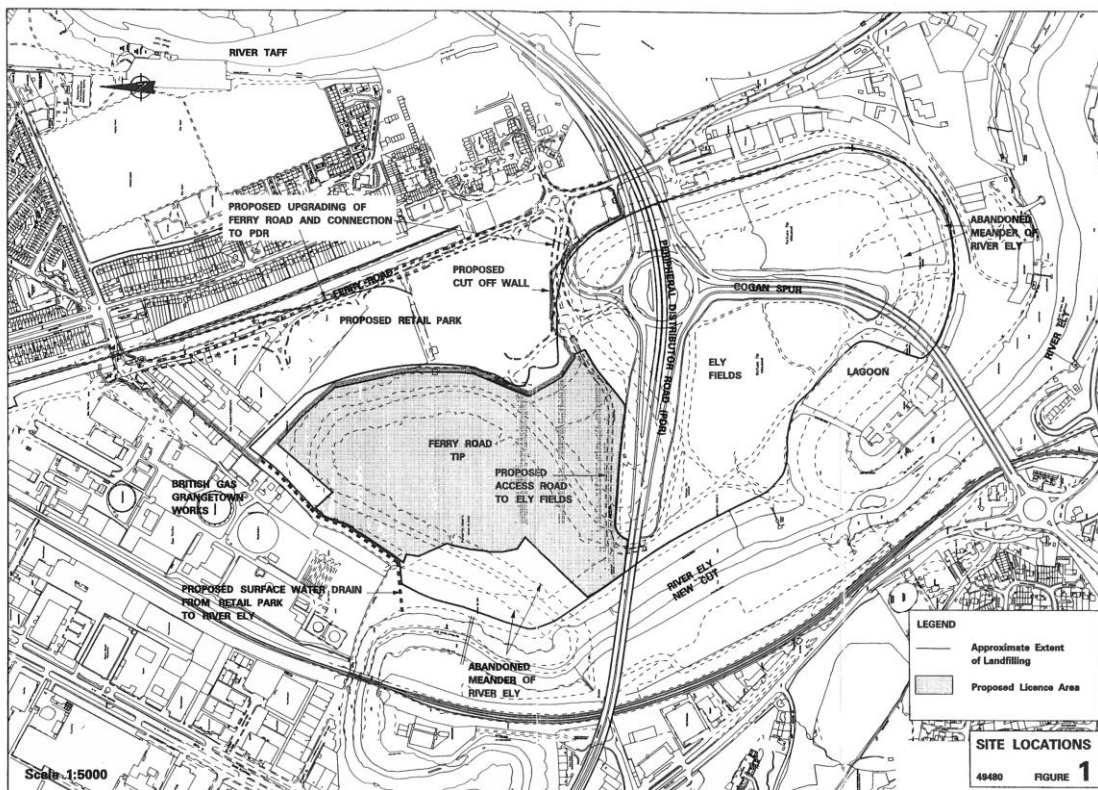
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1 Introduction

1.1 Site location

The site comprises an irregular-shaped plot with an area of approximately 16 hectares (Ha), located in the southern area of the city of Cardiff at National Grid Reference ST 17268 73504. Access to the site is from Ferry Lane located at the north-eastern site boundary.

Figure 1.1: Location plan for Ferry Road Landfill

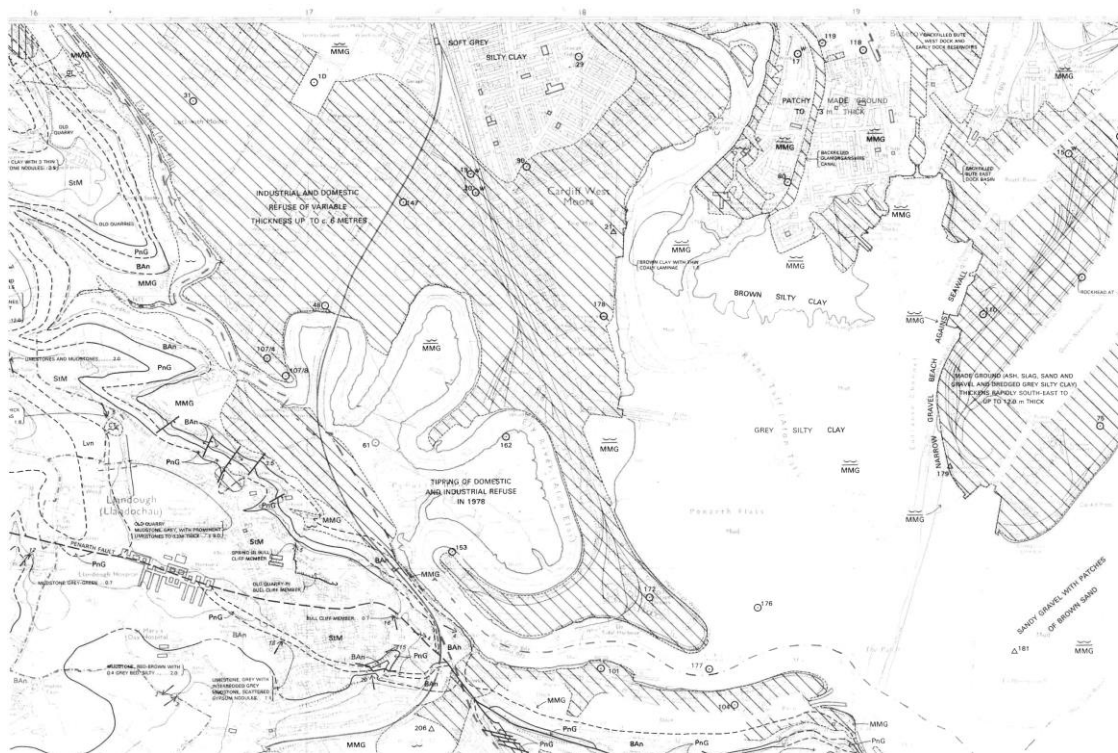


Source: Disposal of Waste at the Ferry Road Landfill – Abridged Version of the Working Plan Supporting WML 95/07 (Mod 1), Ove Arup & Partners

1.2 Site history

The area surrounding the site had apparently already been the subject of significant historical tipping. Figure 1.2 shows the extent of waste disposal tipping operations within the vicinity of the landfill that pre-dated the disposal operations at the site. It shows that much of the area within this location was tipped with approximately 6m depth of municipal and industrial wastes.

Figure 1.2: Plan showing historical tipping, pre-dating disposal at Ferry Road Landfill



The Ferry Road Landfill was originally known as Penarth Moors, a marshy area in an extreme meander of the River Ely.

The site first began accepting waste in 1971. Prior to the start of tipping 1971 the site comprised the meandering River Ely and associated flood plains. In 1969 an Act of Parliament was passed to enable construction of a new cut across the meanders of the River Ely. The cut forms the present-day line of the river. Cardiff City Council used the old riverbed to dispose of builders' rubble, commercial waste and municipal refuse. This original landfill is unlined and achieves a height of around 20m above the surrounding area.

Very little information exists about the exact tipping history of the site, and detailed tipping records are not available. The meander was filled together with much of the adjacent land, with tipping continuing up above the surrounding ground level. Historical aerial photographs indicate the refuse site was developed, at least in part, in individual cells. Wastes accepted on site comprised municipal waste, including household, commercial, industrial, civic amenity wastes, street sweepings and litter, and later contaminated general wastes, contaminated soil and subsoil, and bonded asbestos associated with the redevelopment of the Cardiff Bay area. It is understood that approximately 4 million cubic metres of waste were buried onsite.

Landfilling with commercial and household waste continued until 1994. In 1994 the tip was closed and the land entered into Cardiff Bay Development Corporation (CBDC) ownership. The CBDC created a new retail park on the old industrial site to the east.

The CBDC undertook the following preparatory work for the development:

- For the Cardiff Bay Retail Park, ground with unacceptably high levels of contamination, together with refuse deposits associated with the municipal tip along the site's boundary with the tip, were removed; and
- For the Ely Fields site, the refuse deposits associated with the municipal tip down to the level of the underlying estuarine mud flats, were removed and replaced with imported fill.

The excavated material was deposited on an area of the landfill. The site was, therefore, reactivated under a new Waste Management Licence. The area comprised a mounded area to the north of the A4232.

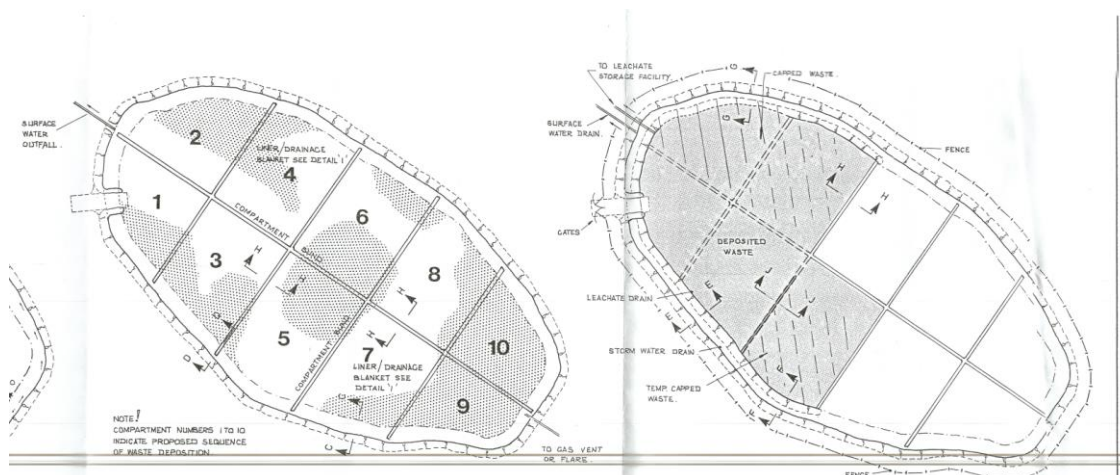
The Ferry Road landfill was, therefore, re-opened under licence, and received wastes scraped from the surrounding areas. This coincided with the impoundment of the Rivers Taff and Ely to form the Cardiff Bay Barrage, one consequence of which was that groundwater levels rose beneath the site from the pre-barrage (tidally influenced) level of +2.0m AOD to +4.5m AOD, where they remain today.

The “Ferry Road Landfill, Closed Landfill Review”, April 2018 prepared by Ramboll Environment and Health UK, lists the following information under their permitted waste types and quantities review of the site’s 1994 waste management licence.

- In Phase I (Disposal Zone 2, as referred to in Ove Arup and Partners Report 95/2592): Industrial wastes constituting contaminated soils, hardcore and similar materials arising from the excavation of land identified as Cardiff Bay Retail Park in Figure 1 of the Working Plan, spoil arising from the construction of the surface water drain to serve the Retail Park Site - maximum quantity 60,000 tonnes; and
- In Phases II and III (Disposal Zone 1): Industrial wastes comprising excavated soils, hardcore and similar materials from municipal refuse arising from construction of the gas cut-off wall and ancillary works, industrial wastes comprising contaminated soils and municipal refuse (including asbestos) arising from the excavation of land identified as Ely Fields, spoil arising from the construction of the surface water drain between the retail park site and spoil arising from the construction of the permanent access road serving Ely Fields - 325,000 tonnes.

The site was filled in ten phases as shown in the following figure:

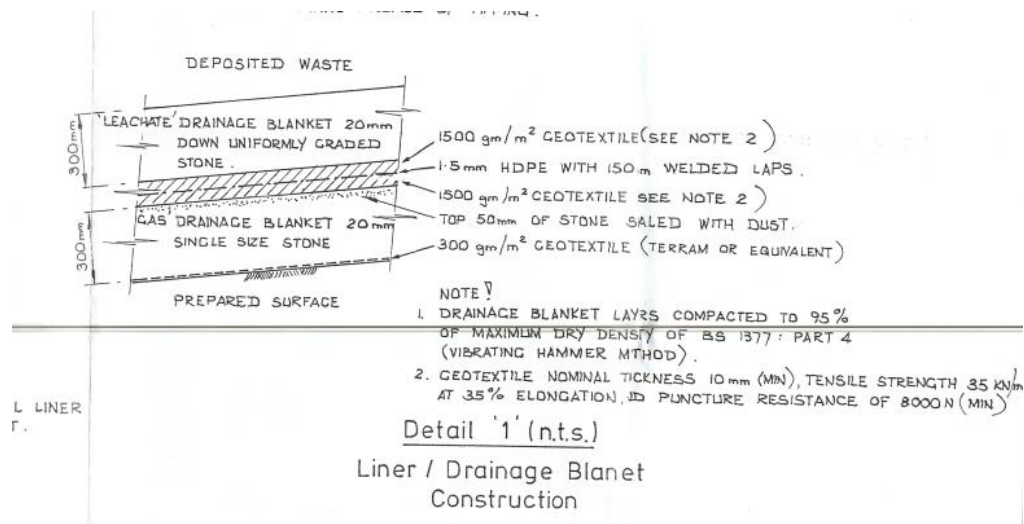
Figure 1.3: Extract of “Disposal cell construction plan – WSK 48 Rev A” showing phasing scheme



Source: Ove Arup & Partners

The site was engineered to provide containment above the historical tipping. This is shown in

Figure 1.4: Extract of “Disposal cell construction plan – WSK 48 Rev A” showing proposed containment detail



Based on the tonnages identified, the total maximum quantity of waste is of 385,000 tonnes.

The landfill was covered, restored and developed to create Grangemoor Park, which was completed in 2000.

1.3 Current layout

Leckwith Moors Business Park is adjacent to the north and Ferry Road Retail Park to the east, with residential properties beyond (from approximately 220m east). The River Taff and Cardiff Bay approximately 520m east. The A4232 borders the southern boundary of the site, beyond which lies Cardiff's International Sports Village and Penarth Marina to the south-east, and residential properties approximately 70m south. The Ely River meanders along the western site boundary (the River Ely discharges into Cardiff Bay), beyond which lies the University Hospital Llandough to the south-west, along with the residential area of Llandough (from approximately 410m south west). See Figure 3.8.

The landfill itself has a 'domed' topography with the highest elevation at approximately 31m Above Ordnance Datum (AOD), in the northern central portion of the site. The ground slopes downwards to the north, east, south and west generally to around approximately 18m AOD. The lowest point lies at 9m AOD in the south east. Grangemoor Park occupies the site itself, which comprises undeveloped grassed areas crossed by tracks / paths and a concentric network of drains broadly following the contours of the dome. Peripheral woodland is present and a pond is located on the eastern boundary at the lowest point of the site.

2 Waste Management Licence Conditions

This section identifies the closure and aftercare waste management licence conditions that are relevant and apply.

2.1 Introduction

Waste management licence 95/07 (Mod 1) dated 29th March 1996 is included as Appendix A. The following sub-sections highlight the conditions that apply to the aftercare period of the landfill.

2.2 Licence Conditions

2.2.1 Landscaping and aftercare – Condition 36

Upon completion of waste disposal operations, the site will be contoured and capped over and landscaped in accordance with the Working Plan. Details of the capping and associated drainage details must be submitted to the Waste Regulation Authority within 4 months of the date of issue of this licence. Written approval from the Waste Regulation Authority shall be obtained before construction of the capping and associated drainage systems.

2.2.2 Landscaping and aftercare – Condition 37

As detailed in the Working Plan, the site will be inspected for evidence of instability. With the exception of settlement anticipated in the Working Plan, any evidence of the uncontrolled movement of waste (including soil) and including that which may be indicated by movement of items of infrastructure, i.e. gas monitoring and control equipment, the drainage systems, the capping system and security fencing, shall be reported in writing to the Waste Regulation Authority as soon as is practicable, and in any case within seven days of the evidence being noted. Calculations to demonstrate the anticipated settlement shall be submitted as an amendment to the Working Plan within 4 months of the date of issue of this licence. Any works of repair and reinstatement shall be undertaken in accordance with the Working Plan.

2.2.3 Landscaping and aftercare – Condition 38

As detailed in the Working Plan, the site will be inspected for evidence of disrepair, damage and malfunction of infrastructure, i.e. gas monitoring and control equipment, leachate and groundwater monitoring equipment, the drainage systems, the capping system and security fencing. Any such evidence shall be reported in writing to the Waste Regulation Authority as soon as is practicable, and in any case within seven days of the defects being noted. Any works of repair or reinstatement shall be undertaken in accordance with the Working Plan.

2.2.4 Landscaping and aftercare – Condition 39

The landfill gas, groundwater and leachate monitoring boreholes and other monitoring points will be sampled for the determinands specified in the Working Plan and at frequencies specified in the Working Plan. All results will be forwarded in writing to the Waste Regulation Authority of any results showing any determinands indicating a variance exceeding 30% of the previous result as soon as is practicable, and in any case, no later than the first working day after the result is known.

2.2.5 Landscaping and aftercare – Condition 40

A copy of any notice or instruction received in respect of the facility from any authority other than the Waste Regulation Authority, which in any way relates to the use of the facility, shall be given to the Waste Regulation Authority within seven days of the receipt of such notice or instruction.

2.2.6 Landscaping and aftercare – Condition 41

Any cessation of operations for a period in excess of three months shall be notified to the Waste Regulation Authority. No less than fourteen days' notice shall be given to the Waste Regulation Authority of the date on which operations are to recommence in the event of such a cessation.

2.2.7 Landscaping and aftercare – Condition 42

In the event of cessation of operations whereby waste delivered to the facility is required to be transferred or diverted elsewhere, the Waste Regulation Authority shall be notified forthwith.

2.3 Working Plan Requirements

2.3.1 Restoration of licence area – Profile

The ground levels at the Licence Area will be raised by varying amounts up to a maximum of around 14m. The additional height will be made up of imported wastes, daily cover and the engineered capping system. Ultimately, the restoration profile will be developed to provide a high-quality open space or parkland environment.

2.3.2 Restoration of licence area – Capping

A permanent clay cap will be installed over the Licence Area closely following deposition of the imported wastes. This will form part of the proposed capping over the whole of the landfill area to the north of the Peripheral Distribution Road. The capping system will separate the relocated wastes from the surface environment, reduce the ingress of rainwater into the wastes and thereby reduce leachate production.

The proposed capping build-up is made of a low permeability soil layer of 1000mm thickness, which will be overlain by a surface/protection soil layer of minimum 500mm thickness. The surface/protection layer will support vegetation which will reduce rainwater infiltration by evapotranspiration and protect the cover from erosion by wind and water. The surface/protection layer will protect the low permeability layer from the effects of freeze-thaw and wetting-drying cycles.

2.3.3 Restoration of licence area – Settlement

With continued biodegradation both the existing and new landfill wastes beneath the Licence Area will compress over time. Under the maximum height of tipping this degradation settlement is estimated to be of the order of 2.5m after 10 years, and 5.0m after 30 years, with minimal settlement thereafter. The landfill wastes will also consolidate under loading from the placement of the new wastes and capping. This consolidation settlement, mainly from squeezing out of gas from the body of refuse, is estimated to be of the order of 2.0m under the max height increase of 14.0m. This consolidation settlement is expected to largely occur during the placement of new waste. There will also be some consolidation settlement of the alluvium beneath the refuse, from squeezing out of water, which is likely to be of the order of 0.5m.

The capping over the Licence Area will, therefore, be subjected to total settlement, and to differential settlement related to the variable composition of the landfill beneath.

With regard to integrity of the capping, differential movements will be more significant than total settlements. The domed shape of the landfill will help to reduce damage from differential movements, but there is inevitably some risk of cracking of the capping.

Minor cracking may be self-healing, however, larger cracks will need to be made sound as part of the maintenance programme. The integrity of gas and leachate drainage measures will also need to be monitored and maintained on a regular basis.

2.3.4 Restoration of licence area – Surface drainage of capping

The Licence Area will be clay capped as part of the final cover system. Following final capping, surface water from the landfill will be collected in a new perimeter drain and discharged to new outfalls into the River Ely. Appropriate consents will be obtained from the Environment Agency¹.

2.3.5 Restoration of licence area – Landfill gas

Disposal Zone 1: Municipal refuse deposits and inert soils

Remediation gas control measures are proposed for the whole landfill north of the Peripheral Distribution Road. Elements of the total system will be installed in conjunction with soil capping at Disposal Zone 1.

Disposal Zone 2: Contaminated soils

Landfill gas will not be an issue with respect to the waste soils placed at Disposal Zone 2 as they do not contain putrescible materials.

Gases generated from municipal refuse underlying the Disposal Zone will be collected via a gas permeable drainage blanket. The landfill gas will be collected at convenient locations and dealt with.

2.3.6 Restoration of licence area – Final landfill restoration and long-term tip remediation

Details of the proposals for capping and overall leachate and gas control have not been included in this document but are contained in Reference 2 – which was submitted separately in support of the Licence application and the original Working Plan.

Surface water collection and disposal for the restored landfill will be achieved by means of surface water ditches and outfalls. Final layout and details of the surface water system will be submitted to the Waste Regulation Authority for approval.

Following final capping of the landfill, any leachate generated within the wastes will be controlled by the measures proposed for the whole landfill area to the north of the Peripheral Distribution Road. The collected leachate will be disposed of in accordance with the requirements of the Regulatory Authorities. Options include pumping to the Western District Pumping Station for onward treatment and discharge, or on-site treatment and discharge to the sewer system or, if of a sufficiently high quality, the river.

2.3.7 Monitoring – Disposal Zone 2 – Contaminated soils

It is not intended to monitor surface water run-off in the immediate vicinity of Disposal Zone 2 once the cap is in place. However, as part of the monitoring of the landfill, any surface water collected through the existing landfill leachate system will be regularly monitored and sampled at the currently consented outfalls prior to ultimate capping and restoration of the landfill.

¹ Forerunner to NRW

2.3.8 Monitoring – Landfill

A proposed monitoring programme for the Ferry Road Landfill was set out in Ove Arup & Partners report titled “General Scope of Works for Monitoring Groundwater, Leachate and Gas”, issued in October 1995 in support of the Licence application and original Working Plan. Changes to the scope of the testing proposed were requested by the Waste Regulation Authority, and have been incorporated into Revision 1 of the report, as issued in March 1996².

² Ove Arup & Partners (1996) – “Ferry Road – General Scope of Works for monitoring of groundwaters, leachate and gas”, Report Serial No. 95/2908, Rev 1 March 1996

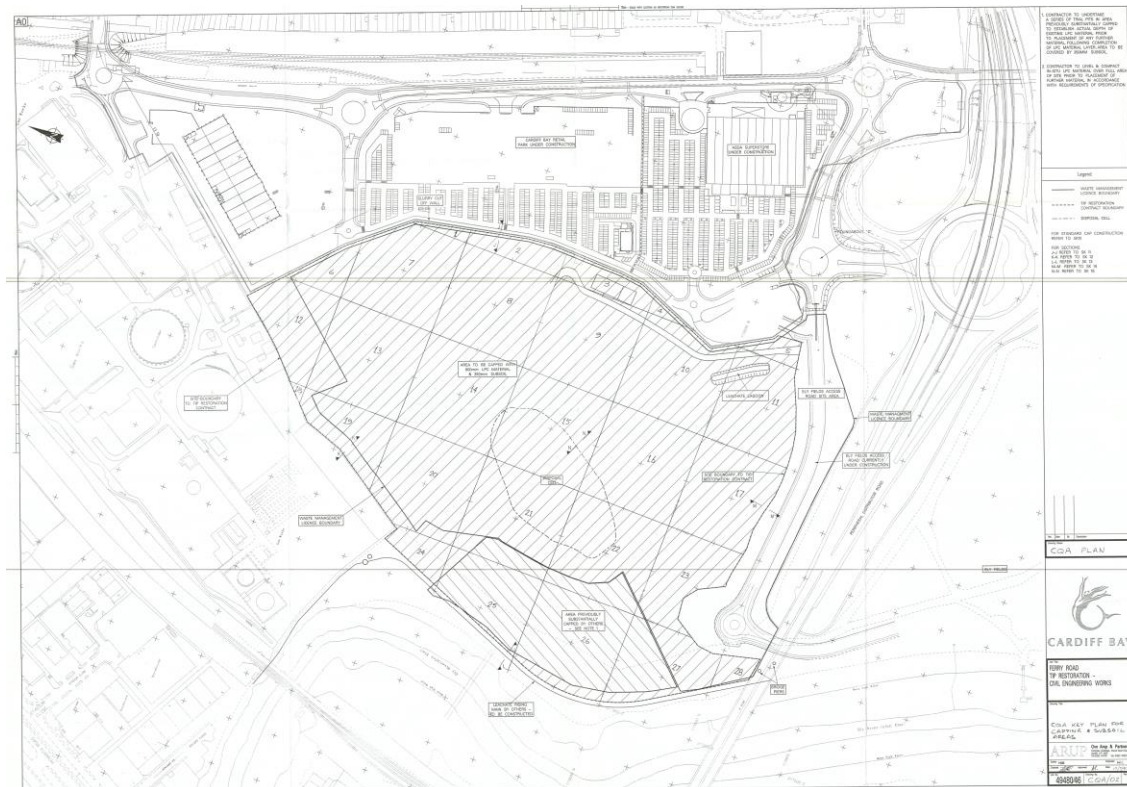
3 Pollution control systems

3.1 Above ground systems

According to the Working Plan, the Licence Area will be clay capped as part of the final cover system. Following final capping, surface water from the landfill will be collected in a new perimeter drain and discharged under consents to new outfalls into the River Ely.

Figure 3.1 shows the extent of the capping works.

Figure 3.1: Extent of capping works



Source: Ove Arup & Partners

It would appear that the site was capped with an 800mm engineered clay layer, which overlays an existing 200mm of previously placed clay cap. A construction quality assurance process was in place with Ove Arup acting as Construction Quality Assurance (CQA) Engineer. However, few records exist of the CQA except for formation surface acceptance forms. The CQA plan and report have not been obtained. The specification for the preparation and placement of the low permeability clay layer has been provided and demonstrates that the material was to be placed in accordance with the “Manual of Contract Documents for Highways Works, Volume 1: Specification for Highways Works”, Department of Transport HMSO 1993. The Highways Works specification identifies the thickness of each layer and the number of passes required with a vibrating roller dependent on the material type placed, to achieve 95% compaction. The master specification also identifies the testing required to demonstrate that the material falls with acceptable thresholds for moisture content, Atterberg limits, in-situ density and thickness.

The anticipated permeability of the clay cap was to be $1 \times 10^{-8} \text{m/s}$. The geotechnical parameters selected required the use of low plasticity soil which has a lower potential for desiccation

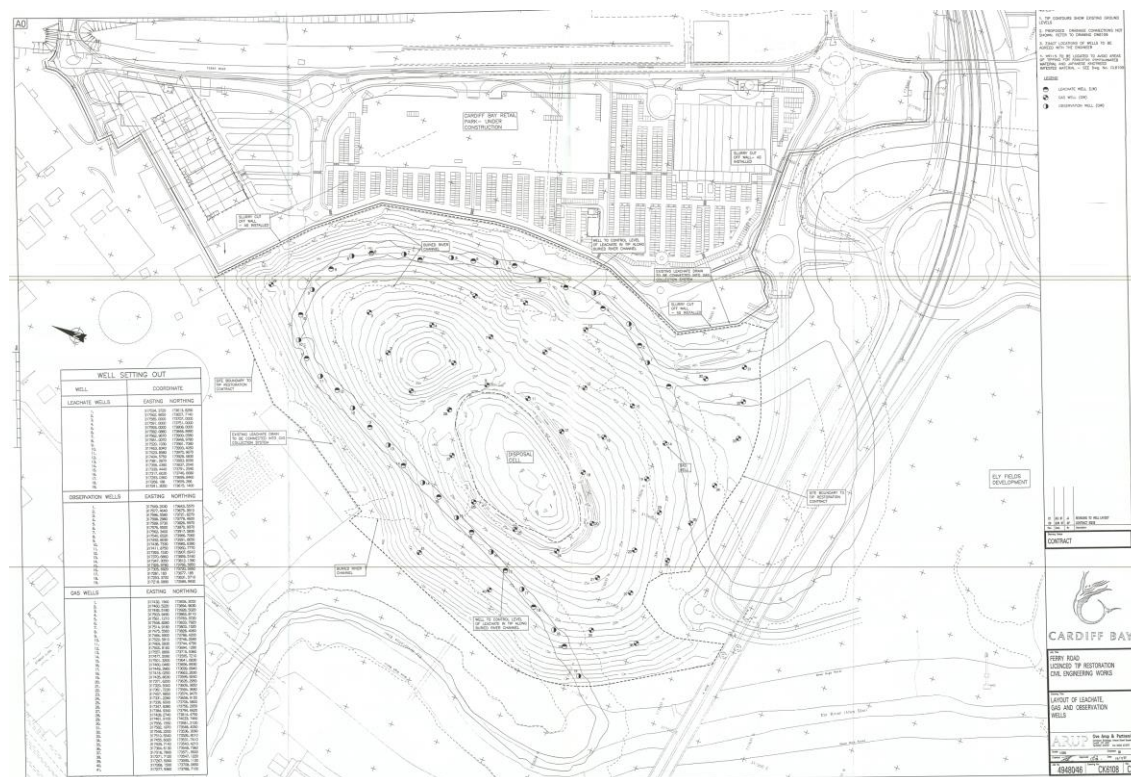
cracking than higher plasticity materials often specified. The overall design strategy accepts a slight infiltration of rainwater, permitting modest degradation of the refuse until it reaches a state which no longer threatens to pollute or, endanger health.

A survey was completed in 2007, but there was no accompanying assessment of the settlement at the site.

3.2 Environmental management and monitoring infrastructure

Significant monitoring infrastructure was installed at the time of the construction of the landfill.

Figure 3.2: Monitoring borehole installation plan



It shows the location of 19 leachate wells, 19 observation wells and 41 gas wells. The observation wells are shown to be installed at approximately 50m centres along three sides but were not installed to the south east of the site. The monitoring point installation logs have been replicated in Table 1.

Typically, the wells comprise 4m of solid High-density polyethylene (HDPE) pipe with screw connections fitted to a varying length of flexible slotted HDPE pipe with telescopic connections, where the slots are 10% of the surface area and the slot widths are 3mm. The internal casing is 110mm in diameter and the wall thicknesses are 11.4mm thick. The gravel surround is 5mm-10mm diameter non-calcareous quarried crushed rock.

The boreholes were installed in September and October 1997. All boreholes were drilled into waste deposits. None of the boreholes installed that have been drilled in natural ground.

Table 1 **Drillers logs for observation wells**

Reference	Easting	Northing	Ground Level AOD	Base level AOD	Top Level AOD	Base Level AOD	Length (m)	Top Level AOD	Base Level AOD	Length (m)	GW level AOD	Geology description
OW2	317577.464	173675.351	12.2	-1.109	11.487	7.487	4	7.487	-0.363	7.85	Unsure	1.0m marl and then waste to toe
OW3	317596.558	173721.627	9.9	-1.216	10.442	6.442	4	6.442	-0.658	7.1	Unsure	0.5m marl and then waste to toe
OW4	317586.708	173779.640	12.7	-0.134	11.851	7.851	4	7.851	-0.449	8.3	5	3.0m marl and then waste to toe
OW5	317561.121	173783.372	13.3	-1.196	13.14	9.14	4	9.14	-0.81	9.95	Unsure	1.0m marl and then waste to toe
OW6	317575.902	173873.286	15.4	-1.2	15.589	11.589	4	11.589	-0.761	12.35	Unsure	1.0m marl and then waste to toe
OW7	317562.340	173917.583	16.5	-1.257	16.654	12.654	4	12.654	-0.696	13.35	5	1.0m marl and then waste to toe
OW9	317492.803	173991.865	18.6	-1.21	18.78	14.78	4	14.78	-0.77	15.55	Unsure	1.0m marl and then waste to toe
OW11	317411.875	173950.777	17.0	-1.265	16.576	12.576	4	12.576	-0.724	13.3	Unsure	1.0m marl and then waste to toe
OW12	317393.153	173907.691	18.7	-1.223	18.51	14.51	4	14.51	-1.04	15.55	Not identified	1.0m marl and then waste to toe
OW13	317370.686	173859.516	19.6	-1.139	19.325	15.325	4	15.325	-0.925	16.25	Unsure	1.0m marl and then waste to toe
OW14	317347.305	173812.139	21.1	-1.21	21.627	17.627	4	17.627	-0.673	18.3	Unsure	1.0m marl and then waste to toe
OW15	317325.063	173765.528	23.1	-1.156	23.716	19.716	4	19.716	-0.884	20.6	Unsure	1.0m marl and then waste to toe
OW16	317305.692	173720.595	21.9	-1.222	21.739	17.739	4	17.739	-0.161	17.9	Unsure	1.0m marl and then waste to toe
OW17	317281.183	173677.185	21.6	-1.288	20.024	16.024	4	16.024	-0.856	16.88	Unsure	2.0m marl and then waste to toe
OW18	317253.370	173631.571	19.6	-1.169	19.178	15.178	4	15.178	-1.092	16.27	Not identified	2.0m marl and then waste to toe
OW19	317218.089	173589.993	13.6	-1.238	11.495	7.495	4	7.495	-1.015	8.51	Unsure	2.0m marl and then waste to toe

Source: Drillers' logs VHE Construction Ltd

A site visit was undertaken on 19th April 2021 to confirm the status of the gas wells. Each well is protected by a metal cover which is locked to ensure that they are inaccessible to the public. Observation Wells No.s 1, 2, 3, 4, 5, 6, 9, 10, 14 and 15 were observed and most had their respective reference sprayed onto the cover. Other wells were not found, but were likely to be inaccessible as a result of brambles or other thick foliage. Sample points OW16 and OW17 were not locatable. These did not appear to be hidden by vegetation, so these points may not be present anymore or were potentially buried under topsoil.

A total of 41 gas wells, labelled GW1 through to GW41 have been installed onsite. The drillers' logs identify the location of the wells and their installation details. The locations of the wells are shown on Figure 3.2. The logs are replicated in Figure 3.4.

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Table 3, but it should be noted that some of the references in the drillers' logs were not at the locations stated on Figure 3.2 (e.g. GW11, GW25, GW28). These are likely to be simple errors e.g. GW28 is actually GW27 and a number error for GW11 and GW25. The logs do not include GW10, GW14, GW15, GW17, GW27, and GW30 to GW41, as these logs were to be submitted once the contractor confirmed casing levels. If this document was sent separately, then this has not been found and therefore the exact details are unknown.

The wells vary in length, but typically comprise a 4.5m length of solid HDPE casing with screw connections fitted to a variable length of slotted HDPE pipe with telescopic connections, where the slots are 10% of the surface area and the slot widths are 3mm. The internal casing is 110mm in diameter and the wall thicknesses are 11.4mm thick. The gravel surround is 20mm single sized diameter non-calcareous quarried crushed rock.

It was estimated that approximately 2,500m³/hr of landfill gas was being generated at the time when the licensed site was being developed. The gas wells were installed to permit venting of the gas initially with a view to gas extraction and potentially utilisation.

The gas extraction system continues to be operated and the layout is shown in Figure 3.4. A selection of the gas wells is monitored on a quarterly basis to balance the system. The results are included in Table 2.

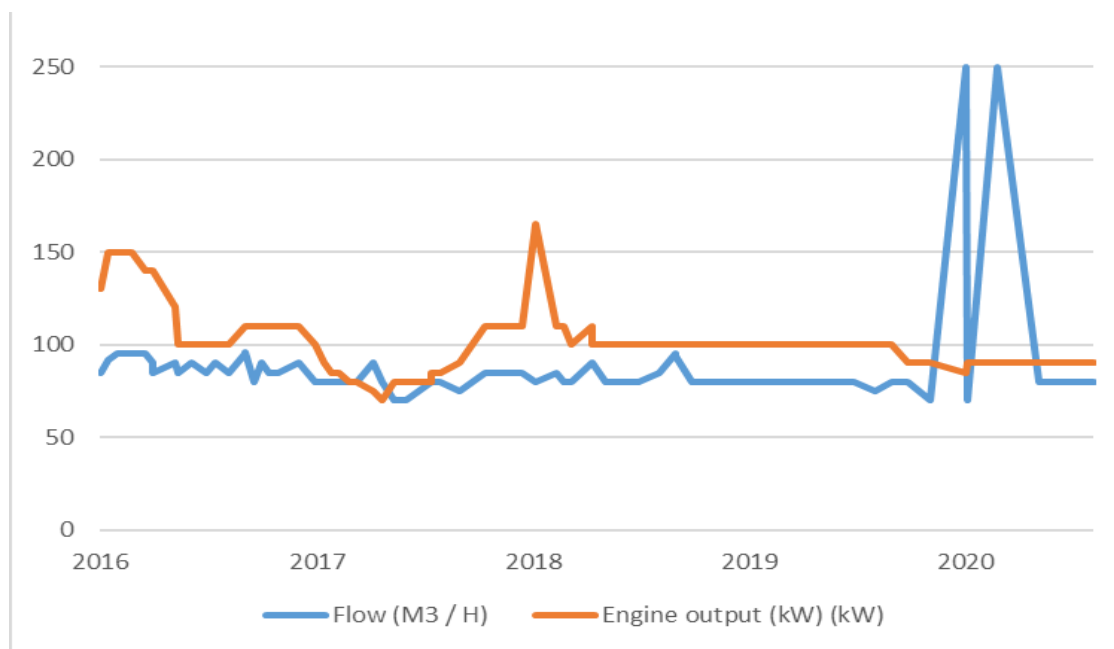
Table 2: Gas well monitoring for 2020

Asset ID	CH ₄ (%) peak	CH ₄ % (mean)	CO ₂ (%) peak	CO ₂ (%) mean	O ₂ (%) min	O ₂ (%) mean
FRYFLAR1	0.1	0.033333	0.5	0.3	20.9	20.9
FRYSITE1	39.6	37.2375	20.1	18.4625	0.8	1.4125
FRYSMAN1	42.4	38.25	23.7	20.75	0.1	0.425
FRYSMAN2	51	49.7	21.8	20.75	0.1	0.425
FRYSMAN3	42.9	36.8	19.8	17.56667	0.1	1.633333
FRYSMAN4	38.9	35.825	20.5	17.35	0.2	1.575
FRYW0008	50.5	18.66667	13.3	6.066667	4.2	14.46667
FRYW001	6	1.575	3.4	1.65	18.2	19.925
FRYW002	55.1	47.475	21	18.725	0.2	1.1
FRYW003	54.7	50.35	21.3	19.5	0.1	0.25
FRYW004	67.1	55.98	28	24.52	0.1	0.16
FRYW005	14.1	4.733333	13.1	4.866667	8	16.6
FRYW006	45	41.03333	20.7	19.33333	0	0.5
FRYW007	0.2	0.133333	1.6	0.833333	20.9	20.9
FRYW009	26.2	8.766667	16	5.666667	3.2	15
FRYW010	48.7	20.46667	16.2	7.133333	1.5	12.53333
FRYW011	24.6	13.2	17.8	10.53333	0.4	7.466667
FRYW012	30.8	25.7	15.5	12.86667	0	1.566667
FRYW013	41.5	28.15	14.7	9.05	0.1	5.6
FRYW014	39.8	32.175	20.6	19.075	0	0.2
FRYW015	78.2	43.85	18.4	16.95	0	0.2
FRYW016	0.3	0.125	2.2	1.05	20.1	20.7
FRYW017	47.7	45.175	20.8	19.325	0	0.175
FRYW018	39.5	38.525	19.1	16.75	0.1	0.425
FRYW019	31.6	21.75	18.6	13.8	0.2	5.9
FRYW020	38.4	35.025	19.3	18.525	0.1	0.225

Asset ID	CH4 (%) peak	CH4 % (mean)	CO2 (%) peak	CO2 (%) mean	O2 (%) min	O2 (%) mean
FRYW021	41.9	21.35	23.1	12.7	0.1	8.575
FRYW022	0.4	0.15	1.6	1	19.6	20.575
FRYW023	16	5.65	19.7	6.95	0.1	14.375
FRYW024	48.7	42.875	24.1	21.75	0.2	0.25
FRYW025	38.3	32.725	22.9	21.225	0.1	0.425
FRYW026	4.6	2.05	8.3	4.9	7.9	14.775
FRYW027	32.4	8.25	18.3	5.6	3.8	16.575
FRYW028	33.6	15.2	23	9.4	0.1	10.575

The gas flow and utilisation at the site has remained relatively stable as shown in Figure 3.3.

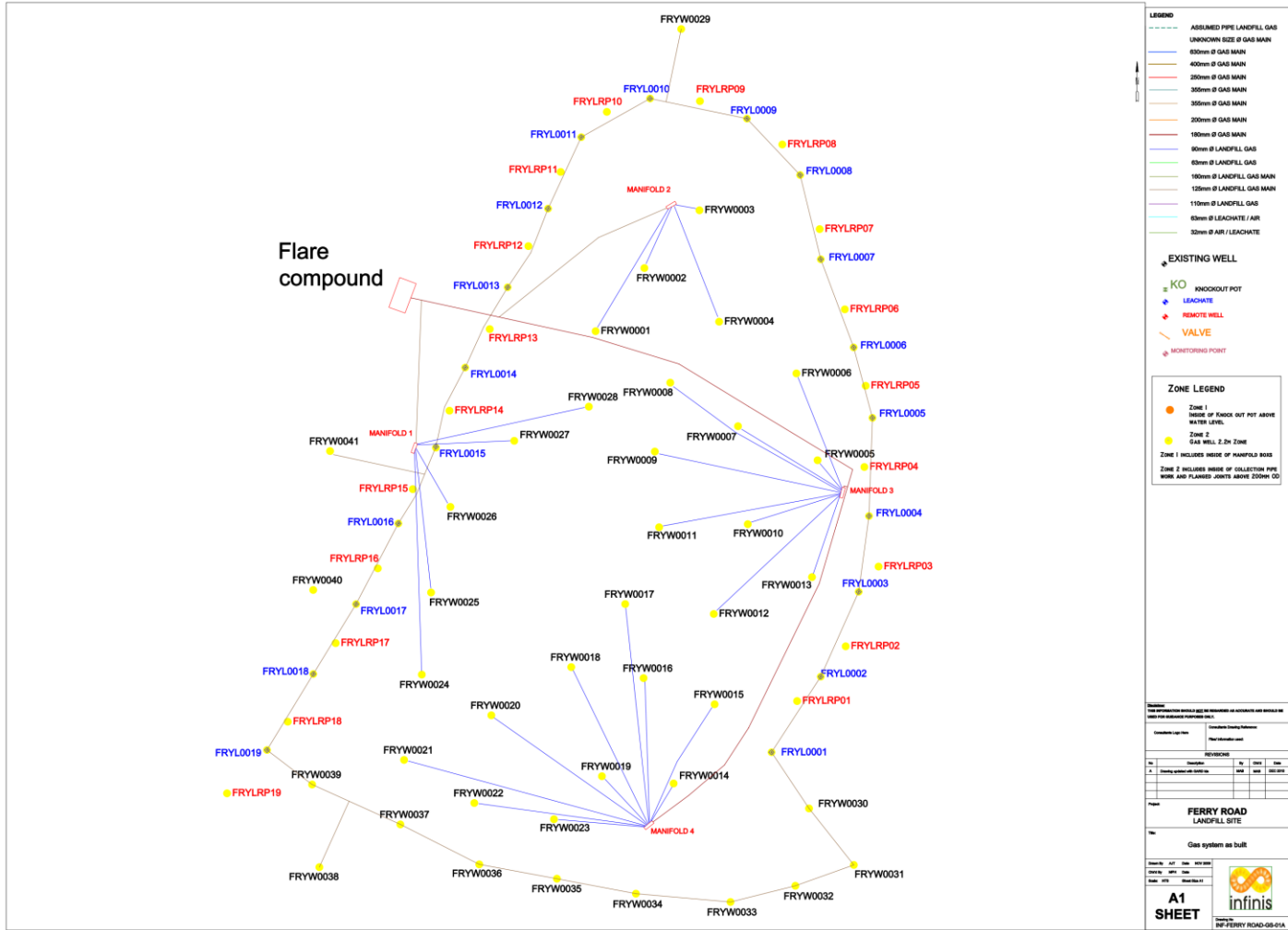
Figure 3.3: Gas flow and engine output



Source: Infinis

A site visit was undertaken on 19th April 2021 to confirm the status of the gas wells. Each well is protected by a metal cover which is locked to ensure that they are inaccessible to the public. Gas Wells No.s 7, 8, 15, 17, 19, 20, 23, 24, 25, 26, 27, 28, 32, 33, 34, 39 were observed and most had their respective reference sprayed onto the cover. Other wells were not found but were likely to be inaccessible as a result of vegetation.

Figure 3.4: Layout of gas extraction system



Source: Infinis

Table 3 Drillers logs for gas wells

Reference	Easting	Northing	Ground Level AOD	Base level AOD	Top Level AOD	Base Level AOD	Length (m)	Top Level AOD	Base Level AOD	Length (m)	GW level AOD	Geology description
GW1	317432.196	173858.305	26.6	3.65	27.935	23.435	4.5	23.435	4.245	19.19	Unsure	Waste to toe
GW2	317460.522	173894.963	27.0	3.673	27.832	23.332	4.5	23.332	4.302	19.03	Unsure	Waste to toe
GW3	317492.518	173928.502	23.1	23.1	23.38	18.88	4.5	18.88	4.78	14.1	Dry	1.0m marl and then waste to toe
GW4	317503.949	173863.811	29.2	3.733	27.707	23.207	4.5	23.207	4.207	19	Unsure	2.3m marl and then waste to toe
GW5	317561.121	173783.372	16.1	3.603	16.24	11.74	4.5	11.74	4.32	7.42	5.1	1.0m marl and then waste to toe
GW6	317548.828	173833.792	19.6	3.799	19.256	14.756	4.5	14.756	4.356	10.4	Unsure	3.0m marl and then waste to toe
GW7	317514.063	173800.626	23.2	3.786	23.604	19.104	4.5	19.104	4.454	14.65	Unsure	3.0m marl and then waste to toe
GW8	317475.556	173828.406	30.6	3.73	29.672	25.172	4.5	25.172	4.242	20.93	Unsure	2.0m marl and then waste to toe
GW9	317466.357	173788.184	23.6	3.651	24.173	19.673	4.5	19.673	4.223	15.45	Unsure	1.0m marl and then waste to toe
GW11	317470.322	173241.950	25.1	3.34	25.625	21.125	4.5	21.125	4.345	16.78	Not identified	Not identified
GW12	317500.816	173694.129	21.1	3.73	20.991	16.491	4.5	16.491	4.191	12.3	Dry	1.0m marl and 14.87m waste, then clay to toe
GW13	317557.889	173715.536	14.2	3.5	14.059	10.559	3.5	10.559	4.459	6.1	Unsure	1.0m marl and then waste to toe
GW16	317460.048	173656.890	24.3	3.9	24.381	19.881	4.5	19.881	4.421	15.46	5.9	1.0m marl and 17.5m waste, then clay to toe
GW18	317420.413	173658.970	28.2	3.367	28.505	24.005	4.5	24.005	4.315	19.69	Dry	2.5m marl then waste to toe
GW19	317435.863	173599.924	22.4	3.714	22.033	17.533	4.5	17.533	4.133	13.4	Unsure	1.0m marl and 15.7m waste, then clay to toe
GW20	317371.944	173634.846	28.1	2.321	28.513	24.013	4.5	24.013	4.183	19.83	Unsure	0.2m marl then waste to toe
GW21	317320.934	173609.385	25.2	3.744	25.357	20.857	4.5	20.857	4.297	16.56	Unsure	2.0m marl and 16.8m waste, then clay to toe
GW22	317361.723	173584.368	23.1	3.729	23.248	18.748	4.5	18.748	4.368	14.38	Unsure	2.0m marl and 13.9m waste, then clay to toe
GW23	317407.985	173574.940	19.6	3.725	20.488	15.988	4.5	15.988	4.038	11.95	Unsure	1.0m marl and then waste to toe
GW24	317326.734	173658.103	26.8	1.671	27.231	22.731	4.5	22.731	4.271	18.46	Unsure	0.2m marl then waste to toe
GW25	317328.672	173210.209	25.9	1.505	26.389	22.889	3.5	22.889	4.329	18.56	Unsure	0.2m marl then waste to toe
GW26	317344.876	173758.238	26.1	2.42	26.567	22.067	4.5	22.067	4.187	17.88	Unsure	0.2m marl then waste to toe
GW28	317381.858	173799.182	23.8	3.712	23.686	19.186	4.5	19.186	4.226	14.96	Not identified	1.0m marl and then waste to toe
GW29	317481.910	174033.746	16.0	3.927	15.021	11.521	3.5	11.521	4.411	7.11	Unsure	2.0m marl and then waste to toe

Source: Drillers' logs VHE Construction Ltd

3.4 Leachate management systems

The leachate management system is described in “The Reactivation and Remediation of the Landfill Site at Ferry Road, Cardiff”, which is a paper prepared by Phillips A. and Cherrill H.E of Over Arup and Partners. It is understood that the paper was published in 2004 in a National Museums of Wales publication called Urban Geology in Wales). It references the measures that were taken to address leachate management at the site that were designed by Over Arup.

It identified that the hydrogeology and groundwater impacts were assessed following a comprehensive investigation. It is assumed that the impacts were reviewed and included within “Ferry Road – Hydrogeology and Groundwater Impact” report serial no. 95/2946, Ove Arup October 1995, which is a reference in the Working Plan document and would have been issued to the Environment Agency (predecessor of the NRW) as part of the permit application for the subsequent tipping. This impact assessment has not been located.

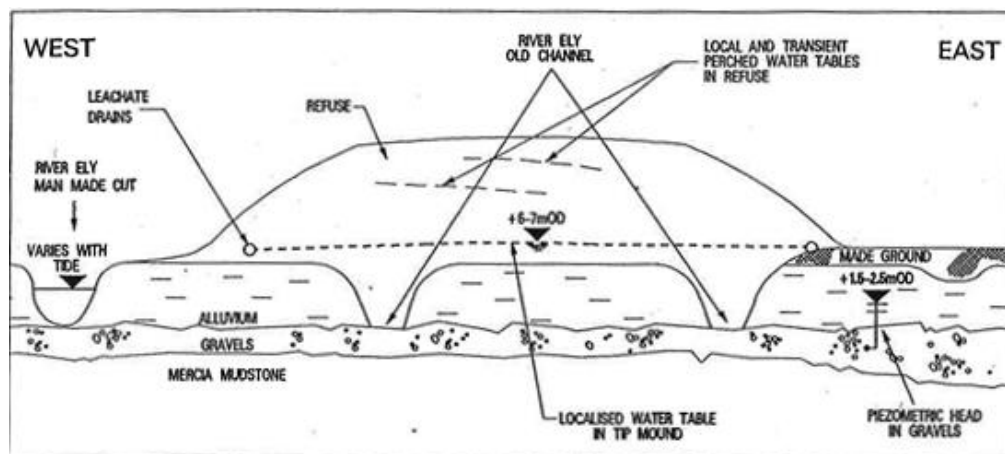
The paper referenced above identified that the existing conditions were investigated and that the original landfill had been developed on the alluvium associated with estuarine flats. The alluvium is reported to be a soft to firm silty clay and the Working Plan identifies this as 7m thick, but locally absent along the meander of the River Ely.

These deposits overlay fluvioglacial gravels and then Mercia Mudstone bedrock. The top of the gravels is at a level of approximately -2m AOD and the Working Plan identifies these to be 4m-5m thick. The meander of the River Ely had eroded through the alluvium and had cut into the underlying gravels. These gravels acted as a confined aquifer with groundwater in the landfill being perched over the alluvium. Groundwater in the dilute and disperse landfilling was typically at +6m to +7m AOD, with the piezometric head in the gravels typically at +1.5m to 2.5m AOD. There was expected to be direct hydraulic continuity between the landfill and the gravels.

The alluvium layer was considered to act as an effective aquitard, where it is in place. Sampling and testing of groundwater from the gravels indicated some contamination by leachate release through the base of the buried meander. This created a pathway for contamination to the River Taff and the River Ely.

The leachate in the original landfill, being in continuity with the tidal groundwater, would be flushed into the rivers twice per day.

Figure 3.5: Conceptual model for historic tipping



Source: Phillips A. and Cherrill H.E

The development of the Cardiff Barrage and the impoundment of the Bay stopped this flushing. Instead, it was expected that the groundwater level would rise to approximately +4.5m AOD and

the flow would be virtually eliminated. However, this would not necessarily reduce the impact on the Bay as the degree of dilution was expected to reduce.

To address these impacts, it was proposed that:

- The later tipping would be contained;
- The site would be capped to control infiltration;
- Leachate would be abstracted to reduce the driving head of leachate; and
- Perimeter cut-off and leachate drains would be installed over the alluvial surface to prevent flow of groundwater into the waste once leachate is abstracted.

Following the completion of tipping at the site, a network of herringbone drains was installed directly under the cap to take any perched leachate produced by infiltrating water into the perimeter drainage pipework at the toe of the landfill. These discharged to eastern and western perimeter gravity drains at an elevation of around 6.0 to 6.5m AOD. Pumping stations were constructed to allow for discharge to foul sewer for onward treatment prior to discharge.

In addition to leachate abstraction, a 600mm wide cement-bentonite slurry wall containing a centrally placed HDPE geomembrane was constructed from ground level down to the alluvium. The aim of the barrier was to restrict leachate and landfill gas movement towards the Cardiff Bay Retail Park. The location of the barrier is shown in Figure 4.2.

19 leachate abstraction wells were installed at approximately 50m centres along the former river meander. See Figure 3.2.

The wells vary in length, but typically comprise a 2.75m-5.75m length of solid HDPE casing with screw connections fitted to a variable length of slotted HDPE pipe with telescopic connections, where the slots are 10% of the surface area and the slot widths are 3mm. The internal casing has a 257mm internal diameter and the wall thicknesses are 28.7mm thick. The gravel surround is 20mm single sized diameter non-calcareous quarried crushed rock.

A site visit was undertaken on 19th April 2021 to confirm the status of the leachate wells. Each well is protected by a metal cover which is locked to ensure that they are inaccessible to the public. Leachate Well No.s 1, 3, 4, 5, 6, 7, 8, 10, 12, 13, 14, 16, 17, 18 were observed and most had their respective reference sprayed onto the cover. Other wells were not found but were likely to be inaccessible as a result of brambles or other thick foliage. All wells, except LW10, were inaccessible to the public, as each structure was locked through the use of a padlock. An example well is shown in Figure 3.6.

Figure 3.6: Leachate abstraction well LW12



Source: Mott MacDonald Ltd

The lid to LW10 has become dislodged, which allowed the staff visiting the site to demonstrate the well head installed. The Council has been informed to ensure that the well head is repaired.

Figure 3.7: Leachate abstraction well LW10



Source: Mott MacDonald Ltd

The aim was to pump the leachate from the wells so that the leachate level is just below the piezometric head in the gravels. The abstracted leachate was then to be discharged by rising main to a treatment plant located approximately 1.0km to the west of the site.

Table 4 Drillers logs for leachate abstraction wells

Reference	Easting	Northing	Ground Level AOD	Base level AOD	Top Level AOD	Base Level AOD	Length (m)	Top Level AOD	Base Level AOD	Length (m)	GW level AOD	Geology description
LW1	317534.322	173613.829	14.7	-1	15.454	12.704	2.75	12.704	-0.146	12.85	Dry	1.0m marl and then waste to toe
LW2	317562.965	173657.714	12.3	-1	12.609	9.859	2.75	9.859	-0.691	10.55	Dry	1.0m marl and then waste to toe
LW3	317596.558	173721.627	11.8	-1	11.533	8.783	2.75	8.783	-0.617	9.4	Unsure	3.0m marl and then waste to toe
LW4	317588.831	173751.213	12.7	-1.539	11.335	8.603	2.732	8.603	-0.527	9.13	Unsure	3.0m marl and then waste to toe
LW5	317593.000	173808.000	12.2	-1.201	12.006	9.256	2.75	9.256	-0.504	9.76	Unsure	2.0m marl and then waste to toe
LW6	317582.088	173848.899	14.8	-1.224	14.604	11.854	2.75	11.854	-0.846	12.7	Unsure	1.0m marl and then waste to toe
LW7	317562.967	173900.058	16.7	-1.227	17.277	12.527	4.75	12.527	-0.773	13.3	5	1.0m marl and then waste to toe
LW8	317551.007	173948.978	17.3	-1.23	17.611	12.861	4.75	12.861	-0.789	13.65	Unsure	1.0m marl and then waste to toe
LW9	317520.103	173981.708	18.0	-1.272	18.519	13.769	4.75	13.769	-0.581	14.35	Unsure	1.0m marl and then waste to toe
LW10	317463.834	173993.405	17.2	-1.094	17.41	12.66	4.75	12.66	-1.24	13.9	5	1.0m marl and then waste to toe
LW11	317423.858	173970.967	16.4	-1.18	15.489	12.739	2.75	12.739	-0.601	13.34	Unsure	1.0m marl and then waste to toe
LW12	317404.575	173929.483	18.0	-1.194	17.886	13.136	4.75	13.136	-0.614	13.75	Unsure	1.0m marl and then waste to toe
LW13	317381.087	173883.809	19.1	-1.135	18.598	13.848	4.75	13.848	-0.652	14.5	Unsure	1.0m marl and then waste to toe
LW14	317356.438	173837.204	20.2	-1.241	20	15.25	4.75	15.25	-0.8	16.05	Unsure	1.0m marl and then waste to toe
LW15	317339.444	173791.259	21.9	-1.228	22.288	16.538	5.75	16.538	-0.612	17.15	Unsure	1.0m marl and then waste to toe
LW16	317317.603	173746.668	23.0	-1.257	23.336	17.586	5.75	17.586	-0.664	18.25	Unsure	1.0m marl and then waste to toe
LW17	317293.036	173699.846	21.7	-1.242	21.036	15.286	5.75	15.286	-0.764	16.05	Unsure	1.0m marl and then waste to toe
LW18	317268.188	173659.266	20.9	-1.287	19.851	15.101	4.75	15.101	-1.629	16.73	Unsure	2.0m marl and then waste to toe
LW19	317241.305	173615.140	17.9	-1.177	15.843	11.093	4.75	11.093	-0.717	11.81	Unsure	2.0m marl and then waste to toe

Source: Drillers' logs VHE Construction Ltd

The leachate has been abstracted through this air lift system. The leachate wells were then connected to gravity drains where the leachate was discharged to one of the three pumping stations around the site. The leachate was then pumped to the Western District Pumping Station for onward treatment.

Both the Eastern Perimeter Drain and the gravity drain from the leachate wells on the eastern side of the landfill discharge leachate to Pumping Station T1 (situated close to the ASDA Petrol Station). From Pumping Station T1 the leachate is pumped over the landfill in a rising main to Pumping Station C. The Western Perimeter Drain and the leachate wells on the western side of the landfill discharge directly into Pumping Station C. The combined flows are pumped to the north of the landfill to Pumping Station D for onward pumping to the Western District Pumping Station.

On behalf of the NRW, and with the support of Cardiff City Council, Geotechnology Ltd has been undertaking further studies to establish the current leachate management situation. These were reported in the "Ferry Road Landfill - Site Inspection Report", Report Number 2140r1v1d0321 in March 2021. A plan showing the leachate drainage installed, taken from this report, has been included as Figure 3.8. This identifies the location of the perimeter drains, the leachate abstraction gravity drains, pumping chambers, the surface water drains and an outfall.

Geotechnology noted that the chamber close to McDonalds (within the adjacent business park) was inspected, now labelled as Chamber 1. This was found to contain leachate at a very high level, though it was not flowing out of the chamber. Nearby, Pumping Station T1 was located and was found to be out of operation. The design plan shows that this station is a key pumping station in that it receives all the leachate draining under gravity from the eastern part of the site (including the leachate pumping wells and the eastern perimeter gravity drain) so any failure of this station would result in leachate backing-up into the drainage system.

The on-site leachate abstraction system has not been operated for an extended period and this has led to leachate build up within the site back to the levels originally observed (approximately +7m OD). This is, therefore, encouraging migration of leachate from the site. Leachate staining has also been observed on the sides of the landfill. The locations for these are indicated in Figure 3.8.

In addition, it was found that "leachate from the site was flowing away from the landfill through one of the original gravity drainage pipes to a surface water culvert on Ferry Road near the Watermark building". "The landfill is connected to the surface water system in Ferry Road at two points; the first is the route to the south of the landfill, passing eastwards to the south of ASDA whilst the second is a connection from Chamber 1 (close to McDonalds) eastward beneath the retail park to the surface water drain beneath Ferry Road".

The aim was that the southern drain was to be discontinued with collection at proposed Pumping Station T1 when available. The pipework is still in place and Cardiff City Council has confirmed it is continuing to transmit leachate. The foul sewer into which it was originally connected has been re-purposed as a surface water system, discharging into the Bay at the Watermark building.

Geotechnology examined a surface water discharge point into the River Ely and assessed the current leachate levels within the landfill. The discharge of water directly into the Ely from a pair of concrete pipes at the northern end of the landfill was noted along with a strong orange discolouration of the water flowing from the pipes. Geotechnology considered it highly likely that this was a direct discharge of leachate contaminated water into the River.

Figure 3.8: Plan showing leachate drainage



Source: Geotechnology Ltd – from report “Ferry Road Landfill - Site Inspection Report” Report Number 2140r1v1d0321

The walkover survey did not identify any areas of obvious instability.

It is recommended that a further topographical survey is undertaken in 2022 and then, depending on the degree of settlement it is recommended that surveys are then conducted every five years.

3.6 Security measures

The site is now a public park and therefore there are no security measures relating to the site. The monitoring infrastructure is secure and inaccessible to the public with the exception of LW10.

3.7 After-use and restoration

The site is now a public park, Grangemoor Park. The park includes extensive natural grasslands, a pond, artwork and a picnic area.

4 Aftercare monitoring and reporting

4.1 Monitoring locations

There are 19 observation wells, 19 leachate abstraction wells and 30 gas wells. The monitoring locations are discussed in Section 3. Drillers logs have been included Appendix B.

4.2 Monitoring procedures

The Working Plan states that “specific monitoring relating to Disposal Zone 2 will consist of regular (frequency to be agreed with the Environment Agency) monitoring, sampling and testing of the leachate/dirty water collected in the perimeter collector system prior to capping. Testing requirements will be agreed and results of analyses will be forwarded to the Environment Agency. It is not intended to monitor surface water run-off in the immediate vicinity of Disposal Zone 2 once the cap is in place. However, as part of the monitoring for the landfill, any surface water collected through the existing landfill leachate system will be regularly monitored and sampled at the currently consented outfalls prior to ultimate capping and restoration of the landfill”.

The plan further states that a proposed monitoring programme for the Ferry Road Landfill was set out in Ove Arup & Partners report titled "General Scope of Works for Monitoring of Groundwater, Leachate and Gas", issued in October 1995 in support of the Licence application and original Working Plan. Changes to the scope of testing proposed were requested by the Waste Regulation Authority, and were incorporated into Revision 1 of the report, as issued in March 1996 (Reference 3). Phasing of the monitoring will cover pre-construction, construction and post construction stages of the Licence Area. This document has not been found and may no longer be available.

Three discharge consent documents have been identified with maximum permissible discharge values for the Ferry Road Landfill Site. These documents are from 1998 and are addressed for Cardiff Bay Development. They are named as follows:

- LTP B Discharge Consent (No. TE 529B), located at Leachate Collection Sump B;
- LTP C Discharge Consent (No. TE 529C), located at Leachate Collection Sump C; and
- LTP D Discharge Consent (No. TE 529D), located at Leachate Collection Sump D.

The locations of the sumps C and D are shown on Figure 3.8. Leachate Collection Sump B is located on the leachate/foul rising main in Penarth Moors East.

The maximum permissible values from these documents have been presented in Table 5. It is not known if the landfill must comply with any additional discharge consent documents.

Table 5: Maximum permissible values from discharge consents

Category	Unit	LTP B	LTP C	LTP D
pH	-	6 – 11	6 – 11	6 – 11
Flow Max	m ³ day ⁻¹	312	624	624
Flow Rate	m ³ hr ⁻¹	13	26	26
Total Suspended Solids	mg/l	400	400	400
Oil, Grease & Fats	mg/l	50	50	50
Anionic Detergents	mg/l	50	50	50
Chemical Oxygen Demand Total	mg/l	2,000	2,000	2,000

Category	Unit	LTP B	LTP C	LTP D
Copper	mg/l	1	1	1
Zinc	mg/l	1	1	1
Lead	mg/l	1	1	1
Chromium	mg/l	1	1	1
Nickel	mg/l	1	1	1
Total Metals (Cu+Zn+Pb+Cr+Ni)	mg/l	2	2	2
Total Xylenes	mg/l	10	10	10
Total Phenol	mg/l	5	5	5
Toluene	mg/l	5	5	5
Benzene	mg/l	2	2	2
Aniline	mg/l	5	5	5
Arsenic	mg/l	1	1	1
Cyanide Free	mg/l	5	5	5
Ammoniacal Nitrogen	mg/l	100	100	100
Dissolved Methane	mg/l	0.14	0.14	0.14

Source: LTP B, LTP C, and LTP D Discharge Consent

4.3 Reporting

4.3.1 Gas monitoring

The gas monitoring undertaken at the site relates solely to the gas extraction works. This appears to show that there is sufficient landfill gas to continue extraction and utilisation.

There does not appear to have been a gas assessment since the development of the “Ferry Road – General Scope of Works for monitoring of groundwaters, leachate and gas”, Serial No. 95/2908 Rev 1, March 1996. However, this document has not been found.

The whole area surrounding the site would appear to have been subject to tipping of municipal and industrial wastes and, therefore, it is unlikely that it will be possible to manage the gas to reduce risks to neighbouring properties.

This aspect should be discussed with the NRW to agree the proposed actions. Initially it is proposed that the following is conducted:

- A desk review is undertaken to determine the extent of historical tipping;
- A review is undertaken with the planning authority to establish whether gas monitoring has been undertaken as part of developments of areas surrounding the site, and of gas protection measures incorporated in the development of any structures in close proximity to the site;
- Gas monitoring continues to be undertaken at a quarterly basis from the gas wells; and
- The results and findings are included in a gas risk assessment.

The monitoring frequency and locations will then be reviewed as part of the gas risk assessment. Landfill gas will be monitored for methane % by volume, carbon dioxide % by volume and oxygen % by volume. The barometric pressure will also be recorded for each reading.

4.3.2 Leachate monitoring

There does not appear to be any regular monitoring of the leachate in the site. It is recommended that leachate is monitored.

A full suite of leachate monitoring should be undertaken from the observation wells to define the current leachate quality. This should be repeated once the leachate abstraction system is reactivated and the quality and depth should be assessed monthly for a six-month period. In addition, depth monitoring should be undertaken on a 2 weekly basis following the restarting of the leachate abstraction system at the observation wells for the first six months.

A hydrogeological risk assessment should be undertaken to confirm the impacts on the surrounding area and to confirm the future monitoring programme and additional wells that may need to be installed. The risk assessment will include a review of the site's geological, hydrogeological and environmental setting along with the engineering data, waste disposal data and all leachate, groundwater and surface water monitoring data available. We will confirm / develop a Conceptual Site Model which will form the basis of a Generic Quantitative Risk Assessment (GQRA) to assess the risk to defined water resource and human health receptors from the site based on the current site conditions. Based on the results of the GQRA, a Detailed Quantitative Risk Assessment (DQRA) may be undertaken for the site if appropriate. This will include fate and transport modelling of contaminants using a probabilistic numerical modelling package, such as LandSim or ConSim to further assess potential risks. The results of the GQRA/ DQRA will also be used to develop remedial actions for the site to reduce potential risks to an acceptable level and to ensure compliance with current UK legislation.

It is anticipated that further monitoring infrastructure may be needed to the south of the landfill to assess the potential for leachate migration.

The following suite of testing is proposed:

- Ammoniacal nitrogen (as N), nitrate, nitrite;
- Arsenic, barium, boron, cadmium, chromium (III), chromium (hexavalent), copper, cyanide (total and free), iron, lead, manganese, elemental mercury, nickel, zinc (all dissolved);
- Chloride, pH, DoC, potassium, sulphate (as SO₄);
- Phthalates;
- Pesticides suite (to include Mecoprop); and
- Total TPH, Total PAH, Total phenols.

The aim would be to review the suite after each round of monitoring, but to make any changes to the suite after the first three rounds.

4.3.3 Groundwater/leachate monitoring

Results from four monitoring locations have been identified in the document "Ferry Road Sampling 2019-2021". The locations of these are shown in Figure 4.1. There is a total of 25 samples for each location, these were taken between January 2019 and February 2021. The dates for sampling are one month apart with the exception of March and June 2019. The details of these samples are provided in

Table 6. As indicated the B&M location is the only point where groundwater is analysed, the other three locations are leachate monitoring points.

Table 6: Ferry road sampling details, 2019-2021

Sample ID	Type	Measurements
B&M	Groundwater	Ammonia, ammoniacal nitrogen
Watkins	Effluent	Ammonia, chloride, nickel, cadmium, mecroprop, ammoniacal nitrogen, xylene
Grangemore	Effluent	Ammonia, chloride, nickel, cadmium, mecroprop, ammoniacal nitrogen, xylene
D Drive	Effluent	Ammonia, chloride, nickel, cadmium, mecroprop, ammoniacal nitrogen, xylene

Source: Ferry Road Sampling 2019-2021 excel spreadsheet

The maximum and median results from the measurements from each of these locations is provided in Table 7 and Table 8 respectively.

Table 7: Ferry road maximum sample result, 2019-2021

Category	Unit	B&M	Watkins	Grangemore	D Drive
Ammonia	mg.l ⁻¹ as NH ₄	234	125	364	481
Chloride	mg.l ⁻¹		185	866	380
Nickel	µg.l ⁻¹		9.6	32	13.5
Cadmium	µg.l ⁻¹		0.39	0.11	0.4
Mecroprop	µg.l ⁻¹		10	27.8	22.6
Ammoniacal Nitrogen	mg.l ⁻¹ as N	180	96	280	370
Xylene	µg.l ⁻¹		3.1	2.4	32.9

Source: Ferry Road Sampling 2019-2021 excel spreadsheet

Table 8: Ferry road median sample result, 2019-2021³

Category	Unit	B&M	Watkins	Grangemore	D Drive
Ammonia	mg.l ⁻¹ as NH ₄	0.16 ⁽²⁴⁾	25 ⁽²⁵⁾	105 ⁽²⁴⁾	25 ⁽²⁴⁾
Chloride	mg.l ⁻¹		99.3 ⁽²⁵⁾	188 ⁽²⁵⁾	214 ⁽²⁵⁾
Nickel	µg.l ⁻¹		2.7 ⁽²¹⁾	6.4 ⁽²³⁾	2.0 ⁽¹⁴⁾
Cadmium	µg.l ⁻¹		<0.08 ⁽²⁾	<0.08 ⁽¹⁾	<0.08 ⁽¹⁾
Mecroprop	µg.l ⁻¹		<0.1 ⁽²⁾	<0.1 ⁽⁷⁾	<0.1 ⁽⁹⁾
Ammoniacal Nitrogen	mg.l ⁻¹ as N	0.12 ⁽²⁴⁾	19 ⁽²⁵⁾	81 ⁽²⁴⁾	19 ⁽²⁴⁾
Xylene	µg.l ⁻¹		<1 ⁽⁹⁾	<1.0 ⁽⁴⁾	<1.0 ⁽²⁾

Source: Ferry Road Sampling 2019-2021 excel spreadsheet

Where values included "<x" the "x" figure was utilised to calculate the median.

³ Number of positive readings shown in brackets

Figure 4.1: Locations of groundwater monitoring points



Source: Cardiff City Council

The concentrations of ammoniacal nitrogen observed at the Watkins, Grangemoor and D Drive locations are indicative of a dilute leachate.

Groundwater monitoring will continue to be undertaken at monthly intervals for at least a six-month period. Consideration will be given to modifying the monitoring suite to reflect the suite proposed for the leachate monitoring. These will then be reviewed as part of the hydrogeological risk assessment.

4.3.4 Surface water monitoring

Surface water is currently being discharged intermittently into the River Ely from a twin piped outfall close to Pumping Station D. This was also identified in “The Proposed Works for the Ferry Road Landfill”, Cardiff City Council April 2003, where foaming discharges in the River Ely were identified. Several water samples were taken from this discharge location between 28 March 2002 and 24 March 2003 and these are included in Appendix C. These showed significant concentrations of several parameters including chloride, ammoniacal nitrogen, sulphates and alkalinity. It was proposed that a CCTV survey would be undertaken and the outfall capped. It would appear that the site is still discharging, albeit intermittently, and it is unclear what further action was taken.

Analysis of the surface water at the Watermark building was undertaken by Geotechnology Ltd on 22nd February 2021. This showed the following concentrations:

- Chlorine, Total (residual) <0.01mg/l;
- Ammoniacal nitrogen as N 9.3mg/l; and
- Potassium (Total unfiltered) 9.92mg/l.

It is recommended that the surface water is monitored upstream and downstream of the discharge at monthly intervals for a six-month period, as well as from the discharge itself.

Discharges to the Watermark building at Cardiff Bay should also be monitored to establish whether restarting the leachate abstraction leads to an improvement of the discharge quality.

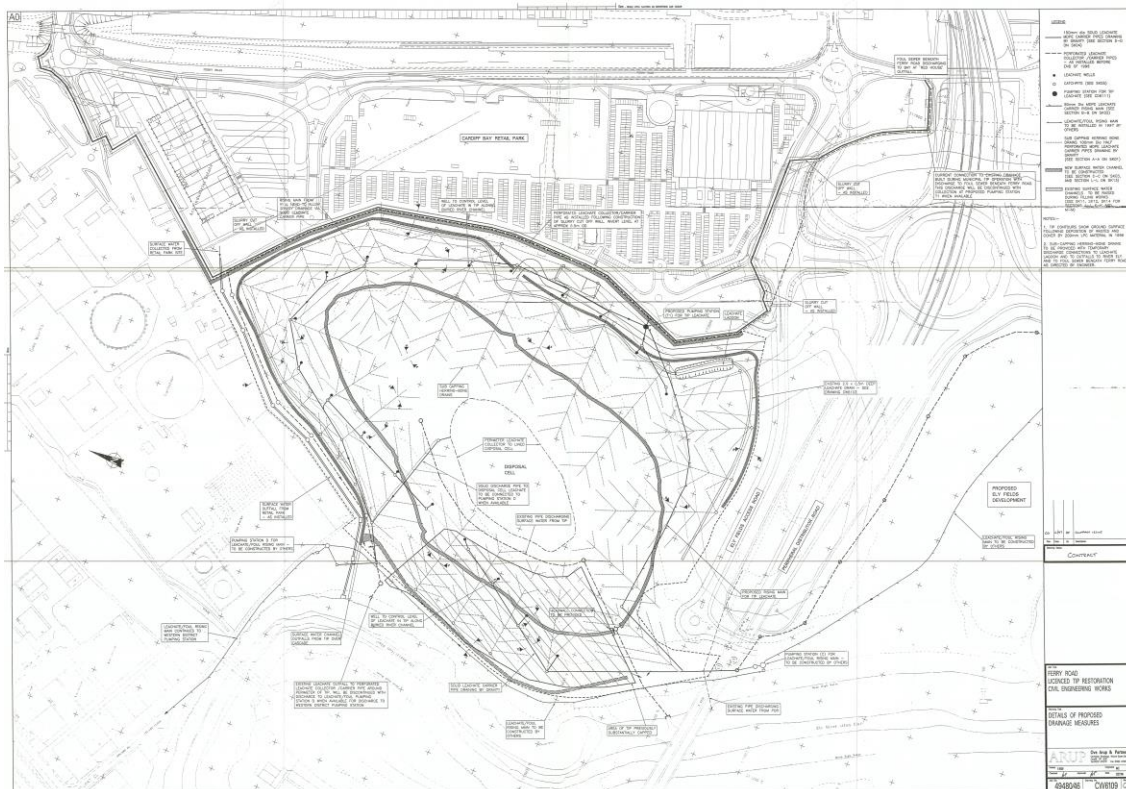
It is proposed that the full suite identified for leachate monitoring is also undertaken for the surface water monitoring. The suite of testing is as follows:

- Ammoniacal nitrogen (as N), nitrate, nitrite;
- Arsenic, barium, boron, cadmium, chromium (III), chromium (hexavalent), copper, cyanide (total and free), iron, lead, manganese, elemental mercury, nickel, zinc (all dissolved);
- Chloride, pH, DoC, potassium, sulphate (as SO₄);
- Phthalates;
- Pesticides suite (to include Mecoprop); and
- Total TPH, Total PAH, Total phenols.

The aim would be to review the suite after each round of monitoring, but to make any changes to the suite after the first three rounds.

In addition, it is proposed that the connectivity to the surface water systems be discontinued. Capping the entrance to the surface water system where the connection occurs to the south should be straightforward. However, in relation to the northern connection to the outfall, the drainage path will need to be established first, as it is possible that this discharge does not just relate to the landfill and therefore the impact of capping should be established before any works are undertaken. The proposed drainage is shown in Figure 4.2.

Figure 4.2: Original leachate management proposal showing outfall, connections and bentonite slurry wall



Source: Ove Arup & Partners

The original outfall was proposed in 1993 and was to allow leachate to discharge directly into the River Ely. Figure 4.2 shows that the original plan was to cap the outfall once the pumping station was installed, however it also shows surface water draining from the retail park.

5 Conclusions and recommendations

To be completed once we have discussed the plan, but primarily confirmation of the proposals in Section 4.

A. Waste management licence

**WASTE MANAGEMENT LICENCE NO. 95/07 [MOD. 1]
SECTION 37 NOTICE OF VARIATION**

**DINAS
CAERDYDD**

GWASANAETHAU'R
AMGYLCHEDD



**CITY OF
CARDIFF**

ENVIRONMENTAL
SERVICES

**ENVIRONMENTAL SERVICES DEPARTMENT
POLLUTION CONTROL DIVISION**

ENVIRONMENTAL PROTECTION ACT 1990

Licence to Dispose of Controlled Waste

Whereas on the 6 February 1996, the Council of the City of Cardiff in pursuance of the powers conferred on them by Section 36 of the Environmental Protection Act 1990 authorised :

CARDIFF BAY DEVELOPMENT CORPORATION
BAL TIC HOUSE
MOUNT STUART SQUARE
CARDIFF CF1 6DH

hereinafter called the "licence holder" to operate a Landfill Site on land at :-

FORMER MUNICIPAL LANDFILL SITE
FERRY ROAD
GRANGETOWN
CARDIFF

as identified in Condition 1 of the licence

NOTICE IS HEREBY GIVEN that the Council of the City of Cardiff in pursuance of the powers conferred on them by Section 37 of the Environmental Protection Act 1990 modifies the said conditions as follows :-

Delete all conditions and drawings set out in Licence No. 95/07 and substitute the conditions and drawings set out in Waste Management Licence 95/07 [MOD 1] attached to this Notice.

Such modification shall take effect on 30th March 1996 at 12:00 noon.

Dated this 29th day of March 1996

Signed

Director of Environmental Services

* The licence holder's attention is drawn to the notes overleaf *
Such modifications are marked **

Pollution Control Division,
Environmental Services Department,
Wood Street, Cardiff. CF1 1NQ.
Tel. 01222-822134

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**WASTE MANAGEMENT LICENCE NO. 95/07 [MOD 1]
SHEET 2 of 15**

NOTES

These notes are for general guidance only, and they do not constitute an authoritative statement of the law. In particular, the licence holder's attention is drawn to Paragraph 1, where primary relevant legislation only is described. The licence holder should therefore satisfy himself that he is conversant with all legislation which may affect his operation of the facility. If there are any doubts, expert legal opinion should be sought.

1. This licence relates only to the requirements of the Environmental Protection Act 1990 for the deposit, keeping, treating and disposal of waste subject to the conditions set out in the Schedules and does not constitute a consent required by other legislation. In particular, it is the responsibility of the licence holder to comply with any requirements of the **ENVIRONMENTAL PROTECTION ACT 1990, WATER RESOURCES ACT 1991, HEALTH AND SAFETY AT WORK ETC. ACT 1974, the RADIOACTIVE SUBSTANCES ACT 1993, the TOWN AND COUNTRY PLANNING ACTS, BUILDING REGULATIONS, and ALL OTHER RELEVANT WATER PROTECTION AND ENVIRONMENTAL HEALTH** legislation.

All discharges to watercourses have to meet the requirements of the National Rivers Authority. Any diversion or other changes will also require National Rivers Authority approval.

All discharges to sewers have to meet the requirements of the water company. Any diversion or other changes will also require the water company's approval.

2. The carriage of controlled waste to and from licensed facilities should only be undertaken by carriers authorised under the provisions of the Control of Pollution (Amendment) Act 1989 and in compliance with Section 34 of the Environmental Protection Act 1990.
3. Compliance with the Conditions of this licence are obligatory to ensure that operations do not cause pollution of the environment, or harm to human health, or would be seriously detrimental to the amenities of the locality affected.

4. Notices of Appeal

[Regulation 6 : The Waste Management Licensing Regulations 1994]

A person who wishes to appeal to the Secretary of State under Section 43 of the Environmental Protection Act 1990 shall do so by notice in writing to :

*The Secretary of State for Wales
The Welsh Office
Cathays Park
Cardiff*

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**WASTE MANAGEMENT LICENCE NO. 95/07 [MOD 1]
SHEET 3 of 15**

An appeal must be lodged with the Secretary of State within six months of the date of the issue of this licence, any modification, suspension or revocation, or at any time that the Secretary of State may allow.

The Notice of Appeal shall be accompanied by :-

- a] a statement of the grounds of appeal;
- b] where the appeal relates to an application for a Waste Management Licence or for the modification, surrender or transfer of a Waste Management Licence, a copy of the appellant's application and any supporting documents;
- c] where the appeal relates to an existing Waste Management Licence [including a Waste Management Licence which has been suspended or revoked], a copy of that Waste Management Licence;
- d] a copy of any correspondence relevant to the appeal;
- e] a copy of any other document relevant to the appeal including, in particular, any relevant consent, determination, notice, planning permission, established use certificate or certificate of lawful use or development; and
- f] a statement indicating whether the appellant wishes the appeal to be in the form of a hearing or to be determined on the basis of written representations.

The appellant shall serve a copy of his notice of appeal on the Waste Regulation Authority together with copies of the documents mentioned in Sections a] to f] above.

If the appellant wishes to withdraw an appeal, he shall do so by notifying the Secretary of State in writing and shall send a copy of that notification to the Waste Regulation Authority.

****** *In accordance with Section 43[4], where conditions have been varied by a Notice of Modification, the effect of this shall be suspended pending any appeal to the Secretary of State. If the appeal is dismissed or withdrawn, this notice will have immediate effect.*

**WASTE MANAGEMENT LICENCE NO. 95/07 [MOD 1]
SHEET 4 of 15**

7. Time limit for making an appeal
[*Section 7: The Waste Management Licensing Regulations 1994*]
- (1) Subject to paragraph (2) below, notice of appeal shall be given in the case of an appeal under Section 43 of the 1990 Act, before the expiry of the period of 6 months beginning with -
- (i) the date of the decision which is the subject of the appeal; or
- (ii) the date on which the Waste Regulation Authority is deemed by Section 36(9), 37(6), 39(10) or 40(6) of the 1990 Act to have rejected the application.
- (2) The Secretary of State may in relation to an appeal under Section 43 of the 1990 Act at any time allow notice of appeal to be given after the expiry of the period mentioned in paragraph (1) above.

CONTRAVENTION OF LICENCE CONDITIONS etc.

Your attention is drawn to the provisions of section 33,38,39,40,42 and 59 of the Environmental Protection Act 1990. A brief resume is included below.

Section 33

Prohibits under penalty, the deposit of waste, or the use of plant and equipment, otherwise than in accordance with the terms of the licence. This section applies to all the conditions contained herein, including any which may be the subject of appeal to the Secretary of State under Section 43 of the Act.

Any deposit which takes place without compliance with all licence conditions may lead to prosecution under this section.

Section 38

Should the licence holder cease to be a 'fit and proper' person by reason of him being convicted of a relevant offence, or the management of activities has ceased to be in the hands of technically competent management, or the continuation of activities may cause pollution of the environment, harm to human health or serious detriment to the amenities of the locality, this may lead to revocation of the licence.

The WRA also has powers to suspend the licence if the management of the site has ceased to be in the hands of technically competent management, or serious pollution of the environment or serious harm to human health is likely or has already occurred as a result of activities at the site.

Section 39

A licence holder may only surrender a licence with the written agreement of the WRA. An application, enclosing the appropriate fee, to surrender must contain such information as the WRA may require in order to demonstrate that the site is unlikely to cause pollution of the environment or harm to human health.

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**WASTE MANAGEMENT LICENCE NO. 95/07 [MOD 1]
SHEET 5 of 15**

Section 40

Should the licence holder wish to transfer to another person, i.e. the transferee, a joint application shall be made, enclosing the appropriate fee, to the WRA. A licence may only be transferred to a 'fit and proper' person as defined by Section 74 of the Environmental Protection Act and, therefore, the WRA will be required to assess the status of the transferee by information contained within the application.

Section 42

Non-compliance with any licence condition may lead to partial revocation of this licence and prosecution.

Section 59

The licensing authority is empowered to require the removal of any controlled waste deposited in circumstances where any of the conditions contained in this licence are not being complied with.

Penalties under Section 33

A person who contravenes section 33, subsection [1] shall, subject to subsection [4], be guilty of an offence, and liable, upon summary conviction, to imprisonment for a term not exceeding six months or a fine of an amount not exceeding £20,000, or both, or on conviction on indictment, to imprisonment for a term not exceeding two years or a fine or both.

WASTE MANAGEMENT LICENCE NO. 95/07 [MOD 1]
SHEET 6 of 15

SCHEDULE "A"
DEFINITIONS

1. In this licence, an "emergency" is defined as a case where a person has reasonable cause to believe that circumstances exist which are likely to give rise to pollution of the environment, or harm to human health, or would be seriously detrimental to the amenities of the locality affected.
2. In this licence, liquids which are "flammable", "highly flammable" or "extremely flammable" shall have the same meaning as Schedule 1, Part 1, of the Chemicals [Hazard Information and Packaging] Regulations 1993.
3. "Technically competent management" shall for the purposes of this licence, mean a person or persons who through training and/or qualification is/are able to identify the nature of wastes arriving at the facility and carry out operations at the facility in accordance with recommended practices. Such a person or persons shall be in possession of :-

a Certificate of Technical Competence [COTC]
or a Provisional Certificate of Technical Competence, [pCOTC]
or a Certificate of Qualifying Experience [CQE]
for managing landfill operations : Biodegradable Waste [Level 4] in accordance with Regulation 4 of the Waste Management Licensing Regulations 1994 as issued by the Waste Management Industry Training and Advisory Board.

or on the 10 August 1994 is 55 years of age or over, and in the 10 years ending on that date he has had at least 5 years experience as the manager of a facility at the equivalent level mentioned above. This competence shall last only until 10 August 2004

or is deemed competent by virtue of section 77(2) of the Environmental Protection Act 1990 and has been notified in writing by the Waste Regulation Authority.
4. In this licence, "liquid" and "solid" have their ordinary everyday meanings.
5. In this licence, "sludge" means an intimate mixture of solid and liquid.
6. Notwithstanding the above, words and phrases in this licence have the meaning ascribed to them by the Environmental Protection Act 1990 and its associated regulations.
7. In this licence, an Authorised Officer is an officer authorised by the Waste Regulation Authority for the purposes of the Environmental Protection Act 1990.
8. In this licence, the "water company" means the sewerage undertaker for the area, as defined by the Water Industry Act 1991.
9. In this licence, "operation" is defined as the receipt, handling, removal or deposit of controlled waste.
10. Any reference in the Working Plan to waste disposal authority shall also be taken to refer to the Waste Regulation Authority.

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**WASTE MANAGEMENT LICENCE NO. 95/07 [MOD 1]
SHEET 7 of 15**

SCHEDULE "B"

THE QUANTITIES OF WASTE TO BE DISPOSED OF AT THE FACILITY

TYPES OF WASTE

- Types of waste materials accepted at the facility, and the maximum quantities stored shall comply with the Schedule below.

TYPE OF WASTE QUANTITIES	MAXIMUM WASTE CODE	MAXIMUM QUANTITY	DOE CODE	FWC CODE
Phase 1 [Disposal Zone 2, as referred to in Ove Arup and Partners Report 95/2592]: Industrial wastes constituting contaminated soils, hardcore and similar materials arising from the excavation of land identified as Cardiff Bay Retail Park in Figure 1 of the Working Plan [Report No. 95/2924 - Ove Arup & Partners], spoil arising from the construction of the surface water drain to serve the Retail Park site, and quantities identified in the Working Plan arising from the excavation of the gas cut-off wall [defined in Figure 4 of Report No. 95/2952 - Ove Arup & Partners].		** 60,000 tonnes	S90	17 05 01
Phases II & III [Disposal Zone 1, as referred to in Ove Arup and Partners Report 95/2592]: a) Industrial wastes comprising excavated soils, hardcore and similar materials and municipal refuse arising from construction of the gas cut-off wall and ancillary works identified in Figure 2 of the Working Plan [Report No. 95/2942 - Ove Arup & Partners] b) Industrial wastes comprising contaminated soils and municipal refuse [including asbestos] arising from the excavation of land identified as Ely Fields, spoil arising from the construction of the surface water drain between the retail park site, and spoil arising from the construction of the permanent access road serving Ely Fields, as identified in Ove Arup and Partners Report 95/2592 c) Reprofilling of municipal wastes presently within the site authorised under this licence to achieve the final contours identified in the Working Plan.		250,000 tonnes 75,000 tonnes	S90 /S95 / S97 / J10 S90 / S95/ S97	20 00 00 17 05 01 17 06 01 20 00 00 17 05 01

THE MAXIMUM QUANTITY OF WASTE DISPOSED OF AT THE FACILITY SHALL NOT EXCEED 60,000 TONNES IN RESPECT OF PHASE I, AND 325,000 TONNES IN RESPECT OF PHASES II AND III.

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**WASTE MANAGEMENT LICENCE NO. 95/07 [MOD 1]
SHEET 8 of 15**

EXCLUSIONS

Notwithstanding the generality of the types of wastes specified in this Schedule, the following wastes shall be specifically excluded from delivery to the facility without the prior *written* approval of the Waste Regulation Authority :-

- a] Controlled Waste being defined as “special waste” in the Control of Pollution [Special Waste] Regulations 1980 and any subsequent amendments;
- b] Any waste containing free flammable solvents;
- c] Liquid wastes;
- d] Any wastes other than those specified in Schedule B.

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**WASTE MANAGEMENT LICENCE NO. 95/07 [MOD 1]
SHEET 9 of 15**

SCHEDULE "C" : OPERATIONAL CONDITIONS

- 1a] *THE TERMS OF THIS LICENCE SHALL BE MADE KNOWN TO ANY PERSON WHO IS GIVEN RESPONSIBILITY FOR THE MANAGEMENT OR CONTROL OF THE FACILITY, AND A COPY OF THESE CONDITIONS AND THE WORKING PLAN SHALL BE KEPT AVAILABLE AT THE FACILITY AND DISPLAYED IN A PROMINENT POSITION.*
- b] *THIS LICENCE SHALL APPLY TO THE SITES SHOWN EDGED IN RED ON THE ATTACHED DRAWING, LOCATED AT ORDNANCE SURVEY GRID REFERENCE ST 175 737, BEING LAND OCCUPIED BY THE LICENCE HOLDER.*
- c]** *THIS LICENCE SHALL NOT PERMIT THE DEPOSIT OF WASTE IN THE AREA IDENTIFIED AS THE DISPOSAL CELL (DISPOSAL ZONE 2 IN THE WORKING PLAN) UNTIL THE FOLLOWING INFORMATION HAS BEEN SUBMITTED TO, AND APPROVED BY, THE WASTE REGULATION AUTHORITY IN WRITING:*
- i] *Construction details of the drainage systems and associated storage tank(s) serving the Disposal Cell, including bunds;*
- ii] *The management arrangements to monitor levels in the leachate drainage system, including the storage tank(s), and to secure the removal of leachate as necessary to prevent the risk of the system's capacity being exceeded, having regard to action levels as detailed in the Working Plan.*
- 1d]** *Before depositing waste in any of the ten phases of the Disposal Cell as defined in drawing WSK/48 revision A, the relevant independent Constructional Quality Assurance performance documents, duly completed, shall be submitted to, and receipt acknowledged by, the Waste Regulation Authority in writing.*
- 1e]** *The construction details of the permanent drainage systems to serve the site authorised by this licence shall be submitted for approval to the Waste Regulation Authority in writing on, or before, 1st January 1997. The systems shall be installed in accordance with the approved scheme and be fully operational before impoundment of the River Taff and River Ely as provided for by the Cardiff Bay Barrage Act 1993.*
- 1f]** *The preliminary groundwater, gas and leachate monitoring report based on the boreholes identified on the drawing entitled "As Built Locations of Long Term Monitoring Boreholes" shall be submitted to the Waste Regulation Authority before the deposit of any waste otherwise permitted by this licence.*
- The proposals for the secondary phase of the long term monitoring programme (the full intended programme having been detailed in the report entitled "General Scope of Works for Monitoring of Groundwater, Leachate and Gas" [Revision 1, March 1996]) shall be submitted to the Waste Regulation Authority in writing on or before 1st July 1996.*

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**WASTE MANAGEMENT LICENCE NO. 95/07 [MOD.1]
SHEET 10 of 15**

- 2a] The statements of intended methods of operation and drawings contained within the documents entitled "Cardiff Bay Development Corporation : Disposal of Waste at the Ferry Road Landfill Site : Working Plan for Contaminated Soil Wastes", "Cardiff Bay Development Corporation, Disposal of Waste at the Ferry Road Landfill Site; Working Plan for the Cut-off Wall Arisings and Municipal Refuse Deposits encroaching within Cardiff Bay Retail Park Site", "Cardiff Bay Development Corporation Disposal of Waste at the Ferry Road Landfill Site; Working Plan for the wastes generated from Advanced Preparation Works for Ely Fields and Cardiff Bay Retail Park Developments", together with the documents entitled "Cardiff Bay Development Corporation : Ferry Road ; Hydrogeology and Groundwater Impact", "Cardiff Bay Development Corporation : Ferry Road : General Scope of Works for Monitoring of Groundwater, Leachate and Gas" and "Cardiff Bay Development Corporation : Ferry Road : Recommendations for Capping Over the Landfill and the Control of Leachate and Gas" submitted as part of the application for this licence shall be referred to as the Working Plan. Any reference in this licence to the Working Plan shall be construed to mean all of these documents unless specifically worded otherwise.
- b] The licence holder shall obtain *written* approval from the Waste Regulation Authority for any proposed changes to the conduct of the operations as detailed in the Working Plan, before any proposed change is implemented.
- c] Any reference in this licence to the Working Plan shall include a reference to any modification to the statement or the drawings which have been approved *in writing* by the Waste Regulation Authority as appropriate.
- d] Subject to the terms of this licence, the site shall be operated in accordance with the Working Plan.
- e] All circumstances of emergency shall be reported forthwith to the Waste Regulation Authority.
- f] Within *three months* of the issue of this licence, all preparation works as detailed in the Working Plan shall be completed.

Preparation Works

- 3.** The following engineering activities shall be subject to independent Constructional Quality Assurance:
- a] The liner and leachate/surface water collection systems serving the Disposal Cell (Disposal Zone 2 as identified in the Working Plan);
 - b] The landfill gas control system serving the wastes to be deposited and those having previously been deposited;
 - c] The leachate and surface water drainage systems serving the whole site authorised by this licence;
 - d] The capping system to be installed upon completion of waste disposal activities.

None of the aforementioned engineering activities may be undertaken until the proposed Constructional Quality Assurance Scheme relevant to that activity has been submitted to, and approved by, the Waste Regulation Authority in writing.

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**WASTE MANAGEMENT LICENCE NO. 95/07 [MOD.1]
SHEET 11 of 15**

4. In accordance with details of the Working Plan, offices shall be provided and maintained.
5. Lighting in accordance with the Working Plan shall be provided at the facility for those operations which are to be carried out during the hours of darkness as defined by the statutory lighting-up times published by the Science and Engineering Research Council. Such lighting shall be sufficient to permit thorough inspection of wastes delivered to the facility to allow identification of wastes acceptable and unacceptable under the terms of Schedule B of this licence.
6. An identification board of durable material and finish shall be displayed at the entrance to the facility. This shall give the name of the facility, the Site Licence number, the name, address and telephone number of the operator and of the Waste Regulation Authority, the hours of operation and the telephone numbers of the personnel to contact in the event of an emergency.
7. Effective security shall be provided at the facility in order to prevent the escape of waste and unauthorised access to the facility. To this end, gates, walls and fencing shall be provided at the facility and maintained at all times in accordance with the Working Plan. The gates shall be locked outside operating hours and at any time the site is left unattended, in order to prevent unauthorised access, deposit on, or removal of materials from the facility. The fencing and gates shall be inspected daily by the site supervisor, and any damage observed shall be rectified within 24 hours of the damage being identified.
8. Under no circumstances shall site activities threaten pollution of ground or surface waters. For this purpose, site drainage shall be constructed and maintained in accordance with the Working Plan to ensure that water does not accumulate at the facility, other than the leachate storage system serving Disposal Zone 2, and the leachate attenuation lagoon serving Disposal Zone 1 as detailed on Drawings C4208 and C4209.
9. Tanks or drums used for the storage of liquids shall be contained within bunded compounds. The containment capacity of the bund shall be at least 110% of the tank capacity in the case of a single tank. Where multiple tanks or drums are contained within a bund, then the bund capacity shall be either 110% of the capacity of the largest tank or drum, or 25% of the total volume of liquid which could be stored in the bund, whichever is the greater. The side walls and base of the bunded areas shall be lined with an impervious material.
 - 1) Within the bund;
 - 2) Discharged vertically downwards;
 - 3) Shut and locked when not in use.

Where liquid from a tank is delivered through a flexible pipe permanently attached to the tank, then -

- a) A tap valve shall be provided at the delivery end which automatically closes when not in use;
- b) An isolating valve shall be provided at the tank end of the flexible pipe which shall be kept locked when not in use
- c) The flexible delivery pipe shall be kept within the bund when not in use.

Every part of the storage tank shall be within the bund.

**WASTE MANAGEMENT LICENCE NO. 95/07 [MOD.1]
SHEET 12 of 15**

All taps or permanent valves through which liquid can be discharged shall be :

No part of the bund shall be situated within 10 metres of any inland or coastal water into which the liquid could enter if it were to escape.

All containers within the bund shall be of a type and construction suitable for liquids they contain, and shall be labelled to show their contents. Containers shall conform, where necessary, to all relevant safety and construction standards.

Any liquid waste temporarily stored/quarantined on the application site shall be stored in sealed containers within a bunded area to the specification detailed above, pending its collection and disposal at a suitably licensed facility elsewhere. This requirement shall not apply to the leachate storage system serving Disposal Zone 2, nor to the leachate attenuation lagoon serving Disposal Zone 1 as detailed on Drawings C4208 and C4209.

10. Measures in accordance with the Working Plan shall be taken to prevent damage to all pipework, valves, pumps and storage tanks.

Operations

11. During all operational and maintenance periods, the facility shall be staffed and supervised by technically competent management as defined in Schedule "A" which is capable of ascertaining, in accordance with the terms of the Working Plan, and having regard to the information supplied with the waste materials, that only wastes permitted by the licence are deposited at the site. As far as practicable, the nature of the waste shall be ascertained by site personnel to ensure that it is acceptable in accordance with this licence. Should there, at any time, be any changes to the technically competent management as presented by the licence holder to the Waste Regulation Authority during the application stage, then within FOURTEEN DAYS of any changes, the Waste Regulation Authority shall be informed *in writing*. Should at any time the management cease to be technically competent, the Waste Regulation Authority shall be informed in writing within FOURTEEN DAYS of such a change.
12. Provision shall be made to deal with any unacceptable waste delivered to or left at the facility in accordance with the Working Plan. Such waste shall be removed from the facility as soon as practicable or within such time as may be agreed with the Waste Regulation Authority and taken for disposal.
13. The types of waste and maximum quantities to be disposed of at the facility shall consist of those specified in Schedule "B" of this licence.
14. A record shall be kept of the types and quantities of waste delivered to, and removed from, the facility, giving details of the final destination, including materials inadvertently delivered to and subsequently removed from the facility. The record shall comprise full details, as required, on forms agreed with the Waste Regulation Authority, and copies shall be sent to the Waste Regulation Authority at a frequency as may be requested by the Waste Regulation Authority. These records shall be made available for inspection by an authorised officer of the Waste Regulation Authority at the facility at any reasonable time.
15. The hours of operation shall be 08:00 to 18:00 Mondays to Fridays, and 08:00 to 14:00 Saturdays only.

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**WASTE MANAGEMENT LICENCE NO. 95/07 [MOD.1]
SHEET 13 of 15**

16. A diary/log book shall be provided and retained on site to record all circumstances of emergency and any defects revealed by the technically competent management or site staff as referred to in this licence and the Working Plan, together with details of any action taken. The diary/log book shall be available for the licence holder, accredited agent or employees and for authorised officers of the Waste Regulation Authority to read or record comments pertaining to the activities at the facility.
17. No waste material shall be burned within the boundaries of the facility. Any fire occurring within the confines of the facility shall be treated as an emergency, and immediate action shall be taken to extinguish it. All outbreaks of fire shall be reported to the Waste Regulation Authority forthwith. Fire-fighting equipment and emergency water supplies shall be provided and regularly maintained at the facility.
18. If required by the Waste Regulation Authority, any waste or other material segregated for re-use or re-sale shall be removed forthwith, if, in the opinion of the Waste Regulation Authority, it is likely to cause pollution of the environment, harm to human health or would be seriously detrimental to the amenities of the locality affected.
19. Appropriate measures, including proper maintenance and use, shall be undertaken to control the noise of machinery and vehicles operating at the facility to ensure it does not cause pollution of the environment, harm to human health, or would be seriously detrimental to the amenities of the locality affected.
20. The facility shall be inspected daily for the presence of vermin and insects, and control measures shall be undertaken as detailed in the Working Plan to deal with any vermin or insects found. Records of these inspections, and any control measures undertaken, including types and quantities of pesticides used, shall be kept permanently on site.
21. No malodours or dust shall be detectable beyond the site boundary of the licensed waste disposal facility which arise from on site activities within the area defined in Condition 1 of this licence. To this end, wastes shall be sprayed with a deodoriser and/or dust suppressant at times and locations in accordance with the Working Plan, or as required by the Waste Regulation Authority.
22. Primary site roads to the standard of construction stipulated in the Working Plan, shall be provided and maintained in accordance with the Working Plan.
23. Provisions shall be made within the confines of the facility for the parking, loading and unloading of vehicles transporting wastes and residues to and from the facility in accordance with the Working Plan.
24. Wheel cleaning facilities shall be provided, maintained and used, in accordance with the Working Plan, to ensure that no mud debris or other material is deposited on any roadway by vehicles using the facility.
25. A system for the collection, settlement and discharge of surface water shall be installed, used and maintained as detailed in the Working Plan in order to minimise leachate production.
26. Surface water intercept drains shall be inspected as necessary and in any case, at least once per seven days. The drains shall be kept free of any blockage and maintained to the specification in the Working Plan.

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**WASTE MANAGEMENT LICENCE NO. 95/07 [MOD.1]
SHEET 14 of 15**

27. All leachates collected at the facility shall be disposed of in accordance with the Working Plan.
28. A leachate collection system shall be provided in accordance with the Working Plan. The system shall be inspected as necessary, and in any case at least once per seven days. The system shall be kept free of blockages and maintained to the original specification.
29. Contaminated surface run-off waters shall be collected and directed to the leachate collection system such that no clean waters at the facility become contaminated.
30. Material used for landfill other than that which is wholly non-putrescible and non-combustible shall be covered progressively with suitable inert stabilised material throughout operating hours, so that by the end of each working day all exposed surfaces including the flanks and face shall have been covered to a depth of at least 15cm.

No putrescible or combustible waste shall be accepted at the site unless there is a stock-pile of inert material located in the vicinity of the working face which is sufficient to cover such wastes by the end of the working day.
31. Details of the landfill gas management system shall be submitted to and approved by the Waste Regulation Authority in writing within four months of the date of issue of this licence. The system shall be installed in accordance with the Working Plan.
32. The gas venting system shall be inspected in accordance with the schedule specified in the working plan. Any part of the gas system that fails to meet the design standards of the Working Plan shall be repaired or replaced after consultation and the agreement of the Waste Regulation Authority, without delay.
33. Any breakdown of the gas venting system shall be reported as soon as is practicable to the Waste Regulation Authority and in any case, not later than the first working day after such an event is identified.
34. Landfill gas, leachate and groundwater monitoring boreholes or other monitoring points will be installed and maintained to the specification detailed in the Working Plan and will be located as detailed in the Working Plan. The boreholes and any other monitoring points will be monitored as detailed in the Working Plan.

All boreholes and other monitoring points will be inspected in accordance with the schedule specified in the working plan. Any defects identified shall be remedied in accordance with the Working Plan.
35. A full record of gas readings, together with the barometric and air temperature shall be kept at the facility and a copy sent to the Waste Regulation Authority every month or as agreed by the Waste Regulation Authority in writing.

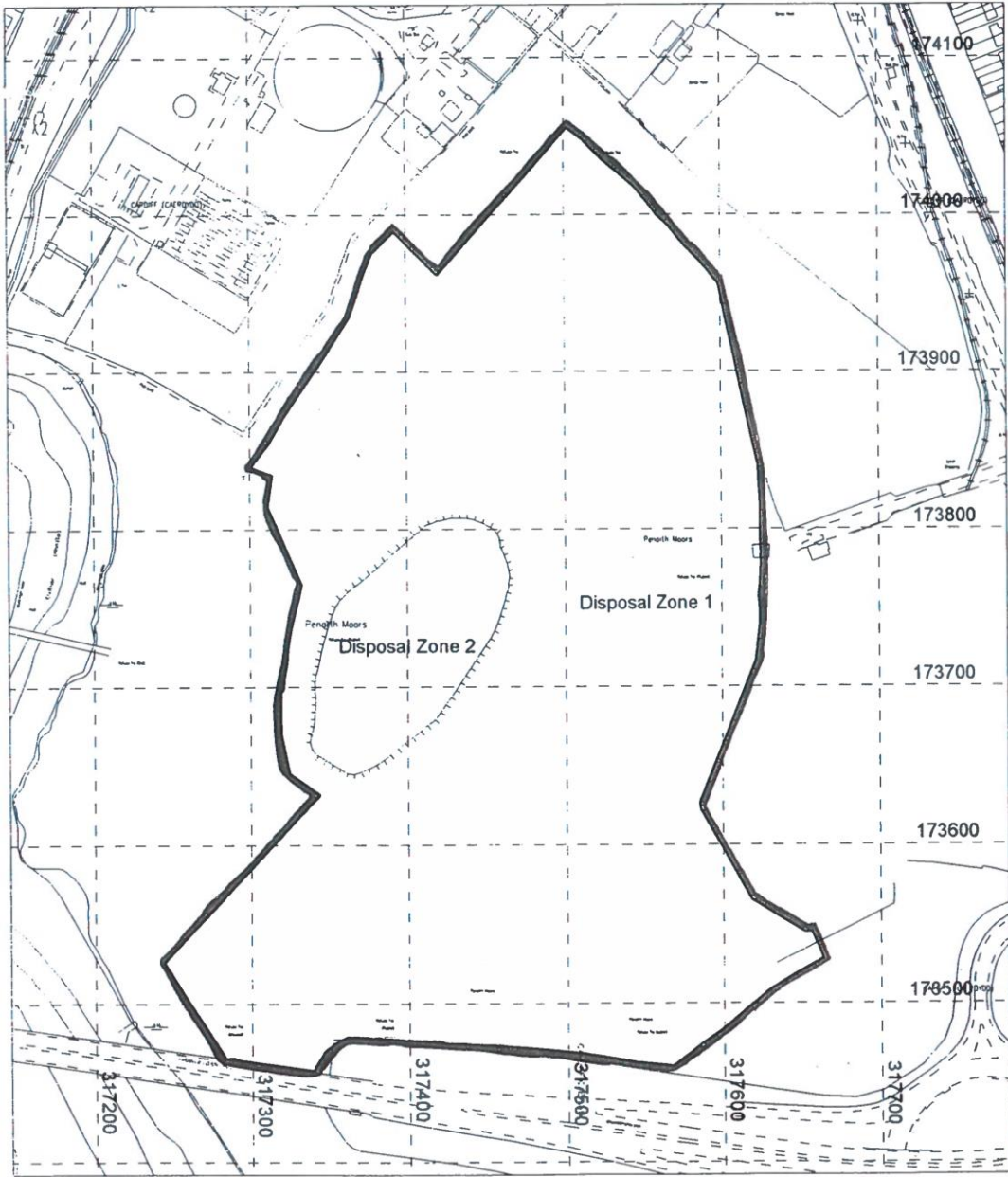
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**WASTE MANAGEMENT LICENCE NO. 95/07 [MOD.1]
SHEET 15 of 15**

Landscaping and Aftercare -

36. Upon completion of waste disposal operations, the site will be contoured and capped over and landscaped in accordance with the Working Plan. Details of the capping and associated drainage details must be submitted to the Waste Regulation Authority within 4 months of the date of issue of this licence. Written approval from the Waste Regulation Authority shall be obtained before construction of the capping and associated drainage systems.
37. As detailed in the Working Plan, the site will be inspected for evidence of instability. With the exception of settlement anticipated in the Working Plan, any evidence of the uncontrolled movement of waste [including soil] and including that which may be indicated by movement of items of infrastructure, i.e. gas monitoring and control equipment, leachate and groundwater monitoring equipment, the drainage systems, the capping system and security fencing, shall be reported in writing to the Waste Regulation Authority as soon as is practicable, and in any case within seven days of the evidence being noted. Calculations to demonstrate the anticipated settlement shall be submitted as an amendment to the Working Plan within 4 months of the date of issue of this licence. Any works of repair or reinstatement shall be undertaken in accordance with the Working Plan.
38. As detailed in the Working Plan, the site will be inspected for evidence of disrepair, damage and malfunction of infrastructure, i.e. gas monitoring and control equipment, leachate and groundwater monitoring equipment, the drainage systems, the capping system and security fencing. Any such evidence shall be reported in writing to the Waste Regulation Authority as soon as is practicable, and in any case within seven days of the defects being noted. Any works of repair or reinstatement shall be undertaken in accordance with the Working Plan.
39. The landfill gas, groundwater and leachate monitoring boreholes and other monitoring points will be sampled for the determinands specified in the Working Plan and at frequencies specified in the Working Plan. All results will be forwarded in writing to the Waste Regulation Authority at intervals agreed in writing with that Authority. The licence holder will notify the Waste Regulation Authority of any results showing any determinands indicating a variance exceeding 30% of the previous result as soon as is practicable, and in any case, no later than the first working day after the result is known.
40. A copy of any notice or instruction received in respect of the facility from any authority other than the Waste Regulation Authority, which in any way relates to the use of the facility, shall be given to the Waste Regulation Authority within *seven* days of the receipt of such notice or instruction.
41. Any cessation of operations for a period in excess of *three months* shall be notified to the Waste Regulation Authority. Not less than *fourteen days* notice shall be given to the Waste Regulation Authority of the date on which operations are to recommence in the event of such a cessation.
42. In the event of cessation of operations whereby waste delivered to the facility is required to be transferred or diverted elsewhere, the Waste Regulation Authority shall be notified forthwith.

TITLE	Areas licenced for the purposes of Waste Management Licence 95/07 issued by Cardiff City Council.
SCALE	NOT TO SCALE.
Crown Copyright, Licence no. LA0774410	



B. Borehole installation logs

C. Water samples

Certificate of Analysis		 1314 0897 1229		SEVERN TRENT Environmental Leadership		STL	
Sample	3	Laboratory Number :	803726				
of	4	Report Number :	TH/181894/2003				
		Issue	1				
Sample Source :		Cardiff County Council					
Sample Point Description :		Cardiff County Council					
Sample Description :		OFD					
Sample Date :		24 March 2003	Sample Received :		24 March 2003	Analysis Complete :	
					7 April 2003		

Test Description	Result	Units	Accreditation	Method
Escherichia coli confirmed	0	cfu/100ml	C	W10
Total Coliforms confirmed	10	cfu/250ml	C	W10
Total Coliform presumpt	10	cfu/250ml	C	W10
E.coli presumptive	0	cfu/100ml	C	W10
Arsenic , Total as As	0.001	mg/l	C	WAS014
Cadmium , Total as Cd	0.0020	mg/l	C	WAS049
Chromium , Total as Cr	<0.005	mg/l	C	WAS049
Copper, Total as Cu	0.009	mg/l	C	WAS049
Iron , Total as Fe	56.67	mg/l	C	WAS049
Lead , Total as Pb	<0.005	mg/l	C	WAS049
Manganese , Total as Mn	1.13	mg/l	C	WAS049
Mercury , Total as Hg	<0.0001	mg/l	C	WAS013
Nickel , Total as Ni	0.013	mg/l	C	WAS049
Potassium , Total as K	106	mg/l	C	WAS049
Sodium , Total as Na	253	mg/l	C	WAS049
Zinc, Total as Zn	0.016	mg/l	C	WAS049
Sulphide as S	<0.01	mg/l	C	WAS033
pH	7.2		C	WAS039
Conductivity- Electrical 20deg	6560	uS/cm	C	WAS039
Total Hardness as CaCO3	1149	mg/l	C	WAS049
Colour	40.8	Hazen	C	WSI021
Ammoniacal Nitrogen as N	125	mg/l	C	WAS036
Chloride as Cl	349	mg/l	C	WAS036
Nitrite as N	0.8	mg/l	C	WAS036
Nitrate as N	1.5	mg/l	C	WAS036
Sulphate as SO4	521	mg/l	C	WAS036
Solids, Suspended	178	mg/l	C	WAS006
BOD + ATU (5 day)	9	mg/l	C	WAS001
COD (Total)	218	mg/l	C	WAS040
TOC as C	48.3	mg/l	C	WAS005
Cyanide Free as CN	<0.1	mg/l	C	WAS048
Cyanide , Total as CN	0.1	mg/l	C	WAS018
Phenols, Monohydric	<0.1	mg/l	C	WAS019
1,2,4-Trichlorobenzene	<40	ng/l	C	GEO36
Aldrin	<40	ng/l	C	GEO36
Chlordane - alpha	<40	ng/l	C	GEO3
Dichlobenil	<40	ng/l	C	GEO36
Dieldrin	<40	ng/l	C	GEO36
Endosulphan alpha	Analyst Comment	ng/l	C	GEO36
Endrin	<40	ng/l	C	GEO36

Severn Trent Laboratories Ltd

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STL Business Centre, Torrington Avenue, Coventry CV4 9GU Tel : 02476 421213 Fax : 02476 856575

Certificate of Analysis				STL
		1314 0897 1229	Environmental Leadership	
Sample 3	Laboratory Number :	803726		
of 4	Report Number :	TH/181894/2003	Issue	1
Sample Source :		Cardiff County Council		
Sample Point Description :		Cardiff County Council		
Sample Description :		OFD		
Sample Date :	24 March 2003	Sample Received :	24 March 2003	Analysis Complete :
				7 April 2003

Test Description	Result	Units	Accreditation	Method
HCH - alpha	<40	ng/l	C	GEO36
HCH - beta	<40	ng/l	C	GEO36
HCH - gamma	<40	ng/l	C	GEO3
Heptachlor Epoxide	<40	ng/l	C	GEO3
Hexachlorobenzene	<40	ng/l	C	GEO36
Hexachlorobutadiene	<40	ng/l	C	GEO36
Isodrin	<40	ng/l	C	GEO36
o,p - DDE	<40	ng/l	C	GEO36
o,p - DDT	<200	ng/l	C	GEO36
o,p - TDE	<40	ng/l	C	GEO36
p,p - DDE	<40	ng/l	C	GEO36
p,p - DDT	<200	ng/l	C	GEO36
p,p - TDE	<40	ng/l	C	GEO36
Tecnazene	<40	ng/l	C	GEO36
Triallate	<40	ng/l	C	GEO36
Trifluralin	<40	ng/l	C	GEO36
BTEX	Analyst Comment	ug/l	*	C
Dissolved Oxygen, Unfixed	0.9	mg/l	*	C
Dissolved Methane (Subcon)	0.01	mg/l	*	S
Chlordane gamma	<40	ng/l	C	GEO36

Analyst Comment for 803726 : Unable to report alpha-Endosulphan due to AQC failure. Indicated result is <40ng/L. Reporting limits raised for DDTs due to instrumental problem.
Please see attached report for BTEX results.
No VOC vial supplied for BTEX analysis, sample taken from waste water bottle.

Accreditation Codes : * = Not UKAS accredited B = Analysed at Bridgend C = Analysed at Coventry R = Analysed at Runcorn S = Sub-contracted analysis

For Microbiological determinands 0 = Not Detected

VOLATILE ORGANIC COMPOUNDS IN WATERS

Client Name	: Cardiff County Council	Method	: EPA 8260 MODIFIED
Lab Sample ID	: 803726	Data Type	: MS DATA
Job No	: 181894	Data Path	: D:\3V-DATA\APR03\3V040403\
Sample Location	: Cardiff County Council	Quant Type	: ISTD
Client Sample ID	: OFD	Accreditation Status	: UKAS
Sample Matrix	: LIQUID	Dilution Factor	: 1
Vial No	: 9	Report Date	: 07/04/2003

CAS NO	Compound	MRL	Result	Flags
71-43-2	Benzene ug/l	5	1.0	J
108-88-3	Toluene ug/l	5	ND	
100-41-4	Ethyl Benzene ug/l	5	ND	
1330-20-7	m,p-xylene ug/l	10	ND	
95-47-6	o-xylene ug/l	5	ND	
Surrogate	Toluene-d8 %Recovered		101.1 Pass	

Certificate of Analysis		UKAS 1314 0897 1229		SEVERN TRENT Environmental Leadership		STL	
Sample	5	Laboratory Number :	785730				
of	6	Report Number :	TH/179293/2003 Issue 1				
Sample Source :		Cardiff County Council					
Sample Point Description :		Cardiff County Council					
Sample Description :		OFD					
Sample Date :		5 March 2003		Sample Received :		5 March 2003	
				Analysis Complete :		24 March 2003	

Test Description	Result	Units	Accreditation	Method
Total Coliforms confirmed	100	cfu/100ml	C	W10
Escherichia coli confirmed	10	cfu/100ml	C	W10
Total Coliform presumpt	100	cfu/100ml	C	W10
E.coli presumptive	10	cfu/100ml	C	W10
Arsenic , Total as As	0.009	mg/l	C	WAS014
Cadmium , Total as Cd	0.0010	mg/l	C	WAS049
Chromium , Total as Cr	<0.005	mg/l	C	WAS049
Copper , Total as Cu	<0.005	mg/l	C	WAS049
Iron , Total as Fe	8.01	mg/l	C	WAS049
Lead , Total as Pb	<0.005	mg/l	C	WAS049
Manganese , Total as Mn	0.71	mg/l	C	WAS049
Mercury , Total as Hg	<0.0001	mg/l	C	WAS013
Nickel , Total as Ni	0.007	mg/l	C	WAS049
Potassium , Total as K	64	mg/l	C	WAS049
Sodium , Total as Na	138	mg/l	C	WAS049
Zinc , Total as Zn	0.029	mg/l	C	WAS049
Sulphide as S	<0.01	mg/l	C	WAS033
pH	8.1		C	WAS039
Conductivity- Electrical 20deg	1860	uS/cm	C	WAS039
Total Hardness as CaCO3	784	mg/l	C	WAS049
Colour	30	Hazen	C	WSI021
Ammoniacal Nitrogen as N	71.3	mg/l	C	WAS036
Chloride as Cl	178	mg/l	C	WAS036
Nitrite as N	<0.1	mg/l	C	WAS036
Nitrate as N	0.8	mg/l	C	WAS036
Sulphate as SO4	241	mg/l	C	WAS036
Solids, Suspended	62	mg/l	C	WAS006
D.O. concentration	<0.5	mg/l	C	WAS052
BOD + ATU (5 day)	7	mg/l	C	WAS001
COD (Total)	98	mg/l	C	WAS040
TOC as C	29.8	mg/l	C	WAS005
Cyanide Free as CN	<0.1	mg/l	C	WAS048
Cyanide , Total as CN	<0.1	mg/l	C	WAS018
Phenols, Monohydric	<0.1	mg/l	C	WAS019
1,2,4-Trichlorobenzene	<20	ng/l	C	GEO36
Aldrin	<20	ng/l	C	GEO36
Chlordane - alpha	<20	ng/l	C	GEO3
Dichlobenil	<20	ng/l	C	GEO36
Dieldrin	<20	ng/l	C	GEO36
Endosulphan alpha	<20	ng/l	C	GEO36

Certificate of Analysis				SEVERN TRENT Environmental Leadership		STL	
Sample	5	Laboratory Number :	785730				
of	6	Report Number :	TH/179293/2003		Issue	1	
Sample Source :		Cardiff County Council					
Sample Point Description :		Cardiff County Council					
Sample Description :		OFD					
Sample Date :		5 March 2003	Sample Received :		5 March 2003	Analysis Complete : 24 March 2003	

Test Description	Result	Units	Accreditation	Method	
Endrin	<20	ng/l	C	GEO36	
HCH - alpha	<20	ng/l	C	GEO36	
HCH - beta	<20	ng/l	C	GEO36	
HCH - gamma	<20	ng/l	C	GEO3	
Heptachlor Epoxide	<20	ng/l	C	GEO3	
Hexachlorobenzene	<20	ng/l	C	GEO36	
Hexachlorobutadiene	<20	ng/l	C	GEO36	
Isodrin	<20	ng/l	C	GEO36	
o,p - DDE	<20	ng/l	C	GEO36	
o,p - DDT	<20	ng/l	C	GEO36	
o,p - TDE	<20	ng/l	C	GEO36	
p,p - DDE	<20	ng/l	C	GEO36	
p,p - DDT	<20	ng/l	C	GEO36	
p,p - TDE	<20	ng/l	C	GEO36	
Tecnazene	<20	ng/l	C	GEO36	
Triallate	<20	ng/l	C	GEO36	
Trifluralin	<20	ng/l	C	GEO36	
BTEX	Analyst Comment	ug/l	*	C	GEO32
Dissolved Methane (Subcon)	0.69	mg/l	*	S	SUBCON
Chlordane gamma	<20	ng/l	C	GEO36	

Analyst Comment for 785730 : Please see attached report for BTEX results - no VOC vial supplied for BTEX analysis, sample taken from Misc. Org. bottle.

Accreditation Codes : * = Not UKAS accredited B = Analysed at Bridgend C = Analysed at Coventry R = Analysed at Runcorn S = Sub-contracted analysis

For Microbiological determinands 0 = Not Detected

VOLATILE ORGANIC COMPOUNDS IN WATERS

Client Name	: Cardiff County Council	Method	: EPA 8260 MODIFIED
Lab Sample ID	: 785730	Data Type	: MS DATA
Job No	: 179293	Data Path	: D:\3V-DATA\MAR03\3V210303\
Sample Location	: Cardiff County Council	Quant Type	: ISTD
Client Sample ID	: OFD	Accreditation Status	: UKAS
Sample Matrix	: LIQUID	Dilution Factor	: 1
Vial No	: 28	Report Date	: 24/03/2003

CAS NO	Compound	MRL	Result	Flags
71-43-2	Benzene ug/l	5	ND	
108-88-3	Toluene ug/l	5	ND	
100-41-4	Ethyl Benzene ug/l	5	ND	
1330-20-7	m,p-xylene ug/l	10	ND	
95-47-6	o-xylene ug/l	5	ND	
Surrogate	Toluene-d8 %Recovered		97.0 Pass	

Certificate of Analysis



STL

Sample **1** Laboratory Number : **750835**
of **1** Report Number : **TH/174350/2003** Issue **1**

Sample Source : **Cardiff County Council**
Sample Point Description : **Cardiff County Council**
Sample Description : **PSD**

Sample Date : **23 January 2003** Sample Received : **23 January 2003** Analysis Complete : **10 February 2003**

Test Description	Result	Units	Accreditation	Method
Cadmium , Total as Cd	0.0010	mg/l	C	WAS049
Chromium , Total as Cr	<0.005	mg/l	C	WAS049
Copper, Total as Cu	<0.005	mg/l	C	WAS049
Iron , Total as Fe	15.98	mg/l	C	WAS049
Lead , Total as Pb	0.006	mg/l	C	WAS049
Manganese , Total as Mn	1.06	mg/l	C	WAS049
Mercury , Total as Hg	<0.0001	mg/l	C	WAS013
Nickel , Total as Ni	0.012	mg/l	C	WAS049
Zinc, Total as Zn	0.013	mg/l	C	WAS049
Sulphide as S	0.03	mg/l	C	WAS033
pH	7.3		C	WAS023
Conductivity- Electrical 20deg	2320	uS/cm	C	WAS024
Total Hardness as CaCO3	1029	mg/l	C	WAS049
Colour	34.8	Hazen	C	WSI021
Ammoniacal Nitrogen as N	87.1	mg/l	C	WAS036
Chloride as Cl	224	mg/l	C	WAS036
Nitrite as N	<0.1	mg/l	C	WAS036
Nitrate as N	1.2	mg/l	C	WAS036
Sulphate as SO4	420	mg/l	C	WAS036
D.O. concentration	1.8	mg/l	C	WAS001
BOD + ATU (5 day)	6	mg/l	C	WAS001
COD (Total)	24	mg/l	C	WAS040
1,2,4-Trichlorobenzene	<5	ng/l	C	GEO3
Aldrin	<5	ng/l	C	GEO3
Carbophenothion	<0.1	ug/l	C	GEO3
Chlordane - alpha	<5	ng/l	C	GEO3
Dichlobenil	<5	ng/l	C	GEO3
Dieldrin	<5	ng/l	C	GEO3
Endosulphan alpha	<5	ng/l	C	GEO3
Endrin	<5	ng/l	C	GEO3
HCH - alpha	<5	ng/l	C	GEO3
HCH - beta	<5	ng/l	C	GEO3
HCH - gamma	<5	ng/l	C	GEO3
Heptachlor Epoxide	<5	ng/l	C	GEO3
Hexachlorobenzene	<5	ng/l	C	GEO3
Hexachlorobutadiene	<5	ng/l	C	GEO3
Isodrin	<5	ng/l	C	GEO3
o,p - DDE	<5	ng/l	C	GEO3
o,p - DDT	<5	ng/l	C	GEO3
o,p - TDE	<5	ng/l	C	GEO3

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STL Business Centre, Torrington Avenue, Coventry CV4 9GU Tel : 02476 421213 Fax : 02476 856575

Certificate of Analysis



STL

Sample **1** Laboratory Number : **750835**
of **1** Report Number : **TH/174350/2003** Issue **1**

Sample Source : **Cardiff County Council**
Sample Point Description : **Cardiff County Council**
Sample Description : **PSD**

Sample Date : **23 January 2003** Sample Received : **23 January 2003** Analysis Complete : **10 February 2003**

Test Description	Result	Units	Accreditation	Method
p,p - DDE	<5	ng/l	C	GEO3
p,p - DDT	<5	ng/l	C	GEO3
p,p - TDE	<5	ng/l	C	GEO3
Tecnazene	<5	ng/l	C	GEO3
Triallate	<5	ng/l	C	GEO3
Trifluralin	<5	ng/l	C	GEO3
Azinphos-methyl	<0.1	ug/l	C	GEO5
Chlorfenvinphos	<0.1	ug/l	C	GEO5
Demeton-s-methyl	<0.1	ug/l	C	GEO5
Diazinon	<0.1	ug/l	C	GEO5
Dichlorvos	<0.1	ug/l	C	GEO5
Dimethoate	<0.1	ug/l	C	GEO5
Disulphoton	<0.1	ug/l	C	GEO5
Fenitrothion	<0.1	ug/l	C	GEO5
Fenthion	<0.1	ug/l	C	GEO5
Malathion	<0.1	ug/l	C	GEO5
Mevinphos	<0.1	ug/l	C	GEO5
Parathion ethyl	<0.1	ug/l	C	GEO5
Parathion-methyl	<0.1	ug/l	C	GEO5
Phorate	<0.1	ug/l	C	GEO5
Phosalone	<0.1	ug/l	C	GEO5
Pirimiphos-methyl	<0.1	ug/l	C	GEO5
Propetamphos	<0.1	ug/l	C	GEO5
Triazophos	<0.1	ug/l	C	GEO5
VOC	Analyst Comment	ug/l	C	GEO32
Dissolved Methane (Subcon)	0.90	mg/l	S	SUBCON
Chlordane gamma	<5	ng/l	C	GEO3

Analyst Comment for 750835 : Please see attached report for VOC results.
No VOC vial supplied. VOC sample taken from Inorganic Bottle.

Accreditation Codes : * = Not UKAS accredited B = Analysed at Bridgend C = Analysed at Coventry R = Analysed at Runcorn S = Sub-contracted analysis

For Microbiological determinands 0 = Not Detected

Signed :

Name : **J. Fell** Date : **10 February 2003**
Title : **Production Manager**

Severn Trent Laboratories Ltd

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STL Business Centre, Torrington Avenue, Coventry CV4 9GU Tel : 02476 421213 Fax : 02476 856575

VOLATILE ORGANIC COMPOUNDS IN WATERS

Client Name	: Cardiff County Council	Method	: EPA 8260 MODIFIED
Lab Sample ID	: 750835	Data Type	: MS DATA
Job No	: 174350	Data Path	: D:\DATA\FEB03\5V060203\
Sample Location	: Cardiff County Council	Quant Type	: ISTD
Client Sample ID	: PSD	Accreditation Status	: UKAS
Sample Matrix	: LIQUID	Dilution Factor	: 1
Vial No	: 7	Report Date	: 09/02/2003

CAS NO	Compound	MRL	Result	Flags
75-71-8	Dichlorodifluoromethane ug/l	5	ND	
74-87-3	Chloromethane ug/l	5	ND	
75-00-3	Chloroethane ug/l	5	ND	
74-83-9	Bromomethane ug/l	5	ND	
75-69-4	Trichlorofluoromethane ug/l	5	ND	
75-35-4	1,1-Dichloroethene ug/l	5	ND	
75-09-2	Dichloromethane ug/l	5	ND	
156-60-9	Trans-1,2-dichloroethene ug/l	5	ND	
75-34-3	1,1-Dichloroethane ug/l	5	ND	
156-59-2	Cis-1,2-dichloroethene ug/l	5	ND	
594-20-7	2,2-Dichloropropane ug/l	5	ND	
67-66-3	Chloroform ug/l	5	ND	
74-97-5	Bromochloromethane ug/l	5	ND	
71-55-6	1,1,1-Trichloroethane ug/l	5	ND	
563-58-6	1,1-Dichloropropene ug/l	5	ND	
107-06-2	1,2-Dichloroethane ug/l	5	ND	
71-43-2	Benzene ug/l	5	ND	
78-87-5	1,2-Dichloropropane ug/l	5	ND	
79-01-6	Trichloroethene ug/l	5	ND	
75-27-4	Bromodichloromethane ug/l	5	ND	
74-95-3	Dibromomethane ug/l	5	ND	
10061-01-5	Cis-1,3-dichloropropene ug/l	5	ND	
108-88-3	Toluene ug/l	5	ND	
10061-02-6	Trans-1,3-dichloropropene ug/l	5	ND	
79-00-5	1,1,2-trichloroethane ug/l	5	ND	
56-23-5	Carbon Tetrachloride ug/l	5	ND	
75-01-4	Vinyl Chloride ug/l	5	ND	
124-28-9	1,3-dichloropropane ug/l	5	ND	
127-18-4	Tetrachloroethene ug/l	5	ND	
124-48-1	Dibromochloromethane ug/l	5	ND	
106-93-4	1,2-dibromoethane ug/l	5	ND	
108-90-7	Chlorobenzene ug/l	5	ND	
630-20-6	1,1,1,2-tetrachloroethane ug/l	5	ND	
100-41-4	Ethyl Benzene ug/l	5	ND	
1330-20-7	m,p-xylene ug/l	10	ND	



STL

VOLATILE ORGANIC COMPOUNDS IN WATERS

Client Name	: Cardiff County Council	Method	: EPA 8260 MODIFIED
Lab Sample ID	: 750835	Data Type	: MS DATA
Job No	: 174350	Data Path	: D:\DATA\FEB03\5V060203\
Sample Location	: Cardiff County Council	Quant Type	: ISTD
Client Sample ID	: PSD	Accreditation Status	: UKAS
Sample Matrix	: LIQUID	Dilution Factor	: 1
Vial No	: 7	Report Date	: 09/02/2003

CAS NO	Compound	MRL	Result	Flags
95-47-6	o-xylene ug/l	5	ND	
100-42-5	Styrene ug/l	5	ND	
75-25-2	Bromoform ug/l	5	ND	
98-82-8	Isopropylbenzene ug/l	5	ND	
79-34-5	1,1,2,2-tetrachloroethane ug/l	5	ND	
96-18-4	1,2,3-trichloropropane ug/l	5	ND	
103-65-1	n-propylbenzene ug/l	5	ND	
108-86-1	Bromobenzene ug/l	5	ND	
75-49-8	2-chlorotoluene ug/l	5	ND	
108-67-8	1,3,5-trimethylbenzene ug/l	5	ND	
106-43-4	4-chlorotoluene ug/l	5	ND	
98-06-6	tert-butylbenzene ug/l	5	ND	
95-63-6	1,2,4-trimethylbenzene ug/l	5	ND	
135-98-8	sec-butylbenzene ug/l	5	ND	
99-87-6	p-isopropyltoluene ug/l	5	ND	
541-73-1	1,3-dichlorobenzene ug/l	5	ND	
106-46-7	1,4-dichlorobenzene ug/l	5	ND	
104-51-8	n-butylbenzene ug/l	5	ND	
95-50-1	1,2-dichlorobenzene ug/l	5	ND	
96-12-8	1,2-dibromo-3-chloropropane ug/l	5	ND	
120-82-1	1,2,4-trichlorobenzene ug/l	5	ND	
87-68-3	Hexachlorobutadiene ug/l	5	ND	
91-20-3	Naphthalene ug/l	5	ND	
87-61-6	1,2,3-trichlorobenzene ug/l	5	ND	
Surrogate	Dibromofluoromethane %Recovered		100.5	Pass
Surrogate	Toluene-d8 %Recovered		101.1	Pass
Surrogate	4-bromofluorobenzene %Recovered		94.4	Pass

VOLATILE ORGANIC COMPOUNDS IN WATERS

Client Name	: Cardiff County Council	Method	: EPA 8260 MODIFIED
Lab Sample ID	: 750835	Data Type	: MS DATA
Job No	: 174350	Data Path	: D:\DATA\FEB03\5V060203\
Sample Location	: Cardiff County Council	Quant Type	: ISTD
Client Sample ID	: PSD	Accreditation Status	: UKAS
Sample Matrix	: LIQUID	Dilution Factor	: 1
Vial No	: 7	Report Date	: 09/02/2003

CAS NO	Compound	MRL	Result	Flags
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Please note : Result of ND is Not Detectable

For Surrogate Compounds 50 ug/l added, lower limit is 75% and higher limit is 125%

Explanation of compound flags :

J : Compound is detectable but is below normal reporting limit

E : Result is above the calibrated range and is therefore an estimate

B : Compound also detected in Blank extract

D : Sample was diluted and re-analysed to obtain a valid result for this compound

Certificate of Analysis



STL

Sample **1** Laboratory Number : **346247**
of **4** Report Number : **TH/161483/2002** Issue **1**

Sample Source : **Cardiff County Council**
Sample Point Description : **Cardiff County Council**
Sample Description : **OF PSD**

Sample Date : **27 September 2002** Sample Received : **30 September 2002** Analysis Complete : **22 October 2002**

Test Description	Result	Units	Accreditation	Method
pH	7.7		C	WAS023
Colour	17.6	Hazen	C	WSI021
D.O. concentration	7.9	mg/l	C	WAS001
BOD + ATU (5 day)	<1	mg/l	C	WAS001
Chloride as Cl	42	mg/l	C	WAS036
Ammoniacal Nitrogen as N	0.4	mg/l	C	WAS036
Nitrite as N	0.3	mg/l	C	WAS036
Nitrate as N	2.1	mg/l	C	WAS036
Iron , Total as Fe	0.29	mg/l	C	WAS049
Manganese , Total as Mn	0.05	mg/l	C	WAS049
Cadmium , Total as Cd	0.001	mg/l	C	WAS049
Chromium , Total as Cr	<0.005	mg/l	C	WAS049
Copper, Total as Cu	<0.02	mg/l	C	WAS049
Lead , Total as Pb	<0.01	mg/l	C	WAS049
Nickel , Total as Ni	0.011	mg/l	C	WAS049
Zinc, Total as Zn	<0.03	mg/l	C	WAS049
Total Hardness as CaCO3	207	mg/l	C	WAS049
Sulphate as SO4	91	mg/l	C	WAS036
Conductivity- Electrical 20deg	625	uS/cm	C	WAS024
Sulphide as S	0.32	mg/l	C	WAS033
COD (Total)	29	mg/l	C	WAS040
Mercury , Total as Hg	<0.0001	mg/l	C	WAS013
Triazophos	<0.09	ug/l	C	GEO5
Phorate	<0.09	ug/l	C	GEO5
Propetamphos	<0.09	ug/l	C	GEO5
Pirimiphos-methyl	<0.09	ug/l	C	GEO5
Phosalone	<0.09	ug/l	C	GEO5
Fenthion	<0.09	ug/l	C	GEO5
Dichlorvos	<0.09	ug/l	C	GEO5
Mevinphos	<0.09	ug/l	C	GEO5
Demeton-s-methyl	<0.09	ug/l	C	GEO5
Dimethoate	0.16	ug/l	C	GEO5
Diazinon	<0.09	ug/l	C	GEO5
Parathion-methyl	<0.09	ug/l	C	GEO5
Disulphoton	<0.09	ug/l	C	GEO5
Fenitrothion	<0.09	ug/l	C	GEO5
Malathion	Analyst Comment	ug/l	C	GEO5
Parathion ethyl	Analyst Comment	ug/l	C	GEO5
Chlorfenvinphos	<0.09	ug/l	C	GEO5
Carbophenothion	<0.09	ug/l	C	GEO3

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Certificate of Analysis



Sample **1** Laboratory Number : **346247**
of **4** Report Number : **TH/161483/2002** Issue **1**

Sample Source : **Cardiff County Council**
Sample Point Description : **Cardiff County Council**
Sample Description : **OF PSD**

Sample Date : **27 September 2002** Sample Received : **30 September 2002** Analysis Complete : **22 October 2002**

Test Description	Result	Units	Accreditation	Method
Azinphos-methyl	<0.09	ug/l	C	GEO5
Aldrin	<5	ng/l	C	GEO3
Dieldrin	<5	ng/l	C	GEO3
Heptachlor Epoxide	<5	ng/l	C	GEO3
Chlordane - alpha	<5	ng/l	C	GEO3
Dichlobenil	<5	ng/l	C	GEO3
Chlordane gamma	<5	ng/l	C	GEO3
Endosulphan alpha	<5	ng/l	C	GEO3
Endrin	<5	ng/l	C	GEO3
HCH - alpha	<5	ng/l	C	GEO3
HCH - beta	<5	ng/l	C	GEO3
HCH - gamma	<5	ng/l	C	GEO3
Hexachlorobutadiene	<5	ng/l	C	GEO3
Hexachlorobenzene	<5	ng/l	C	GEO3
Isodrin	<5	ng/l	C	GEO3
o,p - DDE	<5	ng/l	C	GEO3
o,p - DDT	<5	ng/l	C	GEO3
o,p - TDE	<5	ng/l	C	GEO3
p,p - DDE	<5	ng/l	C	GEO3
p,p - DDT	<5	ng/l	C	GEO3
p,p - TDE	<5	ng/l	C	GEO3
Tecnazene	<5	ng/l	C	GEO3
Triallate	<5	ng/l	C	GEO3
1,2,4-Trichlorobenzene	<5	ng/l	C	GEO3
Trifluralin	<5	ng/l	C	GEO3
Dissolved Methane (Subcon)	0.67	mg/l	* S	SUBCON

Analyst Comment for 346247 : Unable to report results for malathion and parathion ethyl (op analysis) due to AQC breach.

Accreditation Codes : * = Not UKAS accredited B = Analysed at Bridgend C = Analysed at Coventry R = Analysed at Runcorn S = Sub-contracted analysis

For Microbiological determinands 0 = Not Detected

Report ref:- 180
Lab Ref:- 188/299 (29/7/02)
Date:- 7th August 2002



To:- Joanne Taylor-King, Contaminated Land Officer,
Highways and Parks Department, Lamby Way Depot, Cardiff, Cf3 2HP.

Report of Analysis of Water

(- of @ PSD)

Labelled: NRA Point A.

Date of receipt: 29th July 2002.

Chemical Results in mg/litre

Appearance	Light Yellow, No Turbidity
Hydrogen ion, pH Value	8.5
Electrical Conductivity (μ S)	524
Chlorides (as Cl)	44
Total Hardness (as mg Ca/L)	78
Ammonium (as mg NH_4 /L)	1.0
Nitrite (as mg NO_2 /L)	0.1
Nitrate (as mg NO_3 /L)	6
Permanganate Value	8
BOD	8
COD	20
<u>Extractable Metals</u>	
Copper	<0.1
Lead	<0.1
Iron	1.6 (filtered sample 0.1)
Manganese	0.1
Zinc	<0.1
Cadmium	<0.1
Nickel	<0.1
Chromium	<0.1
Methane	2
Acid Sol. Sulphate	46
Sulphide	<0.3
Potassium (as mg K/L)	5.5
Free Cyanide (as mg CN/L)	<0.01

Signed M. Williams B.Sc., M.Chem.A., C.Chem., M.R.S.C.
M. Williams, County Analyst

The laboratory is responsible solely for the analysis of the submitted sample.
Method references are available on request.

Page 1 of 1

PLEASE REPLY TO:
Cardiff Scientific Services, Crofts Street, Roath, Cardiff, CF24 3DY.
Tel: (029) 20871212 Fax: (029) 20871213

County Hall
Cardiff
CF10 4UW
Tel: (029) 2087 2000

www.cardiff.gov.uk

The County Council of the City and County of Cardiff
Cynhordd Sir Ddinys a Sir Caerdydd

Neuadd y Sir
Caerdydd
CF10 4UW
Ffôn: (029) 2087 2000

Certificate of Analysis



STL COVENTRY

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SERVICES

Sample 1 Laboratory Number : 186834
of 1 Report Number : TH /140140/2002 Issue 1

Sample Source : Cardiff County Council
Sample Point Description : Cardiff County Council
Sample Description : PSD OUTFALL

Sample Date : 28 March 2002 Sample Received : 28 March 2002 Analysis Complete : 25 April 2002

Test Description	Result	Units	Accreditation	Method
pH	7.3		C	WAS023
Solids, Suspended	83	mg/l	C	WAS006
Chloride as Cl	413	mg/l	C	WAS036
Alkalinity as CaCO ₃	283	mg/l	C	WAS025
Ammoniacal Nitrogen as N	181	mg/l	C	WAS036
Cadmium, Total as Cd	<0.001	mg/l	C	WAS012
Chromium, Total as Cr	0.006	mg/l	C	WAS012
Copper, Total as Cu	<0.02	mg/l	C	WAS012
Lead, Total as Pb	0.03	mg/l	C	WAS012
Nickel, Total as Ni	0.033	mg/l	C	WAS012
Zinc, Total as Zn	0.09	mg/l	C	WAS012
Phenols, Monohydric	<0.1	mg/l	C	WAS019
Sulphate as SO ₄	456	mg/l	C	WAS036
Sulphide as S	0.01	mg/l	C	WAS033
COD (Total)	594	mg/l	C	WAS040
Cyanide Free as CN	<100	ug/l	C	WSI027
Nitrogen, Total Oxidised as N	0.5	mg/l	C	WAS036
COD (1 hr settled)	224	mg/l	C	WAS040
Cadmium, Total as Cd	<1	ug/l	C	WAS012
Phenol	<20	ug/l	C	GEO18
Dissolved Methane (Subcon)	<0.01	mg/l	* S	SUBCON

Accreditation Codes : * = Not UKAS accredited B = Analysed at Bridgend C = Analysed at Coventry R = Analysed at Runcorn S = Sub-contracted analysis

For Microbiological determinands 0 = Not Detected

Signed :

Name : L. Roberts Date : 25 April 2002
Title : Senior Analyst

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