Appendix A4.6 Surface Water Management Plan

Kerdiffstown Landfill Remediation Project (KLRP)

Kildare County Council (KCC)

Surface Water Management Plan

32EW5604/DOC/0042 | 2

30 June 2017

Kerdiffstown Landfill Remediation Project (KLRP)

Project No:	32EW5604
Document Title:	Surface Water Management Plan
Document No.:	32EW5604/DOC/0042
Revision:	2
Date:	30 June 2017
Client Name:	Kildare County Council (KCC)
Client No:	
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File Name:	\\Iedub1-fil001\ji\Sustainable Solutions\Kerdiffstown Landfill\4 - Documents\4.3 - Draft Documents\32EW5604 L Additional Design Work\4 Surface Water\KLRP_SWMP Rev 2.docx

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1. Introduction

1.1 Background

The site of the proposed Project, is located in County Kildare, approximately 3km north-east of central Naas, approximately 400m north-west of Johnstown village and in close proximity to the strategically important M7/N7 corridor. The site is located in close proximity to a number of residential and commercial receptors as well as being a short distance away from the larger settlements of Johnstown and Naas. In addition to the above, the site neighbours a number of recreational land uses, specifically Palmerstown House Estate and Naas Golf Course to the north-east and north-west respectively.

The site occupies approximately 30 hectares and is a former sand and gravel quarry which was progressively backfilled by a number of operators from the 1950s onwards. In January 2011 a major fire developed in a mound of waste material in the northern part of the site. This required intervention of a number of state agencies including Kildare County Council and the Environmental Protection Agency (EPA). The site was under the control of Kildare Fire Service until late February 2011, when it was handed over to the care of the EPA. Since 2011, measures have been taken to secure the site and limit environmental impact.

In April 2015 the Minister for the Environment, Community and Local Government, Alan Kelly TD, announced that funding would be made available for the remediation of the landfill site, and that Kildare County Council would take control of the site and commence remediation.

The objective in remediating the site in terms of surface water management is to:

- Take all necessary and reasonable measures to prevent and limit future leachate impact upon groundwater and surface water receptors and reduce/control the future production of leachate from the site; and
- Reduce contaminant loads discharging to groundwater.

Linked to the overarching objectives of the project is the aim to provide a future landform and end use appropriate for the site and of potential benefit to the local community. To that end, the intended end-use for the site is public access parkland and recreational use.

1.2 Aims and Objectives

This Surface Water Management Plan has been prepared in support of a planning application and industrial emissions licence for the remediation and operational (end-use) phases, outlined as follows:

- *Development / Remediation* – The works required to re-profile the site including excavation of waste and other materials for deposition on site to achieve the proposed final landform. The works will also include the installation of landfill infrastructure such as capping, landfill gas, leachate and surface water management. A second stage of remediation will comprise the works required to restore the site to the proposed park end use, including planting and landscaping, installation of sports pitches, changing rooms, car parks and associated services.
- *Operational / Aftercare* – The life cycle stage of the site following the remediation works when the site will be used for public access parkland and recreation. The responsibility for the management of the site and the landfill infrastructure systems as well as park operation and maintenance will be retained by Kildare County Council (KCC).

At all stages the aim of the management plan is to:

- Develop a strategy for surface water management ensuring that the site is compliant with relevant regulations and best practice at all stages (during development/ remediation and operation / aftercare);
- Ensure that the management plan is based on the current site operations and development, data arising from the site and foreseen future proposals for changes to the site;
- Ensure safety of site operatives and contractors working on site;

- Not increase the future flood risk to land or properties outside the site boundary;
- Avoid adverse impacts and increased pollution risk to local streams and rivers;
- Prevent the escape of excessive sediment that may arise in the initial years following remediation works;
- Be sufficiently flexible to control surface water throughout different phases of the remediation works;
- Integrate with other environmental control systems to be employed as part of the remediation works;
- Be compatible with final restoration and after-use of the site; and
- Reduce potential environmental impact of the site throughout its whole life.

Section 2 of Annex 1 of the 1999 EU Landfill Directive outlines surface water control requirements which are applicable for all classes of landfill sites. The specific requirements with regards to surface water management are:

- Control water from precipitations entering into the landfill body;
- Prevent surface water from entering into the landfilled waste;
- Collect contaminated water and leachate; and
- Treat contaminated water and leachate collected from the landfill to the appropriate standard required for discharge.

This Directive was transposed into Irish law by the Waste Management Licensing Regulations 2004 (S.I. 395 of 2004) and the Waste Management Act 1996 (as amended). The development of the site, comprising remediation works, takes cognisance of the Directive as far as reasonably practicable, whilst applying Best Available Techniques (BAT) where appropriate.

Relevant guidance and best practice documents referred to in the development of this management plan are listed in Appendix A.

1.3 Roles and Responsibilities

This management plan is a live document where site use and operations, monitoring and performance data informs regular updates to the proposals and procedures within the document in order to mitigate the risks posed by surface water. The following provides definition of some of the terms used within the management plan:

- *Operator* – Kildare County Council, who hold responsibility and liability for the operation and maintenance of the surface water management system;
- *Site Manager* – the individual representing the Operator on site during the remediation works and operation of the park/ aftercare of the site; and
- *Designated Representative* – the entity or individual appointed by the Operator to undertake management of the surface water management system for a defined phase of its lifecycle.

The Operator will have full responsibility to ensure that surface water is properly managed on site in accordance with relevant regulations, guidance and best practice at all times and that all activities are fully documented in the Site File.

1.4 Risk Assessment

The control, collection and disposal of surface waters is required to prevent pollution of the environment. By controlling waters from precipitation and surface run-off from entering the waste body the system will also serve to minimise the production of leachate.

The Detailed Qualitative Risk Assessment (DQRA) and operational risk assessments confirm that measures are required to manage surface waters.

2. Surface Water Management Measures

2.1 Design Philosophy

The philosophy and methodology applied to the surface water drainage design is set out in Appendix B, with existing site conditions and future proposals set out below.

2.2 Existing Site Drainage

2.2.1 Site Characteristics

The site is uncapped and as such surface water is not currently collected for formal discharge. The site is classified into zones, with the key surface water management characteristics set out in the table below.

Zone	Key Characteristics
1	Wastes deposited in the north-west area which account for approximately 65% of the entire estimated volume of waste on site. Wastes in this area of the site are currently uncapped and unlined. Rainfall mostly infiltrates into the ground, waste and also runs off to the adjacent ground. No surface water collection system is in place over this zone.
2A	Much of this zone is covered by reinforced concrete pads, which form an impermeable layer over underlying wastes and prevent direct rainwater ingress. In the small area without concrete slabs, rainfall infiltrates into the ground and waste. No surface water collection system is in place over this zone.
2B	Much of this zone is covered by reinforced concrete pads, which form an impermeable layer over the wastes and prevent direct rainwater ingress. In the small area without concrete slabs, rainfall infiltrates into the ground and waste. No surface water collection system is in place over this zone.
3	This zone comprises a lined cell, filled with processed waste materials. The cell has a remaining void capacity to be infilled during the proposed remediation works. The existing waste mass has been temporarily capped using a geomembrane liner, with run-off directed to perimeter trench and directed to an unlined pond located within Zone 4.
4	This zone contains large waste stockpiles, redundant infrastructure including concrete tanks, bays, walls and pads. The pads form an impermeable layer over local pockets of wastes and prevent direct rainwater ingress. No surface water collection system is in place over this zone. A small pond is present discharging surface water run-off from Zone 3 to groundwater.

Previous zoning of the site included Zone 5 which has not shown waste to be present hence is considered as outwith remediation proposals. A large part of this zone currently has houses present with one known to have a septic tank present within the bounds of the property. A further property located to the south-east of the site also has a septic tank which may be discharging to land within the site boundary. Drainage from the site access road is collected in buried pipes and discharges to a settlement tank and directed to the Canal Feeder located to the south of the site. Drainage from a property located to the south of the site discharges via the site road drainage system and settlement tank to the Canal Feeder.

To facilitate construction of an additional pitch as part of the Operational Phase a property and adjoining field located off Kerdiffstown Road and outwith the previous site boundary is to be sought as part of a Compulsory Purchase Order. The land is located immediately adjacent to the site between Zone 1 (to north) and Zone 2A (to south). This land is greenfield and has an approximate ground level of 98mOD. There is no surface water collection system in place over this area with rainfall water infiltrating to the ground.

Foul and grey waters drainage from the existing site offices is collected in a septic tank and removed from site on a regular basis.

The layout of the site is shown on Drawing Number 32EW5604-00-001.

2.2.2 Watercourses / Receptors

The closest watercourse to the site is the Morell River which lies to the north-east of the site. A second small local stream is Canal Feeder located to the south of the site.

The Morell River generally flows northwards within 40m of the site boundary and discharges into the River Liffey approximately 7km northwest of the site. The summary flow statistics downloaded from EPA for existing hydrometric station near the weir adjacent to Kerdiffstown House (gauging station ref. 09044) indicates an annual minimum daily flow rate of 0.059m^3/s and Q95 (95 percentile flow) of 0.119m^3/s (a statistical measure of flow rate based on long-term flow records).

The Hartwell River joins the Morell River upstream from the site. This is not shown on OS mapping but has been surveyed to record this connection. This is shown on the figure below.

The Canal Feeder stream is located approximately 150m south of the site. This generally flows in westward direction and discharges into the Grand Canal, which is located approximately 2km west of the site.

Other surface water features in the area include the Rathmore Stream and the lakes/ponds at Palmerstown House Estate and Golf Course. The Rathmore Stream lies southeast of the site and joins with the Morell River upstream. The lakes / ponds at Palmerstown House Estate and Golf Course are located 100m to the east. The plan showing location of watercourses is shown in Figure 2.1 below.

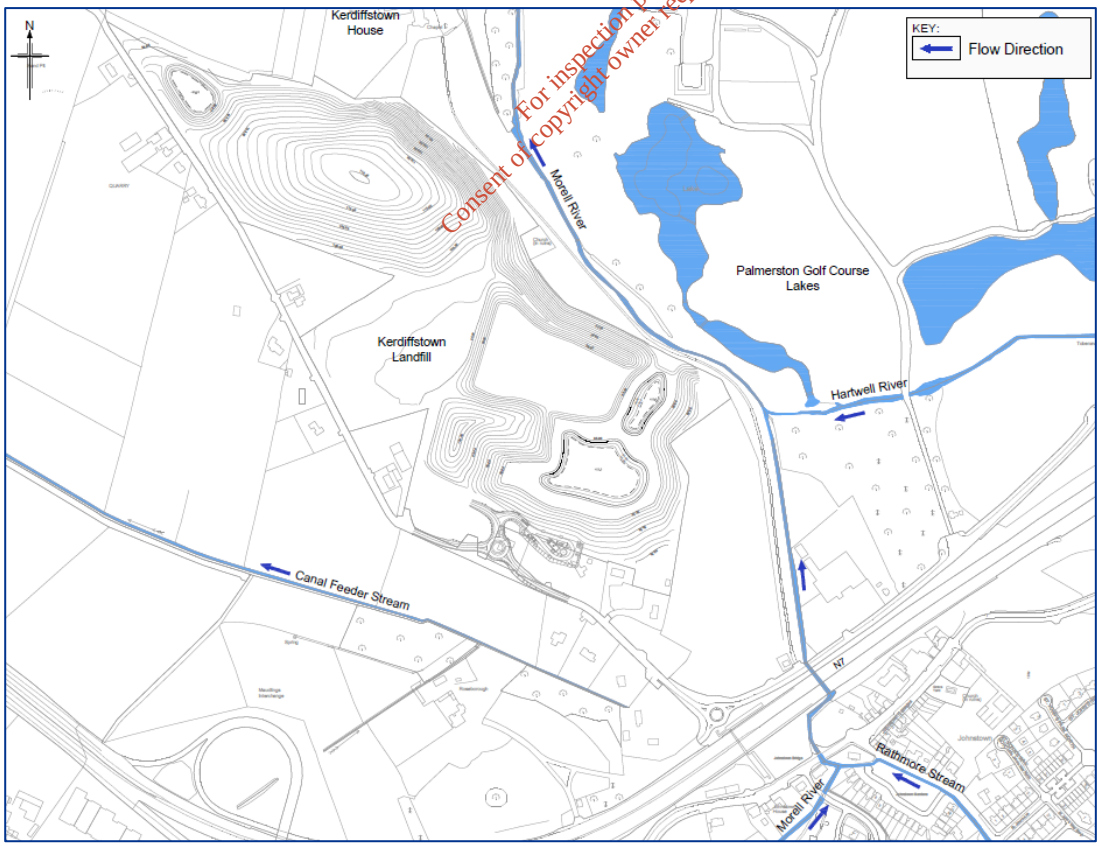


Figure 2.1: Existing watercourses

There is only one existing discharge point from the site into the Canal Feeder Stream in the form of the overflow from the settlement tank adjacent to the site entrance. There is currently no direct discharge from the site to the Morell River.

2.2.3 Surface Water Quality

The Morell River and Canal Feeder Stream are classified as moderate watercourses under Water Framework Directive classification. Baseline water quality monitoring is currently undertaken monthly at several locations on the Morell River and Canal Feeder Stream to determine any detrimental impacts potentially caused by the landfill site. An extended suite of sampling is undertaken on bi-annual basis for an increased number of locations and parameters. Surface water run-off samples are also collected on-site from the oil interceptor located adjacent to the site entrance.

Details of surface water quality are detailed in the Environmental Impact Statement, Chapter 14 Water – Hydrology. Findings are also presented in monthly monitoring reports.

2.3 Remediation Works Measures

Remediation works are to be undertaken in a phased basis, over a period of approximately 3.5 years. This is subject to a number of assumptions. The outline phasing of works is set out in Table 2.1 below.

Phase of Works	Surface Water Management Proposals
Works to site entrance and access area, including construction of new landfill infrastructure compound.	• On-going surface water monitoring around the site. • Re-align existing drainage pipe from adjacent property, around site boundary to reconnect to a buried pipe discharging to Canal Feeder. • Relocate existing or construct new septic tank for property to south-east of the site. • Construct surface water drainage provisions as detailed in the Management Plan within the new landfill infrastructure compound. • Install drainage from new site office (to be connected in future). • Install temporary septic tank for drainage from site office. • Install foul water sewer pipe and connection to public sewer network, via Johnstown Pumping Station.
Remediation of slopes in Zone 4, including the removal of wastes. Clean materials to be stockpiled on Zones 2A and 2B for re-use within Zone 4 or elsewhere on site. Waste materials to be disposed of within Zone 3 or Zone 1.	• Construct surface water management ponds in Zone 4, and install geomembrane liner. • Monitor run-off from placement of low permeability soils to Zone 4. • Install surface water open channels and ditches to connect to pond on completion of remediation over slope areas. • Construct outfall from pond 3 for future discharge.
Capping of Zone 3.	• Install permanent capping system (geosynthetic) in Zone 3. • Install perimeter surface water drainage system. • Monitor run-off from Zone 3.
Progressive capping of Zones 2A and 2B beyond extents of concrete slabs.	• Install silt fences on north / north-east perimeter to Zone 2B. • Retention of the concrete yard slabs, with placement of low permeability capping layer (soils) on areas outwith the slabs. • Place cover soils and vegetation over capping system. • Locate drainage systems from concrete slabs and direct to surface water system (with intermediate controls, e.g. silt trap). • Install new surface water drainage channels around completed areas.

Phase of Works	Surface Water Management Proposals
Re-grading wastes in Zone 1 to achieve proposed landform.	• Install silt fences on north perimeter to Zone 1. • Construct perimeter swale / catchment ditch. • Inspection of reprofiling works to identify any indications of leachate presence. • Increased monitoring frequency for surface water receptors along northern perimeter. • As areas of waste are exposed, construct temporary separation bunds for management of surface water. • Utilise silt buster or similar system for run-off. • Construct and line temporary ponds as necessary. • Capping system (geosynthetic) to be installed in phases. • Place cover soils and vegetation over capping system. • Install surface water management system as soon as practicable. • Monitor surface water management system for contamination (i.e. silt). • Construct soakaway adjacent to pond 1. • Enter 3 month period for monitoring of run-off to obtain baseline data.
Works within additional field to incorporate into park area for multi-use sports pitch. Ground re-profiling, demolition of existing building, installation of pitch and landscaping.	• Undertake minor ground re-profiling works to allow surface water to drain to perimeter ditches and swale. • Install surface water ditches and connect to open channels in Zone 1 and Zone 2A. • Install reed bed.
Final site works – installation of park infrastructure and planting.	• Install drainage from changing rooms building and connect to rising main, for discharge to public sewer network. • Clean surface water management ponds of all silt, install stone drainage layer (with supporting geotextile) and plant ecological enhancements. • Commission off-site discharge locations (soakaway and to Morell River). • Site enters Aftercare Phase for surface water management and monitoring.

Table 2.1 : Outline Remediation Works Phasing Proposals

Surface Water Management Ponds 2 and 3

The surface water run-off volume from Catchment Zone 1 will be retained within two ponds (2 & 3) in the south-eastern side of the site. Both ponds will become park water features with a permanent pool of water to provide attenuation and treatment of surface water run-off. Attenuation storage will be provided by freeboard above the permanent water level. A flow control system (e.g. orifice plate, hydrobrake or throttle pipe) will be installed at the outfall from pond 3 to limit the discharge rate to the maximum permissible rate of 51.07l/s. Following the remediation works the installed impermeable geomembrane liner will be cleaned of any silt deposits, with a stone layer placed above the liner for protection during maintenance / emptying operations and top soil/growing medium over the stone to encourage plant growth and provide ecological enhancement. The storage ponds will

be designed to encourage settlement of solids which can be removed from the base of the retention area. In addition access points will be provided to each pond to facilitate future maintenance (vegetation management and sedimentation removal).

Surface Water Management Pond 1

The surface water run-off flows from Catchment Zone 2 will be gravitated and stored in pond 1 in the north-west corner of the site. The attenuation storage volume provided in the pond is sufficient to prevent flooding due to rainfall events. The bed and slopes of the pond will be lined with an impermeable heavy duty liner geomembrane with a stone layer placed on the top of the liner. The flows from this storage pond will be discharged into a new soakaway located west of the pond.

Ground investigations in this area have identified 'waste', though largely comprising inert and/ or construction and demolition (C&D) waste. Remediation proposals comprise the reduction in waste extents in this area. A key design element for the function of the soakaway is groundwater levels in this proposed location. Assessment of the remediation profile suggests that the ground would be between 10m and 12m above groundwater levels hence suitable for installation of a soakaway. Ground conditions comprise overburden which is layered hence horizontal permeability from the soakaway into the soils will be greater than vertical permeability, with the effect that water in the soakaway will likely across rather than down. The ability to percolate vertically will be influenced by the degree of interconnection between the layers. Borehole logs in this area do not show any perched water above the groundwater table which suggests that there is reasonable downward movement of infiltration.

With this indication of possible horizontal movement of water, waste cannot be present in the proximity of the soakaway. Borehole EMW12 shows the base of the waste at being at around 84.4mOD compared to the current designed base of the soakaway at circa 87 to 88mOD. However, the soakaway will be positioned approximately 60m from borehole EMW12 hence water would have to move a reasonable distance to effect the waste. The regional groundwater flow direction is also away from the waste and the various ground investigation logs in this part of the site do not show any evidence of perched groundwater further discounting the possibility of water from the soakaway migrating to the waste deposits. Remediation works will identify and classify the wastes in this area and remove to ensure that a sufficient 'buffer' exists between the soakaway and remaining waste deposits in Zone 1, with levels confirmed during detailed design.

The soakaway should be filled with granular material and lined with geotextile to prevent migration of fines into the soakaway and ingress of backfill material during and after surface reinstatement. Alternatively the soakaway could take the form of perforated concrete manhole ring units placed within a square pit with sides about twice the selected ring unit diameter and granular material backfill placed between the rings and the sides of the pit. The granular material must be separated from the surrounding soil by a suitable geotextile. The top surface of the granular fill should also be covered with geotextile.

Road and Hardstanding Drainage

Oil interceptors will be required during landfill remediation works to serve temporary working areas (e.g. potential laydown area, fuelling station, temporary car park and wheel wash area). These interceptors will be removed on completion of restoration works.

2.4 Future Surface Water Management Proposals

2.4.1 Surface Water Catchment Zones

The proposed remediation works comprises re-profiling of the site to generate a suitable profile for capping and surface water management to be effected. Based on the design proposals, the site has been divided into smaller sub-catchments in order to determine surface water flow paths, the direction of flows, locations for storage ponds and discharge points. This assessment determined that three main catchment zones are prevalent. These are approximated as shown in Figure 2.2 below and will be based on the final topography achieved through the remediation works. (Note that the boundary shown in the below figure is not the final proposed project boundary)

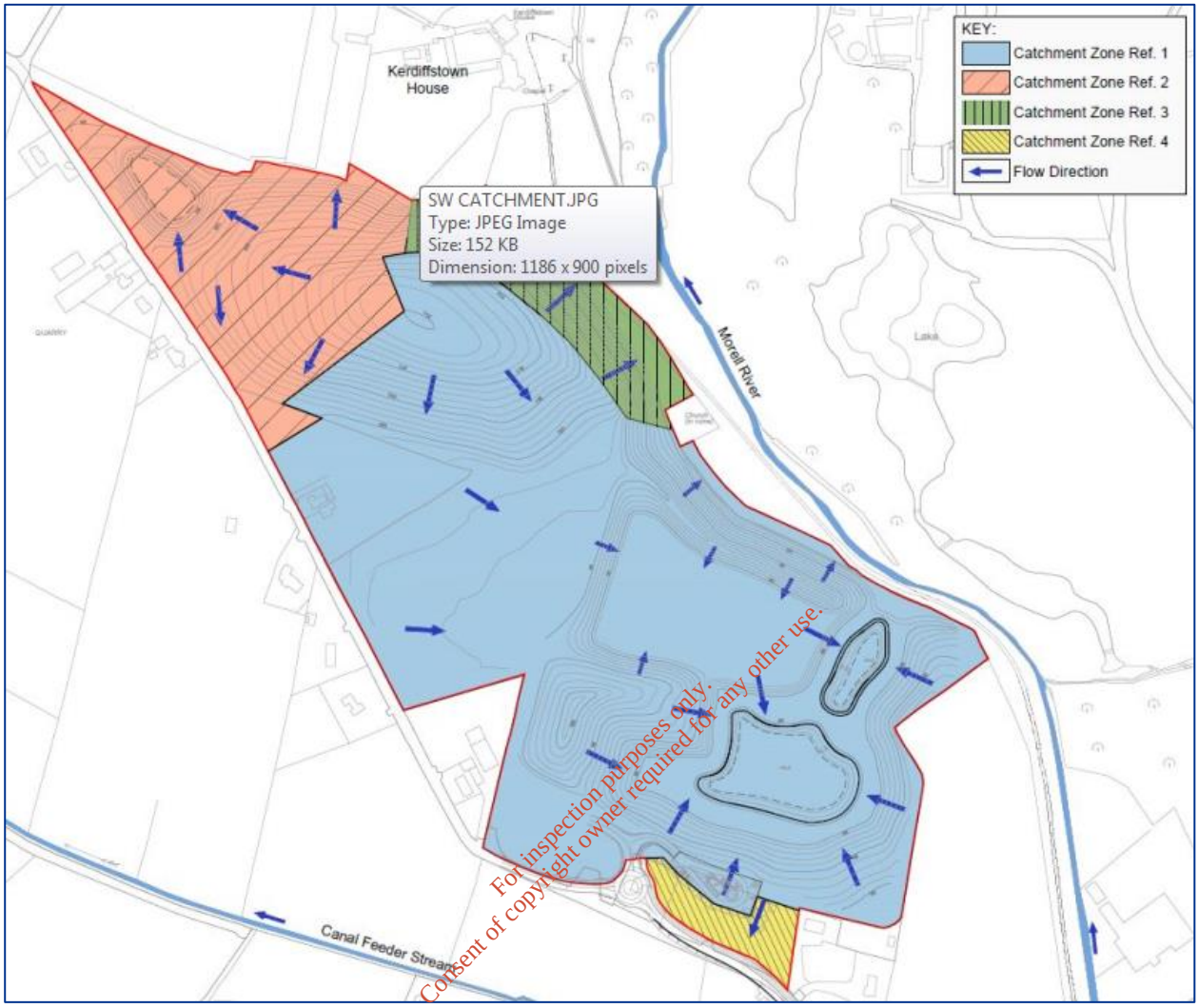


Figure 2.2: Outline Surface Water Catchment Zones

This approximation of catchment zoning indicates that most of the surface water captured on the site, as shown as Catchment Zone 1, can flow by gravity via system of open channels and perimeter ditches to the south-eastern area of the site, for collection and discharge. Due to topographic constraints a limited area to the north-west of the site (Catchment Zone 2) cannot be readily drained to the south east and requires an alternative solution. Similarly, steep slopes to the north of the site (Catchment Zone 3) fall to a low level preventing sustainable drainage options to be used to drain back into the site. Catchment Zone 4 represents an area of land currently comprising residential properties and gardens, which falls away from the site and is located outwith the licensed boundary containing no landfill infrastructure. As a result Catchment Zone 4 does not form part of the site catchment or surface water management proposals.

2.4.2 Surface Water Run-off Rates

The peak rainfall run-off rates have been estimated based on the rainfall intensity depths attached in Appendix C. A climate change factor of 10% was applied to all rainfall intensities as recommended in the Sustainable Drainage Guidance for Ireland. The estimated design peak flow rates were then used to determine indicative sizes, gradients and alignment of the drainage system required to convey surface water flows. The peak design run-off flow rates can be found in the summary table in Appendix E.

2.4.3 Fluvial Flood Extent

The online Office of Public Works (OPW) National Flood Hazard Mapping contains historical flood information and shows a number of flood events on the Morell River, in the area of Johnstown east of the site. The flood report and flood risk map are attached in Appendix D for reference.

The map indicates that the site is located just outside the fluvial flood risk zone. However, an area located to the north extents of the site boundary aligning with the access road to Kerdiffstown House is positioned within the 0.1% AEP (annual exceedance probability) and 1% AEP fluvial flood events which represents areas at risk of 1 in 1000 and 1 in 100 year flood events respectively.

Remediation works proposals are not required in this area, although realigning of the road to Kerdiffstown House is likely in order to provide surface water management and future maintenance access to the site.

2.4.4 Outline Drainage Strategy

The proposed concept drainage design comprises surface water management measures for the remediation and post-remediation works phases to mitigate the risk of environmental pollution and flooding. The design and sizing of the drainage components is based on the proposed pre-settlement remediation profile, estimated peak run-off rates, specific requirements in each zone and the permissible discharge rate from the site.

The drainage system for the site will include a network of open ditches, channels and swales to intercept and control surface water run-off generated from the capped and restored landfill areas and direct it towards storage ponds. The ditches will be supplemented with culverts and road drainage as required. The proposed drainage plan and cross sections are shown on Drawing Numbers 32EW5604-00-044 and 046. The strategy for the management of surface water run-off embraces the anticipated phasing of the remediation works.

During site remediation, construction of perimeter, temporary bunds will enable separation of working areas from restored areas. However, it is anticipated that until initial vegetation coverage, comprising grass, fully germinates silty run-off from capping soils may still be prevalent and require control. As a result the surface water management design proposals do not permit surface water discharge until such time as it can be shown through monitoring that water quality is stable and clean, with sufficient background data to support this assessment. Monitoring proposals are discussed further in Section 3.

2.4.5 Surface Water Management Proposals

Table 2.2 sets out proposals for surface water management at the site according to the zonal categorisation for areas containing waste. The specific details, locations and levels of infrastructure will require to be confirmed as remediation works progress.

Zone	Remediation and End-Use Proposals	Surface Water Management Proposals
1	The remediation proposals for this zone comprise capping using a geosynthetic system (low permeability geomembrane or similar) with capping soils. End-use proposals will see this area become a public open space.	Catchment Zone 1: Open ditches and channels, with buried pipes to traverse paths, tracks and roads as necessary. Discharging via Zone 2B infrastructure to surface water management ponds 2 and 3. Catchment Zone 3: Infiltration swale constructed on toe of re-profiled slopes, discharging to groundwater.
1A	The remediation proposals for this zone comprise re-profiling to create a suitable landform and capping using a geosynthetic system (low permeability geomembrane or similar) with capping soils. End-use proposals will see this area as public open space.	Catchment Zone 2: Surface water management pond (1), providing retention and linking to a soakaway, discharging to groundwater. Open ditches and channels directing run-off to pond.

Zone	Remediation and End-Use Proposals	Surface Water Management Proposals
2A	The remediation proposals comprise the retention of the concrete pads (with repairs) over which a sports pitch will be located. Outwith the concrete pads a low permeable cap (soils) will be placed. End-use proposals will see this area become a public open space, incorporating car parking, a sports pitch and a changing rooms building.	Catchment Zone 1: Open ditches and channels, with buried pipes to traverse paths, tracks and roads as necessary. Sports pitch drainage to connect to channels. Road drainage to include silt and oil interceptors. Discharging to ponds 2 and 3.
2B	The remediation proposals comprise the retention of the concrete pads (with repairs) over which a sports pitch will be located. Outwith the concrete pads a low permeable cap (soils) will be placed. End-use proposals will see this area become a public open space, incorporating a sports pitch and paths.	Catchment Zone 1: Open ditches and channels, with buried pipes to traverse paths and tracks as necessary. Sports pitch drainage to connect to channels. Discharging to surface water management ponds 2 and 3. Drainage from perimeter bund (north) to be collected via open channel and French drain (as topography and levels dictate) to discharge to pond 1.
3	The remediation proposals zone comprise re-profiling to create a suitable landform and capping using a geosynthetic system (low permeability geomembrane or similar) with capping soils. End-use proposals will see this area as public open space.	Catchment Zone 1: Open ditches and channels, with buried pipes to traverse paths and tracks as necessary.
4	Remediation proposals comprise excavation of identified wastes as far as practicable, to create safe slope profiles. Low permeable soils will be placed over re-profiled slopes. End-use proposals will see this area used for surface water management ponds with paths.	Surface water management ponds (2 & 3), providing retention and, discharging to Morell River.

Table 2.2: Surface Water Management Proposals

2.4.6 Discharge Rates and Key Discharge Points

The estimated discharge rate (Q_{BAR}) is based on the outline remediation works design drawings is provided in Appendix F for reference.

The topographical features of the site define the direction of flow paths and locations at which water can be discharged from the site. Generally surface water flows from Catchment Zone 1 can be gravitated via a system of open channels and perimeter ditches to the south-eastern area of the site, where the water will be retained within attenuation ponds and discharged via a new outfall structure to the Morell River.

Surface water from the north-west part of the site (i.e. Catchment Zone 2) will flow northwards and westwards, and cannot be readily captured for transfer to the south-east area of the site. The surface water run-off from Catchment Zone 2 will therefore be discharged into an attenuation pond in the western corner of the site with an overflow discharging to a soakaway.

The ground profile at the toe of the north slopes, represented as Catchment Zone 3 prevents drainage to the attenuation ponds in the south-east corner of the site. The surface water run-off from this limited catchment area will be discharged into an infiltration swale located along the mound toe, with waters permitted to discharge to groundwater.

2.4.7 Surface Water Storage Requirements

Attenuation storage will be required as surface water management ponds 2 and 3, located in the south-east area of the site, and surface water management pond 1 in the north-west area, in order to temporarily retain water within the site during periods when storm water run-off exceeds the allowable discharge rate. The use of attenuation ponds will also protect the site against flooding and the river from detrimental impacts due to high flows from the site. In addition, the attenuation ponds will permit settlement of suspended solids from the drainage system.

Estimation of surface water storage requirements is based on peak run-off rates and the restricted discharge rate from the site. The storage volumes designed to provide protection to the site against flooding and mitigate the risk of detrimental impact on the discharge locations (where applicable) are summarised in Table 2.3.

Catchment Zone	Storage volume (m^3)	Storage Provision	Discharge Point	Receiving Receptor
Catchment Zone 1	16,783	Ponds 2 & 3	Morell River	Surface water
Catchment Zone 2	2,452	Pond 1	Soakaway	Groundwater
Catchment Zone 3	614	Swale	Infiltration Swale	Groundwater

Table 2.3: Surface Water Storage Volumes and Discharge Locations

The proposed outline site layout with storage ponds is shown on Drawing Number 32EW5604-00-044.

Surface Water Management Ponds 2 and 3

The surface water run-off volume from Catchment Zone 1 will be retained within two ponds (2 & 3) in the south-eastern part of the site. Both ponds will become park water features with a permanent pool of water to provide attenuation and treatment of surface water run-off. Attenuation storage will be provided by freeboard above the permanent water level. A flow control system (e.g. orifice plate, hydrobrake or throttle pipe) will be installed at the outfall from pond 3 to limit the discharge rate to the maximum permissible rate of 51.07l/s. Following the remediation works the installed impermeable geomembrane liner will be cleaned of any silt deposits, with a stone layer placed above the liner for protection during maintenance / emptying operations and top soil/growing medium over the stone to encourage plant growth and provide ecological enhancement. The storage ponds will be designed to encourage settlement of solids which can be removed from the base of the retention area. In addition access points will be provided to each pond to facilitate future maintenance (vegetation management and sedimentation removal).

A sampling and monitoring point will be provided downstream of the outlet from pond 3 to allow for water quality monitoring. A penstock will be installed in the manhole downstream of the sampling and monitoring point to allow for isolation and containment of flows in the event of suspected or confirmed contamination of surface water in the ponds, preventing discharge to the Morell River. This penstock will be controlled using a SCADA (Supervisory Control and Data Acquisition) automation control system based on data reported from the sampling point. During normal operational conditions this penstock will remain open to allow flows to be discharged to the Morell River. Further information on monitoring proposals is detailed in Section 3.

The position of the proposed outfall structure to the Morell River is restricted by the extent of the existing rock armour that stretches approximately 80m along the adjacent riverbank. The outfall is proposed to be constructed beyond the northern extents of the rock armour with the discharge pipework to the river laid at an angle to avoid disturbance to the opposite river bank. The proposed orientation of discharge pipework and position of the outfall is shown on Drawing Number 32EW5604-00-044 with typical outfall detail shown on Drawing Number 32EW5604-00-046.

Surface Water Management Pond 1

The surface water run-off flows from Catchment Zone 2 will be gravitated and stored in pond 1 in the north-west corner of the site. The attenuation storage volume provided in the pond is sufficient to prevent flooding due to rainfall events. Following the remediation works the installed impermeable geomembrane liner will be cleaned of any silt deposits with a stone layer placed above the liner for protection during maintenance / emptying operations.

A new soakaway will be constructed immediately adjacent to the pond. The soakaway will be constructed using large diameter concrete rings or similar and filled with appropriately sized granular material with the top surface of the granular fill covered with a filter geotextile to retain fines.

Monitoring will be undertaken in pond 1 to verify quality of discharge. A penstock will be installed in the underground manhole downstream of the pond to allow for isolation and containment of flows in the event of suspected or confirmed contamination of water within the pond. During normal operating conditions this penstock will remain open to allow flows to be discharged to the soakaway.

Infiltration Swale

Run-off from Catchment Zone 3 will be collected in an infiltration swale, constructed along the toe of the re-profiled slope beyond the capping system as a shallow, flat-bottomed drainage feature to convey run-off to ground. Swales may be planted with grasses and other vegetation to provide a level of pollution control and treatment for smaller storm events. The extent of the swale is constrained by a historic shrine and graveyard and gardens of Kerdiffstown House. The location and detail of the proposed infiltration swale are shown on Drawing Numbers 32EW5604-00-044 and 32EW5604-00-045. The water retained in the swale will infiltrate into the ground. The proposed infiltration swale is located outside 1 in 1000 year fluvial flood extent and will be constructed at an elevation above the 1 in 1000 year flood level. An access track will be provided adjacent to the swale to facilitate future maintenance.

During extreme rainfall events it is anticipated that surface water flows may overtop the swale onto adjacent land. However, this will not increase any run-off volume that is currently discharged onto this land as the additional run-off volume resulting from the site will be retained within the swale. The proposed swale may require installation of intermediate bunds along its length to compensate for the reduction in ground profile along its length allowing sub-catchment management.

2.4.8 Road and Hardstanding Drainage

Any new roads and hardstandings which are to be built or retained within the site as part the remediation works and / or end-use development (i.e. access roads to car parking, changing rooms, and landfill infrastructure compound) will require permanent drainage to collect surface water flows. The surface water flows will be collected by a system of road gullies and underground drainage pipework with the flows discharged to ditches and then to pond 2. As run-off from such roads and hardstandings have the potential to contain silt, oil and fuel washed off roads silt and oil interceptors will be provided to separate these contaminants from the surface water, prior to entering pond 2, and preventing pollution of the Morell River.

All oil interceptors, road gullies and silt traps that will remain post-remediation will require regular maintenance to sustain their long-term performance. This is discussed further in Section 3.

Run-off from the proposed new roundabout at the site entrance external to the site will be collected by new road gullies and discharged into the existing road drainage on Kerdiffstown Road. The flows from the existing road drainage are discharged to the Morell River to the south of the site. During detailed design it is considered that a silt and oil interceptor may be installed as part of the road improvement works that will be required on Kerdiffstown Road.

2.4.9 Landfill Infrastructure Compound Drainage

Surface water from the compound will be collected by system of road gullies and underground pipework which will be supplied with silt and oil interceptor(s). These flows will be discharged to the main road drainage. However due to the risk of run-off from the compound containing contaminants due to leachate spillages the drainage system from the compound will also be provided with an isolation point before discharge into the main road drainage. An isolation penstock will be installed within a manhole and the surface water run-off will be retained within the storage manhole until mitigation works have been carried out. Contaminated surface water may need to be transported off-site for disposal during this period until the normal operation has been restored.

Contingency plans to address leaks from valves and tankers used in the management of leachate in the Landfill Infrastructure Compound are outlined in the Leachate Management Plan.

2.5 Foul Water and Grey Waters Drainage Strategy

2.5.1 Guidance

Design considerations for foul and grey waters generated from the site post-remediation are outlined in Appendix B. The site is proposed to be used as a public open space/ park with three multi-use sports pitches.

The following technical specifications have been used as references in the determination of options for the future treatment and discharge of foul and grey waters from the changing rooms and site compound office:

- Wastewater Code of Practice;
- Sewers for Adoption;
- Sewers for Scotland;
- BS EN 752 Drain and Sewer Systems Outside Buildings;
- BS EN 12056-2 Gravity Drainage Systems Inside Buildings; and
- Theory of Simplified Sewerage (web link: http://www.efm.leeds.ac.uk/CIVE/Sewerage/manual/docs/chap2.pdf).

The Greater Dublin Regional Code of Practice provides guidance for the design and construction of sewers in the Greater Dublin Area. Where sufficient data or particular elements were not available within this document, it was supplement through the use of Sewers for Scotland in conjunction with Sewers for Adoption as is typical.

A full list of guidance used for the surface water management proposals is detailed in Appendix A.

2.5.2 Proposals

A packaged pumping station (PS) is proposed to be located adjacent to the changing rooms building. The PS will pump sewage from the changing rooms through a 150mm (internal diameter) barrier MDPE pipe rising main. The approximate proposed route of the rising main is shown on Drawing Number 32EW5604-00-049.

A packaged mass rate pump will be located adjacent to the site office in the landfill infrastructure compound. The pump will inject flows from the site office into the rising main taking flows from the changing rooms via a 100mm (internal diameter) buried pipe. A telemetry control link will be installed between the pumping station at the changing rooms and the one at the site office to ensure to the optimal operation of the pumps.

The sewage rising main will break via an air valve. From the air valve chamber, the foul and grey water will gravitate to Johnstown Wastewater Pumping Station (WwPS), discharging to the public local sewer network. The sewage pipe will run parallel to the leachate main (refer to the Leachate Management Plan). The proposed route of the sewerage gravity main is shown on Drawing Number 32EW5604-00-049. he transfer main shall be a fully welded 150mm (internal diameter) barrier MDPE pipe. The minimum depth of cover to the crown of the pipe will be 900mm in field areas, increasing to 1200mm beneath roads.

The gravity sewerage pipework route consists of the following major sections:

1. A section along the boundary of the waste mass;
2. A section through a grass field;
3. A section under a minor road;
4. A section under a major three-lane motorway (N7);
5. A section under the Morell River; and
6. A section to Johnstown WwPS.

The final design of the sewerage rising main and gravity main shall be in accordance with relevant guidance such as Sewers for Scotland technical specification, BS EN 752 Drain and Sewer Systems Outside Buildings and BS EN 12056-2 Gravity Drainage Systems Inside Buildings. The pumping stations at the changing rooms building and the site compound shall be in accordance with relevant technical specifications.

Rainfall collected by roof drainage from buildings on the site such as the changing rooms will be discharged to the road drainage system.

There is an opportunity to re-use this water on site (e.g. for flushing toilets) which will be determined at detailed design stage.

2.6 Water Quality

Surface water flows from the site may contain an increased concentration of suspended solids, oil and fuels. In addition surface water flows are at risk of contact with contaminated waste and leachate which may result in the increased elevation of ammoniacal nitrogen, chloride, suspended solids, nitrate, iron and Total Organic Carbon. Therefore the surface water run-off from the site will require appropriate management and control measures throughout the remediation works and development of the park as the end-use. The primary control measure is to not permit surface water discharge from the site during remediation works, unless it can be shown to be free from contamination. The quality of the discharged water will require to comply with discharge parameters to be agreed with the EPA. Monitoring requirements are further outlined in the EIS, Chapter 14 Water – Hydrology.

2.6.1 Remediation Phase

Surface Water Quality and On Site Treatment

The remediation works will comprise excavation and re-profiling of waste, resulting in open areas of waste. The works are to be phased to reduce exposed working areas, both from excavation and filling locations, with surfaces covered with inert soils at the end of each working day as a minimum. Rainfall coming into contact with waste may generate contaminated run-off or leachate. Therefore segregation of surface water from open areas of waste and leachate will be required through use of temporary bunds and/or ditches. The precise position and general arrangement of required bunds will be confirmed during detailed design phase once the phasing and sequence of the proposed restoration works have been confirmed.

The areas for pond construction to be utilised in the end-use design will be used temporary lined condition for storage of run-off during the construction works. Further temporary ponds may be constructed at locations adjacent to working areas to assist with management of run-off if the phasing and timing works require additional storage volumes.

Any contaminated run-off will be captured and contained separately. This water will not be discharged from the site unless monitoring shows discharge to be acceptable. Water will be required for on-site purposes such as dust suppression. Any waters confirmed to be contaminated and considered as unsuitable for treatment or re-use on site will require to be removed from the site. Depending on procurement strategies for the construction works this may be achieved through road tanker removal. Alternatively, on agreement with Irish Water, the water may be discharged to sewer in accordance with the Leachate Management Plan.

Identification of leachate outbreaks from the waste mass will require to be remediated by installation of stone filled drains, to direct the leachate back into the waste mass. Procedures are detailed in the Leachate Management Plan.

Immediately following capping works completed areas will be susceptible to erosion by surface water run-off. During rainfall events increased sediments may be carried in the surface water run-off as a result of this erosion. This effect is likely to continue until the surface are fully grassed and stable making them less susceptible to erosion. To mitigate this siltation fencing will be provided at the perimeter of completed areas / ditches to catch silt as far as practicable. Silt buster or other similar tank arrangements may also be utilised by contractors undertaking the works to remove silt prior to discharge to the ponds and reduce the loading to the ponds and requirement to clean in the future. Despite these measures surface water run-off collected by perimeter ditches is still likely to carry suspended solids content which will need to be contained and managed such that it is not discharged from the site. The flows will be directed to the retention ponds located in the south-eastern part of the site. The retention ponds will be designed to encourage settlement of solids. Stone bunds / baffle boards along the base of the retention pond may be required to improve settlement. The suspended medium and coarse silts will settle out of the water to the bottom of the ponds and can then be removed from the base of the retention area.

The contractor(s) undertaking earthworks at the site will be required to be responsive to potentially changing conditions across the site and adopt a proactive approach to managing silt removal.

In addition to these contamination risks, the use of plant and construction materials (including, but not limited to, cement, oil and fuel) may lead to contamination if these are not adequately controlled during the restoration period. During remediation works contractor(s) will be required to put in place a strategy to ensure that no oil and fuel spills from machinery and plant reach the watercourse or groundwater. Silt traps and oil interceptors will be required to serve any areas which are designated as temporary laydown areas, fuelling stations, temporary car parks and potential wheel wash areas. These interceptors will be removed on completion of works.

If any temporary haul roads are required during the restoration phase then these will be provided with a channel drain on one side of the road connecting back to the main perimeter drains. The roads will be coated with a binder to prevent the release of silt during time of rainfall.

Construction of an outfall on the Morell River is to be undertaken during low flow conditions. Construction of a cofferdam may be required during outfall construction to protect the Morell River and provide a safe working environment. Mitigation for construction works is outlined in the EIS, Chapter 14 Water – Hydrology.

Surface Water Monitoring

Monitoring of surface water will be undertaken at the storage ponds for verification purposes. As water is likely to be required during remediation works, such as for dust suppression, contamination from waste will be the key characteristics to check such that these are not made airborne during dust suppression activities.

During remediation works, sampling of adjacent surface water locations will continue at the following locations (as a minimum):

- Upstream and downstream of the future discharge location on the Morell River;
- Each storage pond; and
- Infiltration swale.

The minimum monitoring frequency is proposed to be monthly, increasing to weekly when immediately adjacent to remediation works areas. Monitoring staff and site operatives will monitor the efficiency of the surface water management during works on a daily basis and report evidence of any potential contamination, excessive sedimentation or any other factors that may compromise the efficiency of the system to the site manager.

The details of chemical analysis for the weekly and monthly sampling will cover key contaminants associated with typical landfill operations, including total suspended solids (TSS), chloride, ammoniacal nitrogen, nitrate, iron, chemical oxygen demand (COD), electrical conductivity (EC), pH and total organic carbon (TOC). The full details including allowable discharge concentrations and typical monitoring suites are provided in the Monitoring and Control Management Plan.

2.6.2 Operational Phase

Surface Water Quality and On Site Treatment

Following completion of remediation works surface water run-off will not come into contact with waste materials. However, water may still contain some suspended solids and possibly oil, fuel and silt washed off roads.

Silt fences installed around the site as part of the remediation works will remain in place until the vegetation within the site is well established and perimeter ditches and swales grassed. Once it has been established that sediment retention techniques are no longer required silt fences may be removed.

All oil interceptors, road gullies and silt traps that serve permanent access road, car park and hardstandings will remain in place due to the potential risk of oil, fuel and silt being washed off these areas. This water would require separation from surface water. All oil interceptors, road gullies and silt traps that will remain post-remediation will require regular inspection and maintenance to sustain long-term performance.

Surface Water Monitoring and Sampling Plan

The sampling and monitoring of surface water discharges will be required post restoration works to confirm that the run-off quality complies with the discharge parameters agreed with the EPA. Auto-sampling points will be provided at the outlets from pond 1 in the northwest corner of the site, discharging to groundwater, and pond 3 in the south-eastern area, discharging to the Morell River.

A flow meter will also be installed at the sampling point on the outlet from pond 3 to record discharge rates to the Morell River. This data will be maintained via data logger and linked to the site office, located within the landfill infrastructure compound.

Monitoring of the infiltration swale at the northern perimeter of the site will also be undertaken. Sampling upstream and downstream of the outfall to the Morell River will continue (as a minimum).

The frequency of monitoring at all locations is to be monthly as a minimum, with the auto-sampling points recording data more frequently. The frequency of the monitoring of the Morell River may be reduced following sufficient data to support ongoing assessment, to quarterly and six-monthly periods.

The details of chemical analysis for the monthly sampling will cover key contaminants associated with the former landfill site including TSS, chloride, ammoniacal nitrogen, nitrate, iron, COD, EC, pH and TOC. A more comprehensive analytical suite should be employed annually to include trace organics and metals. The full details of the monitoring suites are provided in the Monitoring and Control Management Plan.

2.7 Construction Quality Assurance

The outline design principles for the surface water management system are provided herein. Detailed design of future surface water management facilities will be undertaken following a detailed topographical survey to determine appropriate gradients and alignments.

The installation of the requisite management measures will be subject to Construction Quality Assurance and Control. This will provide assurance that the surface water management system was constructed as specified in the design and will include inspections, verifications, audits and evaluations of materials and workmanship necessary to determine and document the quality of the constructed facility.

To enable overall quality management works to the surface water management system will be governed by a comprehensive Construction Quality Assurance (CQA) Plan, prepared for submission to and review by the EPA. CQA is defined as a planned system of activities that provide assurance that the materials used meet design specifications and infrastructure is constructed in accordance with the contract and technical specifications. The CQA Plan will set out:

- Construction quality control (CQC) procedures;
- Technical specification and the conditions of contract drawn up by the designer; and
- Roles and responsibilities for the works. The Construction Environmental Management Plan (CEMP) may also inform and be informed by the CQA Plan.

On completion of the infrastructure works a CQA Report will be prepared, to demonstrate that the system(s) and associated components comply with the specification as set out in the CQA Plan. To align with phasing of the remediation works CQA of surface water infrastructure may be embraced within an overarching Remediation CQA Plan, subject to confirmation of procurement approach and detailed design.

2.8 Surface Water Management Review

Management of surface water will be maintained under review by Site Management to ensure that, as far as is reasonably practicable, the surface water collection, treatment and disposal system will have sufficient capacity to handle the maximum predicted flow rates.

Further review may be necessary following agreement with Irish Water for the sewer connection to Johnstown Pumping Station, agreed in principle (February 2017).

If the review process identifies potential shortfalls in the provision of surface water management facilities at the site, action will be taken to upgrade the system capability. Proposed changes shall be discussed with the EPA prior to implementation.

3. Installation, Monitoring and Maintenance

3.1 Installation Plan

Phased development of drainage works will take place as re-profiling and remediation (capping) works progress on the project as shown on Drawing Numbers 32EW5604-00-027 and 028. The remediation works will include a network of open ditches and channels that will capture and control any surface water run-off generated from the capped areas towards the surface water management ponds. These ditches will be supplemented with herringbone drainage, pipework and culverts as required. It is recorded that drains cannot be installed across steep slopes (1:2.5 to 1:3) due to required use of geogrid in capping soils to provide stability to the system.

During the operation of the surface water management ponds inspections will be carried out to ensure that the system is operating as designed and has not been contaminated with leachate.

Post remediation works inspections of drainage channels will continue. Recording of data relating to the volume discharged to the Morell River and quality thereof and the water quality present in ponds 2 and 3 will be logged in the site manager's office, and reviewed to determine any detrimental changes.

Records from the construction works and testing will be retained in the Site File.

3.2 Monitoring Plan

Routine monitoring of the site to assess the performance of the surface water management system will be undertaken. Monitoring staff will carry out checks of infrastructure each time the gas and groundwater monitoring boreholes are sampled. Observations will be recorded, and evidence of contamination such as excessive sedimentation or any other factors that may compromise the efficiency of the system will be reported to the Site Manager prior to leaving the site.

Details of the monitoring programme/plan for the site are set out in the Monitoring and Control Management Plan and cover (as a minimum):

- Surface water monitoring (on-site: levels; quality; quantities);
- Surface water monitoring (off-site: quality; flows to River);
- Surface water infrastructure inspections; and
- Surface water infrastructure maintenance programmes.

3.3 Maintenance

The surface water drainage system will require long term maintenance and upkeep including:

- Inspections and maintenance of silt and oil traps;
- Inspections and maintenance of swales, ditches and reed beds;
- Inspections and maintenance of road gullies and underground drains, and repairs if required;
- Inspections and maintenance of discharge point, outfall and isolation penstocks; and
- Maintenance of auto-sampling system.

In order to maintain the effectiveness of the surface water system following identification of defects action will be taken to remove any obstructions to flow.

4. Action Plan

4.1 Overview

As identified in Section 2 reductions in infiltration will be achieved by progressive phases of capping works, across areas of the landfill. The surface water management scheme is also important in providing a collection system for surface water run-off that will reduce the loading on the leachate collection and disposal system (see also Leachate Management Plan).

It is proposed that the Surface Water Management Plan and Surface Water Action Plan would be regularly reviewed, and updated where necessary, to ensure that sufficient surface water management options are available to adequately control run-off at the site, and to prevent any uncontrolled escape of surface water into the surrounding environment.

4.2 Action Plan

The maintenance, monitoring and sampling procedures, and action plan will be maintained throughout construction and post-remediation works. However, in the event of suspected or confirmed contamination of surface water the following action plan should be in place:

- Identify which catchment area is affected and close the relevant penstock at the outlet from pond 3 and/or 1 to allow for isolation and containment of discharge flows within the site.
- Contingency measures to be put in place:
  - Undertake sampling and analysis to confirm suspected contamination.
  - Identify source of pollution and isolate the area of concern.
  - EPA to be informed as soon as possible.
  - Where appropriate undertake actions to remove contaminated water for site treatment and ensure that the source of pollution has been eliminated. Temporary pumping operations might be required to remove/pump contaminated water for site treatment.
  - Agree any other necessary actions with EPA.
- Following emergency response plan and successful removal/treatment of contaminated water and source of pollution, increased monitoring and sampling of surface water is to be put in place. The frequencies and chemical analysis requirements are to be in line with the Monitoring and Control Management Plan.

5. Work Instructions

5.1 Maintaining Surface Water Infrastructure

Work instructions for the Site Manager and Site Operatives are as follows:

5.1.1 Duty of Site Manager

- Ensure that all constructed engineering works prevent the uncontrolled escape of surface water into the surrounding environment;
- Manage any controlled pumping into the surface water system;
- Ensure any pumps employed to deal with the management of the surface water system are sized accordingly to deal with predicted ingress;
- Review and approve the CQA Plan for each phase of remediation works (if required) with particular regard to the control and management of surface water;
- Consider both surface water management during remediation works and the long term control and management from completed parts of the site;
- Regularly inspect bunded areas for ponding liquids and remove as necessary;
- Ensure that routine monitoring of surface water is undertaken in accordance with the guidelines detailed within this management plan;
- Ensure that data loggers are working appropriately and are maintained according to manufacturer's recommendations;
- Ensure that regular checks of the surface water management system are undertaken;
- Review monitoring data to determine any reduction in frequency;
- Ensure that any notifications required by this management plan are submitted to the EPA; and
- Ensure that the Action Plan detailed within this management plan is implemented.

5.1.2 Duty of the Site Operative

- Ensure any pumps employed in the management of surface water are serviced and fully operational;
- Ensure discharge points of any pumps are placed in the correct position of the installed surface water system;
- Maintain all surface water ditches with regards to debris and litter to ensure water runs freely;
- Inspect the surface water ponds for debris and litter and remove as necessary;
- Inform the Site Manager of any blockages, overflow or abnormal operation of installed surface water collection system immediately;
- Ensure that all pumps are placed on a drip tray for environmental protection of virgin ground;
- Do not use pumps for surface water management if previously used for the control and management of leachate unless they have been appropriately cleaned.
- When using the water bowser for surface water management always ensure that there is no contamination from the tanker body prior to use.

Appendix A. Relevant Guidance Documents

Below is a non-exhaustive list of guidance. Review of this and prevailing best practice should be made on future updates to this Management Plan:

Guidance	Year
Sustainable Drainage Guidance for Ireland (www.uksuds.com/irish_suds)	-
WRc Sewers for Adoption (7th Edition)	2013
Irish Water Code of Practice for Wastewater Infrastructure	2016
IS EN 752 Drain and Sewer Systems Outside Buildings	2008
CIRIA Report C753 - The SuDS Manual	2007
IS EN 12056-2 Gravity Drainage Systems Inside Buildings	2000
CIRIA Report C692 Environmental Good Practice on site (third edition)	2010
Civil Engineering Specification for the Water Industry (7th Edition)	2011
Sewers for Scotland (3rd Edition)	2015
Scottish Water Standard and Specifications for Waste Water Pump Stations	2015
Theory of Simplified Sewerage: (www.efm.leeds.ac.uk/CIVE/Sewerage/manual/docs/chap2.pdf)	2016
EPA Final Draft BAT Guidance Note on Best Available Techniques for the Waste Sector: Landfill Activities	2011
EPA Landfill Manual - Guidance note of Landfill Monitoring	2003
EPA Landfill Site Design	2000
EPA Landfill Manuals Investigations for Landfills	1995
EPA Landfill Manuals Landfill Operational Practices	1997
EPA Landfill Manuals Landfill Restoration and Aftercare	1999
EPA Landfill Manuals Landfill Monitoring	2003
UK Environment Agency Technical Guidance Note (Monitoring) M18: Monitoring of discharges to water and sewer	2015
The Safety, Health and Welfare at Work Act	2005
The Safety, Health and Welfare at Work (Construction) Regulations 2013 SI 291	2013
ATEX 94/9/EC Directive, the ATEX 'Product' Directive, concerned with the manufacture of equipment and protective systems designed for use in potentially explosive atmospheres	1994
ATEX 1999/92/EC Directive, the Worker Protection Directive (also known as the 'ATEX 137' Directive), concerned with the "minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres"	1999

Standard Type:

- IS Irish Standard
- BS British Standard
- IS EN European Standard adopted as an Irish Standard
- BS EN European Standard adopted as a British Standard
- WIS UK Water Industry Specification
- EPA Environmental Protection Agency
- CIRIA Construction Industry Research and Information Association

Appendix B. Drainage Design Philosophy & Methodology

Surface Water Design Input Data

The rainfall intensity depths have been obtained via the EPA from the Met Éireann Meteorological Service (weather station at Casement). These data is shown in Appendix C.

1. Key Design Parameters

The following key design parameters have been adapted in the assessment of the surface water strategy for the proposed restoration site:

- Discharge rate from the landfill remediation site should be limited in line with the recommendations in Sustainable Drainage Guidance for Ireland (maximum discharge rate of Q_{BAR} or 2 l/s/ha, whichever is the greater). However if the catchment is less than 2.5ha, the discharge rate will be dictated by the minimum orifice size of 75mm which will control the outflow to 5l/s).
- 10% climate change factor is to be applied to all rainfall intensities as per Sustainable Drainage Guidance for Ireland.
- The capacity of the surface water drainage system (including storage system) will be designed in line with Sustainable Drainage Guidance for Ireland (durations from 15 minutes to 48 hours are to be assessed). If no relevant information can be found in the Irish SUDS guidance then CIRIA C753 SUDS Manual is to be utilised. It is currently assumed that the drainage system and associated storage/sedimentation ponds are to be designed for no flooding for a 1 in 100 year, 6 hour duration storm event.
- A minimum freeboard allowance of 150mm is to be provided for open channels / ditches and 500mm for storage ponds.
- Flows from site (post-remediation) should be discharged to the Morell River if possible.

2. Design Constraints

The key constraints to be managed from the perspective of surface water management and drainage were identified through initial design and consultations with relevant stakeholders. The key constraints are divided into the following sections:

- Topography
  - Ground profile and existing watercourses: the topography defines the direction of surface water flow paths and location at which water can be discharged. In addition the position of discharged points is restricted by location of the existing watercourses.
- Environment
  - Discharge quality: this is determined by the nature of the ground that the surface water run-off has travelled over. The potential for an increased concentration of suspended solids in surface water resulting from remediation works will require appropriate controls. Any surface water that was in contact with contaminated waste and leachate will require treatment on site. In addition surface water run-off from roads and car park may contain silt, oil and fuels which will require appropriate control and management measures. Without these controls, impacts could include a reduction in water quality and could negatively affect ecology and habitats across the site and local watercourses.
  - Discharge quantity: the discharge rate from the development site to watercourse will need to be restricted to protect and minimise detrimental effect on the river. The size of any soakaways will depend on the permissible infiltration rate. Therefore surface water run-off will require provision of retention area/s within the development site.
  - Discharge permit: EPA consents will be required for discharge of surface water from the development site into the river and for the construction of a new outfall. Monitoring controls will be required in order to demonstrate compliance with the agreed discharge parameters.

- Historic shrine and graveyard: restricting positioning of perimeter ditches.
- Site of archaeological interests possibly located within additional land for additional pitch (end-use).
- Ecology: existing copse in the northern part of the site will restrict the construction of perimeter ditches.
- Contaminated waste mound and proposed capping and restoration layer: this will restrict the positioning of the drainage system.

- Existing Infrastructure
  - Existing service and infrastructure within the development site: existing underground and/or uncharted services, existing concrete retaining wall, and underground obstructions within the former landfill site will restrict the construction of the drainage system.
  - Existing services in the private access road to Kerdiffstown House: these will restrict the position of discharge pipework to the Morell River.
  - Rock armour along the bank of the Morell River.
- Construction
  - Remediation works phasing may impact on the surface water management proposals.
- Operations
  - Location of gas control and leachate treatment infrastructure.
- Access Road
  - Restricted space within the development site to accommodate access tracks for future maintenance.
  - Proposed roads within the site requiring underground drainage system.

The SWMP sets out the strategy and drainage proposals taking cognisance of site constraints.

3. Design Outputs

Catchment Areas

The approximate catchment areas for each zone are shown as follows.

Catchment Zone	Area (ha)
Catchment Zone 1	22.90
Catchment Zone 2	5.40
Catchment Zone 3	2.0
Catchment Zone 4	0.52
Total Catchment Area	**30.82***

* Total Catchment Area represents that within the site boundary. However, Catchment Zone 4 is greenfield only with overland flow away from the site, hence the area applicable for this surface water management plan is 30.30ha.

Discharge Rates

The discharge rate from the proposed restoration site should be limited to Q_{BAR} or 2 l/s/ha, whichever is greater, in order to ensure that the surface water run-off from the site does not have a detrimental impact on the downstream river network and increase the risk of flooding. The estimated Q_{BAR} from the whole site catchment is 68.73l/s, equivalent to 2.23 l/s/ha. The greenfield run-off estimation calculation and results is attached in Appendix F for reference.

Discharge via a new outfall structure to the Morell River would be at a maximum rate of 51.07l/s (permissible Q_{BAR} rate per approximate Catchment Zone 1 area of 22.90ha).

Foul and Grey Waters Design Input Data

1. Assumptions

The end-use design accounts for two multi-use sports pitches, with a changing rooms building available for use. There will be four changing rooms, with a capacity of 30 people each. A typical layout of a building shows that each changing room may have two toilets, two washbasins and four showers. There will also be four rooms for referees / first aid, each comprising one shower, one toilet and one washbasin. Further there is outline provision for three additional public toilets in the building. In total design has been based on the following:

- 15 toilets;
- 15 washbasins; and
- 20 showers.

2. Peak Daily Flow

Showers
On average, a shower would use 0.16 l/s. Assuming the worst case water usage scenario, when all 20 showers are all in use at once, the water consumption for the showers would be 3.2 l/s.

Toilets
A typical WC would use approximately 0.1 l/s. The most conservative water usage scenario would be that all 15 toilets are used at once. Therefore, the total water consumption for the toilets would be 1.5 l/s if all of the toilets are flushed simultaneously.

Washbasins
An average tap would require 0.08 l/s. If all of the taps are running simultaneously, that will be 1.12 l/s.

Peak Daily Flow
The maximum daily peak flow would occur when all of the toilets, washbasins and showers are used at the same time. Thus, the instantaneous peak flow for the changing rooms building would be approximately 6 l/s.

3. Average Daily Flow

The wastewater peak factor can be estimated as follows:

$$k_1 = \frac{peak\ daily\ flow}{average\ daily\ flow}$$

Where $k_1 = peak\ factor$.

A suitable design value for k_1 is 1.8, therefore the average daily flow can be calculated as follows:

$$Average\ daily\ flow = \frac{peak\ daily\ flow}{k_1} = \frac{6\ l/s}{1.8} \cong 3.3\ l/s$$

The sewerage pipe is designed for the average daily flow of 3.3 l/s. The nominal diameter of the pipe is calculated as per BS EN 12056-2, which dictates that for a hydraulic capacity of 3.3 l/s, the nominal diameter of the pipe should not be less than 100mm and 60mm for vents. Sewage design dictates pipes should not be less than 150mm in diameter hence the rising main sewage pipe shall be a fully welded 150mm (internal diameter) barrier MDPE pipe. The minimum depth of cover to the pipe crown will be 900mm.

4. Site Compound Office

It is proposed that that the site office will have two toilets – one male and one female, providing two toilets and two washbasins. The peak flow would occur when all of the facilities are used at once, hence would be the sum of the water usage per second of all of the facilities. Therefore, the peak daily flow for the site compound office would be 0.36 l/s.

The average daily flow would then be:

$$Average\ daily\ flow = \frac{peak\ daily\ flow}{k_1} = \frac{0.36\ l/s}{1.8} = 0.2\ l/s$$

Due to the low flows and short distance of pipe, this rising main sewage pipe shall be a fully welded 100mm barrier MDPE pipe. The minimum depth of cover to the pipe crown will be 900mm.

5. Design Constraints

The key constraints to be managed from the perspective of foul and grey water management were identified through initial design and consultations with relevant stakeholders. The key constraints are divided into the following sections:

- Topography
  - Ground profile and existing watercourses: the topography defines the direction of foul water flow paths and location at which water can be discharged. In addition the position of discharged points is restricted by location of the existing foul water network / treatment works.

Appendix C. Rainfall Data

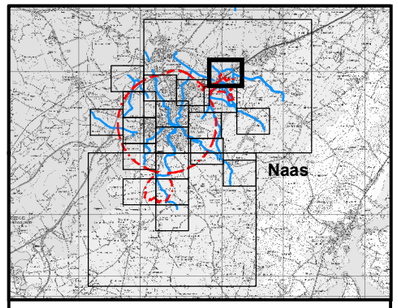
Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 291400, Northing: 222100,

DURATION	Interval 6months	Interval 1year	Years 2	3	4	5	10	20	30	50	75	100	150	200	250	500
5 mins	2.6	3.7	4.4	5.3	6.0	6.5	8.2	10.2	11.5	13.4	15.1	16.4	18.4	20.0	21.3	N/A
10 mins	3.6	5.2	6.1	7.5	8.4	9.1	11.5	14.2	16.0	18.7	21.0	22.8	25.7	27.9	29.7	N/A
15 mins	4.2	6.1	7.2	8.8	9.8	10.7	13.5	16.7	18.9	21.9	24.7	26.8	30.2	32.8	35.0	N/A
30 mins	5.6	8.0	9.3	11.3	12.6	13.7	17.1	21.0	23.6	27.3	30.6	33.2	37.2	40.3	42.8	N/A
1 hours	7.4	10.5	12.1	14.5	16.2	17.5	21.7	26.4	29.6	34.0	38.0	41.0	45.8	49.4	52.5	N/A
2 hours	9.8	13.6	15.7	18.7	20.8	22.3	27.5	33.3	37.1	42.4	47.1	50.7	56.3	60.7	64.2	N/A
3 hours	11.5	15.9	18.2	21.7	24.0	25.8	31.6	38.0	42.3	48.2	53.4	57.4	63.6	68.4	72.3	N/A
4 hours	13.0	17.8	20.3	24.1	26.6	28.6	34.8	41.8	46.4	52.8	58.4	62.7	69.3	74.4	78.7	N/A
6 hours	15.3	20.8	23.7	27.9	30.8	33.0	40.0	47.9	52.9	60.0	66.2	71.0	78.3	83.9	88.5	N/A
9 hours	18.0	24.3	27.5	32.4	35.6	38.1	46.0	54.7	60.4	68.2	75.1	80.4	88.4	94.6	99.7	N/A
12 hours	20.2	27.1	30.7	36.0	39.5	42.1	50.7	60.2	66.3	74.8	82.1	87.8	96.4	103.0	108.4	N/A
18 hours	23.8	31.6	35.7	41.7	45.6	48.6	58.3	68.8	75.6	85.0	93.2	99.4	108.9	116.1	122.1	N/A
24 hours	26.7	35.3	39.8	46.3	50.6	53.9	64.3	75.7	83.0	93.1	101.9	108.6	118.7	126.4	132.8	154.5
2 days	32.3	41.8	46.6	53.5	58.1	61.7	72.4	84.1	91.5	101.7	110.4	117.1	127.1	134.7	140.9	161.9
3 days	37.0	47.3	52.5	59.9	64.7	68.3	79.7	91.9	99.5	110.0	119.0	125.7	135.9	143.6	149.8	171.0
4 days	41.4	52.3	57.8	65.6	70.7	74.5	86.4	99.0	107.0	117.7	126.9	133.9	144.3	152.1	158.4	179.9
6 days	49.2	61.4	67.4	76.0	81.5	85.6	98.4	112.0	120.4	131.8	141.5	148.8	159.7	167.8	174.4	196.6
8 days	56.3	69.6	76.1	85.3	91.2	95.6	109.3	123.7	132.6	144.6	154.7	162.3	173.7	182.2	189.0	212.0
10 days	62.9	77.2	84.2	94.0	100.3	105.0	119.4	134.5	143.9	156.4	167.0	174.9	186.7	195.5	202.6	226.3
12 days	69.2	84.4	91.8	102.2	108.8	113.8	129.0	144.7	154.5	167.5	178.5	186.7	198.9	208.0	215.3	239.7
16 days	81.1	98.1	106.2	117.6	124.9	130.3	146.7	163.8	174.3	188.3	200.0	208.8	221.7	231.3	239.1	264.8
20 days	92.4	110.9	119.8	132.1	139.9	145.7	163.4	181.5	192.7	207.5	220.0	229.2	242.9	253.0	261.1	288.1
25 days	106.0	126.2	135.8	149.2	157.6	163.9	183.0	202.5	214.4	230.2	243.4	253.2	267.7	278.4	286.9	315.3

NOTES:
N/A Data not available
These values are derived from a Depth Duration Frequency (DDF) Model
For details refer to:
'Fitzgerald D. L. (2007), Estimates of Point Rainfall Frequencies, Technical Note No. 61, Met Eireann, Dublin',
Available for download at www.met.ie/climate/dataproducts/Estimation-of-Point-Rainfall-Frequencies_TN61.pdf

Appendix D. Flood Risk Map & Local Flood Report

Node Label	Water Level (OD) 10% AEP	Flow (m³/s) 10% AEP	Water Level (OD) 1% AEP	Flow (m³/s) 1% AEP	Water Level (OD) 0.1% AEP	Flow (m³/s) 0.1% AEP
01NAAS2400	81.27	N/A	81.45	N/A	82.23	N/A
09HART00185	87.74	6.86	88.16	11.97	88.49	18.39
09HART00177	87.27	6.97	87.64	11.90	88.11	21.39
09HART00137	84.82	N/A	85.25	N/A	85.63	N/A
09HART00096aD	82.46	7.20	82.73	11.54	82.91	20.20
09HAYN00008	83.88	1.47	84.07	2.09	84.33	3.56
09JOHN00004	83.47	0.08	84.11	0.39	84.37	0.91
09MORE00841	83.27	8.80	83.68	14.66	84.21	25.36
09MORE00834	83.14	10.33	83.53	16.82	83.84	30.47
09MORE00806	82.42	10.44	82.84	18.06	83.02	30.94
09MORE00782	82.08	N/A	82.51	N/A	82.83	N/A
09TOBE00050	89.64	0.11	89.68	0.20	89.74	0.37
09TOBE00007	87.27	0.33	87.64	0.44	88.11	2.62



IMPORTANT USER NOTE:
THE VIEWER OF THIS MAP SHOULD REFER TO THE DISCLAIMER, GUIDANCE NOTES AND CONDITIONS OF USE THAT ACCOMPANY THIS MAP.

Legend

- 10% Fluvial AEP Event
- 1% Fluvial AEP Event
- 0.1% Fluvial AEP Event
- Modelled River Centreline
- AFA Extents
- Embankment
- Wall
- Defended Area
- 1% AEP Standard of Protection of Flood Defence (Walls / Embankments)
- Node Point
- Node ID Node Label

Turnings/Killeenmore model downstream of this point.

09MORE00782 09HART00096aD 09HART00137 09HART00177 09HART00185 09TOBE00007 09MORE00806 09MORE00834 09HAYN00008 09MORE00841 09JOHN00004 01NAAS2400 09TOBE00050

PALMERSTOWN TOBERTON

291400 291600 291800 292000 292200 292400 292600 292800 293000
222400 222200 222000 221800 221600 221400

0 50 100 200 300 400 500 Metres

FINAL

REV:	NOTE:	DATE:
01	Amendments made to wire grid.	20/09/16

EASTERN CFRAM STUDY
CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT

OPW Oifig na nOibreacha Poiblí The Office of Public Works
RPS

The Office of Public Works
Jonathan Swift Street
Trim
Co Meath

Elmwood House
74 Boucher Road
Belfast
BT12 6RZ

T +44(0) 28 90 667914
F +44(0) 28 90 668286
W www.rpsgroup.com
E ireland@rpsgroup.com

Map: Naas Fluvial Flood Extents

Map Type:	EXTENT
Source:	FLUVIAL
Map Area:	HPW
Scenario:	CURRENT
Drawn By : C.C.	Date : 20 September 2016
Checked By : T.D.	Date : 20 September 2016
Approved By : G.G.	Date : 20 September 2016
Drawing No. :	E09NAA_EXFCD_F1_20
Map Series :	Page 20 of 21
Drawing Scale :	1:5,000 @ A3

OPW National Flood Hazard Mapping

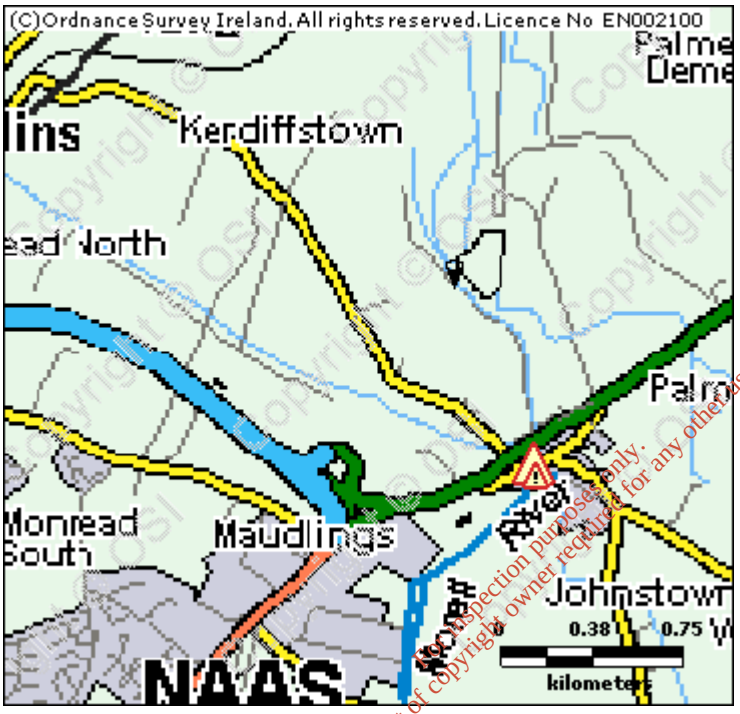
Summary Local Area Report

This Flood Report summarises all flood events within 2.5 kilometres of the map centre.

The map centre is in:

County: Kildare

NGR: N 912 219



Map Scale 1:34,079

Map Legend	
	Flood Points
	Multiple / Recurring Flood Points
	Areas Flooded
	Hydrometric Stations
	Rivers
	Lakes
	River Catchment Areas
	Land Commission *
	Drainage Districts *
	Benefiting Lands *

* Important: These maps do not indicate flood hazard or flood extent. Thier purpose and scope is explained in the Glossary.

4 Results

1. Monread Sallins Co Kildare 30th Nov 2009
Start Date: 29/Nov/2009
County: Kildare
Flood Quality Code:3
Additional Information: Reports (2) More Mapped Information

2. Morell Johnstown Nov 2000
Start Date: 05/Nov/2000
County: Kildare
Flood Quality Code:2
Additional Information: Reports (2) More Mapped Information

3. Morell Johnstown June 1993
Start Date: 10/Jun/1993
County: Kildare
Flood Quality Code:3
Additional Information: Reports (2) More Mapped Information

4. Morell Johnstown Recurring
Start Date:
County: Kildare
Flood Quality Code:3
Additional Information: Reports (2) More Mapped Information

Report Produced: 21-Nov-2016 12:21

OPW National Flood Hazard Mapping

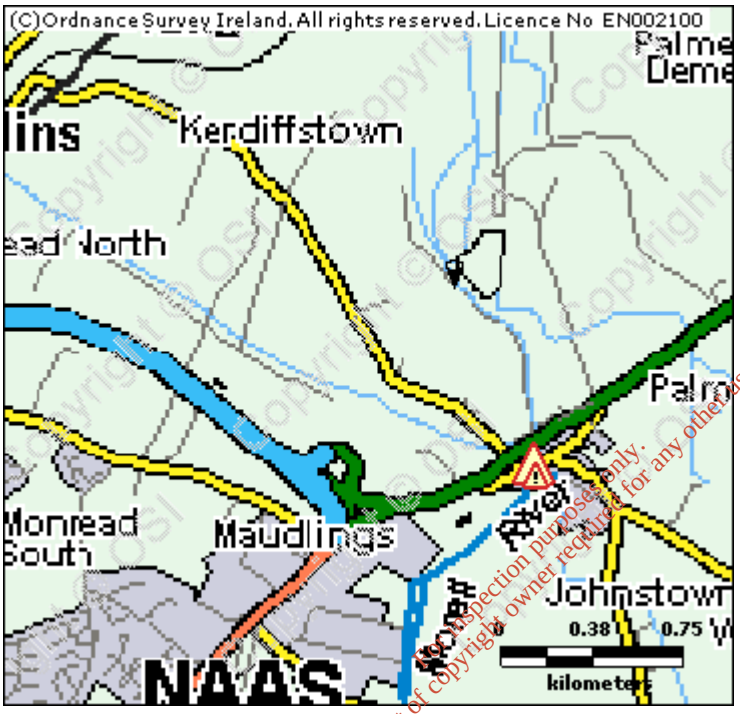
Summary Local Area Report

This Flood Report summarises all flood events within 2.5 kilometres of the map centre.

The map centre is in:

County: Kildare

NGR: N 912 219



Map Scale 1:34,079

Map Legend	
	Flood Points
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	Hydrometric Stations
	Rivers
	Lakes
	River Catchment Areas
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	Benefiting Lands *

* Important: These maps do not indicate flood hazard or flood extent. Thier purpose and scope is explained in the Glossary.

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Additional Information: Reports (2) More Mapped Information

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Flood Quality Code:3
Additional Information: Reports (2) More Mapped Information

4. Morell Johnstown Recurring
Start Date:
County: Kildare
Flood Quality Code:3
Additional Information: Reports (2) More Mapped Information

Report Produced: 21-Nov-2016 12:21

Appendix E. Peak Run-off Rates

Peak run-off rates and open channels summary table									
Channel reference	Catchment Area (ha)	Flow rate (m^3/s)	Gradient 1 : X (m)	Base width (m)	Channel Depth (m)	Channel bank slope	Top channel width (m)	Length (m)	Gravel lining (Y/N)
CH01	2.49	0.245	172	0.50	0.40	1 in 3	2.90	138.00	N
CH02	2.68	0.254	172	0.50	0.40	1 in 3	2.90	162.00	N
CH03	1.15	0.188	150	0.50	0.40	1 in 3	2.90	314.00	N
CH04	2.75	0.451	87	0.45	0.43	1 in 3	3.03	391.00	Y
CH05	4.16	0.390	150	0.50	0.45	1 in 3	3.20	361.00	N
CH06	0.57	0.047	300	0.45	0.30	1 in 3	2.20	166.00	N
CH07	3.90	0.639	80	0.45	0.50	1 in 3	3.45	98.00	Y
CH08	6.90	0.983	300	0.55	0.65	1 in 3	4.45	269.00	N
CH09	3.00	0.344	300	0.50	0.50	1 in 3	3.50	347.00	N
CH10	7.60	0.851	40	0.50	0.46	1 in 3	3.26	242.00	Y
CH11	0.91	0.149	500	0.50	0.40	1 in 3	2.90	380.00	N
CH12	0.73	0.120	300	0.50	0.35	1 in 3	2.60	84.00	N
CH13	15.23	1.610	150	0.50	0.70	1 in 3	4.70	197.00	Y
CH14	0.52	0.085	80	0.50	0.30	1 in 3	2.30	217.00	N
CH15	0.72	0.059	100	0.50	0.30	1 in 3	2.30	254.00	N
CH16	0.29	0.033	150	0.50	0.30	1 in 3	2.30	107.00	N
CH17	0.55	0.090	200	0.50	0.35	1 in 3	2.60	143.00	N
CH18	1.91	0.313	200	0.50	0.45	1 in 3	3.20	184.00	N
CH19	0.19	0.009	300	0.10	0.25	1 in 3	1.60	118.00	N
CH20	1.33	0.065	300	0.45	0.30	1 in 3	2.25	210.00	N

Appendix F. Q_{BAR} Calculations

HR Wallingford
Working with water

Greenfield runoff estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Patryk Ciesla
Site name:	Kerdiffstown Landfill Remediation Project
Site location:	Kerdiffstown Landfill

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site coordinates

Latitude:	53.24040° N
Longitude:	6.62838° W

Reference:	5902657
Date:	2017-03-09T08:29:34

Methodology	IH124

Site characteristics

Total site area (ha)	30.82

Methodology

Qbar estimation method	Calculate from SPR and SAAR
SPR estimation method	Calculate from SOIL type

	Default	Edited
SOIL type	2	2
HOST class	---	---
SPR/SPRHOST	0.3	0.3

Hydrological characteristics

	Default	Edited
SAAR (mm)	831	831
Hydrological region	12	12
Growth curve factor: 1 year	0.85	0.85
Growth curve factor: 30 year	2.13	2.13
Growth curve factor: 100 year	2.61	2.61

Notes:

(1) Is Q_{BAR} < 2.0 l/s/ha?

(2) Are flow rates < 5.0 l/s?

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite may be a requirement for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Qbar (l/s)	68.65	68.65
1 in 1 year (l/s)	58.35	58.35
1 in 30 years (l/s)	146.23	146.23
1 in 100 years (l/s)	179.18	179.18

32EW5604-00-044-2

Discharge pipework to soakaway

Open channel ref. CH01
Top width=2.90m
Base width=0.50m
Depth=0.40m
Ditch bank slope 1 in 3

Proposed soakaway

1200mm internal diameter manhole with isolation penstock

Pond 1
Storage Volume=2452m3
Maximum water depth=1.00m+0.50m freeboard
Assumed TWL=94.5m OD (subject to confirmation upon final detailed design)

Open channel ref. CH02
Top width=2.90m
Base width=0.50m
Depth=0.40m
Ditch bank slope 1 in 3

Open channel ref. CH04
Top width=3.03m
Base width=0.40m
Depth=0.43m
Ditch bank slope 1 in 3

Open channel ref. CH19
Top width=1.6m
Base width=0.40m
Depth=0.25m
Ditch bank slope 1 in 3

Open channel ref. CH20
Top width=2.25m
Base width=0.45m
Depth=0.3m
Ditch bank slope 1 in 3

Open channel ref. CH05
Top width=3.20m
Base width=0.50m
Depth=0.45m
Ditch bank slope 1 in 3

Road/car park drainage which includes:
- road gullies
- oil/silt interceptors
- underground pipework

Open channel ref. CH06
Top width=2.20m
Base width=0.45m
Depth=0.30m
Ditch bank slope 1 in 3

Open channel ref. CH10
Top width=3.20m
Base width=0.50m
Depth=0.46m
Ditch bank slope 1 in 3

Open channel ref. CH13
Top width=4.70m
Base width=0.50m
Depth=0.70m
Ditch bank slope 1 in 3

Open channels ref. CH14 & CH15,
Top width=2.30m
Base width=0.50m
Depth=0.30m
Ditch bank slope 1 in 3

Road drainage/car park drainage which includes:
- road gullies
- oil/silt interceptors
- underground pipework

Manhole with penstock to allow isolation of flows from gas and leachate infrastructure compound in the event of contamination

Flat laying infiltration swale along northern mound toe.
Swale size is subject to confirmation following percolation tests on site to determine permissible infiltration rate.

Open channel ref. CH03
Top width=2.90m
Base width=0.50m
Depth=0.40m
Ditch bank slope 1 in 3

Open channel ref. CH07
Top width=3.45m
Base width=0.45m
Depth=0.50m
Ditch bank slope 1 in 3

Open channel ref. CH08
Top width=4.45m
Base width=0.55m
Depth=0.65m
Ditch bank slope 1 in 3

Open channel ref. CH09
Top width=3.50m
Base width=0.50m
Depth=0.50m
Ditch bank slope 1 in 3

Open channel ref. CH11
Top wicth=2.90m
Base width=0.50m
Depth=0.40m
Ditch bank slope 1 in 3

Outfall to Morell River
Bank level=80.80m OD
Pipe invert level=80.20m OD
(levels subject to confirmation)

225mm dia. discharge pipework to Morell River

Approximate extent of existing rock armour

1200mm internal diameter manhole with isolation penstock

Auto sampling / monitoring point

Pond 3
Volume=2777m3
Overall water depth=1.60m+0.5m freeboard.
GL=84.80m OD
TWL=84.30m OD
BWL=82.70m OD
Pond invert level=82.30m OD

Open channel ref. CH17
Top width=2.60m
Base width=0.50m
Depth=0.35m
Ditch bank slope 1 in 3

Open channel ref. CH12
Top width=2.60m
Base width=0.50m
Depth=0.35m
Ditch bank slope 1 in 3

Culvert connecting two ponds (refer to note 5)

Pond 2
Volume=13235m3
Overall water depth=1.60m+0.5m freeboard.
GL=85.00m OD
TWL=84.50m OD
BWL=82.90m OD
Pond Invert Level=82.50m OD

Open channel ref. CH18
Top width=3.20m
Base width=0.50m
Depth=0.45m
Ditch bank slope 1 in 3

Kerdiffstown House
Pool
Chapel
Kerdiffstown Road
QUARRY
Church (in ruins)
Morell River
Palmerstown House Estate and Golf Course
Lake
Canal Feeder Stream
Spring
Maudlings
Roseborough

N

KEY:

- Licence boundary
- Approximate extent of existing rock armour
- Proposed storage pond
- Proposed ditch/open channel
- Proposed infiltration swale/trench
- Proposed underground pipework
- Proposed manhole / chamber
- Proposed outfall
- Direction of flows
- Proposed soakaway
- Surface water emission point
- Ground emission point
- Existing Copse (mature trees)
- GL — Ground Level
- TWL — Top Water Level
- BWL — Bottom Water Level

NOTES:

1. All levels are to metres OD (Malin Head) unless stated otherwise.
2. All dimensions are in millimetres unless stated otherwise.
3. This drawing should be read in conjunction with the Surface Water Management Plan.
4. The size and shape of the proposed soakaway is to be confirmed during detailed design phase.
5. The size and general arrangement of culvert between Pond 2 and Pond 3 is to be confirmed during detailed design phase.
6. For section details refer to Drawings 32EW5604-00-045 and 32EW5604-00-046. (In Surface Water Management Plan).
7. Drainage from upgraded road will tie into the existing road.

0 50 100 150 200 m

SCALE 1 : 2000

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
2	07/08/2017	EIAR SUBMISSION	AR	CD	CD	RR
1	30/06/2017	EIAR SUBMISSION	KMA	CD	CD	RR
0	14/12/2016	EIS SUBMISSION	VT	PHC	AHK	RR

JACOBS
Jacobs, Merrion House, Merrion Road, Dublin 4
Tel:+353(1)269 5666
www.jacobs.com

Client: Kildare County Council / Comhairle Contae Chill Dara

Project: KERDIFFSTOWN LANDFILL REMEDIATION PROJECT

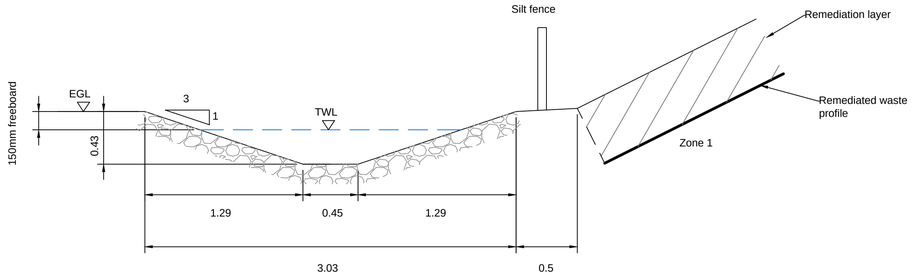
Drawing title: SURFACE WATER MANAGEMENT PLAN
OUTLINE DRAINAGE LAYOUT

Drawing status: EIAR SUBMISSION

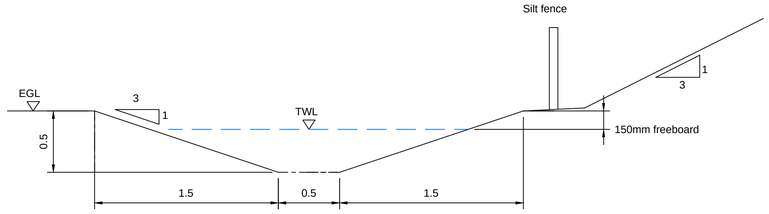
Scale	1:2000 @A1	DETAILS SHOWN ARE NOT FOR CONSTRUCTION PURPOSES HENCE DRAWING SHOULD NOT BE SCALED
Jacobs No.	32EW5604	
Client no.	6286	

Drawing number: 32EW5604-00-044
Rev: 2

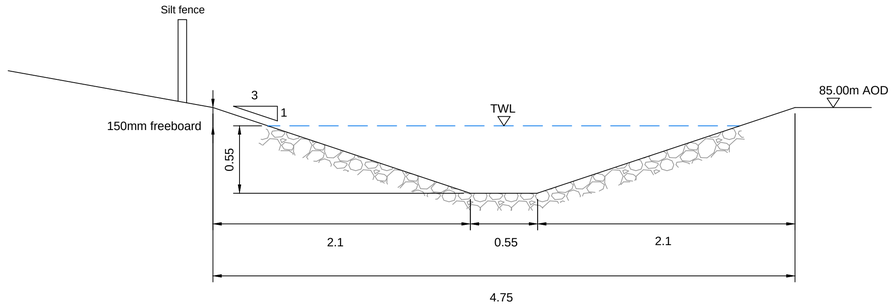
\\iedub1-fil001\j\Sustainable Solutions\Kerdiffstown Landfill\5 - Drawings\CAD\Engineering Design - EIS\32EW5604-00-044-2.dwg - 11/08/2017 10:23:59 - SWMP - atroberts



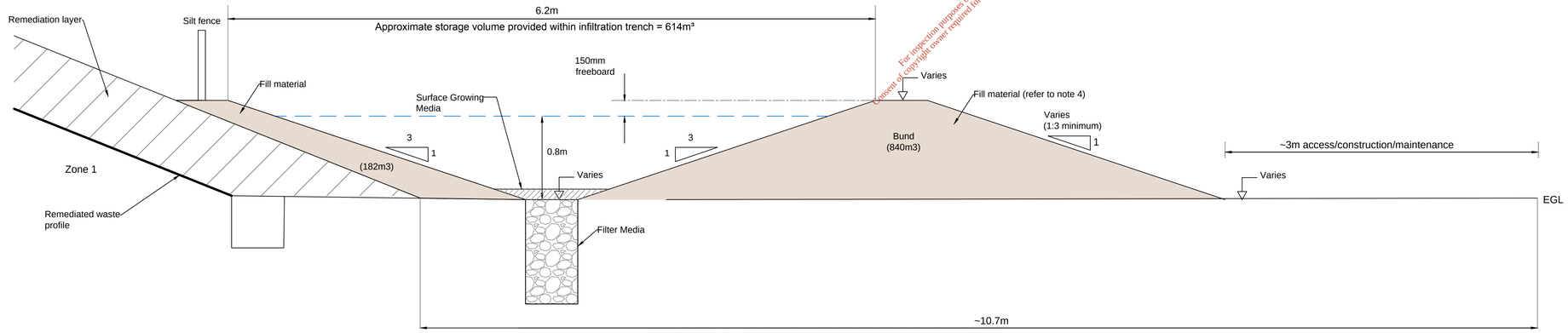
SECTION A-A CHANNEL REF. CH04
TYPICAL DRAINAGE CHANNEL SECTION
(WITH GRAVEL LINING)
SCALE 1:25



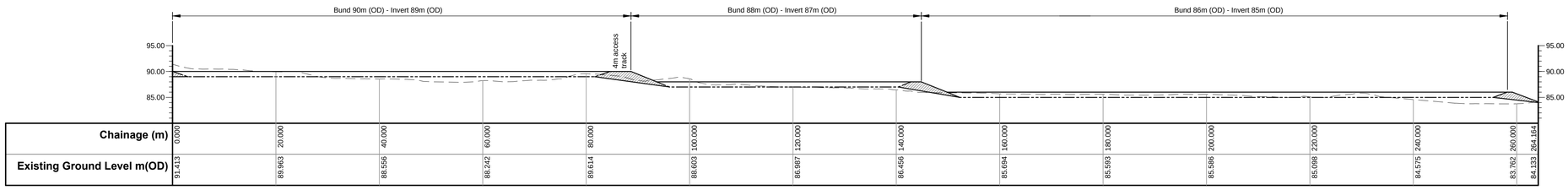
SECTION C-C - CHANNEL REF. CH09
TYPICAL DRAINAGE CHANNEL SECTION
(WITHOUT GRAVEL LINING)
SCALE 1:25



SECTION B-B - CHANNEL REF. CH13
TYPICAL DRAINAGE CHANNEL SECTION
(WITH GRAVEL LINING)



SECTION D-D - INFILTRATION SWALE INDICATIVE DETAIL
SCALE 1:25



INFILTRATION SWALE - INDICATIVE LONG SECTION
SCALE 1:500

KEY:

EGL Existing Ground Level

TWL Top Water Level

NOTES:

1. All levels are in metres OD (Malin Head).
2. All dimensions are in millimeters unless stated otherwise.
3. Silt fence to remain in place until the vegetation within restoration areas and mounds have been well established and perimeter ditches grassed.
4. The details of the proposed bund will be confirmed during detailed design. The bund material will need to prevent seepage along plane between fill and existing ground.

0 10 20 30 40 50m
SCALE 1 : 500

0 0.5 1.0 1.5 2.0 2.5 m
SCALE 1 : 25

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Revd	Apprv'd
2	07/08/2017	EIAR SUBMISSION	AR	CD	CD	RR
1	30/06/2017	EIAR SUBMISSION	AR	CD	CD	RR
0	14/12/2016	DRAFT EIS SUBMISSION	VT	PHC	AHK	RR

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Client
Kildare County Council
Comhairle Contae Chill Dara

Project
KERDIFFSTOWN LANDFILL
REMEDIATION PROJECT

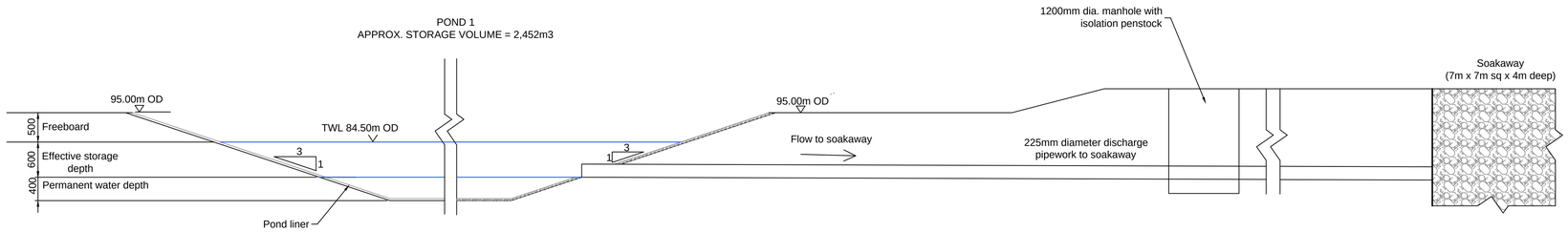
Drawing title
SURFACE WATER MANAGEMENT PLAN
CHANNEL AND INFILTRATION
SWALE DETAILS

Drawing status
EIAR SUBMISSION

Scale	AS SHOWN	DO NOT SCALE
Jacobs No.	32EW5604	
Client No.	6286	

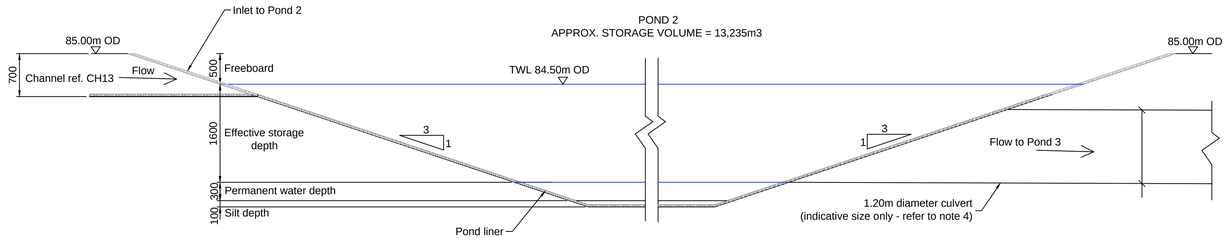
Drawing number
32EW5604-00-045

Rev
2



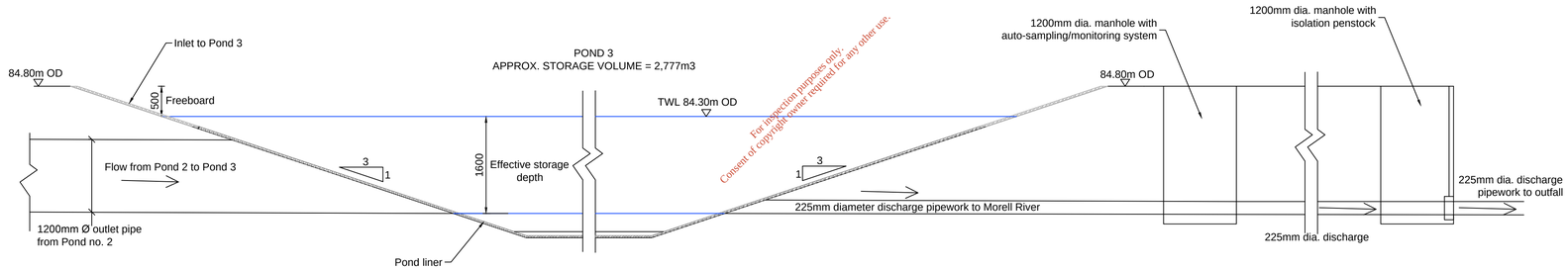
SECTION F-F - POND 1

SCALE (1:50)



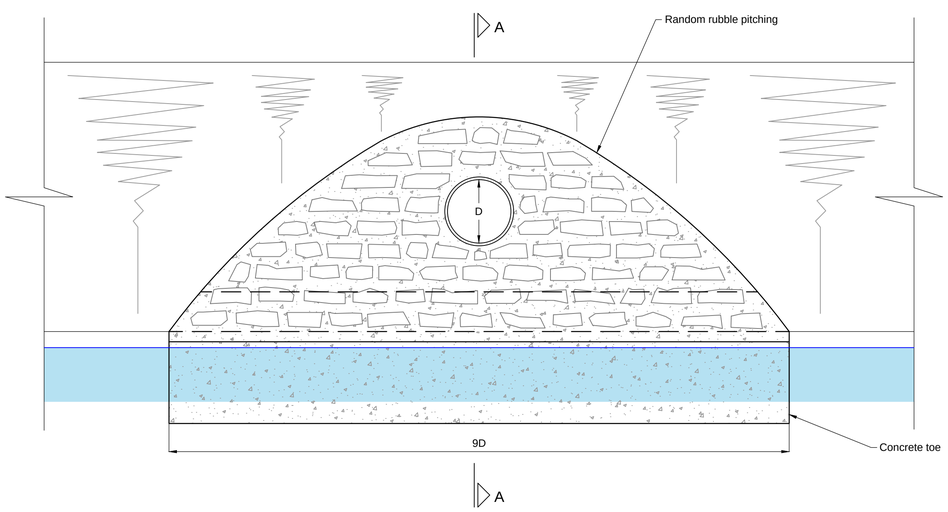
SECTION E-E - POND 2

SCALE (1:50)



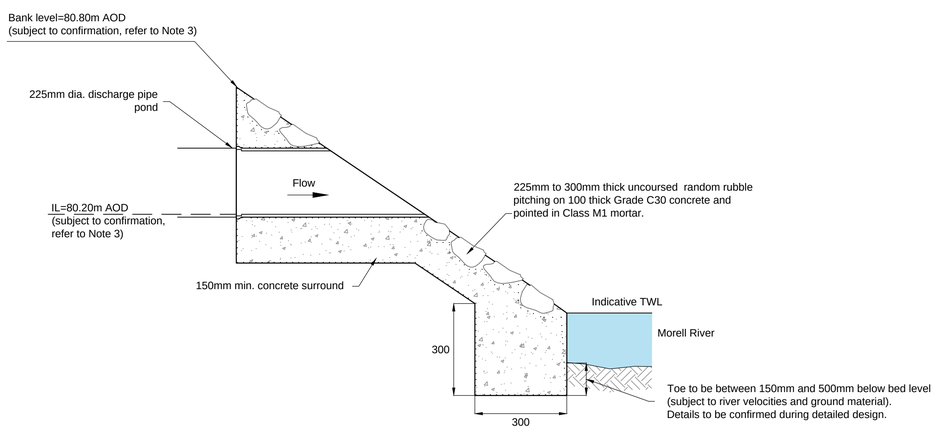
SECTION E-E (continuation) POND 3

SCALE (1:50)



TYPICAL OUTFALL FRONT ELEVATION

(SCALE 1:10)



SECTION A-A

(SCALE 1:10)

NOTES:

1. All levels metres OD (Malin Head) unless stated otherwise.
2. All dimensions are in millimeters unless stated otherwise.
3. Both ponds to be lined with an impermeable heavy duty geomembrane with a stone layer placed on top of the liner to protect it during maintenance/emptying operations. Specification for stone layer to be confirmed in detailed design. A growing medium/top soil to be placed on top of the stone layer to provide ecological enhancement (details to be confirmed during detailed design by environmental engineers and landscapers).
4. The size and general arrangement of culvert between Pond 2 & Pond 3 is to be confirmed during detailed design phase.

0 1 2 3 4 5 m

SCALE 1 : 50

0 0,1 0,5 1.0 m

SCALE 1 : 10

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
2	07/08/2017	EIAR SUBMISSION	AR	CD	CD	RR
1	30/06/2017	EIAR SUBMISSION	AR	CD	CD	RR
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Client: Kildare County Council
Comhairle Contae Chill Dara

Project: KERDIFFSTOWN LANDFILL REMEDIATION PROJECT

Drawing title: SURFACE WATER MANAGEMENT PLAN POND AND OUTFALL DETAILS

Drawing status: EIAR SUBMISSION

Scale	AS SHOWN @ A1	DETAILS SHOWN ARE NOT FOR CONSTRUCTION PURPOSES HENCE DRAWING SHOULD NOT BE SCALED
Jacobs No.	32EW5604	
Client no.	6286	

Drawing number: 32EW5604-00-046 Rev: 2