BALLYNACARRICK LANDFILL SITE OPERATIONAL REPORT

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1 INTRODUCTION

This Operational Report has been prepared as part of the licence review application. Ballynacarrick Landfill Site is located at Ballynacarrick, Ballintra, Co Donegal and occupies an area of approximately 9 hectares. The facility, as shown on Drawing IBR1279/LR100 Site Location (Appendix A), is located in a rural setting and surrounding land use is agricultural. The site lies approximately 3km southeast of Ballintra and 7km south of Laghey, Co Donegal. The National Grid Reference for the facility is 193531E 367597N.

Ballynacarrick Landfill Site operated from c.1980 until closure in July 2012 due to the capacity of the facility being exhausted. The site was initially operated as an unlined landfill with peat removed in the eastern part of the site to the top of the glacial deposits, and waste was tipped directly onto the surface of the glacial till. An engineered cell was constructed 2002, with an extension to the west of the site being developed in 2004/05. The extension consisted of two engineered cells (Phase 1 and Phase 2). The site has been progressively restored on a phased basis in accordance with the Waste Licence (Ref: W0024-04) since 2004 with the final restoration being completed in 2013.

Since the granting of the Waste Licence a significant investment in the restoration of the site, including the installation of leachate management infrastructure, has been made by Donegal County Council (DCC). Leachate management infrastructure has been installed progressively as the site has been developed and restored in accordance with the current waste licence issued by the Environmental Protection Agency (Licence Ref: W0024-04).

An Integrated Constructed Wetland (ICW) as agreed with the Office of Environmental Enforcement will be installed at the landfill facility to provide an effective, sustainable and self-sufficient leachate management and treatment system which minimises, and where possible eliminates, the requirement to export leachate (19 07 03 landfill leachate other than those mentioned in 19 07 02) from the site to Letterkenny WwTW for final treatment. The effluent from the leachate treatment plant will be diverted to ICW for tertiary treatment and discharge to the adjacent waterbody.

1.1 Waste Activities Carried Out At The Facility

The licensed disposal activities, in accordance with the Third Schedule and Fourth Schedule of the Waste Management Act, 1996, are restricted to those listed as per Schedule A: Waste Activities in the current licence (Table 1.1).

Table 1.1 Classes Of Activity Concerned

D and R Codes	Class as per current licence[1]	
Third Schedule of the Waste Management Act		
D5 Specially engineered landfill, (e.g. placement into lined discrete cells which are capped and isolated from one another and the environment, etc.)	**Class 5**	Specially engineered landfill, including placement into lined discrete cells which are capped and isolated from one another and the environment. [Principal Activity]
D8 Biological treatment not specified elsewhere in this Annex which results in final compounds or mixtures which are discarded by means of any of the operations numbered D1 to D12	**Class 6**	Biological treatment not referred to elsewhere in this Schedule which results in final compounds or mixtures which are disposed of by means of any activity referred to in paragraphs 1. to 10. of this Schedule.
D15 Storage pending any of the operations numbered D1 to D14 (excluding temporary storage, pending collection, on the site where the waste is produced	**Class 13**	Storage prior to submission to any activity referred to in a preceding paragraph of this Schedule, other than temporary storage, pending collection, on the premises where the waste concerned is produced.
Fourth Schedule of the Waste Management Act		

[1] Waste Licence W0024-04 Schedule A : Waste Activities

D and R Codes	Class as per current licence[1]	
R3 Organic substance recycling/reclamation	**Class 2**	Recycling or reclamation of organic substances which are not used as solvents (including composting and other biological transformation processes).
R4 Metal recycling/reclamation	**Class 3**	Recycling or reclamation of metals and metal compounds.
R5 Inorganic substance recycling/reclamation	**Class 4**	Recycling or reclamation of other inorganic materials:
R13 Storage of waste pending any of the operations numbered R1 to R12 (excluding temporary storage, pending collection, on the site where the waste is produced)	**Class 13**	Storage of waste intended for submission to any activity referred to in a preceding paragraph of this Schedule, other than temporary storage, pending collection, on the premises where such waste is produced.

2 PROCESS DESCRIPTION (ICW)

The effluent from the existing leachate treatment plant will be diverted to ICW for tertiary treatment and discharge to the adjacent waterbody.

2.1 Integrated Constructed Wetland Treatment (ICW's)

Wetlands both natural and constructed have an innate ability to cleanse water through physical, chemical and biological processes. The main treatment processes include;

- Uptake and transformation of contaminants/nutrients by micro-organisms and plants,
- Breakdown and transformation of contaminants/pollutants by micro-organisms and plants,
- Filtration and chemical precipitation through contact with substrate and plant litter,
- Settling of suspended particular matter,
- Chemical transformation of pollutants,
- Absorption and ion exchange on the surface of plants, sediment, and litter (of particular relevance to the capture and storage of phosphorous),
- Predation and natural die-off of pathogens (e.g. E. coli and Cryptosporidium).

2.2 Leachate Treatment Plant Purpose and Description

The purpose of the facility is to manage raw leachate abstracted from Ballynacarrick Landfill Site, to treat, and to discharge to the existing balance tank at the site for subsequent export to Letterkenny WwTW. Following completion of works associated with Phase 2 the effluent form the leachate treatment plant will be diverted to Integrated Constructed Wetlands for tertiary treatment and discharge to adjacent waterbodies. The proposed leachate system is described below.

2.3 Leachate Generation and Collection

The existing leachate collection infrastructure has been developed over the lifespan of the landfill site to maintain environmental performance. The leachate collection infrastructure is proposed to remain largely unchanged however amendments shall be made to the pipework on site to allow for the redirection of flow as laid out below. In addition to the alterations, two leachate pumping mains shall be installed as detailed on IBR1279/LR110 Leachate /ICW system to facilitate the diversion of existing flows to the new leachate treatment plant.

The collection sump along the northern boundary will be disconnected from the pipework to the existing balancing tank and new connection shall be formed between it and the proposed leachate main south of the sump.

An existing pipe network connects Leachate Pumps 2, 3 & 4 and the existing balancing tank. The pipework shall remain in place however non return valves shall be reversed to direct extracted leachate from these locations to the proposed leachate treatment tank instead of the existing tank compound.

Monitoring in Leachate Pump 5 has identified high levels of iron which may cause blockages within the pipework if pumped directly to the proposed treatment plant. It is proposed that the leachate collected here will continue to flow to the existing balancing tank where it will then be pumped through larger diameter pipework and more capable pumps to the proposed treatment tanks.

The pipework between leachate Pumps 1 and 7 and the existing balancing tank shall be decommissioned and flow redirected in a westerly direction, predominantly via existing pipework, along the landfill's southern and western boundaries towards to the proposed leachate treatment plant.

In addition to the leachate extraction points across the site a Groundwater Pumping Station in the north-west corner outside of the landfill bounds is contaminated, albeit with levels of contamination which are typically lower than are currently present in treated leachate.

Given the variability in flows abstracted from the Groundwater Pumping Station and limited treatment which may be undertaken on this effluent by the leachate treatment plant it is proposed that at least 20m^3 of leachate will be pumped from this chamber per day to the proposed leachate treatment tank (equivalent to baseflows at this location). Where capacity is available in the proposed treatment system additional leachate may be received by the treatment system for aeration. All additional leachate over and above this and abstracted from the Groundwater Pumping Station will be fed directly to the new balance tank for onward feeding to the Integrated Constructed Wetland for final treatment and subsequent discharge.

The pumps will be controlled by an existing SCADA system located in the existing site offices which will require modifications and upgrades to receive data associated with the revised treatment and control methodology.

2.4 Treatment Performance

The collection system will deliver raw leachate from the site to the proposed leachate treatment tank as outlined in Section 2.3 above. The proposed glass lined steel treatment tank will be located in a bunded area to the north Phase 2 as shown in Drawing IBR1279/LR110 Preliminary ICW Pond and Leachate Management Layout. Existing levels will allow the 17.94m diameter 4.86m high tank to be located approximately 3.75m lower than the level of the existing access road around Phase 2 and close an existing disused building. The tank will allow for a 0.75m freeboard above liquid level.

The top of the proposed treatment tank will be covered and the top of the tank will be at 96.36mOD, with the top of the cover expected to be at 97.36mOD. The tank compound will be surrounded by a 2.8m high close boarded absorbent acoustic barrier for screening purposes.

The proposed treatment system will be designed in detail by a specialist contractor. It is proposed that the system will use aerators mounted on the external face of the treatment tank at ground level to increase oxygen levels to enable nitrification processes within the proposed tank to take place. This process will reduce the Ammoniacal Nitrogen and COD concentrations of up to 103m^3/day of leachate abstracted from the site to at least the effluent parameters currently achieved by the existing leachate treatment system.

The operation of the pumps and aerator will be controlled automatically via a Programmable Logic Controller (PLC) and operator panel with supervisory control and data acquisition (SCADA) provision in the onsite offices. High level alarms will warn of potential overtopping of the tanks. The alarm system will be connected to shut off valves on the leachate pumps throughout the site to prevent further leachate from entering the treatment tank. The leachate treatment processes at the site and all discharges will be managed by a technically competent person to meet discharge requirements. The treatment process will be monitored continuously using suitable probes and sensors. In addition volumes of leachate extracted and treated will be measured using flowmeters.

It is expected that leachate will continue to be treated on a batched basis overnight as is currently the case at Ballynacarrick LFS. Following aeration and a settlement period to allow for settlement of solids within the treated effluent, leachate will be drawn off at high level and forwarded to a balance tank within the treatment compound for storage. The volume of treated leachate moved from the treatment tank to the balance tank will largely be equivalent to the daily inflow treated during the previous day. The purpose of this balance tank is primarily to permit onward movement of effluent to the Integrated Constructed Wetland at a regulated, consistent rate over a 24-hour period. Pending completion of Phase 2 of the works this balance tank will allow for excess leachate abstracted from the site to be stored and all treated leachate to be forwarded to the existing Balance Tank at the site entrance for collection by tanker and export to Letterkenny WwTW

The proposed balance tank will provide capacity to store 235m^3 (equivalent to approximately 2 days treatment capacity) and will be covered in a similar manner to the proposed treatment tank.

2.5 Design

The infrastructure for the storage of leachate collection on site shall be designed in detail with reference to the IPC Guidance Note: Guidance Note on Storage and Transfer of Materials for Scheduled Activities as published by the Environmental Protection Agency. For the purposes of this preliminary design the key measures required to comply with this guidance have been considered and outlined.

The design and operation of the proposed treatment works will be in compliance with the Safety, Health and Welfare at Work Act (1989). This states that all facilities must complete a risk assessment to determine the risk of pollution associated with it. As such facilities must be designed, installed, operated and maintained in

a manner that does not allow for polluting substances to escape into the surrounding environment. In the event of escape substances are required to be properly managed.

2.6 Containment Bunding

The proposed glass lined steel treatment tank will be located in a bunded area between the northern site boundary and existing landfill access track as shown on Drawing IBR1279/LR110 Preliminary ICW Pond and Leachate Management Layout.

The provision of secondary containment is required due to the hazardous nature of the leachate being stored, in the event of loss in sealing or escaping fluid from the proposed treatment tanks. Retention is required in overground facilities where the Water Hazard Class (WHC) is 1,2 or 3 (i.e. the material stored is hazardous to waters) where the total volume of all containers is greater than 1m3. For the purposes of this guidance leachate is considered WHC 3 where it poses a severe hazard to waters.

The proposed tanks, control panels and valve work will be contained within a concrete bunded system designed to contain at least 110% of the capacity of the largest tank and at least 25% of the total volume of leachate which could be stored within the bunded area within the treatment and balance tanks.

The bund wall shall be formed of reinforced concrete to BS8007 (requirements from Class 2 or 3 containment) and shall not exceed 1.5m allow natural ventilation and not hinder access in the event of an emergency. The bund has been designed to be constructed to comply with the performance criteria summarised below:

- Impermeable to the extent that less than 2/3 of the material thickness shall be penetrated by escaped liquids
- Capable of withstanding static and dynamic loading associated with release of liquid from storage tanks, release of water form hire hose operations and wind loading
- Capable of resisting the effect of weather, ground conditions and abrasion (durability of 50 years unless otherwise specified)
- Structurally independent from the primary containment
- Sufficiently accessible for inspection and maintenance in line with health and safety requirements – providing a minimum space of 0.75m between primary tanks and bund walls

2.7 Leachate Monitoring and Level Control

Ballynacarrick Landfill Site is closed. The site has been fenced off and is kept locked at all times when the facility is unsupervised. The Landfills Operations Manager is currently based at Ballynacarrick landfill site. Leachate will be extracted from the site and pumped via leachate pumping mains to the new treatment compound. Flow of leachate to the treatment system shall be controlled via a SCADA system and PLC/HMI based on level readings within the collection points and total daily flows which can be accommodated by the treatment system.(with flow measurements recorded via a flow meter on the rising main). Flow of leachate shall also be recorded on the PLC /HMI within the primary control panel. The monitoring and control infrastructure will be housed in a GRP cabin located at high level within the leachate treatment compound.

2.8 Leachate Discharge

Discharge rates from the ICW systems will be variable depending on the volumes to be treated and on climatic conditions, with higher rates of discharge during the winter months and reduced or no discharges during the summer months. The discharge rates will be proportional to flow rates in the receiving waters, i.e. during low flows in the stream there will be reduced flows discharging from the ICW (and at times will be eliminated as evapotranspiration rates exceed influent flow) and higher rates of discharge during wet weather when flow rates are higher in the receiving waters.

The flow estimates in the receiving water for the purposes of a mass balance assessment were derived from the EPA Hydronet tool. The Ballymagrorty_Scotch_010 waterbody disappears underground downstream of the proposed point of discharge resurfacing at the downstream end of the Ballymagrorty_Scotch_010 water body prior to discharge into Durnesh Lough. On this basis, and for the purposes of assessing the impact on the water body's supporting physico-chemical and water chemistry conditions and the potential impact on the

conservation objectives of the downstream European Sites, this was established as the appropriate location for the point of assessment.

As outlined above, the assessment when taking the 95 percentile low flow statistics into consideration is not applicable to the discharge from the ICW given that during low flow conditions there will be no or minimal discharge. Therefore, the mass balance assessment has been undertaken using an estimated maximum discharge flow of 0.0014 m^3/s and an estimate of the mean flows (Q30) based on the EPA Hydronet tool as a more appropriate flow statistic. This suggests that the flow rate within the Ballymagrorty_Scotch_010 watercourse is likely to be 0.302 m^3/s.

An Assimilative Capacity and Mass Balance Assessment has been undertaken within Ballymagrorty_Scotch_010 watercourse rather than Durnesh Lough itself. Given the dilution that would occur to any discharge from the watercourse into Durnesh Lough, the assessment undertaken is considered extremely conservative.

The assimilative capacity assessments and mass balance calculations have been calculated to measure the receiving water body's ability to assimilate the residual pollutants in the treated effluent discharged from the Integrated Constructed Wetlands, based on the above discharge concentrations, whilst still maintaining an acceptable level of water quality that will ensure the Environmental Objectives of the water body are not compromised. Details of the assessment are included in Waste Licence Review Application.

On the basis of the above assumptions the mass balance assessment indicates that the headroom utilised will remain below 11% for all contaminants of potential concern. This is deemed to be a conservative estimate given that the discharge from the ICWs are likely to be reduced during mean flow conditions when evapotranspiration from the ICW is likely to occur and inflow of influent from the LTP and site sources are also likely to be below the maximum design flow rate of 120m^3/day.

The management and operations at Ballynacarrick Landfill Site it will be via SCADA package which may be monitored remotely to assess and control the performance of the site treatment infrastructure. The site will be monitored and controlled remotely via a Web hosting accessible by authorised users via password. A unit operated via a data enabled Sim card will be fitted to take all alarms, flows, and general controls and site information from the PLC/HMI control panel. This information will be relayed to the monitoring centre at timed intervals and have the facility to send alarms to the appropriate people if required. The remote interface will display a live mimic of the plant displaying all data including flows and level information within the leachate collection sump.

2.9 Integrated Constructed Wetlands

In order to protect surface water drains within the landfill site and to minimise ingress of effluent being treated within the ICW to groundwater in adjacent lands it is proposed to line the ICW ponds with 1mm thick LLDPE and a protection geotextile. The format of lining system is outlined in Table 2.1 below.

Table 2.1 Proposed Lining Materials

Layer	Thickness (mm)	Properties	Purpose
Topsoil	150		To provide a growing medium for ICW Planting
Subsoil	400 minimum	Permeability of less than $1x10^{-8}$m/s	To provide a layer of protection against damage to the LLDPE layer, provide additional containment for leachate under treatment and form the containment structure of the ICW Ponds
LLDPE Liner and Protection Geotextile		Permeability of less than $5x10^{-11}$m/s	To provide a low permeable barrier to prevent infiltration of effluent into underlying groundwater
Regulating Layer	≤300		To provide a base level upon which the ICW Ponds may be constructed
Underlying Strata			

2.10 Surface Water Management

Incident rainfall on the ICW will be contained within the ICW ponds and discharged with the treated leachate effluent. Surface water generated by incident rainfall on the perimeter slopes of the ponds will be directed by overland and subsurface flows within the subsoil cover and surface water drainage geocomposite on the landfill site for management. Surface water generated by incident rainfall on the perimeter slopes of the ponds constructed in adjacent lands will ultimately discharge to existing field drains.

2.11 Leachate Treatment and ICW Design

2.11.1 Area Requirements

Integrated Constructed Wetlands operate on the retention and controlled flow of effluent through a series of level ponds planted with aquatic plants to breakdown, uptake and transform contaminants/pollutants by micro-organisms and plants. On the basis of expected leachate abstraction rates and management of contaminated groundwater from the Groundwater Pumping Station as outlined in Section 2.2 a preliminary assessment of the required treatment area of an Integrated Constructed Wetland is expected to be 1.89ha.

This area is subject to the proposed leachate treatment plant achieving similar levels of primary and secondary treatment as the existing leachate treatment plant as outlined in Section 2.3. On this basis, given the anticipated treatment efficacy of an Integrated Constructed Wetland of this scale, it is expected that the effluent quality from the proposed ICWs at Ballynacarrick Landfill Site' will be as outlined in the Table 2.2 below.

Table 2.2 Proposed Emission Limit Values

Parameter	Limit
pH	6-8
BOD	<20mg/l
COD	<50mg/l
Suspended Solids	<15mg/l
Orthophosphate	<0.1mg/l
Total Ammonia (as N)	<2mg/l
Cadmium	<0.5µg/l
Chromium	<1µg/l
Copper	<5µg/l
Lead	<1µg/l
Mercury	<0.5µg/l
Nickel	<20µg/l
Zinc	<50µg/l

Given the experiences of treatment at Churchtown Landfill Site (W0062-02) of similar leachate volumes and concentrations it is expected that the concentrations of Ammoniacal Nitrogen and BOD within the effluent discharge will be lower than the above concentrations. It should be noted however that the scale of the ICW network at Ballynacarrick LFS will make management of water levels within the ponds more difficult, particularly in dry weather conditions, and consequently may adversely affect the treatment performance of the ICW.

Baseflow from the Groundwater Pumping Station generally generates approximately 20m^3/day, which will remain in flow for some period following commencement of a drought period and will continue to contribute to the flows to the ICW Ponds. Similarly, Pump 5 can be expected to abstract leachate for a prolonged period during dry conditions. Existing flows within the surface water drains are typically originating in peat bogs, and tend to continue flowing, albeit at reduced flow rates, during drought conditions. This however tends to result in increased concentrations of contaminants in surface water flows (from unlined areas of the site) and a manual system is expected to be installed to allow site operatives to divert surface water flows from the vicinity of SW3 to the Groundwater Pumping Station and onwards to the ICW Ponds for some treatment and irrigation/maintenance of the ponds.

Furthermore, it is noted that assimilation capacity has been demonstrated at Lough Durnesh on the basis that mean (Q30) flows are present in the receiving watercourse. Although it is expected that discharges from the ICWs will similarly reduce during drier weather conditions due to reduced abstraction from the site and increased evapotranspiration, it is proposed that an actuated valve is installed at the discharge point which is controlled by weather data. Where it is believed that the flows in the receiving watercourse is reduced below levels which can assimilate the discharge, any effluent will be recirculated to Pond 1 to provide additional irrigation and eliminate discharges to the receiving watercourse.

2.11.2 ICW Layout

ICWs operate on the general principle of controlled flows through a series of level vegetated ponds to retain effluent for a designated period to permit natural biological, chemical and physical processes to remove contaminants from the effluent.

The topography of the existing landfill site and adjacent lands and presence of peat and bedrock at levels close to the surface has necessitated the development of a preliminary ICW Layout which utilises existing ground levels as far as practicable and minimise the volume of peat, drift materials and bedrock to be excavated to undertake the proposed works.

Due to the topography of the plateau on within the existing landfill site boundary and the lands north of the landfill site boundary the ICW will consist of one system of 9 ponds (denoted Ponds 1, 2 and 3 within the landfill site and Ponds 4 - 9 in Drawing IBR1279/LR110 (Preliminary ICW Pond and Leachate Management Layout) respectively.

Access tracks (nominally 4m wide) and vehicle turning areas to service a number of groups of ponds will be provided to minimise construction costs and import requirements to form the elevated track. The proposed access arrangements limit the crossing of existing drains and channels to existing crossings to minimise the disturbance of these habitats. External containment bunds will be reduced in width (nominally 2m wide) to provide the containment structure of the individual ponds and provide pedestrian access to monitor, operate and maintain the wetlands.

The layout and gradient of the surface of the sites facilitates all leachate to be discharged and treated sequentially through one pond network as outlined in Drawing IBR1279/LR110 (Preliminary ICW Pond and Leachate Management Layout).

Leachate from the on-site leachate treatment plant will be pumped up into a stilling chamber in advance of Pond 1, which will be utilised to direct a steady flow of leachate into ICW Pond 1 for treatment. All further flows of effluent into subsequent remaining ICW ponds will be under gravity. Due to the separation distance between Ponds 3 and 4 however, and nature of the majority of the intervening lands as landfill with variable settlement potential, a secondary backup pumping system is proposed to be provided to permit temporary pumping of effluent from Pond 3 to Pond 4 in the event that the gravity pipeline connection becomes restricted.

Retention times will be subject to the degree of control of effluent depths within the ponds by the operator and degree of incident rainfall but is expected to be approximately 45-60 days.

2.11.3 ICW Construction Details

The wetland ponds will be constructed from both imported soil material and soil material sourced onsite. The base and sides of the ICW ponds will be formed using a low permeability subsoil material and subsequently lined with a supplementary LLDPE lining system to minimise the risk of fugitive emissions to underlying soils and groundwater. Imported topsoil will be placed over the subsoil as a growing medium for the wetland plants, at a minimum depth of 150mm as outlined on Drawing IBR1279/LR110 (Preliminary ICW Pond and Leachate Management Layout). The subsoil material used to form the ICW ponds will be layered and compacted to ensure that there is containment of waters within the system and that permeability rates are less than $1x10^{-8}$m/s throughout.

The plant species used in the ICW ponds is that similar to other ICW systems and which are native to the region. These include *Carex riparia*, *Typha latifolia*, *Typha angustafolia*, *Glyceria maxima* and *Iris pseudacorus*. Other plant species are used to enhance the biodiversity and habitat potential of the site, both on within the ponds and along the embankments. Any planting on embankments will be done so as not to restrict access, nor to compromise the impermeability of the containment walls.

Each pond will comprise of a dense vegetation cover and shallow water depth (100-200mm). The base area of each pond is level, with a level difference occurring from one pond to the next. Gravity flow is provided through the system. Due to the separation distance between Ponds 3 and 4 however, and nature of the majority of the intervening lands as landfill with variable settlement potential, a secondary backup pumping system is proposed to be provided to permit temporary pumping of effluent from Pond 3 to Pond 4 in the event that the gravity pipeline connection becomes restricted. Each pond is connected by means of 150mm diameter inter-connecting pipes. The pipes are placed at the bottom of the pond floor and water levels can be managed within each pond by adjusting bends on the outlet pipe of each pond.

3 OPERATION AND MAINTENANCE

ICWs are designed to be as self-maintaining and as self-operable as possible. The main maintenance procedures are as follows:

1. Water level management and flow maintenance – Maintain an operational water level of ~100-200mm. Overtime there will be a build up of vegetation and sediment in the cells, which will require the outlet pipes to be adjusted to maintain appropriate water depths.
2. Vegetation monitoring and maintenance – The vegetation in the wetland cells should be assessed regularly to ensure they are well. Vegetation, especially grassed areas, around the wetland cells should be maintained to provide for easy and safe access for monitoring and maintenance.
3. Maintenance of access – fences, gates and access routes should be maintained to ensure safe and easy access is maintained, while also restricting access for livestock.
4. Maintenance of inlet and outlet pipes – The area around the inlet and outlet pipes should be kept clear so that flows between cells are maintained and that vegetation or sediments do not build up in or around the pipework.
5. Sediment/sludge management – Overtime there will be a build up of sediment in the wetland cells, which will need to be cleaned out to maintain the proper functionality of the ICW.

Desludging is dependent on the cell No, cell area, and influent loading. The initial wet-land cell will require cleaning out first, however this is not expected for at least 5-10 years. Sediment build up in the wetland will include metals accumulated. Sediment will be removed from the ponds as required when the pool volume has become reduced significantly or the ponds have become eutrophic. The management of sludge will depend on the contamination concentrations and the proposed reuse or disposal.

3.1 Specified Engineering Work

A Specified Engineering Work (SEW) for these works will be submitted and agreed with the Agency in advance of the works.

4 EMISSIONS FROM ICW

4.1 Emission to Water

4.1.1 Emission Limit Value

The emission point from the Constructed Wetland Ponds are provided in Table 4.1 and showing Drawing IBR1279/LR111 Monitoring locations.

Table 4.1 Emissions to Water

Emissions to Water	
Emission Point Reference No	**Location**
D1	E193128 N367882

The volume to be emitted from the Constructed Wetland Ponds will be a maximum of 120m^3/day. The Emission Limit Value as calculated in the assimilation capacity is provided in Table 4.2.

Table 4.2 Emission Limit Value

Emission Limit Value	
Parameter	**Emission Limit Value**
pH	6-8
BOD	<20mg/l
COD	<50mg/l
Suspended Solids	<15mg/l
Orthophosphate	<0.1mg/l
Total Ammonia (as N)	<2mg/l
Cadmium	<0.5µg/l
Chromium	<1µg/l
Copper	<5µg/l
Lead	<1µg/l
Mercury	<0.5µg/l
Nickel	<20µg/l
Zinc	<50µg/l
pH	6-8
BOD	<10mg/l
COD	<50mg/l
Suspended Solids	<15mg/l

Table Note

4.2 Control Of Emission To Water

Emission Point Reference No E193128 N367882

Emission Control Location - Integrated Constructed Wetland

Description of Treatment - Constructed Wetland Pond

Table 4.3 Control Of Emission To Water

Control Of Emission To Water		
Control Parameters	**Monitoring**	**Key Equipment**
Flow and flow patterns	Continuous for discharge flow	Flow regulators

Control Of Emission To Water		
		Flow meters Shut off valve discharge Pond isolation valves
Bank inspections, water depth , turbidity in final segments	Weekly	Visual inspection and appropriate measuring equipment
Sediment depth, vegetation monitoring	Quarterly	Visual inspection and appropriate measuring/monitoring equipment
Sediment composition : heavy metals	Annually for two years and once every three years thereafter Prior to sediment removal	Appropriate sampling equipment

4.3 Monitoring of Emissions to Water

The proposed monitoring of emissions to water at D1 is provided in Table 4.4.

Emission Point Reference No D1

Table 4.4 Monitoring Of Emissions To Water

Monitoring Of Emissions To Water		
Control Parameter	**Monitoring Frequency[2]**	**Key Equipment**
Flow	Continuous	Flow meter with recorder
Visual Inspection/Odour	Weekly	Standard Method
Electrical Conductivity	Quarterly	Standard Method
pH	Quarterly	Standard Method
TOC	Quarterly	Standard Method
Ammonia (as N)	Quarterly	Standard Method
BOD	Quarterly	Standard Method
COD	Quarterly	Standard Method
Suspended Solids	Quarterly	Standard Method
Total Dissolved Solids	Quarterly	Standard Method
Dissolved Oxygen	Quarterly	Standard Method
Orthophosphate (as P)	Quarterly	Standard Method
Total Phosphorous	Quarterly	Standard Method
Nitrates (as N)	Quarterly	Standard Method
Nitrites	Quarterly	Standard Method
Metals	Annual	Standard Method
Ammoniacal Nitrogen	Quarterly	Standard Method
Chloride	Quarterly	Standard Method
Sulphate	Quarterly	Standard Method
Phenols	Quarterly	Standard Method
Organic Compounds	Quarterly	Standard Method
Total Alkalinity	Quarterly	Standard Method
Toxicity	As may be required	To be agreed with the Agency

[2] Frequencies may be amended following agreement with Office of Environmental Enforcement (OEE).

5 EXISITING OPERATIONAL CONTROLS.

5.1 Leachate Control Measures

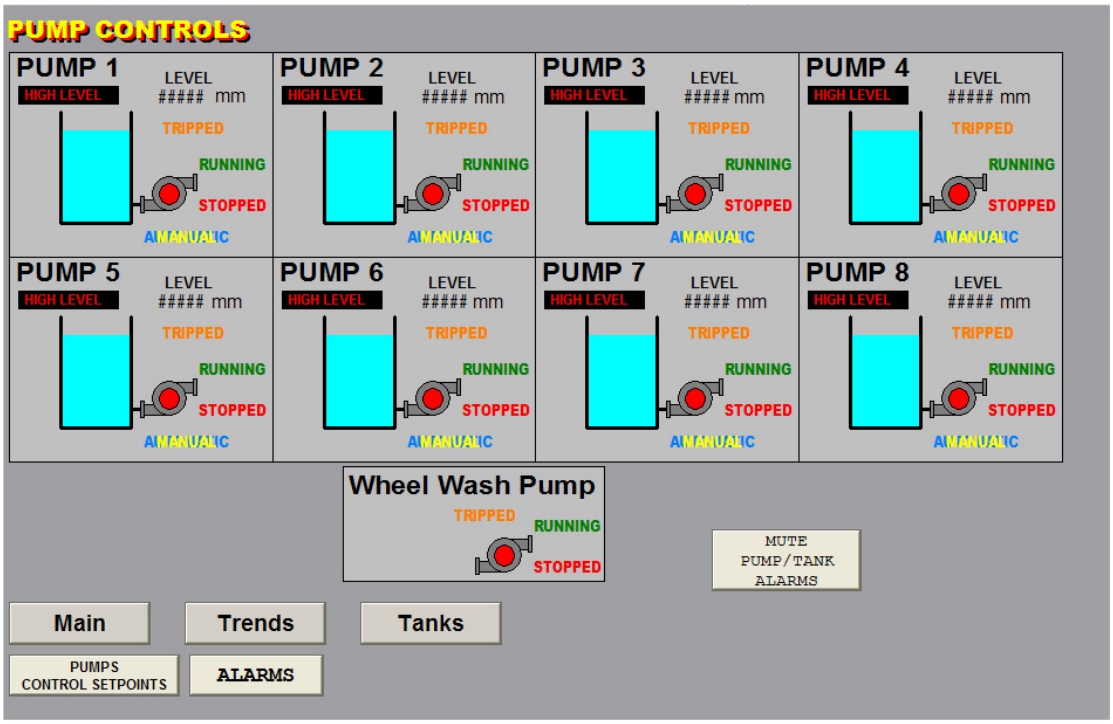
Ballynacarrick was historically developed to operate under the dilute and disperse principles. Leachate levels in the unengineered sections of the site is controlled through four leachate abstraction towers. Leachate level monitoring facilities are installed in the four abstraction towers.

The engineered cell (Cell 4) and the extension phases (Phase 1 and 2) were designed on a containment basis. The leachate collection system comprises of a 500 mm deep drainage blanket, with 250 mm diameter perforated High Density Polyethylene (HDPE) collection pipes along the base of the cell floor. The pipe discharges into a collection sump at the low point of the cell. Similar to the leachate abstraction towers, level monitoring has been installed in the side slope riser and these levels will be recorded on a daily basis.

Leachate can be removed by the submersible pumps installed at each of these points to the leachate holding tank located adjacent to the site office. Levels within the abstraction towers will be maintained below targets levels set above the base of the tower. Levels within the lined cell will be maintained at less than 1m above the base of the liner.

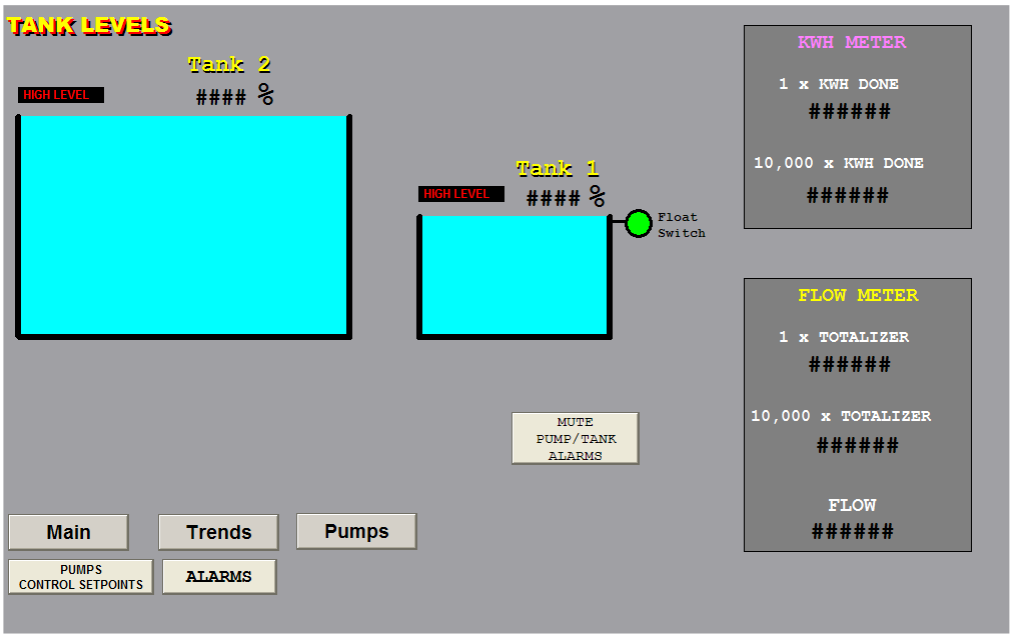
Leachate levels will be monitored and recorded on a daily basis through the SCADA System. Leachate, above the head limit is removed from the cell by pumping, to the collection tank.

The pumps can be accessed on a on the supervisory level from a PC in the site office via the Supervisory Control and Data Acquisition System (SCADA).



This is the main operating screen for the pumps control system, which contains the status indicators for the system. The leachate tank is fitted with an easy access draw pipes, with a standard coupling to facilitate leachate removal by tanker.

This is the main operating screen for the tanks control.



Procedures have been developed and are included in the Environmental Management Manual with regards to the management of leachate at the site.

The leachate is automatically pumped into the 1000m^3 treatment tank from the cells when pre-set level of leachate are reached within the cells and leachate extraction towers

The 1000m^3 treatment tank aerates the leachate from 4.30pm to 6.00am. There is then a settlement period of 1.5 hour before tankering can begin at 7.30a.m until 4.30p.m.

The level in the storage tank is controlled by an ultrasonic sensor , which is linked to main control panel and Scada. The level in the storage tank is checked visually twice daily. A minimum freeboard of 0.75m is maintained. The leachate is removed in 30m^3 storage tankers. The leachate is removed from the leachate tank via flexible pipework attached to the outlet of the tank and connected to the tankers as required. The flow from the leachate tank to the tankers is controlled via a manual valve, however a decanting system is installed to remove better quality leachate. The removal of leachate is undertaken on a purpose built concrete slab. All surface water and spillages in this area are collected into a gully which passes through a silt filter prior to being pumped back into the leachate treatment tank.

The levels of the leachate in the treatment tank are recorded on the SCADA system.

5.2 Landfill Gas Control Measures

5.2.1 Flare Stack Operation

The flare and associated works will be operated on a continuous basis. Any adjustments to the operational parameters of the flare will be made in accordance with manufacture operational instructions. No adjustment shall be made which will result in the flare failure to achieve the emissions limits or operational parameters as set out in the Waste Licence and EPA Landfill Operational Manual.

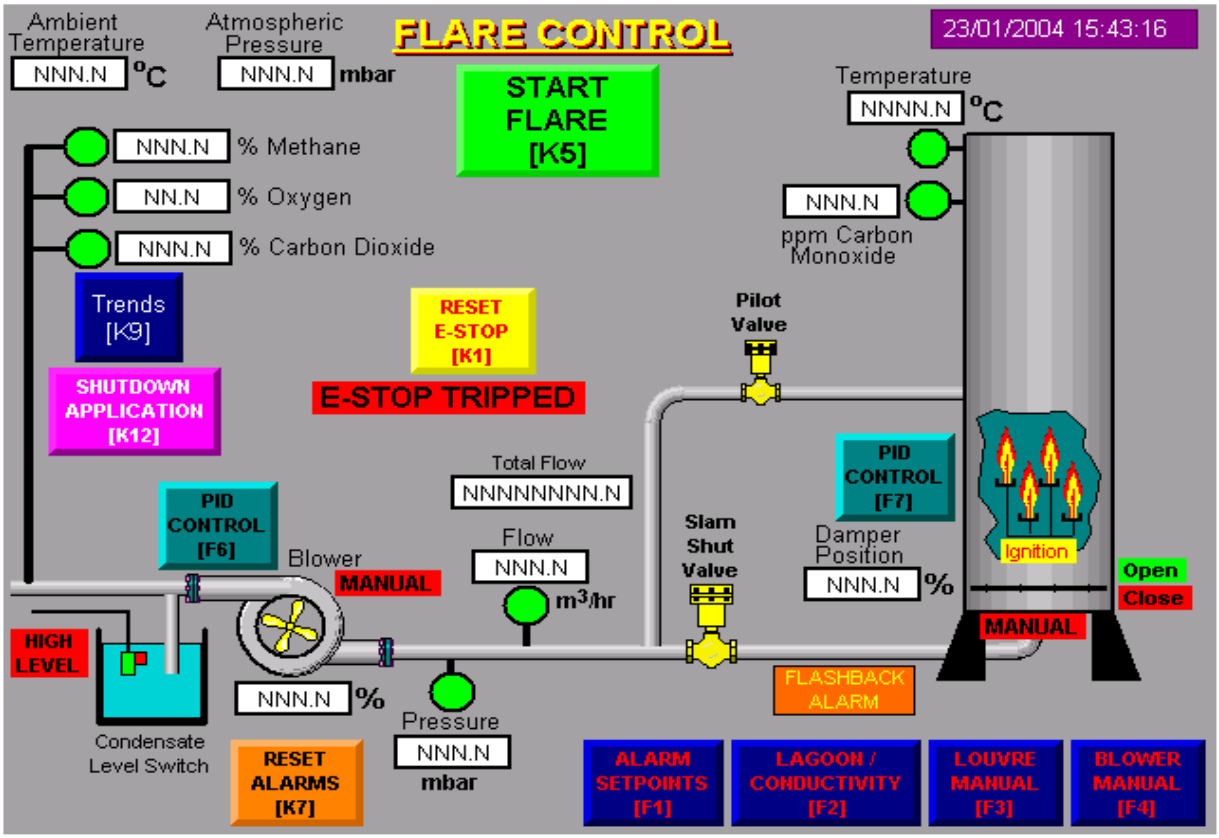
Maintenance and servicing of the flare will be carried out in accordance with the manufactures instructions.

The flare is equipped with automatic controls to ensure that the flare is operated in a controlled and safe matter. The flare will be inspected on a daily basis.

Table 5.1 Flare Monitoring

Parameter	Flare (enclosed) Monitoring Frequency
Inlet	
Methane (CH_4) % v/v	Continuous
Carbon dioxide (CO_2) % v/v	Continuous
Oxygen (O_2) % v/v	Continuous
Process Parameters	
Combustion Temperature	Continuous
Residence Time	Quarterly
Outlet	
Volumetric Flow Rate	Continuous
Carbon monoxide (CO)	Continuous
Nitrogen Oxides (NOx, as NO_2	Annually
Sulphur dioxide (SO_2)	Annually
Total Organic Carbon (TOC)	Annually

The graphics display on the flare will default to the main mimic display, titled '**FLARE CONTROL**'. This is the main operating screen, which contains all the main flare controls and status indicators; all other displays can be accessed from this screen.



The following analogue signals are displayed on this screen:

Atmospheric Pressure	800 – 1200 mbar
Ambient Temperature	0 – 100 'C

Louvre (Damper) Position	0 – 100 % Open
Blower Speed	0 – 100 % Full Speed
Flare Temperature	0 – 1300 ‘C
Residual Carbon Monoxide	0 – 100 ppm
Methane composition	0 – 100 %
Oxygen composition	0 – 25 %
Carbon Dioxide composition	0 – 100 %
Gas line Pressure	0 – 150 mbar
Gas line Flow	0 – 400 m3/hr
Gas Flow Totaliser (m3)	

5.2.1.1 Flare Start-Up Sequence:

On the main ‘Mimic’ screen, when the operator presses the ‘[K5] START FLARE’ key, then providing the following ‘startup‘ conditions are met, the flare will commence its startup procedure.

5.2.1.1.1 Startup Conditions:

No ‘High Temperature’ Alarm

No ‘Low Pressure’ Alarm

No ‘High Condensate Level’ Alarm

No ‘Blower Fail-to-Start’ Alarm

No ‘Blower Manual Override’ condition

No ‘High/High Oxygen’ Alarm

No ‘Low/Low Methane’ Alarm

No ‘High Pressure’ Alarm

No ‘Flashback’ Alarm

Emergency Stop circuit ‘healthy’

After a 2 secs delay, the Blower will start, and the Main Gas Valve will open, to make sure that the gas pipeline and flare are full of gas, after an 80 secs delay, the Main Gas Valve will close, 5 secs later, the Pilot valve will open.

10 secs after the Pilot Valve has opened, the ignition circuit will energise for 15 secs, then shutdown for 10 secs, and then energise again for 15 secs. This will repeat until the flare is shutdown, or the flame has been established. If the flame hasn’t been established within 10 mins, then the pilot Valve will close and the system will go back to the beginning of the startup routine and open the main Gas valve to re-prime the Gas pipeline and Flare.

20 secs after the flame has been established, the louvre will be opened from its initial closed position to its starting position of 15% Open. When the louvre has reached its starting position, the Main Gas Valve will reopen. 2 mins after this, the system will check the Flare temperature to see if it is above the temperature setpoint to allow full automatic temperature control. If the flare has not reached this temperature within 10 mins, then the system is allowed to go into automatic temperature control anyway. The Louvre PID controller

will be switched into Automatic mode, and will begin to vary the position of the louvre to control the temperature of the flare against its setpoint. The Flare is now fully running.

5.2.1.1.2 Flare Shutdown

When the flare is running / during the startup procedure, on the main 'Mimic' screen, when the operator presses the '[K5] SHUTDOWN FLARE' key, then the flare will shutdown. The Louvre will close, the Main Gas Valve will close, the Pilot Gas valve will close, and the Blower will stop. The Flare is now shutdown.

The following is a list of the conditions which will shutdown the Flare system, and prevent it from being started:

a). High Temperature Alarm. If the temperature of the Flare rises above the High Temperature Alarm Setpoint, a High Temperature Alarm will occur.

b). Low Pressure Alarm. If the Gas Line Pressure falls below the Low Gas Line Pressure Alarm Setpoint, a Low Pressure Alarm will occur.

c). High Condensate Alarm. If the Condensate High Level Switch is tripped, a High Condensate Alarm will occur.

d). Blower Fail-to-Start Alarm. If the PLC output to start the Inverter for the Blower is On, but the Inverter Running signal is not On within a preset time, a Blower Fail-to-Start Alarm will occur.

e). Blower Manual Override. If the operator has selected Manual Override Mode for the Blower by pressing the key **'[K2] Enable Manual Blower Control'** On the 'Blower Manual' screen.

f). High/High O2 Alarm. If the % Oxygen rises above 30%, a High/High Oxygen Alarm will occur. (This 30% value is set in the PLC program, and cannot be overridden by the operator).

g). Low/Low CH4 Alarm. If the % Methane (CH4) falls below 20%, a Low/Low CH4 Alarm will occur. (This 20% value is set in the PLC program, and cannot be overridden by the operator).

h). High Pressure Alarm. If the Gas Line pressure rises above the High Pressure Alarm Setpoint, a High Pressure Alarm will occur.

i). Emergency Stop Alarm. If the Emergency Stop circuit is tripped (E-stop pushbutton pressed, or power failure), an Emergency Stop Alarm will occur. {Emergency Stop circuit will need to be reset; **'Reset E-Stop [K1]'** on main 'Mimic' screen.

j). Flashback Alarm. If the Flashback circuit detects a flame, a Flashback Alarm will occur.

5.2.1.1.3 SCADA System

The flare can be accessed on a supervisory level from a PC in the site office via the Supervisory Control and Data Acquisition System (SCADA).

5.2.1.1.4 Trouble Shooting

Please refer to the manufacture flare operational manual for trouble shooting guidance. If the flare shuts down due the listed conditions above, a text message will be sent to a mobile indicating which condition has caused the shutdown. Out of hours alerts will be dealt with first thing in the morning or in any event within 24hrs.

5.3 Landfill Gas Monitoring And Field Balancing

Landfill gas piezometers have been installed along the site boundary. These are currently monitored on a quarterly basis as agreed with Office of Environmental Enforcement (OEE) for the presence of landfill gas. Trigger levels for Methane and Carbon Dioxide are 1% v/v and 1.5%v/v respectively as per Waste Licence requirements.

Monitoring will be carried out using GA2000 analyser. This equipment will be maintained and calibrated in accordance with manufactures instructions. Operational manuals and maintenance records will be maintained on site. Landfill gas results will be reported on as per Waste Licence requirement. If monitored indicates exceedances in accordance with the Waste Licence requirements then the environmental incident and corrective action procedure will be adopted.

Field balancing will be undertaken as required on landfill gas extraction wells in order to operate landfill gas flare on a continuous basis and to extract optimum landfill gas from the site.

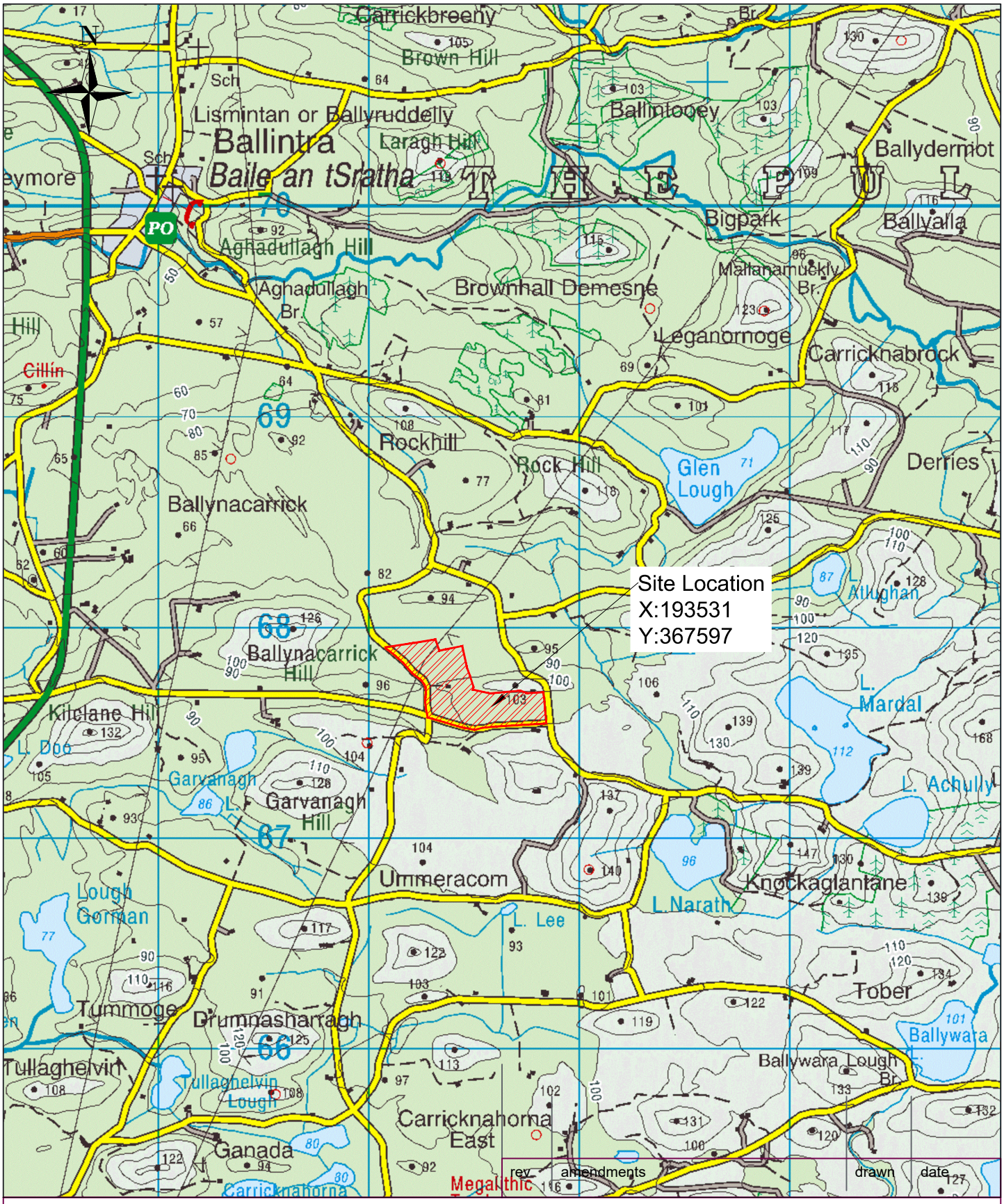
5.4 Emergency Response Procedures

Emergency situations are identified as follows;

- Fire,
- Landfill Gas Migration,
- Plant breakdown,
- Significant spillages,
- Accident or injury.

Emergency response procedures have been developed on site and are contained in the Environmental Manual. These include emergency telephone numbers.

Appendix A
Drawings



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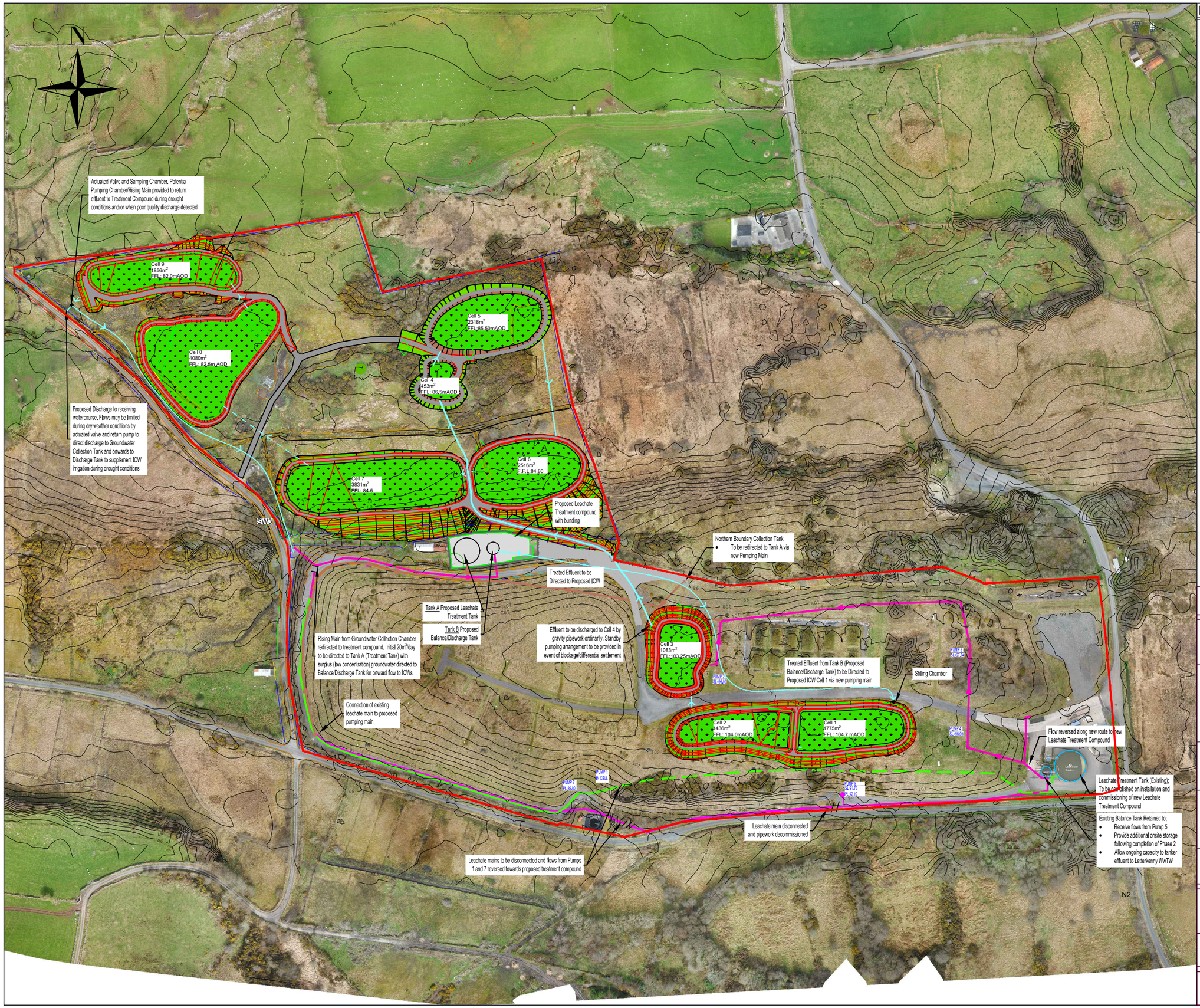
Drawing Number	Rev
IBR1279/LR100	-

Client	Title
Donegal County Council	Site Geograhical Location

Project
Ballynacarrick LFS - Integrated Constructed Wetlands

Project No.	Sheet Size	Drawing Scale	Drawing Status	Drawn By	Checked By	Approved By	Date
IBR1279	A4	1:25,000	Preliminary	MC	JD	JD	03/11/2021



NOTES

1. Verifying Dimensions.
   The contractor shall verify dimensions against such other drawings or site conditions as pertain to this part of the work.
2. Existing Services.
   Any information concerning the location of existing services indicated on this drawing is intended for general guidance only. It shall be the responsibility of the contractor to determine and verify the exact horizontal and vertical alignment of all cables, pipes, etc. (both underground and overhead) before work commences.
3. Issue of Drawings.
   Hard copies, dwf and pdf will form a controlled issue of the drawing. All other formats (dwg, dxf etc.) are deemed to be an uncontrolled issue and any work carried out based on these files is at the recipients own risk. RPS will not accept any responsibility for any errors arising from the use of these files, either by human error by the recipient, listing of un-dimensioned measurements, compatibility issues with the recipient's software, and any errors arising when these files are used to aid the recipients drawing production, or setting out on site.
4. Datum: Ordnance Datum (Malin Head)
5. Key:

- Proposed Licence Boundary
- Proposed Cells/Ponds
- Proposed Vehicle Access Tracks
- Proposed Pedestrian Access Tracks
- Rock Outcrop
- Dense Vegetation
- Proposed ICW Pipework
- Existing 90mm Dia Pumping Main
- Existing 100mm Dia Pumping Main
- Proposed Pumping Main

rev	amendments	check	date

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Client
Donegal County Council

Project
Ballynacarrick LFS
Licence Review

Title
Preliminary ICW Pond and Leachate Management Layout

Project Number	Sheet Size	Drawing Scale
IBR1279	A3	1:2,500

Drawing Number
IBR1279/LR110

Drawn By	Status	Revision
MC	Preliminary	-

Checked By	Approved By	Date
AmcG	JD	24/10/2022

NOTES

1. Verifying Dimensions.
   The contractor shall verify dimensions against such other drawings or site conditions as pertain to this part of the work.
2. Existing Services.
   Any information concerning the location of existing services indicated on this drawing is intended for general guidance only. It shall be the responsibility of the contractor to determine and verify the exact horizontal and vertical alignment of all cables, pipes, etc. (both underground and overhead) before work commences.
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4. Datum.

- Proposed Licence Boundary
- Phase 1 Boundary
- Phase 2 Boundary
- Cell 4 Boundary
- LG17 Landfill Gas Monitoring Point
- DG2 Dust Monitoring Point
- N1 Noise Monitoring Point
- SW2 Surface Water Monitoring Point
- GW1 Ground Water Monitoring Point
- L6 Leachate Monitoring Point
- LL4 Leachate Level
- BP13 Bait Point
- A1 Landfill Gas Flare
- D1 Treated Leachate Discharge
- 3 Leachate Pump connected to Main

Ground Water Monitoring Points

Existing	X	Y
GW1	193882	367722
GW2	193476	367536
GW4	193301	367581
GW5	193283	367720
GW6	193480	367717
GW7	193653	367697
GW8	193727	367700
GW9	193651	367543
GW10	193545	367524
Replacement Boreholes		
GW6A	193487	367711
GW8A	193741	367693
GW9A	193660	367539
Additional Boreholes (as per HRA Recommendations)		
GW12	193331	367488
GW13	193271	367635
Proposed Groundwater Monitoring Boreholes		
GW14	193113	367911
GW15	193290	367823
GW16	193389	367776
GW17	193349	367891

Surface Water Monitoring Points

Existing	X	Y
SW1	193471	367537
SW2	193860	367567
SW3	193274	367734
SW4	193209	367800
Proposed Surface Water Monitoring Points		
SW5	193094	367907
SW6	188809	368529

Landfill Gas Monitoring Points

Existing	X	Y
LG1	193706	367623
LG2	193769	367586
LG4	193648	367677
LG5	193716	367674
LG6	193775	367688
LG8	193476	367538
LG9	193426	367543
LG10	193336	367570
LG11	193285	367635
LG12	193354	367712
LG13	193417	367728
LG14	193549	367704
LG15	193648	367701
LG16	193838	367696
LG17	193847	367715

Leachate Monitoring Points

Existing	X	Y
L1	193652	367550
L3	193496	367556
L6	193798	367567
L8	193283	367714

Dust Monitoring Points

Existing	X	Y
DG1	193722	367601
DG2	193827	367691
DG3	193490	367544
DG4	193288	367588
DG5	193502	367715

Noise Monitoring Points

Existing	X	Y
N1	193820	367756
N2	193868	367479
N3	193423	367536

Landfill Gas Flare

Existing	X	Y
A1	193805	367574

ICW Discharge Monitoring Point

Proposed	X	Y
D1	193128	367882

rev	amendments	check	date

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Client
Donegal County Council

Project
Ballynacarrick Landfill Site
Licence Review

Title
Monitoring Points

Project Number	Sheet Size	Drawing Scale
IBR1279	A1	1:2000

Drawing Number
IBR1179/LR111

Drawn By	Status	Revision
MC	Preliminary	-

Checked By	Approved By	Date
AMcG	JD	07/11/2022