This Report has been cleared for submission to Eimear Cotter, Director by Warren Phelan, Programme Manager.

Signed: Warren Phelan *Date:* 23rd of May 2022

OFFICE OF ENVIRONMENTAL SUSTAINABILITY

INSPECTOR'S REPORT ON AN APPLICATION FOR A CERTIFICATE OF AUTHORISATION FOR A CLOSED LANDFILL

TO:	Eimear Cotter, Director
FROM:	Ewa Babiarczyk, Inspector. Environmental Licensing Programme
DATE:	7th June 2022
RE:	Application by **Clare County Council** for a Certificate of Authorisation for a closed landfill at **Dysert, Kilrush, County Clare**. Certificate of Authorisation Register Number **H0030-01**.

1. Application details

Type of facility:	Closed landfill as defined in the Regulations[1].
Original site ownership	Clare County Council.
Current site ownership	Clare County Council.
Operator of closed landfill	Clare County Council has operated this site since 1981.
Proposed use post remedial works	The site is intended to be returned to wild habitat.
Risk category of closed landfill:	Moderate risk (class B) due to • Migration of landfill leachate into surface waters (SPR 8).
Section 22 register number:	S22-02498
Grid Reference	102749 E and 154514 N (ING)
Application received:	9th October 2020

[1] Waste Management (Certification of Historic Unlicensed Waste Disposal and Recovery Activity) Regulations 2008 (S.I. No. 524 of 2008).

AA screening determination:	5th February 2021
Publication date for Notice for Public Consultation on Appropriate Assessment:	18th October 2021
No of Submissions or Observations on Appropriate Assessment:	There were no Submissions or Observations received.
Regulation 7(4) notice:	5th February 2021
Additional information received:	Regulation 7(4) Reply received on 2nd March 2021.
Name of Qualified Person:	Sean Moran, Credentials provided by The Institute of Geologists of Ireland.
EPA site inspection:	No inspection was required.

2. Information on the closed landfill

Location of facility	The closed landfill is located in the townland of Dysert, 2.5km south-east of Kilrush town in County Clare. The location of the landfill site is shown in Figure 1.
Period of landfilling	1981 to 1992.
Surrounding area	The landfill is located in a rural area which was subject to extensive peat harvesting and now is used for forestry and agriculture. Immediately to the north, east and south-west of the site are cut-over peat bogs. To the south and north-west of the site lie agricultural fields. The site is bound by a road along the eastern and south-western site boundary, as shown in Figure 2. Immediately along the western site boundary runs a drainage ditch, hereafter referred to as the western ditch, which discharges to another ditch approximately 110m north of the site. There is also a drainage ditch approximately 100m south of the site, hereafter referred to as the southern ditch, as shown in Figure 4. The closest residential dwelling is located 130m south of the site.
Area of the closed landfill	The site covers an area of approximately 2.6 ha.
Quantity of waste at the facility	Approximately 33,250 tonnes (66,500 m^3)
Characterisation of	The waste comprises mainly municipal waste. Other waste streams

waste deposited	include agricultural waste, industrial waste, commercial waste and construction & demolition (C&D) waste. The waste encountered during site investigations includes rubble, plastic, cables and cable casings, bottles, domestic waste, dumper tyre, car parts, newspaper, black bags, furniture making cloth and a metal cased intermediate bulk container (IBC). The site investigations revealed that some of the deposited waste was burnt. No waste, as classified in accordance with the List of Waste Classification was identified as being hazardous. Waste was deposited across the entire site.

3. Site investigations

Current condition and appearance of closed landfill:	The site rises by approximately 4m above the surrounding lands and gently slopes from south to north and east to west. There is exposed waste on the landfill surface and waste in a few locations in the adjacent ditches, as shown in Figure 3. Condition 3.1(b) requires that the local authority removes this waste for disposal or recovery at an appropriate facility. Condition 3.1(c) provides for appropriate capping of the landfill, as outlined in Section titled *Proposed remedial actions* below.
Site investigations	The site investigations carried out as part of Tier 1, 2 and 3 assessments established the following facts: • The site is underlain by peat which lies over the bedrock; • The waste body in unlined; • Waste is deposited above groundwater table. • The average waste thickness is 3.5m; • The maximum depth of waste measured during a trial pit investigation is 4.5mbg; • The waste body is partially covered with a 0.2m layer of soil; • Landfill gas is being generated; • The rainwater infiltrates through the cover material into the waste body; • Landfill leachate is being generated and there are perched tables of leachate and infiltrated rainwater within the waste body; and • The leachate is migrating into the nearby drainage ditches.
Monitoring and analysis of samples (water, gas, waste):	The following site investigations were carried out as part of Tier 1, 2 and 3 assessments: • Desk study including, but not limited to, studying Geological Survey Ireland (GSI) maps, Ordnance Survey Ireland (OSI) aerial photographs and archived records; • Site Walkovers were carried out in 2009, 30th August 2010 and on 28th May 2020; • Trial pit investigation was carried out at nine trial pits on 30th

	August 2010; • Leachate sampling (six samples were collected from six trial pits on 30th August 2010); • Soil sampling (three samples were collected from three trial pits on 30th August 2010); • Private well sampling was carried out on 30th August 2010; • Landfill gas monitoring (one round at four locations within the site was carried out on 12th November 2008); • Biological assessment of surface water was carried out in October 2015; • Surface water monitoring (three rounds, at six monitoring locations in total, were carried out on 30th August 2010, 13th May 2020 and 11th June 2020); • Site level survey was carried out in 2010.
Hydrology	The closed landfill is located within the Shannon Estuary North catchment (Catchment Identification Number: 27). The northern part of the site lies within the sub-catchment of the Wood river, Wood_SC_010 River (sub-catchment Id: 27_4), and the southern part of the site lies within the sub-catchment of the Cloon river, Cloon [Clare]_SC_010 River (sub-catchment Id: 27_5). Along the western site boundary runs the western ditch. This ditch connects, via other drainage ditches, to the Moyadda_Beg river (waterbody code: IE_SH_27W010100) which flows 415m north of the site, as shown in Figure 4. It is noted that Figure 4 shows a ditch along the northern site boundary with a monitoring location SW104. The applicant stated however that no drainage channel was observed in this location. The southern ditch runs approximately 100m south of the site where the monitoring location SW106 is located, as also shown in Figure 4. This ditch lies within the Cloon [Clare]_SC_010 River (sub-catchment Id: 27_5). The Moyadda Beg river (waterbody code: IE_SH_27W010100) flows into a westerly and then northerly direction prior to discharge into the Kilcarroll stream (waterbody code: IE_SH_27W010100) approximately 1km downstream of the site. The Water Framework Directive (WFD) status assigned to the Moyadda Beg river and the Kilcarroll stream is Poor. The Kilcarroll stream discharges into the Wood river (waterbody code: IE_SH_27W010100) approximately 1.5km downstream of the site. The WFD status of the Wood river is also Poor. The WFD assigned to the Wood river (waterbody code: IE_SH_27W010200) 850m downstream of the discharge location from the Kilcarroll stream is Moderate and remains Moderate until the Wood river discharges into the Mouth of the Shannon (HAs23;27) coastal waterbody (waterbody code: IE_SH_060_0000) approximately 4.6km downstream of the landfill. The WFD of the Mouth of Shannon is Good. Agriculture is identified in the catchment monitoring assessment reports (catchments.ie) as a significant pressure contributing to the

poor ecological status of the Wood river, at the point of discharge of the Kilcarroll stream (waterbody code: IE_SH_27W010100). Another contributing pressure is identified as Historically Polluted Sites. The 'Impact Assessment' notes[1] associated with this pressure, refer to the historic landfill as the likely immediate cause *of "unusual brown slimes" on the river substratum*. This indicates that the closed landfill is likely impacting surface water quality, resulting in Poor WFD status at this location. Forestry, agriculture, other anthropogenic pressures (golf courses) and urban run-off are identified as the significant pressures contributing to the Moderate ecological status of the Wood river, downstream of the discharge point of the Kilcarroll stream (waterbody code: IE_SH_27W010200). No information on pressures contributing to the poor status of the Moyadda Beg river and Kilcarroll stream are available.

Three rounds of surface water monitoring were carried out on 30th August 2010, 13th May 2020 and 11th June 2020. In 2010 surface water monitoring was conducted at the drainage ditch located approximately 110m north of the closed landfill at an upstream location SW100, at a downstream location SW101 and on the Wood river at downstream location SW102. The same locations SW100, SW101 and SW102 were sampled on 13th May 2020 and 11th June 2020. The sampling on the 11th June 2020 also included additional locations 4, 5 and 6, as shown in Figure 4. It is noted that the western ditch at location SW105 and the southern ditch at location SW106 were dry at the time of all the monitoring events.

Table below shows the maximum parameter concentrations from the most recent monitoring on 11th June 2020 from the upstream location SW100 and the downstream location SW101.

Table 1: Surface water monitoring results

Parameter	**EQS [2,3]**	**Monitoring locations**	
		SW100 upstream	**SW101 downstream**
Biochemical Oxygen Demand (BOD) [mg O_2/l]	≤ 2.2 [1] (high status, 95%)	<2	<2
Ammonia as N [mg/l]	≤ 0.090 [1] high status, 95%, for Total Ammonia [mg N/l]	0.033	0.037
Total Phosphorous as P [mg/l]	≤ 0.045 [1] high status, 95%, for Molybdate	**<0.2**	**<0.2**

[1] Source: Water Framework Directive (WFD) website available at https://wfd.edenireland.ie/waterbody/ie_sh_27w010100/ (Accessed 29th April 2022).

[2] Environmental Quality Standard (EQS) as set out in European Communities Environmental Objectives (Surface Water) Regulations 2009, as amended.

[3] European Union (Drinking Water) Regulations 2014, S.I. 122 of 2014, as amended.

	Reactive Phosphorus [mg P/l]		
Arsenic [µg/l]	25 [1]	<0.8	0.8
Chromium [µg/l]	4.7 [1]	<1.0	<1.0
Copper [µg/l]	5 [1]	3	<3
Cyanide [µg/l]	10 [1]	<0.7	<0.7
Fluoride [µg/l]	500 [1]	<100	<100
Phenol [µg/l]	8 [1]	<1	<1
Toluene [µg/l]	10 [1]	<0.5	<0.5
Zinc [µg/l]	50 [1]	2.0	4.0
Fluoranthene [µg/l]	0.0063 [1]	**<1.0**	**<1.0**
Lead [µg/l]	1.2 [1]	<0.3	<0.3
Mercury [µg/l]	0.07 [1]	0.02	0.02
Naphthalene [µg/l]	2 [1]	<1	<1
Nickel [µg/l]	4 [1]	1.8	2
Cadmium [µg/l]	0.15 [1]	<0.1	<0.1
Benzo(a)pyrene [µg/l]	0.00017 [1]	**<1.0**	**<1.0**
Benzo(b)fluor-anthene [µg/l]	0.017 [1]	**<1.0**	**<1.0**
Benzo(k)fluor-anthene [µg/l]	0.017 [1]	**<1.0**	**<1.0**
Benzo(g,h,i)-perylene [µg/l]	0.0082 [1]	**<1.0**	**<1.0**
Coliforms [mpn/100ml]	0 [2]	**14,136**	**7,500**
E.Coli [mpn/100ml]	0 [2]	**185**	**5,200**
Faecal Coliforms [cfu/100ml]	0 [2]	**230**	**5,500**

The monitoring results show exceedances of environmental quality standards (EQSs) molybdate phosphorous set out in *European Communities Environmental Objectives (Surface Water) Regulations 2009, as amended*. However, it is further noted that the exceedance of molybdate reactive phosphorus, faecal coliforms and other parameters at the upstream location SW100 indicates that the surface water quality is also impacted by factors other than the landfill. It is also noted that it cannot be determined whether the actual concentrations of polycyclic aromatic hydrocarbons (PAHs) were within the relevant standards as the limits of detection for the monitoring methods were above the EQS. The above monitoring results indicate, that the landfill does not appear to be having a significant impact on surface water quality, aside from e.coli and faecal coliforms.

Condition 3.9(d) requires monitoring of surface water in accordance with Schedule A.3, which requires monitoring of surface water at the locations SW100 and SW101 on a quarterly basis and specifies the

	minimum parameters to be monitored. Additionally, Schedule A.3 requires monitoring of surface water in the western ditch at location SW105. Furthermore, it is noted that the Tier 2 Assessment states that '*a limited monitoring of surface water in the area took place which showed there was a limited impact on a first order surface water stream located approximately 100m south of the landfill*'. Accordingly, Schedule A.3 requires monitoring of the southern ditch at location SW106. Additionally, the applicant proposes monitoring of the Wood river at location SW102. This proposal is reflected in Schedule A.3. Condition 3.9(g) also requires that the sensitivity of the monitoring methods utilised shall have an appropriate limit of detection to allow for comparison of pollutant concentrations against the relevant standard reference values.
Hydrogeology	The closed landfill lies within the Kilrush groundwater body (GWB Number: IE_SH_G_123). The status of this groundwater body is good. The bedrock aquifer beneath the landfill is classified as a Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones (Ll). The aquifer vulnerability beneath the site varies from Moderate, through High to Extreme. Groundwater flow is towards the north and northwest, as shown in Figure 5 and may discharge to local streams and rivers. Drinking water for the area where the landfill is located is supplied by West Clare Regional Water Supply (RWS) (Supply Id. 0300PUB1022_1) which abstracts water from the Doolough lake located 20km northeast of the site. Due to the fact that groundwater beneath the site flows in the north and north-western direction, there will be no impact on the water quality in this RWS. The closest water well is located 610m to the north-east of the site and is used for agricultural purposes. The Table below lists water wells and boreholes located downgradient of the site. *Table 2: Downgradient water wells*

Well/Borehole Id	Location	Use
0815SEW010	2.2km north-west of the site	Industrial use
0815SEW011	2.1km north-west of the site	Agri & domestic use
0815SEW013	2.0km north-west of the site	Agri & domestic use
0815SEW036	3km north-west of the site	Agri & domestic use
0815SEW037	2.9km north-west of the site	Agri & domestic use
0815SEW039	2km north of the site	Agri & domestic use

	0815SEW041	1.5km north-west of the site	Agri & domestic use
	0815SEW047	2.8km north-west of the site	Agri & domestic use

Due to the fact that groundwater beneath the site flows towards north and north-west, there may be a potential impact on the above wells and other wells located in the direction of groundwater flow. However, the appropriate capping will limit ingress of rainwater into the waste body thus limiting the generation of leachate. Condition 3.9(e) requires monitoring of groundwater in accordance with Schedule A.4, which requires groundwater monitoring upgradient and downgradient of the waste body on a quarterly basis and specifies the minimum parameters to be monitored. Additionally, Condition 3.4 requires appropriate monitoring on a biannual basis to identify any impact on the quality of water abstracted at wells downgradient of the landfill and the assessment of the monitoring results against drinking water standards.

Leachate and water quality:

Trial pit investigation

Nine trial pits TH011 to TH09 were investigated on 30th August 2010, as shown in Figure 6. Waste was present in all trial pits. Landfill gas odour was also clearly evident in all trial pits.

Scrape back areas

Five scrape back areas, SB01 to SB05, were carried out along the eastern site boundary, as shown in Figure 6. All scrape back areas were shallow and recorded the presence of waste, indicating that the site was landfilled right up to the fence adjoining the road on the eastern and southern site boundary.

Soil analysis (solids)

Soil samples were collected from three trial pits TH02, TH05 and TH07 on 30th August 2010, as shown in Figure 6, and analysed on 8th September 2010 for a number of parameters, as shown in the table below.

Table 3: Soil analysis (solids) results

Parameter	**Landfill Waste Acceptance Criteria Limits** [1]			**Concentration Sample referred to as 10-1602 [%]**
	Inert	**Non-haz**	**Haz**	
Total Organic Carbon [%]	3	5	6	**39.9**
Loss on Ignition [%]	-	-	10	**82.4**

[1] Waste Acceptance Criteria (WAC) as set out in *Council Decision of 19 December 2002 establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC*

Sum of 7 PCBs [mg/kg]	1	-	-	<0.003
Mineral Oil [mg/kg]	500	-	-	313
PAH Sum of 17 [mg/kg]	-	-	-	<10.0
pH	-	Minimum 6	-	6.77

The analysis results show that the concentrations of dissolved organic carbon and loss on ignition meet the hazardous landfill waste acceptance criteria set out in *Council Decision of 19 December 2002 establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC*.

Leaching tests on soil samples

The eluate from the mix of the soil samples collected from trial pits TH02, TH05 and TH07 was tested on 8th September 2010 for a number of parameters, as shown in the table below.

Table 4: Leaching tests on soil results

Parameter	**Leaching limit values** [1]			**Concentration Sample referred to as 10-1602**
	Inert	**Non-haz**	**Haz**	
Dissolved organic carbon [mg/kg]	500	800	1,000	**2,000**
Arsenic [mg/kg]	0.5	2	25	0.0844
Barium [mg/kg]	20	100	300	0.168
Cadmium [mg/kg]	0.04	1	5	<0.001
Chromium [mg/kg]	0.5	10	70	0.0384
Copper [mg/kg]	2	50	100	0.108
Mercury dissolved [mg/kg]	0.01	0.2	2	<0.0001
Molybdenum [mg/kg]	0.5	10	30	0.0395
Nickel [mg/kg]	0.4	10	40	0.0694
Lead [mg/kg]	0.5	10	50	0.111
Antimony [mg/kg]	0.06	0.7	5	0.0165

[1] Waste Acceptance Criteria (WAC) as set out in *Council Decision of 19 December 2002 establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC*

Selenium [mg/kg]	0.1	0.5	7	0.0763
Zinc [mg/kg]	4	50	200	0.18
Total monohydric phenols [mg/kg]	1 Phenol index	-	-	<0.15
Chloride [mg/kg]	800	15,000	25,000	Not measured
Fluoride [mg/kg]	10	150	500	Not measured
Sulphate [mg/kg]	1,000	20,000	50,000	Not measured
Total dissolved solids [mg/kg]	4,000	60,000	100,000	Not measured

The testing shows that the concentrations of dissolved organic carbon exceeded the hazardous landfill waste acceptance criteria set out in *Council Decision of 19 December 2002 establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC*.

Leachate monitoring

Leachate samples were taken from trial holes TH02, TH04, TH05, TH07, TH08 and TH09 on 30th August 2010. The range of leachate monitoring results, for the parameters monitored, varied across the samples collected. The table below shows the monitoring results for locations TH02 and TH08 which were monitored for an extensive range of parameters.

Table 5: Leachate monitoring results

Parameter	**EQS/ Limit [1,2,3]**	**Monitoring locations**	
		TH02	**TH08**
Ammoniacal Nitrogen as N [mg/l]	0.065 [1] Ammonium [mg N/l]	**30.8**	**18.9**
Arsenic [µg/l]	7.5 [1]	**9.7**	2.83
Orthophosphate as PO_4 [mg/l]	0.035 [1] Molybdate Reactive Phosphorous [mg P/l]	**<0.05**	**<0.05**
Calcium [mg/l]	200 [2]	**343**	**202**
Manganese [µg/l]	50 [2]	**1,810**	**1,170**

[1] European Communities Environmental Objectives (Groundwater) Regulations, 2010, as amended.

[2] As set out in the EPA publication 'Towards setting guideline values for the protection of groundwater in Ireland – Interim Report', 2003.

[3] Environmental Quality Standard (EQS) as set out in European Communities Environmental Objectives (Surface Water) Regulations 2009, as amended.

Nickel [µg/l]	4 [3]	**12.4**	**4.29**
Copper [µg/l]	30 [1]	<0.85	<0.85
Mercury [µg/l]	0.75 [2]	<0.01	<0.01
Potassium [mg/l]	5 [3]	**88**	**24.8**
Cyanide [µg/l]	10 [3]	**<50**	**<50**
Benzo(bk)fluoranthene [µg/l]	Total PAHs 0.075 [2]	**<2**	**<1**
Indeno(123cd)pyrene [µg/l]		**<2**	**<1**
Benzo(ghi)perylene [µg/l]		**<2**	**<1**
Anthracene [µg/l]		**<2**	**<1**
Naphthalene [µg/l]		**<2**	**<1**

The monitoring results show that a number of parameters in the landfill leachate exceeded the relevant standards/limits. Furthermore, it cannot be determined whether the actual concentrations of cyanide and total PAHs were within the relevant standards as the limits of detection for the monitoring methods were above the EQSs. It is also noted that no Faecal Coliforms and Total Coliforms were measured.

The applicant was requested to carry out updated leachate monitoring, however, no results were submitted. The applicant, in correspondence dated 2nd March 2021, stated that '*As illustrated in the Conceptual Site Model and Risk Assessment there is no significant pathway for leachate migration to the water table. The only potential pathway is via overland flow to the surface water receptor'* and that *'If there is an impact on the surface water network, the extensive surface water monitoring that (Clare County Council) have undertaken, and propose to undertake would detect it'.* The applicant further notes that this was the advice received by Clare County Council when it took part in a pilot program in 2009 and 2010 on the remediation of closed landfills, which was run by the Department of the Environment (DoE) and EPA. However, no record confirming this advice, or a record demonstrating that a Tier 2 assessment was completed by Clare County Council during that time, could be found by the Agency's Office of Environmental Enforcement.

It is noted that the submitted 2020 monitoring results for surface water, outlined in Table 1 above, indicate that the landfill does not appear to be having a significant impact on surface water quality. However, as no groundwater monitoring was carried out upgradient and downgradient of the waste body, as outlined under the heading 'Groundwater monitoring' below, it cannot be excluded that landfill leachate is not impacting groundwater and therefore, the

	recommended certificate of authorisation requires leachate monitoring, if required by the Agency. Accordingly, Condition 3.1(g) requires installation of at least two leachate monitoring boreholes within the waste body, if required by the Agency. Condition 3.9(b) requires leachate monitoring in accordance with Schedule A.1, which requires monitoring of leachate on a biannually basis and specifies the minimum parameters to be monitored, if required by the Agency. Additionally, Condition 3.9(g) requires that the sensitivity of the monitoring methods utilised shall have an appropriate limit of detection to allow for comparison of pollutant concentrations against the relevant standard reference values. *Groundwater monitoring* The applicant sampled a private well located 610m north-east of the site on 30th August 2010. Due to the fact that groundwater beneath the site flows in the north and north-western direction, no impact from the landfill is expected in the said well. No other monitoring of groundwater outside the waste body was carried out. The applicant was requested to carry out groundwater monitoring in groundwater monitoring boreholes at, a minimum, one location upgradient of the waste body and two locations downgradient of the waste body. However, no results for the requested groundwater monitoring were submitted. The applicant, in correspondence dated 2nd March 2021, stated that '*The Tiered Risk assessment clearly shows that Groundwater is not at risk from the landfill leachate. As such, and as was agreed with the EPA in 2009/2010 that there was no requirement to monitor it'.* As noted above in relation to this pilot program, no records regarding this Agency agreement could be found and there was no record of a Tier 2 assessment for the pilot program to confirm the applicant's Tier 1 findings. It is noted however, that based on the submitted 2010 leachate monitoring results, it cannot be excluded that groundwater quality is impacted by the landfill leachate. Additionally, due to the fact that the aquifer beneath the landfill is a Locally Important Aquifer and the aquifer vulnerability varies from Moderate, through High to Extreme, it is considered that groundwater monitoring is required. Condition 3.1(h) requires installation of at least one groundwater monitoring borehole upgradient of the waste body and two downgradient boreholes. Condition 3.9(e) requires groundwater monitoring in accordance with Schedule A.4, which requires groundwater to be monitored in the proposed boreholes on a quarterly basis and specifies the minimum parameters to be monitored. Also, due to the fact that the waste contains car parts, municipal waste and industrial waste, it is considered that monitoring for organic compounds in the groundwater is appropriate. Accordingly, Condition 3.9(f) requires an annual screening of groundwater for trace organic substances. As previously noted, Condition 3.9(g) requires that the sensitivity of the monitoring

	methods utilised shall have an appropriate limit of detection to allow for comparison of pollutant concentrations against the relevant standard reference values and/or parametric values.
Landfill gas:	There is a risk of landfill gas migration off-site. The most likely pathway for the migration of the landfill gas is through the underlying peat and existing landfill cover material. Gas monitoring was carried out, using impact searcher bars to measure gas levels at depths of 0.5m to 1m, at four locations L1, L2, L3 and L4 on 12th November 2008. It is noted that no drawing showing the gas monitoring locations was provided. It is considered however, that gas monitoring using impact searcher bars may not be reflective of the actual gas concentrations within the waste body which can reach 4.5m in depth. Accordingly, the applicant was requested to carry out updated gas monitoring at gas monitoring boreholes within the centre and along the perimeter of the waste body. However, no results for the requested gas monitoring results were submitted. The applicant, in correspondence dated 2nd March 2021, stated that '*the Risk Assessment clearly shows that there is no risk whatsoever from either vertical or horizontal migration of landfill gas. The feedback from … the EPA at the time was that … it was not required. The Tier 2 assessment excluded any investigation of landfill gas as it was not considered necessary and this was agreed and advised to (Clare County Council) … Requesting it now, in the light of the fact that it was ruled out at all stages of the Risk Assessment process contradicts the advice given at the time by the DoE and EPA. It is not consistent with the approach outlined in the Code of Practice. Furthermore and most significantly, there are no receptors at risk from landfill gas*'. As noted previously in relation to this pilot program, no records recording the advice received by the applicant regarding gas monitoring could be found. The EPA Code of Practice[1] states that if a landfill is older than 30 years '*landfill gas generation is likely to have significantly reduced or ceased and hence the hazard from the site should be reduced. However, on-site monitoring will be required to confirm this*'. The Code of Practice also states that '*The use of a searcher bar … may assist in determining whether or not landfill gas in being generated on-site*'. However, gas monitoring using searcher bars to measure the level of gas in a waste body that can reach a depth of 4.5m is considered inadequate. In accordance with the EPA Landfill Manuals – Landfill Monitoring 2nd Edition, 2003 searcher bars are only recommended for monitoring for gas during a surface survey. Also, the Tier 3 Assessment states '*Given the high water levels in the probe holes* (at the time of monitoring) *it is unlikely that the results are indicative of landfill gas levels in the waste body. It is likely however that given the lack of cover of the waste that landfill gas vents freely to atmosphere and the risk posed to off site receptors as*

1 EPA Code of Practice, Environmental Risk Assessment for Unregulated Waste Disposal Sites.

a result of gas migration is consequently low'.

Considering that the closest dwelling is located 130m from the site boundary and that gas odour was evident during the trial pit investigation, it is considered appropriate that gas monitoring is required. Furthermore, as a landfill cap will be installed, the increased back-pressure caused by the cap may result in an increased lateral movement and flow of gas.

Notwithstanding the above, gas monitoring in 2008 using the impact searcher bars detected no methane above the instrument detection limit of 0.1%. Other monitored parameters were carbon dioxide (CO_2) and oxygen (O_2). Gas flow rate was also measured. Table 6 shows the maximum concentrations of methane and carbon dioxide measured during the monitoring event.

Table 6: Landfill gas monitoring results

Monitoring Location Id	Methane (% v/v)	Carbon dioxide (% v/v)	Trigger levels outside the waste body [1]	
			Methane (% v/v)	Carbon dioxide (% v/v)
L1	0	0	1	1.5
L2	0	0.7		
L3	0	**2.8**		
L4	0	1.2		

The monitoring results show that carbon dioxide was detected at three locations, one of each was outside the trigger level of 1.5% v/v for carbon dioxide.

It is noted that the applicant proposes to install four gas vent pipes close to the perimeter of the site, as detailed in Section titled *Proposed Remedial Actions* below and shown in Figure 7. However, it is considered that one additional gas vent pipe in the centre of the waste body is required to ensure that adequate gas venting is provided. Accordingly, Condition 3.1(e) requires the installation of an additional gas vent pipe in the centre of the waste body.

Condition 3.9(c) requires gas monitoring in accordance with Schedule A.2, which requires monitoring of methane, carbon dioxide and oxygen on a quarterly basis at the gas vents and at the nearest dwelling, if required by the Agency subject to gas monitoring at the gas vent pipes. Condition 3.11 enables changes to monitoring requirements, with the agreement of the Agency following evaluation of test results and/or relevant proposals.

Conceptual site model:	Tier 1 Assessment determined that the overall risk score for the closed landfill was Moderate (Class B). This classification was due to the risk of migration of landfill leachate into surface waters.

[1] As set out in the EPA Landfill Manuals - Landfill Monitoring, 2nd Edition, 2003.

	Following Tier 2 and Tier 3 investigations this risk classification remains Moderate (Class B), due to the risk of migration of landfill leachate into surface waters. The conceptual site model is shown in Figure 8.

4. SPR linkages and remedial actions

SPR linkage scenarios (applicable ones only):	**Leachate and gas migration scores**: High scores: No pathways were identified as High Risk. Moderate scores: One pathway was identified as Moderate Risk: • Migration of leachate, via surface water drainage/runoff, to surface water bodies (SPR 8). Low scores: Five pathways were identified as Low Risk: • Migration of leachate, via groundwater flowing to water drainage/runoff, into surface waterbodies (SPR 1); • Migration of leachate to private wells (SPR 3); • Migration of leachate to the underlying aquifer (SPR 5); • Migration of leachate, via groundwater migration, to surface water bodies (SPR 7); and • Human health exposure pathway of off-site lateral migration of landfill gas (SPR 10). **Summary:** Upon the review of the monitoring data; • remedial action is warranted to address the risk of leachate migrating from the site directly into the adjacent stream and into the underlying aquifer and, via groundwater, to surface waters. • remedial action is warranted to address the risk of migration of landfill gas within the site and gas off-site.
Proposed remedial actions:	The applicant considered the following remedial measures as the feasible options: 1. Landfill cap with a perimeter berm The applicant proposes a 0.5m thick layer of compacted soil as a landfill cap. The Tier 3 Assessment states that given the age of the landfill, 'the weak nature of the leachate and lack of landfill gas the landfill is essentially inert' and refers to the EPA Landfill Manuals – Landfill Restoration and Aftercare which recommends such a cap for inert landfills.

	However, it is considered that a landfill cap of 0.5m of compacted soil is not sufficient due the fact that the deposited waste does not meet criteria for inert waste. As outlined above, the analysis on soil samples (solids) for total organic carbon and loss on ignition exceeded the hazardous waste criteria (39.9% vs. 6% for total organic carbon and 82.4% vs. 10% for loss on ignition). Also, the concentration of dissolved organic carbon was measured at 2,000mg/kg in soil leachate, exceeding the hazardous waste criteria limit of 1,000mg/kg. Accordingly, Condition 3.1(c) requires a landfill cap that comprises of a minimum 1m mineral layer with 1mm thick low permeability geomembrane, or equivalent, to achieve a hydraulic conductivity of less than or equal to $1x10^{-9}$m/s. In addition, Condition 3.1(c) requires a surface water drainage layer to ensure that only uncontaminated surface water is discharged into the adjacent drains. Additionally, the applicant proposes a compacted clay berm, as shown on Figure 7. The Tier 3 Assessment states that waste around the sides of the landfill needs to be pulled back from the surface water ditches and a low permeability clay retaining berm should be constructed between the edge of the waste and the ditches and integrated with the landfill cap. Accordingly, Condition 3.1(d) reflects the proposal for the berm and further requires that it has the same hydraulic conductivity as the landfill cap. 2. <u>Gas ventilation</u> The applicant proposes installation of four gas ventilation wells, one in each quadrant of the site to prevent lateral landfill gas migration, as shown in Figure 7. Condition 3.1(e) reflects this requirement and requires one additional gas vent in the centre of the site, as shown in Figure 7. Condition 3.9(c) and Schedule A.2 require gas monitoring at the gas vents and at the nearest dwelling, if required by the Agency subject to gas monitoring at the gas vent pipes. 3. <u>Environmental monitoring</u> The applicant proposes quarterly monitoring of surface water at the locations SW100 and SW101 on the adjacent drain and at the location SW102 on the Wood river. The applicant lists also the parameters to be monitored: ammonia, sodium, chloride, potassium, manganese, electrical conductivity and heavy metal suite (cadmium, chromium, copper, lead, mercury, nickel and zinc). Schedule A.3 reflects this proposal. Having regard to the monitoring results submitted in support of the application for a certificate of authorisation, the age of the closed landfill and the fact that the nearby dwellings are serviced by a public water supply, the following remedial measures are considered appropriate and recommended in Condition 3.1:

	(a) Minimise the disturbance of deposited waste to the extent possible; (b) Remove, for disposal or recovery at an appropriate facility, waste from the adjacent ditches or any area outside the waste body, and waste resulting from remediation works, within three months of the date of grant of this Certificate of Authorisation or the date of generation of waste from remediation works where applicable; (c) Install a low permeability landfill cap over the waste body, minimum 1m with 1mm thick low permeability geomembrane, or equivalent, to achieve a hydraulic conductivity of less than or equal to $1x10^{-9}$m/s; The landfill cap shall incorporate the following elements installed in accordance with the EPA Landfill Manuals – Landfill Site Design and its design shall be agreed by the Agency prior to installation: (i) Water drainage layer. Uncontaminated surface water drained from the water drainage layer shall discharge to an appropriate local drain or ditch. (d) Install a compacted clay perimeter berm around the waste body. The clay berm shall be integrated with the landfill cap and achieve the same hydraulic conductivity; (e) Install and operate a gas management system, as specified below. The design of the gas management system (layout, depth, sealing etc.) shall be in accordance with the EPA Landfill Manuals – Landfill Site Design. The gas management system shall include the following elements: (i) Five gas vent pipes, one of which shall be in the centre of the waste body, with fans or rotating cowls, as appropriate. • The gas vent pipes shall not be perforated above ground level; and • The spacing between the gas vent pipes shall be sufficient to achieve adequate gas venting. (f) On agreement by the Agency, the gas management system and associated infrastructure may be removed or altered if required. (g) Install at least two leachate monitoring boreholes within the waste body, if required by the Agency; (h) Install at least three groundwater monitoring boreholes, one of which shall be upgradient of the waste body and two of which shall be downgradient of the waste body; and (i) Reseed grass within the site. The proposed remedial measures are intended to break the SPR linkages by preventing:

	• migration of leachate into the surface waters and the underlying aquifer, and via groundwater, into surface water bodies. • migration of landfill gas off site. The recommended certificate of authorisation allows for the importation and use of soil and stone to complete the works.
Proposed aftercare monitoring and assessment:	Monitoring as specified in Condition 3.9 and Schedule A of the recommended certificate of authorisation. Validation report to be submitted within 30 months.
Adequacy of risk assessment:	Regulation 7(7) of the Regulations states that the EPA must be satisfied with the risk assessment before proposing to grant a certificate of authorisation. The risk assessment is adequate as it has identified, assessed and adequately addressed the associated risks inherent within the landfill site.

5. Appropriate Assessment

Appendix 1 lists the European Sites assessed, their associated qualifying interests and conservation objectives along with the assessment of the effects of the activity/activities on the European Sites.

A screening for Appropriate Assessment was undertaken to assess, in view of best scientific knowledge and the conservation objectives of the site, if the activity, individually or in combination with other plans or projects is likely to have a significant effect on any European Site. In this context, particular attention was paid to the European Sites at Lower River Shannon SAC (site code: 002165) and River Shannon and River Fergus Estuaries SPA (site code: 004077).

The activity is not directly connected with or necessary to the management of any European Site and the Agency considered, for the reasons set out below, that it cannot be excluded, on the basis of objective information, that the activity, individually or in combination with other plans or projects, will have a significant effect on any European Site and accordingly determined that an Appropriate Assessment of the activity was required. A Natura Impact Statement was not requested as it was considered that there was sufficient information available to allow Appropriate Assessment to be carried out.

The reason for the determination that an Appropriate Assessment was required is as follows:

- There is a hydrological connection between the closed landfill and the above listed European Sites, which are located 5.7km downstream of the site within the Mouth of the Shannon (waterbody code: IE_SH_060_0000). This connection is via the land drains, which are located immediately adjacent to the site and discharge into the Moyadda Beg River (waterbody code: IE_SH_27W010100), which flows into the Kilcarroll Stream (waterbody code: IE_SH_27W010100), which then discharges into the Mouth of the Shannon.

An Inspector's Appropriate Assessment has been completed and has determined, based on best scientific knowledge in the field and in accordance with the European Communities (Birds and Natural Habitats) Regulations 2011 as amended, pursuant to Article 6(3) of the Habitats Directive, that the activity, individually or in combination with other plans or projects, will not adversely affect the integrity of any European Site, in particular Lower River Shannon SAC (site code: 002165) and River Shannon and River Fergus Estuaries SPA (site code: 004077), having regard to their conservation objectives and will not affect the

preservation of these sites at favourable conservation status if carried out in accordance with the recommended certificate of authorisation and the Conditions attached hereto for the following reasons:

- specifically, the remedial works will be undertaken to minimise the potential for water pollution in the Lower River Shannon SAC (site code: 002165) and River Shannon and River Fergus Estuaries SPA (site code: 004077) and will ensure that there will be no significant impact on these European Sites; and
- the project alone, which consists of the remediation of the closed landfill, or in-combination with other projects, will not adversely affect the integrity and conservation status of any of the qualifying interests of the Lower River Shannon SAC (site code: 002165) and River Shannon and River Fergus Estuaries SPA (site code: 004077).

In light of the foregoing reasons, no reasonable scientific doubt remains as to the absence of adverse effects on the integrity of those European Sites: Lower River Shannon SAC (site code: 002165) and River Shannon and River Fergus Estuaries SPA (site code: 004077).

6. Recommendation

I recommend granting the certificate of authorisation as proposed.

Signed

Date 7th June 2022

Ewa Babiarczyk

Procedural Note

Any representations received by the Agency within 30 days of the draft certificate of authorisation being made available will be considered by the Agency.

As soon as practicable after the expiry of the 30-day period the Agency will determine the certificate of authorisation, which may vary from the draft certificate, and shall issue an appropriately validated certificate of authorisation in accordance with the Waste Management (Certificate of Historic Unlicensed Waste Disposal and Recovery Activity) Regulations 2008.

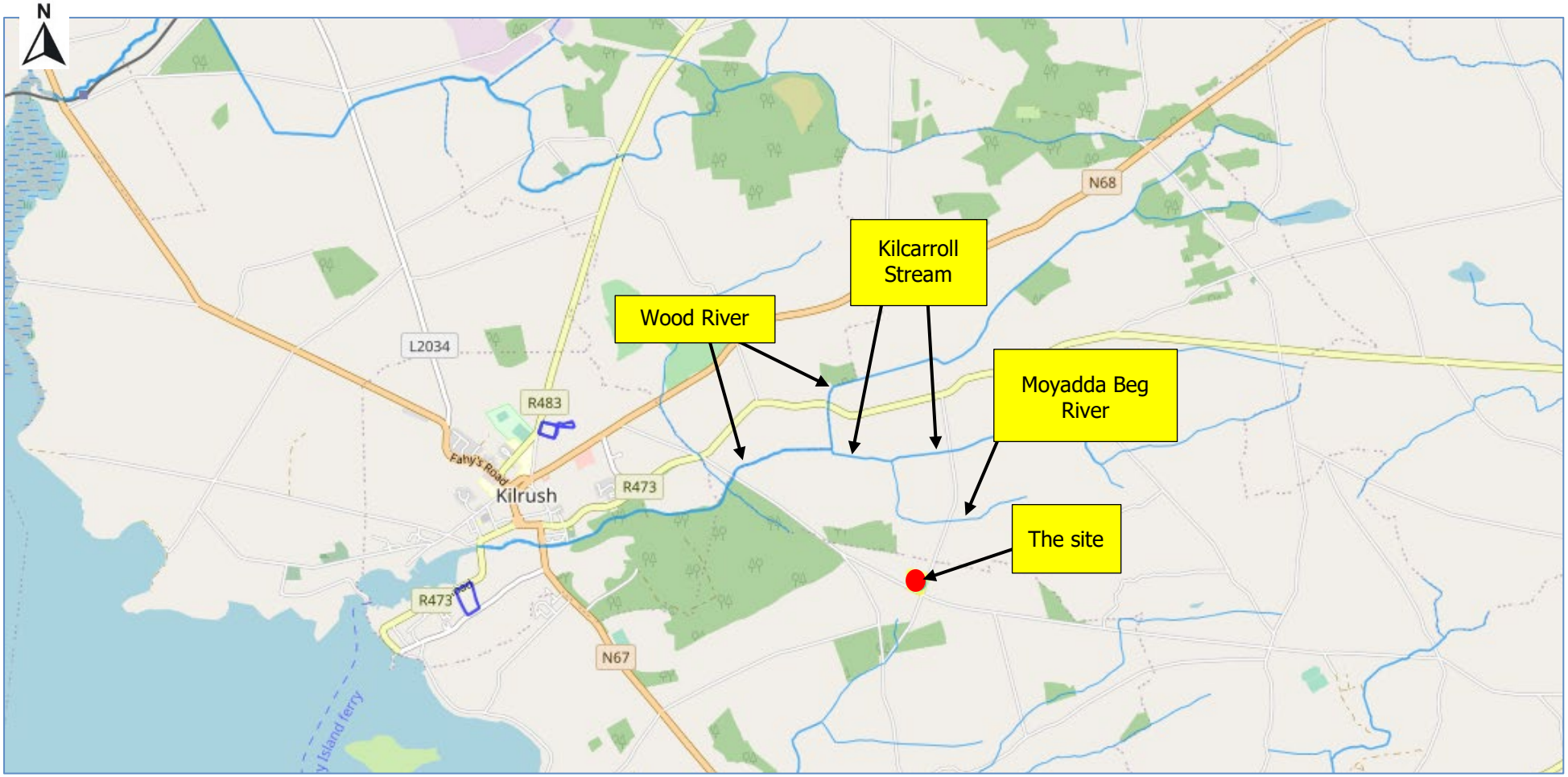

Figure 1: Location of Kilrush Landfill

Figure 2: Site boundary & site surroundings

Figure 3: Waste on the landfill surface and in the nearby drainage ditch (Site 1)

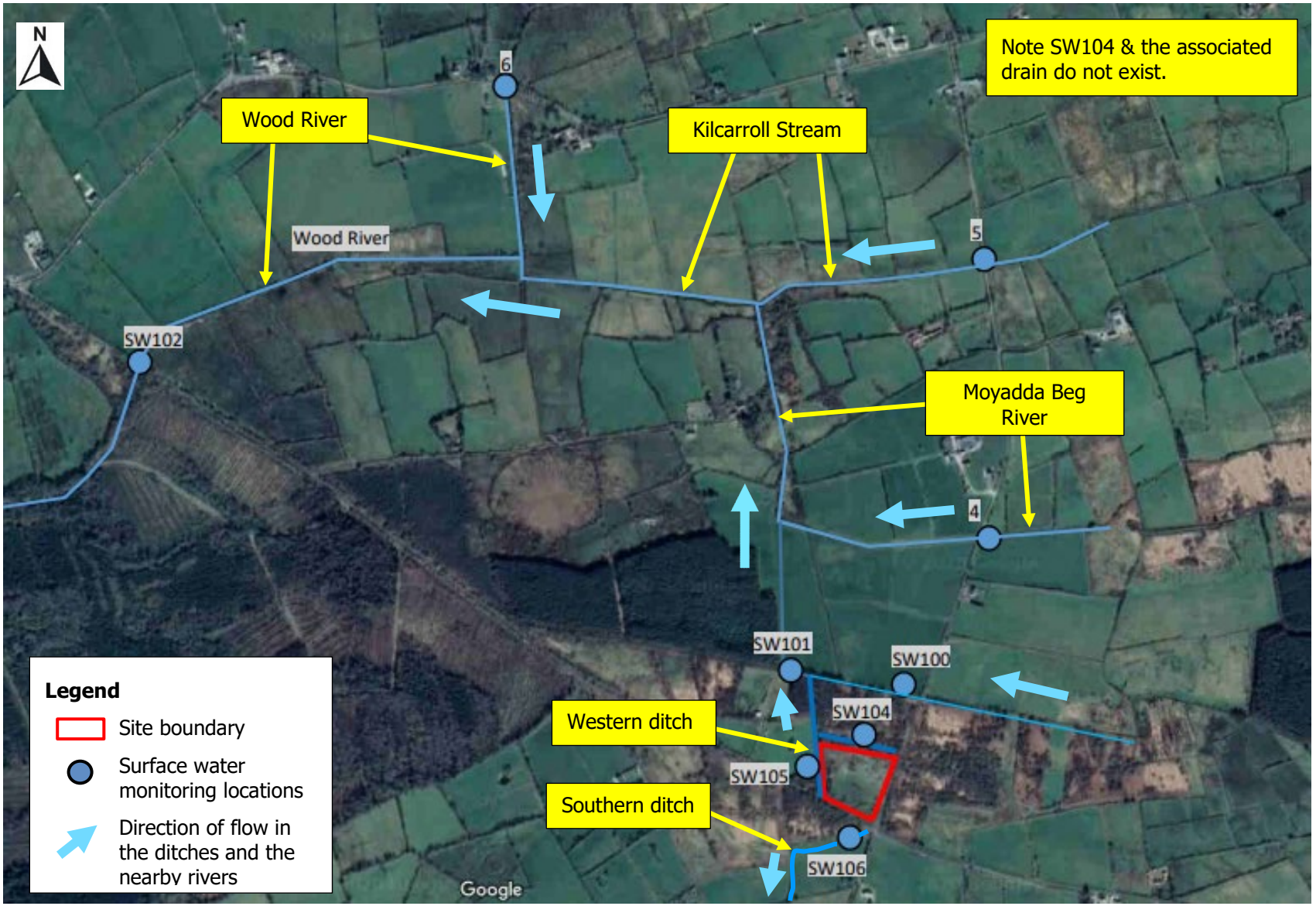

Figure 4: Surface water monitoring locations

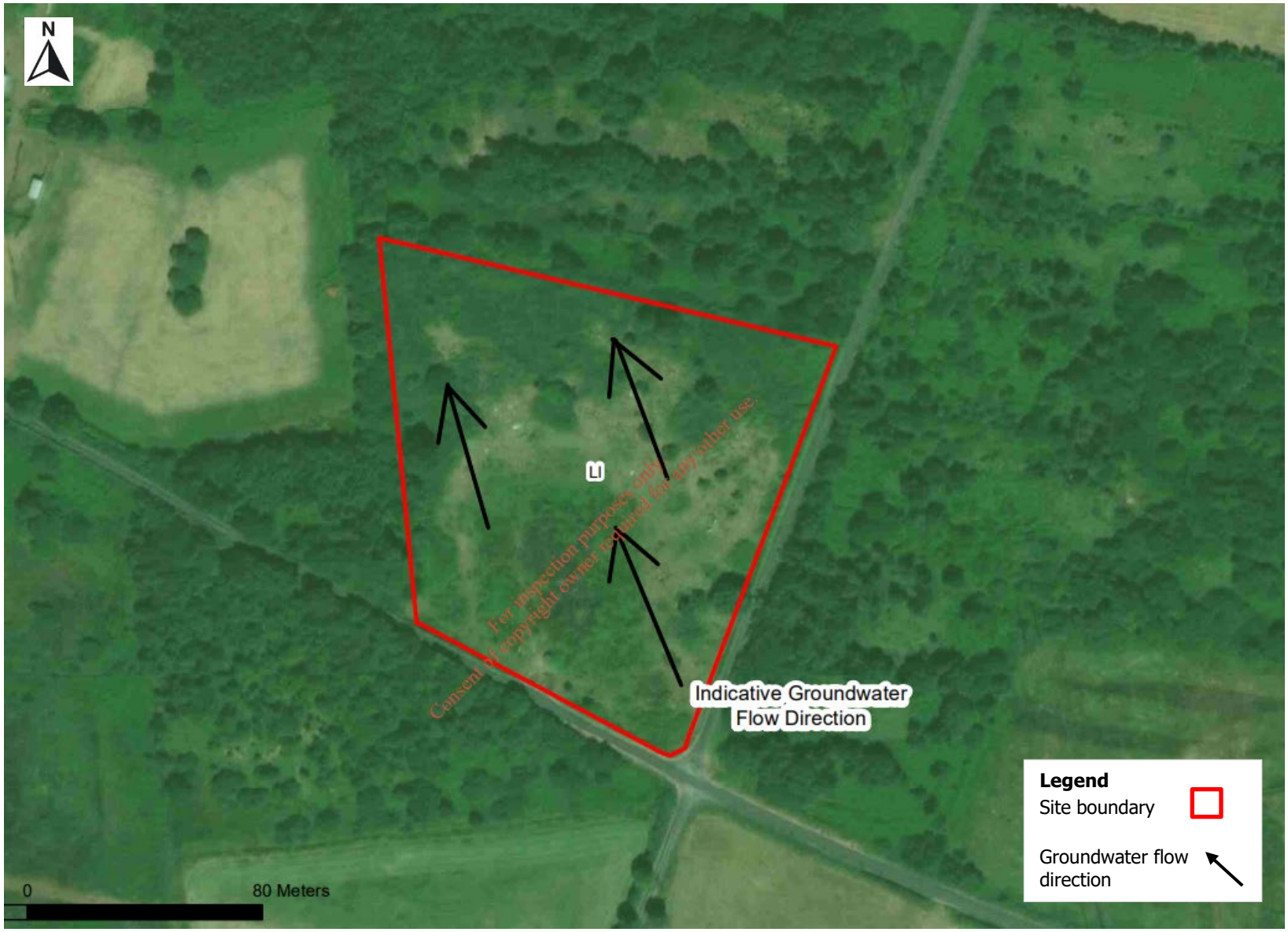

Figure 5: Groundwater flow direction

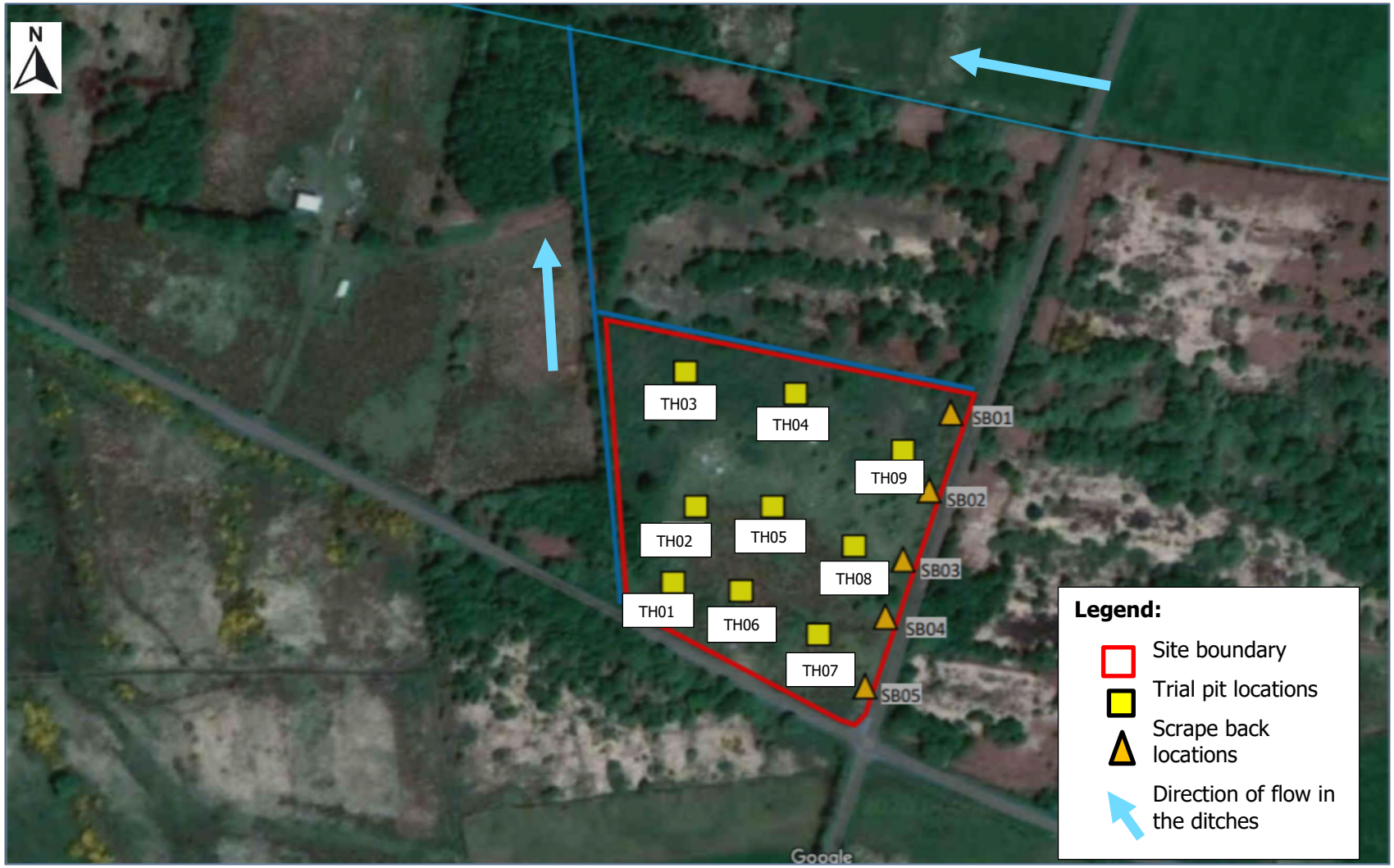

Figure 6: Trial pit (TH) and scrape back (SB) locations

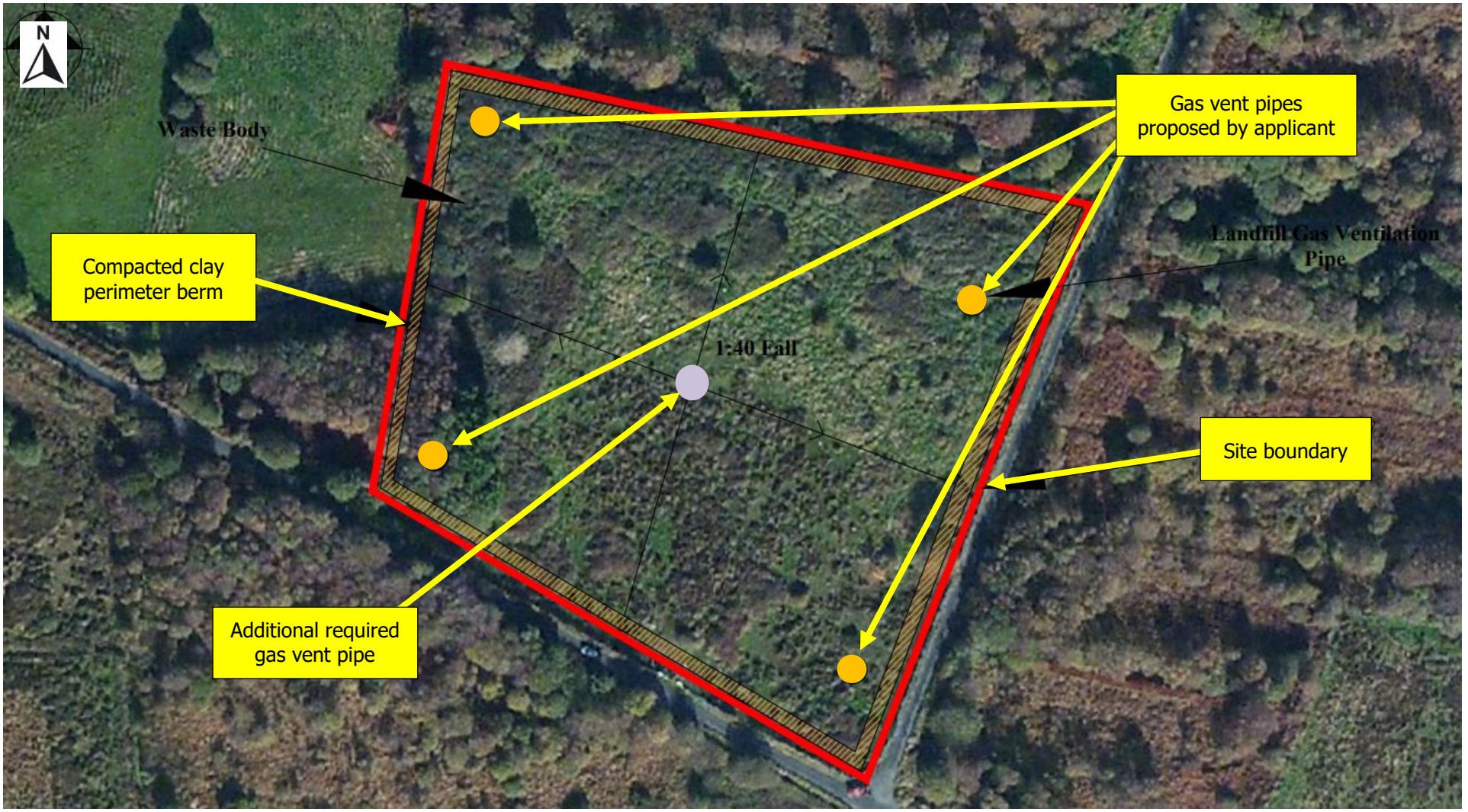

Figure 7: Proposed remedial measures

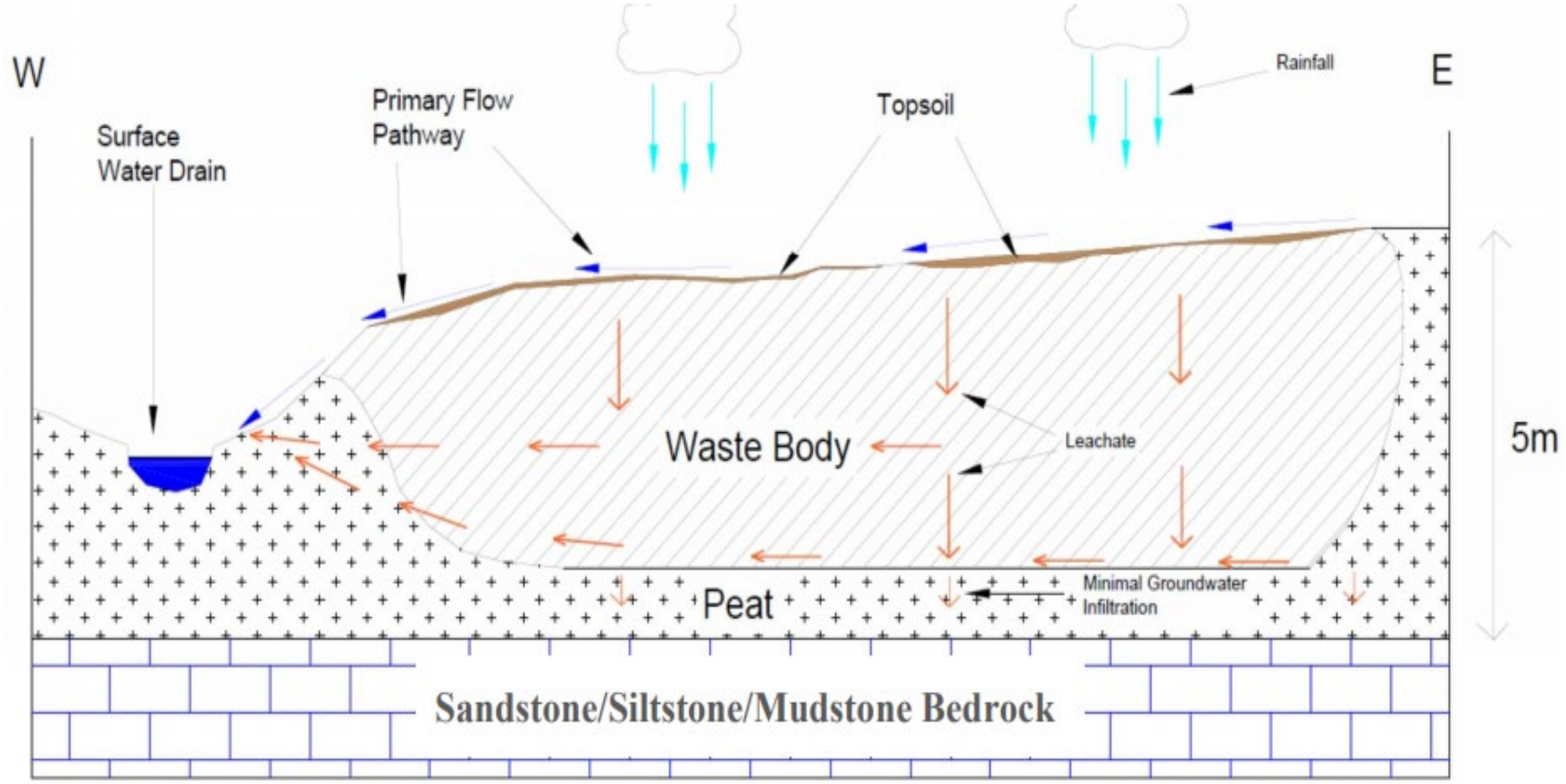

Figure 8: Conceptual site model for Kilrush Landfill

Appendix 1: Assessment of the effects of activity on European sites and proposed mitigation measures.

European Site	Direction from the facility (km)	Qualifying Interests (* denotes priority habitat)	Conservation Objectives	Assessment
Lower River Shannon SAC (site code: 002165)	2.1km south of the closed landfill	**Species:** 1029 Freshwater Pearl Mussel *Margaritifera margaritifera* 1095 Sea Lamprey *Petromyzon marinus* 1096 Brook Lamprey *Lampetra planeri* 1099 River Lamprey *Lampetra fluviatilis* 1106 Atlantic Salmon *Salmo salar* (only in fresh water) 1349 Bottlenose Dolphin *Tursiops truncatus* 1355 Otter *Lutra lutra* **Habitats:** 1110 Sandbanks which are slightly covered by sea water all the time 1130 Estuaries 1140 Mudflats and sandflats not covered by seawater at low tide 1150 *Coastal lagoons 1160 Large shallow inlets and bays 1170 Reefs 1220 Perennial vegetation of stony banks 1230 Vegetated sea cliffs of the Atlantic and	NPWS (2012) Conservation Objectives: Lower River Shannon SAC [002165]. Version 1.0. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht [dated 7th August 2012].	Although there will be no emissions from the landfill site to surface water or groundwater, there is a potential risk of migration of landfill leachate into surface waters and groundwater. However, the appropriate capping, as required under Condition 3.1, will limit ingress of rainwater into the waste body thus limiting the generation of leachate. Condition 3.9 and Schedule A require monitoring, sampling, analysis and characterisation of leachate, if required, groundwater upgradient and downgradient of the waste body and surface water upstream and downstream of the landfill. Additionally, Condition 3.1 requires installation of a gas venting system. Condition 3.9 and Schedule A require gas monitoring from the gas vent pipes. Furthermore, Condition 3.3 requires that the closed landfill and the remedial works shall not cause environmental pollution or deterioration in the status of the receiving surface water body or groundwater body. The controls in the recommended certificate of authorisation will ensure that the qualifying interests of this European site will be protected.

		Baltic coasts 1310 *Salicornia* and other annuals colonizing mud and sand 1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) 1410 Mediterranean salt meadows (*Juncetalia maritimi*) 3260 Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation 6410 *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) 91E0 *Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)		
River Shannon and River Fergus Estuaries SPA (site code: 004077)	2.1km south of the closed landfill	**Species:** A017 Cormorant *Phalacrocorax carbo* A038 Whooper Swan *Cygnus cygnus* A046 Light-bellied Brent Goose *Branta bernicla hrota* A048 Shelduck *Tadorna tadorna* A050 Wigeon *Anas penelope* A052 Teal *Anas crecca* A054 Pintail *Anas acuta* A056 Shoveler *Anas clypeata* A062 Scaup *Aythya marila* A137 Ringed Plover *Charadrius hiaticula* A140 Golden Plover *Pluvialis apricaria* A141 Grey Plover *Pluvialis squatarola* A142 Lapwing *Vanellus vanellus*	NPWS (2012) Conservation Objectives: River Shannon and River Fergus Estuaries SPA 004077. Version 1.0. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht [dated 17th September 2012].	Although there will be no emissions from the landfill site to surface water or groundwater, there is a potential risk of migration of landfill leachate into surface waters and groundwater. However, the appropriate capping, as required under Condition 3.1, will limit ingress of rainwater into the waste body thus limiting the generation of leachate. Condition 3.9 and Schedule A require monitoring, sampling, analysis and characterisation of leachate, if required, groundwater upgradient and downgradient of the waste body and surface water upstream and downstream of the landfill. Additionally, Condition 3.1 requires installation of a gas venting system. Condition 3.9 and Schedule A require gas monitoring from the gas vent pipes.

		A143 Knot *Calidris canutus* A149 Dunlin *Calidris alpina* A156 Black-tailed Godwit *Limosa limosa* A157 Bar-tailed Godwit *Limosa lapponica* A160 Curlew *Numenius arquata* A162 Redshank *Tringa totanus* A164 Greenshank *Tringa nebularia* A179 Black-headed Gull *Chroicocephalus ridibundus* **Habitats:** A999 Wetlands		Furthermore, Condition 3.3 requires that the closed landfill and the remedial works shall not cause environmental pollution or deterioration in the status of the receiving surface water body or groundwater body. The controls in the recommended certificate of authorisation will ensure that the qualifying interests of this European site will be protected.