Site Specific Flood Risk Assessment

Project Ref: Knockharley Landfill Environmental Risk Assessment Report – Appendix 6.3

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Title	Principal Hydrological Consultant	Director Water
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1. INTRODUCTION

1.1 Background

AWN Consulting Ltd (AWN) has been appointed by Beauparc to undertake a Site Specific Flood Risk Assessment ("FRA") as part of the EIAR. The proposed development is located within the townlands of Knockharley, Flemingstown and Tuitrath, Navan, Co. Meath and part of the site is currently primarily in use as an active landfill (Industrial Emissions Directive (IED) Licence no. W0146-04). The site is located c. 800m from the N2 National Primary Road and landfill facility has its own private entrance off the N2.

The landfill was originally permitted in 2001 (Meath County Council (MCC) Reg. Ref. 01/5006) and most recently extended in size in 2021 (ABP-303211-18).

The proposed development primarily seeks to continue the existing landfill operations across an extended footprint within the site boundary. The proposed extension will add an additional 4.12 million m3 of additional void space for landfilling.

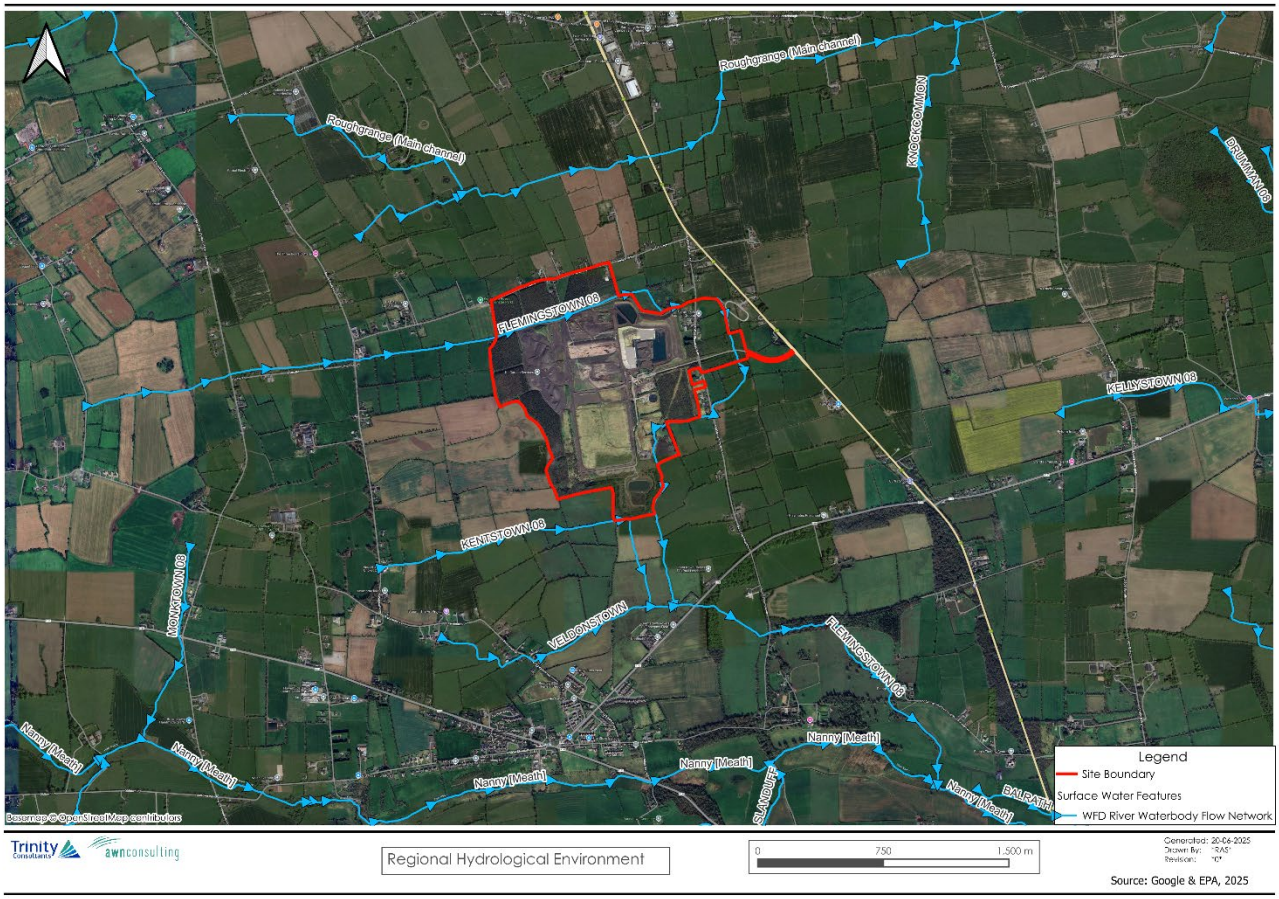
The site is surrounded at all sides by agricultural land which is the primary land use of the wider region. There are dispersed residential properties in the vicinity of the site, with the nearest residential houses located along the Knockharley road to the immediate north of the site and along the Rathdrinagh/Flemingstown road (L5056) to the east of the site.

The Knockharley Stream (EPA Name: Flemingstown 08, EPA Code: 08F05) flows west to east through the northern portion of the site and then flows along the eastern boundary of the site where it travels south /southeast away from the site and joins the Nanny River (EPA Name: Nanny (Meath), EPA Code: 08_757) c. 3km downstream. The Knockharley stream traverses or runs along the boundary of the site for c. 3km. A portion of the Knockharley Stream to the north of the landfill was diverted as part of the permitted ABP-303211-18 application.

The Kentstown Stream (EPA Name: Kentstown 08, EPA Code: 08K18) flows along the southern boundary of the site for c. 90 m before turning south and joining the Knockharley Stream c. 550 m downstream.

Refer to Figure 1-1 for the location of the proposed development and the hydrological environment.

Figure 1-1. Hydrological Environment



1.2 Planning Policy

The following planning policy documents are relevant to the assessment of the proposed development:

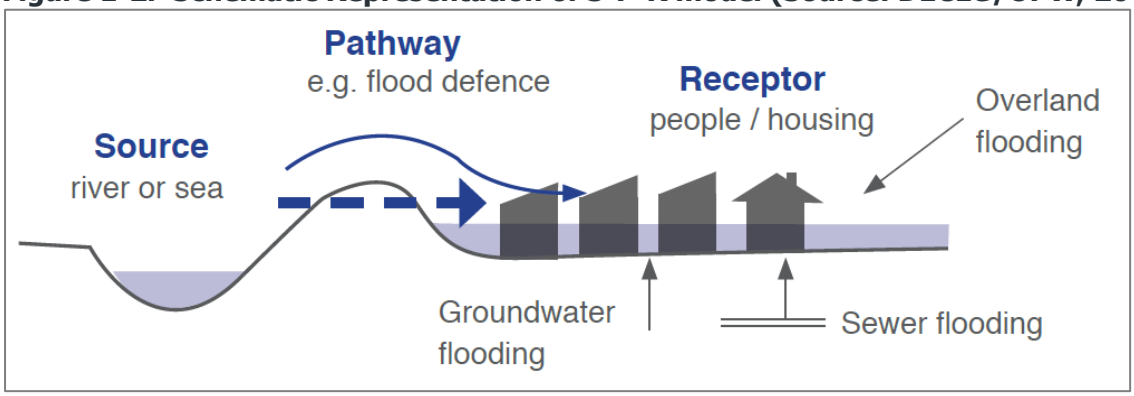
- The National Planning Guidelines published by the OPW and the Department of the Environment, Heritage and Local Government in November 2009 entitled 'The Planning System and Flood Risk Management Guidelines for Planning Authorities'.
- Meath County Development Plan 2021-2027.
- National Development Plan 2018-2027.
- National Development Plan Review 2025.

1.3 Relevant Guidelines and Flood Risk Management

As mentioned above, the relevant guidelines used by the Planning Authorities for Flood Assessment, 'The Planning System and Flood Risk Management', was published by the Department of Housing, Planning and Local Government (DECLG/OPW) in 2009. The purpose of the guidelines is to ensure that where relevant, flood risk is a key consideration in preparing development plans and assessing planning applications to avoid inappropriate development in areas at risk of flooding or increasing flood risk elsewhere as a result of development.

For carrying out a Site-specific Flood Risk Assessment (SSFRA), the OPW Guidelines recommend using Source-Path-Receptor (S-P-R) concept model to identify where the flood originates from, what the floodwaters path is and the areas in which assets and people might be affected by such flooding (Section 2.18 of the OPW Guidelines, 2009). Figure 1-2 below shows a schematic representation of S-P-R model.

Figure 1-2. Schematic Representation of S-P-R model (Source: DECLG/OPW, 2009)



A Flood Risk Assessment is undertaken over several stages with the need for progression to a more detailed stage dependent on the outcomes of the former stage. As per the relevant guidelines a tiered approach has been taken. The main aim of this assessment is to determine the risk of flooding to the site and the impact development will have on the floodplain, developments off site, upstream and downstream levels and any mitigation measures necessary.

This report follows the DECLG/OPW guidance for the staged approach to flood risk management as follows:

- Stage 1: Flood Risk Identification - to identify whether there may be any flooding or plan issues related to a plan area or proposed development site that may warrant further investigation.
- Stage 2: Initial Flood Risk Assessment - to confirm sources of flooding that may affect a plan area or proposed development site, to appraise the adequacy of existing information and to determine what surveys and modelling approach is appropriate to match the spatial resolution required and complexity of the flood risk issues. The extent of the risk of flooding should be assessed which may involve preparing indicative flood zone maps. Where existing river or coastal models exist, these should be used broadly to assess the extent of the risk of flooding and potential impact of a development on flooding elsewhere and of the scope of possible mitigation measures; and,
- Stage 3: Detailed Flood Risk Assessment - to assess flood risk issues in sufficient detail and to provide a quantitative appraisal of potential flood risk to a proposed or existing development, of its potential impact on flood risk elsewhere and of the effectiveness of any proposed mitigation measures. This will typically involve use of an existing or construction of a hydraulic model of the river or coastal cell across a wide enough area to appreciate the catchment wide impacts and hydrological processes involved.

As described in the FRM guidelines flood risk is a combination of the likelihood of flooding and the potential consequences arising. This is normally expressed in terms of the following relationship:

Flood Risk = Probability of Flooding x Consequences of Flooding

The likelihood of flooding is normally expressed as the percentage probability based on the average frequency measured or extrapolated from records over a large number of years. A 1% probability indicates the flood level that is expected to be reached on average once in 100 years, i.e. it has a 1% chance of occurring in any one year. Therefore:

- 100-year flood = 1% Annual Exceedance Probability (AEP).
- 1000-year flood = 0.1% AEP.

The purpose of this report is to carry out a Stage 1 Flood Risk Assessment for the site and the development proposals in accordance with the requirements outlined in "The Planning System and Flood Risk Management Guidelines for Planning Authorities". This report will make any recommendations for Stage 2 or Stage 3 FRA as necessary.

1.4 Flood Zones

According to the aforementioned guidelines: "*Flood zones are geographical areas within which the likelihood of flooding is in a particular range, and they are a key tool in flood risk management within the planning process as well as in flood warning and emergency planning*". The likelihood of a flood occurring is established through the identification of Flood Zones which indicate a high, moderate, or low risk of flooding from fluvial or tidal sources, as defined as follows (refer also to Figure 1-3 below):

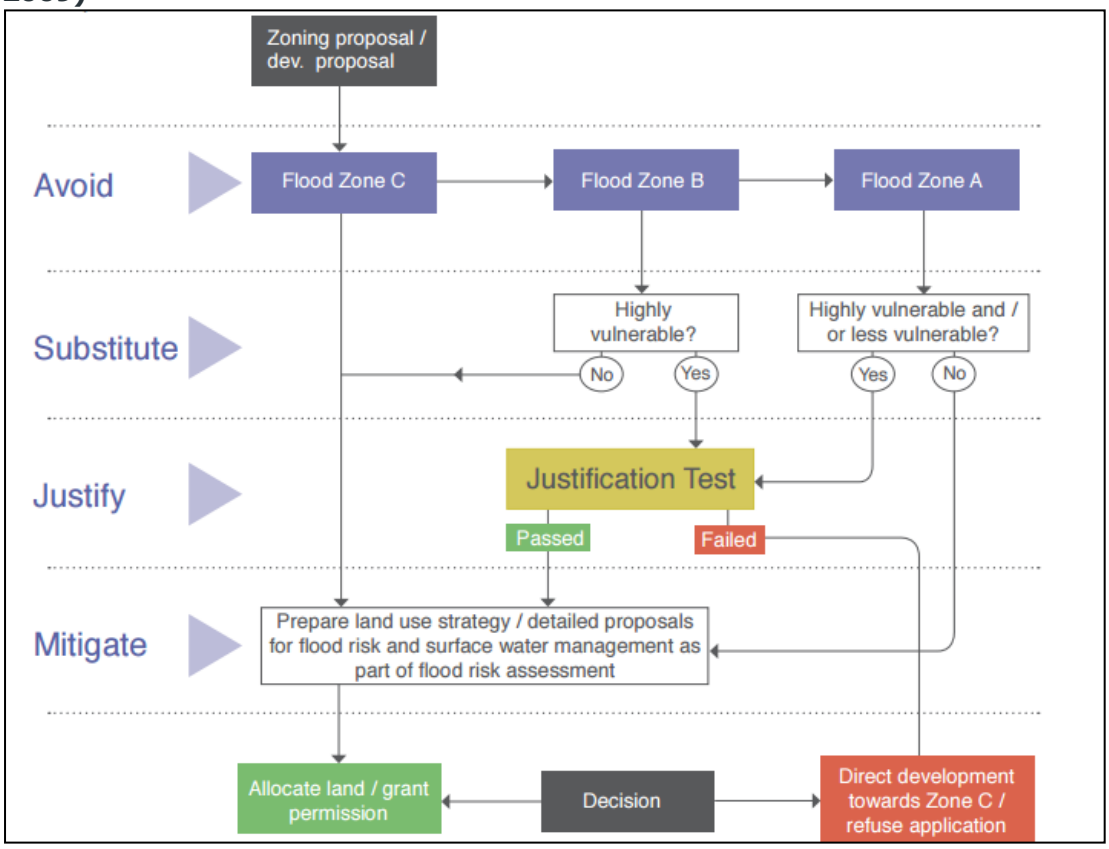
- Flood Zone A - Where the probability of flooding is highest (greater than 1% AEP or 1 in 100 for river flooding and 0.5% AEP or 1 in 200 for coastal flooding) and where a wide range of receptors would be vulnerable.
- Flood Zone B - Where the probability of flooding is moderate (between 0.1% AEP or 1 in 1000 and 1% AEP or 1 in 100 for river flooding and between 0.1% AEP or 1 in 1000 year and 0.5% AEP or 1 in 200 for coastal flooding); and
- Flood Zone C - Where the probability of flooding is low (less than 0.1% AEP or 1 in 1000 for both river and coastal flooding).

Figure 1-3. Indicative Flood Zone Map (Source: DECLG/OPW, 2009)

1.5 Sequential Approach and Justification Test

A sequential plan approach was undertaken for this risk assessment under the relevant guidance mentioned above. Specifically, a sequential approach is first and foremost directed towards land that is at low risk of flooding. The underpinning philosophy of the sequential approach is highlighted in the illustration below. It should be noted that the above guidance is applicable in the layout and design of the specific subject site at the development management stage (refer to Figure 1-4 below).

Figure 1-4. Sequential Approach Mechanism in the Planning Process (Source: DECLG/OPW, 2009)



According to the Guidelines, if a development falls in the justification test category, then the test must demonstrate that the development meets the following criteria:

1. The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of the Guidelines.
2. The proposal has been subject to an appropriate flood risk assessment that demonstrates:

    a. The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk.
    b. The development proposal includes measures to minimise flood risk to people, property, the economy, and the environment as far as reasonably possible.
    c. The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and
    d. The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to development of good urban design and vibrant and active streetscapes.

The acceptability or otherwise of levels of residual risk should be made with consideration of the type and foreseen use of the development and the local development context.

1.6 Classification of Vulnerability

As explained, the sequential approach presented above makes use of flood risk assessment and of prior identification of flood zones for river and coastal flooding and additionally, classification of the vulnerability to flooding of different types of development, as illustrated in Table 1-1 below.

Table 1-1. Classification of Vulnerability of Different Types of Development (Source: DECLG/OPW, 2009)

Vulnerability class	Land uses and types of development
Highly Vulnerable Development (including essential infrastructure)	Garda, ambulance and fire stations and command centres required to be operational during flooding. Hospitals. Emergency access and egress points. Schools. Dwelling houses, student halls of residence and hostels. Residential institutions such as residential care homes, children's homes and social services homes. Caravans and mobile home parks. Dwelling houses designed, constructed or adapted for the elderly or, other people with impaired mobility. Essential infrastructure, such as primary transport and utilities distribution, including electricity generating power stations and sub-stations, water and sewage treatment, and potential significant sources of pollution (SEVESO sites, IPPC sites, etc.) in the event of flooding.
Less Vulnerable Development	Buildings used for retail, leisure, warehousing, commercial, industrial and non-residential institutions. Land and buildings used for holiday or short-let caravans and camping, subject to specific warning and evacuation plans. Land and buildings used for agriculture and forestry. Waste treatment (except landfill and hazardous waste). Mineral working and processing. Local transport infrastructure.
Water-compatible Development	Flood control infrastructure. Docks, marinas and wharves. Navigation facilities. Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. Water-based recreation and tourism (excluding sleeping accommodation). Lifeguard and coastguard stations. Amenity open space, outdoor sports and recreation and essential facilities such as changing rooms. Essential ancillary sleeping or residential accommodation for staff required by uses in this category (subject to a specific warning and evacuation plan).

Finally, Table 1-2 below illustrates those types of development that would be appropriate to each flood zone and those that would be required to meet the Justification Test.

Table 1-2. Matrix of Vulnerability versus Flood Zone (Source: DECLG/OPW, 2009)

Vulnerability class	Flood Zone A	Flood Zone B	Flood Zone C
Highly Vulnerable	Justification Test	Justification Test	Appropriate
Less Vulnerable	Justification Test	Appropriate	Appropriate
Water-compatible	Appropriate	Appropriate	Appropriate

Landfill facilities are classed as 'Highly Vulnerable', therefore the development requires a Justification Test if it is to be located in Flood Zone A or B.

1.7 Climate Change

Flood risk is anticipated to increase as a result of climate change. Projected impacts for Ireland include:

- Sea level rise of between 18cm and 59cm this century;
- More intense storms and rainfall events;
- Increased likelihood and magnitude of river and coastal flooding; and
- Increased storm surges.

With respect to this assessment and the development area only changes in the intensity of rainfall events and the magnitude of river flooding are of direct relevance.

In all developments, climate change should be considered when assessing flood risk and in particular residual flood risk. Consideration of climate change is particularly important where flood alleviation measures are proposed, as the design standard of the proposal may reduce significantly in future years due to increased rainfall, river flows and sea levels.

The Guidelines recommend that a precautionary approach to climate change is adopted due to the level of uncertainty involved in the potential effects. A significant amount of research into climate change has been undertaken on both a national and international front, and updates are ongoing.

The OPW guidance recommends two climate change scenarios are considered and an allowance provided. These are the Mid-Range Future Scenario (MRFS) and the High-End Future Scenario (HEFS). The allowances should be applied to the 1% AEP fluvial or 0.5% AEP tidal levels. Based on these two scenarios the OPW recommended allowances for climate change are given in Table 1-3 below. These climate change allowances are particularly important at the development management stage of planning and will ensure that proposed development is designed and constructed to take into account best current knowledge.

Table 1-3. Allowances in Flood Parameters for the Mid-Range and High-End Future Scenarios for Fluvial and Tidal Sources

Parameter	MRFS	HEFS
Extreme Rainfall Depths	+20%	+30%
Peak Flood Flows	+20%	+30%
Mean Sea Level Rise	+500 mm	+1,000 mm
Land Movement	-0.5 mm/year [1]	-0.5 mm/year [1]
Urbanisation	No General Allowance – Review on Case-by-case basis	No General Allowance – Review on Case-by-case basis
Forestation	- 1/6 Tp [2]	- 1/3 Tp [2] + 10% SPR [3]
Note 1: Applicable to the southern part of the country only (Dublin – Galway and south of this) Note 2: Reduction in the time to peak (Tp) to allow for potential accelerated runoff that may arise as a result of drainage of afforested land Note 3: Add 10% to the Standard Percentage Runoff (SPR) rate: This allows for temporary increased runoff rates that may arise following felling of forestry.		

For most development, including residential, nursing homes, shops and offices, the medium-range future scenario (20% increase in flows / 0.5 m sea level) is an appropriate consideration. This should be applied in all areas that are at risk of flooding (i.e. within Flood Zone A and B) and will be considered for sites which are in Flood Zone C but are adjacent to Flood Zone A or B. This is because land which is currently not at risk may become vulnerable to flooding when climate change is taken into account.

Where a development is critical or extremely vulnerable the impact of climate change on 0.1% AEP flows should also be applied, and greater climate change allowances tested for resilience purposes (30% increase in flows / 1.0m level).

Where the risk associated with inundation of a development is low and the design life of the development is short (typically less than 30 years) the allowance provided for climate change may be less than the 20% / 0.5m level. It should be noted that the operational life of the Proposed Development in terms of landfilling activities is planned to cease in 2043.

Refer to Table 1-4 for the allowance classification by vulnerability and flood source.

Table 1-4. Climate Change Allowances by Vulnerability and Flood Source

Development Vulnerability	Fluvial climate change allowance (increase in flows)	Tidal climate change allowance (increase in sea level)	Storm water/ surface water
Less Vulnerable	+20%	0.5m (MRFS)	20% increase in rainfall
Highly Vulnerable	+20%	0.5m (MRFS)	
Critical or extremely vulnerable (e.g. hospitals, major sub-stations, blue light services)	+30%	1.0m (HEFS)	
Note: There will be no discounting of climate change allowances for shorter lifespan developments			

In general, climate change will be accounted for by the setting of finished floor levels to a height which includes an allowance for climate change. However, climate change may also reveal additional flow paths which need to be protected or give rise to flows which exceed culvert capacity or overtop defences. These outcomes will need to be specifically investigated for each site, and an appropriate response provided.

2. HYDROLOGICAL AND HYDROGEOLOGICAL ENVIRONMENT

2.1 Regional and Local Hydrology

The proposed development site is located within the former Eastern River Basin District (ERBD) (now the Irish River Basin District), as defined under the European Communities Directive 2000/60/EC, establishing a framework for community action in the field of water policy – this is commonly known as the Water Framework Directive (WFD). The site is located in the Eastern River Basin District (IESE) (Hydrometric Area No. 08).

The proposed development site lies within the Nanny-Delvin Catchment (Catchment ID: 08) and the Nanny [Meath]_SC_010 Sub-Catchment (Sub-Catchment ID: 08_4). The current EPA watercourse mapping shows two watercourses flowing adjacent to the site. The Flemingstown(Meath)_10 (European Code: IE_EA_08F050930) stream transverses with the site in the northern section, flowing in an easterly direction before turning south as it transverses with the south section of the site before discharging to River Nanny c.2.8km south of the site. The existing surface water pond discharges to the Flemingstown Stream south of the wetland. A second tributary, the Kentstown Stream flows east along the southern licensed boundary before turning south and joining the Veldonstown Stream, just upstream of its confluence with the Flemingstown Stream.

The current EPA watercourse mapping shows two watercourses flowing adjacent to the proposed development site. The Flemingstown 08 stream transverses with the site in the northern section, flowing in an easterly direction before turning south as it transverses with the south section of the site before discharging to River Nanny c.2.8km south of the site. A second tributary, the Kentstown Stream flows east along the southern licensed boundary before turning south and joining the Veldonstown Stream, just upstream of its confluence with the Flemingstown Stream. The Flemingstown Stream originates from the west near the Realtogue area c. 2.5 km upstream of the site. The stream emerges from a 1.0 m diameter circular concrete culvert at the western boundary.

With regard to the local hydrology, there is an existing surface water and foul drainage on site as shown in Figure 2-1 below. In the northern section of the site, there are a holding pond and an attenuation pond while a storm attenuation lagoon is present in the southern section of the site.

Surface water swales are present in the northern section of the site around the IBA Cells which flow from the western side of the cells flowing in a south easterly direction before turning north and discharging to the holding pond through surface water piped network. Two separate piped storm networks exist in the eastern section of the site which collects all storm water and flows in a general southernly direction. Both storm networks combine towards the centre of the site and flow in a southernly direction towards the storm attenuation lagoon.

Also, a surface water swale runs parallel on the eastern and western side of the existing landfill. The western swale flows in southern direction before flowing east while the eastern swale flows in southernly direction. Both swales merge near the southeastern boundary of the existing landfill. From here they join the exiting storm water pipeline through a piped network before discharging to the storm attenuation lagoon.

A network of foul drainage also exists along the facilities and existing buildings which collects to the foul water and discharge it into the waste leachate lagoon.

Refer to Figure 2-1 for the local hydrological environment.

Figure 2-1. Local Hydrological Environment

2.2 Hydrogeology

The bedrock aquifer underlying the proposed development site, according to the GSI (www.gsi.ie/mapping) National Draft Bedrock Aquifer Map, is classified as a "Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones". The potential for vertical or horizontal migration within this type of aquifer is not significant and on local scale. The GSI map does not identify structural faults underneath the area of the subject site.

The site is underlain by the Realtage groundwater body (GWB) (European Code: IE_EA_G_020), According to GSI (2004), The dominant subsoil lithology overlying this GWB is till, mainly derived from Namurian sediments, although some limestone-derived tills are seen closer to the contact with the limestone. There are smaller areas of alluvium and gravel deposits along the River Nanny floodplain. recharge will occur via rainfall percolating through the subsoil. The GWB is composed primarily of low permeability rocks, although localized zones of enhanced permeability do occur. Recharge occurs diffusely through the subsoils and via outcrops. It takes place mainly in the upland areas where subsoils are thinner and more permeable. The aquifers within the GWB are generally unconfined, but may become locally confined where the subsoil is thicker and/or lower permeability. Most flow in this aquifer will occur near the surface. In general, the majority of groundwater flow occurs in the upper 10 m, comprising a weathered zone of a few metres and a connected fractured zone below this. However, deep-water strikes in more isolated faults/ fractures can be encountered at 30-50 mbgl. Flow path lengths are relatively short, and in general are between 100 and 500 m. Groundwater discharges to the numerous small streams crossing the aquifer, and to the springs and seeps.

Based on the most recent data (EPA, 2025; www.epa.ie), the Realtage GWB for which the site is located entirely within, has a WFD status of "Good" (WFD Period: 2016-2021) and a WFD risk score (3rd Cycle) of "Not at Risk" of not achieving good status.

The GSI presently classifies the groundwater vulnerability of the entire site as 'Low' vulnerability, and this has been confirmed by the site investigation carried out by Ground Investigation Ireland (GII, 2025). Based on the subsoil type and description, the expected depth to bedrock is expected to be greater than 10m.

The site is sloped with elevations ranging from 70 mOD in the northwest to 55 mOD in the southeast of the site. The groundwater flow direction likely follows the local topography to Flemingstown and Kentstown Stream contributing to their baseflow

3. CHARACTERISTICS OF THE PROPOSED DEVELOPMENT

The proposed development primarily seeks to continue the existing landfill operations across an extended footprint within the site boundary. The proposed extension will add an additional 4.12 million m^3 of additional void space for landfilling. The drainage system will include additional swales, petrol interceptors, and changes and expansion of the existing attenuation ponds to manage surface water effectively. In addition, a stream diversion with a new culvert is proposed to facilitate the landfill expansion.

A 10% increase in the precipitation depth has been incorporated in the design to allow for climate change (based the Greater Dublin Regional Code of Practice (section 3.2)). According to the Drainage Report prepared by WSP and included as part of this application, a high-level analysis of storage requirements during post-closure has been undertaken to confirm that the High-Range Future Scenario 30% increase in extreme rainfall can be accommodated in the proposed attenuation ponds.

The proposed Northern Attenuation Pond system has been designed to provide long-term storage which will discharge at a maximum rate of 109 l/s for a 1:100 AEP event through a Hydro-brake device, or similar on the outlet pipe to regulate the discharge rate. The total storage volume required to attenuate the 1:100 AEP event is 7,901 m^3. The current attenuation capacity provided by the Northern Attenuation Pond and the Holding Pond will be sufficient to accommodate the proposed design storage volume, however modification will be required to the discharge pipe arrangements (refer to the Drainage Report prepared by WSP for further reference). An existing emergency spillway (which will also be part of the proposed development) has been provided above the 1:100 AEP level to safely pass any exceedance flows.

The Southern Attenuation Pond has been designed to provide long-term and short-term storage. The long-term storage will discharge at a maximum rate of 107 l/s during a 1:100 AEP event. It has been assumed that an orifice, or similar, will be installed on the outlet pipe to regulate the discharge rate. The total storage volume required to attenuate the 1:100 AEP event is 9,401m^3. Similarly, the minimum long-term storage volume required in the pond is 3,249 m^3 to attenuate the 1:1 AEP event. The current attenuation capacity provided by the Southern Attenuation Pond will be increased from 6,900m^3 app. to 12,700m^3 app. to meet this criterion. An emergency spillway has been provided above the 1:100 AEP level to safely pass any exceedance flows.

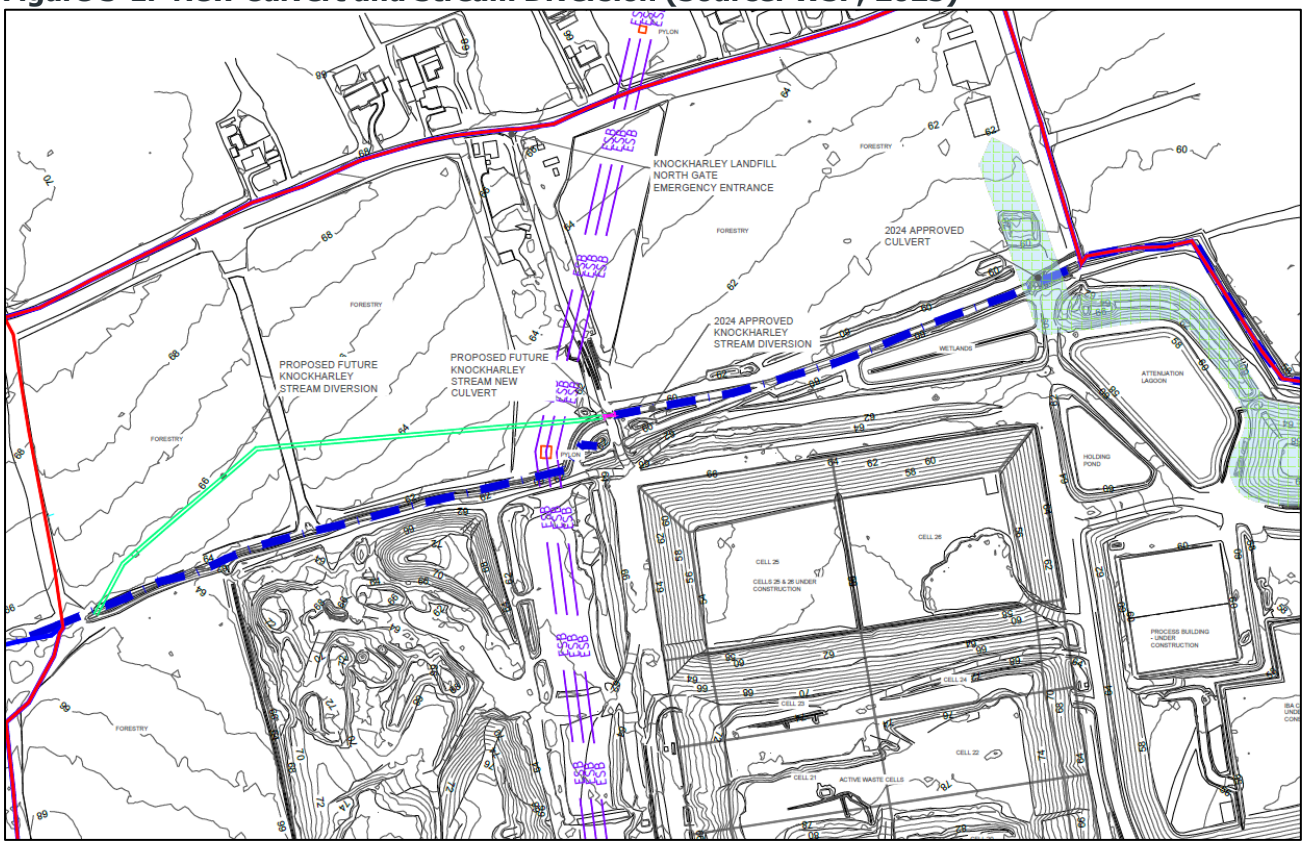
Grassed swales have been proposed to provide treatment and convey surface water from the landfill to the attenuation ponds.

The proposed development works also include the diversion of the existing Knockharley Stream. It is proposed to realign the river to the north of the current channel to facilitate the extension of the existing landfill footprint. The diverted stream will be unculverted with the exception of existing access road crossing which will require a culvert to allow the road to passover.

Consultation has taken place with Inland Fisheries Ireland regarding the design of the stream diversion and culvert. Requirements for the culvert construction were agreed on and incorporated into the design, which has been appended to the aforementioned Drainage Report prepared by WSP. Specifically, that the culvert will be buried to a minimum depth of 0.5 m below the stream bed and that the gradient in the culvert should not exceed 3%. The material used to embed the culvert will be similar to that of the existing stream bed.

A Culvert Hydrologic and Hydraulic Assessment has been prepared by WSP (2025) as part of its Section 50 application appended to the Drainage Report and submitted with the planning application documentation. The report summarises the methodologies employed and outcomes from the completed hydrologic and hydraulic assessment. The design of watercourse crossings will be subject to the approval of the OPW, under Section 50 of the Arterial Drainage Act, 1945 and OPW standards. Figure 3-1 below presents the proposed diversion.

Figure 3-1. New Culvert and Stream Diversion (Source: WSP, 2025)



According to the Hydraulic Assessment, the proposed culvert will have adequate capacity to pass the design flood flow with sufficient freeboard and without causing more than 300 mm afflux. It is not anticipated that the flood risk in the catchment area for the 1% AEP (plus 20% increase due to climate change) will increase as a result of the presence of the proposed new culvert. There are some roads, and residential buildings present in the upstream catchment of the culvert which will not be affected by the proposed culvert. Refer to the WSP Assessment for further information.

4. FLOOD RISK ASSESSMENT

4.1 Stage 1 – Flood Risk Identification

Stage 1 identifies whether there are any flooding or surface water management issues related to the area indicated from Regional Planning Guidelines or Development Plans that may warrant further investigation. This will provide a general indication of the potential flood risk to the site and identify whether there are any flooding or surface water management issues that may warrant further investigation work in the form of a Stage 2 (Initial Flood Risk Assessment) and Stage 3 (Detailed Flood Risk Assessment) as required.

The following data sources indicate if a flood risk in the area of interest exists:

- OSi Historical Flood Maps and Satellite imagery.
- OPW Flood Hazard Mapping.
- CFRAM Indicative Flood Zone Maps.
- GSI Groundwater Flooding Viewer.
- Strategic Flood Risk Assessment – Meath County Development Plan 2021-2027.

These data sources were used to identify any potential flood risk from the following sources:

1. Fluvial Flooding.
2. Pluvial Flooding – Surface Water Run-off.
3. Coastal Flooding.
4. Groundwater Flooding.

4.1.1 Fluvial Flood Risk

The OPW online viewer was accessed to establish if any historical flood plains were marked on the assessment area. No historical flood plains were identified in the vicinity of the development site. The OPW flood hazard maps were also used to establish if there is a risk of fluvial flooding.

The OPW mapping portal (www.floodinfo.ie) includes mapping showing the extent of the predicted Flood Zone A (1% AEP event) and Flood Zone B (0.1% AEP event) in the Study Area. The mapping was developed by hydraulic modelling during the CFRAM projects undertaken for the OPW and is in line with the Meath County Development Plan 2021-2027 Strategic FRA. An extract from the mapping is shown in Figure 4-1 and Figure 4-2 below in the context of the proposed development site. A Flood Zone B area is indicated in the permitted landfill area, associated with the existing northern attenuation pond as well as a Flood Zone A in its southern area associated with the existing wetland. However, part of the Flood zone B is now covered by the cell 25-26, therefore the extent of this zone may be obsolete. The Flood Risk Assessment prepared by the applicant as part of the 2021 Extent application process[1] estimated a 1:1000-year compensation flood footprint that replaces the Flood Zone B initially estimated by the CFRAM projects (refer to Figure 4-3 below).

[1] Environmental Impact Assessment Report (EIAR) for the Proposed Development at Knockharley Landfill. Appendix 12.5. Flood Risk Assessment. Fehily and Timoney, November 2018.

Figure 4-1. Extract from CFRAM Fluvial Flooding Map (Source: OPW, 2025)

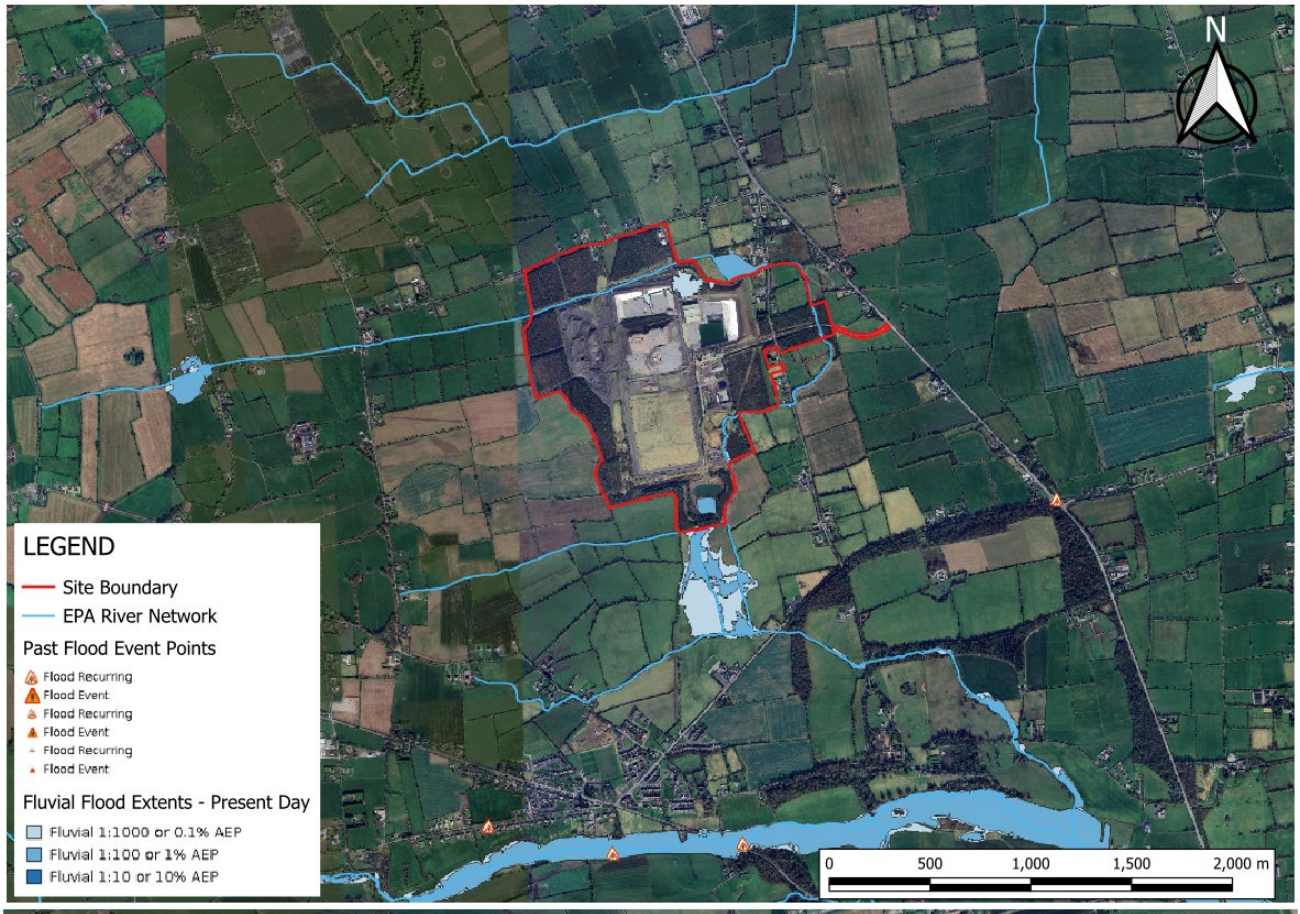
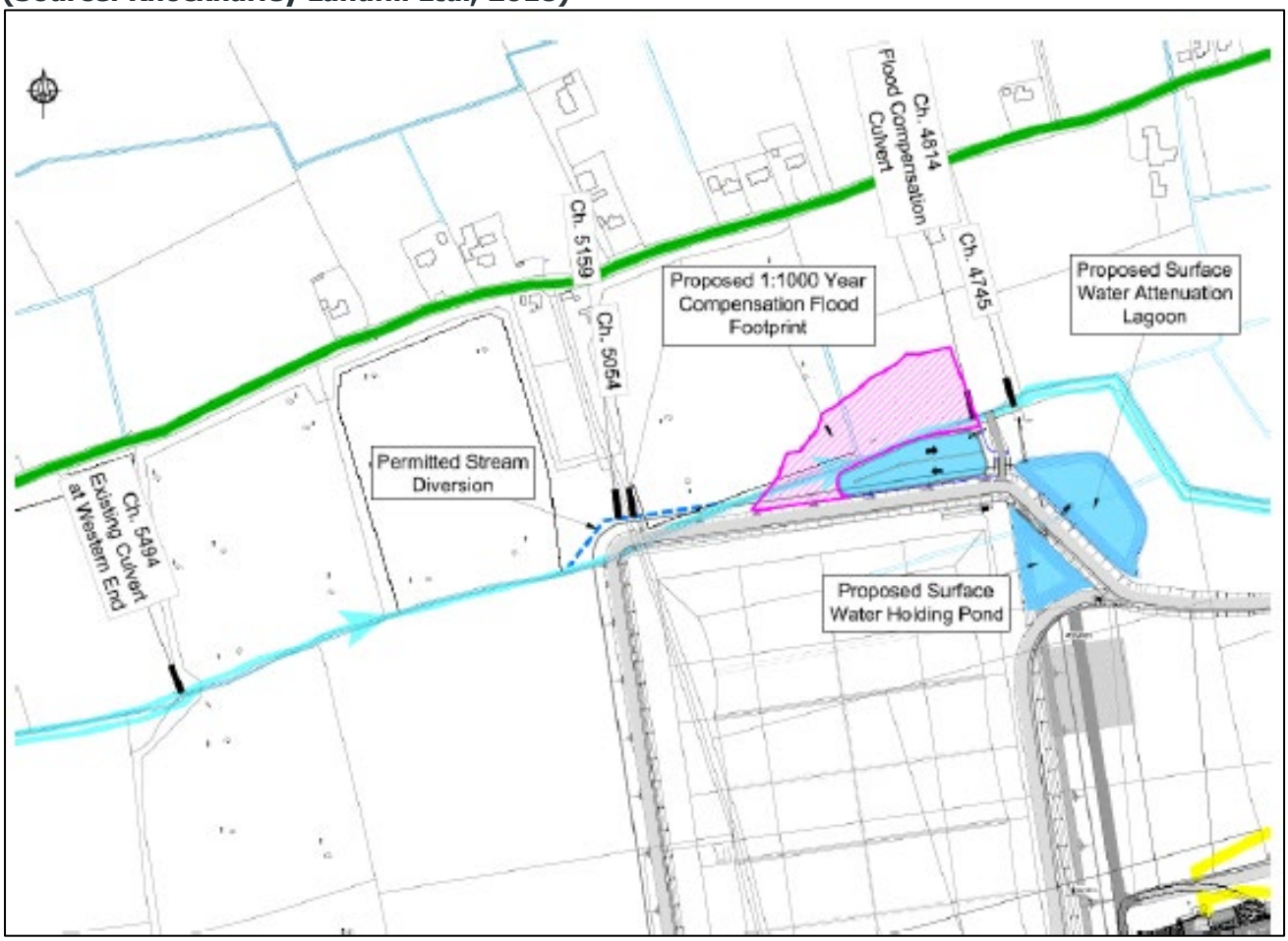


Figure 4-2. Extract from Meath County Development Plan 2021-2027

Figure 4-3. Existing Flood Footprint associated with Flood Zone B in the Northern Area (Source: Knockharley Landfill Ltd., 2018)



As mentioned in Section 3 above, the proposed development works includes the diversion of the existing Knockharley Stream to facilitate the proposed development. This diversion will require a culvert for the existing access road crossing.

4.1.2 Pluvial Flood Risk

The potential risk of flooding from surface water would arise from the accumulation of rainfall runoff across the site and the surrounding areas. The past flood events map created by the OPW does not present historical flood locations associated with the proposed layout. Small areas of indicative pluvial flooding are noted at the site and these areas are currently addressed by the existing surface water drainage in the landfill.

4.1.3 Coastal Flood Risk

The proposed development is located approximately 21km upstream from the nearest transitional/coastal waterbody on the River Nanny (Nanny Estuary). The proposed layout is therefore outside any coastal/tidal influence and the risk of coastal flooding can be considered low.

4.1.4 Groundwater Flood Risk

The Geological Survey Ireland (GSI) Groundwater Viewer provides predictive and historic groundwater flood maps for Ireland. Figure 4-4 below shows no groundwater flooding events within the development site. The risk of groundwater flooding can be considered low.

Figure 4-4. Groundwater Flooding Map (Source: GSI, 2025)

4.1.5 Summary of Potential Sources of Flooding

A brief appraisal of the potential sources of flooding and their impact on the proposed development is summarized in Table 4-1 below.

Table 4-1. Appraisal of Flood Risk Sources

Source	Pathway	Receptor	Likelihood	Consequence	Risk
Fluvial	Overbank	Infrastructure/People	Possible	Medium	Medium
Pluvial	Overflow	Infrastructure/People	Possible	Low	Low
Coastal	Overtop/breach	Infrastructure/People	Remote	Medium	Low
Groundwater	Rising water level	Infrastructure/People	Low	Low	Low

4.2 Stage 2 – Initial Flood Risk Assessment

With regard to the existing northern attenuation pond and the southern wetland both associated with CFRAM flooding zones, the proposed development will not affect these water features and their capacities. The Northern Attenuation Pond has been already designed to provide storage for the 1:100 AEP event and any flow above the 1:100 AEP level is conveyed through an emergency spillway provided to safely pass any exceedance flows.

The compensation flood footprint associated with Flood Zone B presented in the previous application process in the northern area (and presented in Figure 4-3 above) will not be affected by the proposed development and therefore, the food risk will not be increased.

The Southern Attenuation Pond has also been designed to provide long-term storage whose discharge has been designed to convey the 1:100 AEP event. An emergency spillway has been provided above the 1:100 AEP level to safely pass any exceedance flows. As such, these works do not affect the extent of the existing Flood Zone A associated with the wetland where this attenuation pond discharges, as the storm 1:100 will be attenuated and managed by this existing system.

The High-Range Future Scenario (1% AEP plus 30% increase in extreme rainfall) can be accommodated in the proposed attenuation ponds at closure.

In addition, as mentioned in Section 3 above, the proposed development works includes the diversion of the existing Knockharley Stream to facilitate the extension of the existing landfill footprint. The diverted stream will be unculverted with the exception of existing access road crossing which will require a culvert to allow the road to passover.

According to the Hydraulic Assessment carried out by WSP, the proposed culvert will have capacity to convey the design flood flow (1% annual exceedance probability or 1 in 100-year flow without significantly changing the hydraulic characteristics of the watercourse) with sufficient freeboard. The available freeboard at the culvert during the 1% AEP event, inclusive of climate change (calculated as 0.96 m). It is not anticipated that the flood risk in the catchment area for the 1% AEP + climate change will increase as a result of the presence of the proposed new culvert.

A Stage 3 (Detailed Flood Risk Assessment) is not required as the Stage 2 assessment is conclusive in terms of the potential flood risk.

4.3 Identification of Development Vulnerability

The proposed development type is considered to be essential infrastructure, associated with facilities with potential significant sources of pollution (IPPC sites, etc.) in the event of flooding and therefore it is classified as 'Highly Vulnerable' as per the definition given in 'The Planning System and Flood Risk Management: Guidelines for Planning Authorities', as shown in Table 1-1 above.

As presented above, part of the proposed layout is within Flood Zone A and B. Therefore, as this landfill is considered a "Highly Vulnerable" development, and in accordance with Table 1-2 above, a Justification Test will be required for this part of the development.

4.4 Justification Test

According to the Guidelines, if a development falls in the justification test category, then the test must demonstrate that the development meets the criteria presented in Section 1.5 above.

Table 4-2. Justification Test

Criteria	Test
(1) The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of the Guidelines.	The land at the proposed development is zoned Rural Area (RA) as part of the Meath County Development Plan. It is noted that landfill use is neither a 'open for consideration use' or 'permissible use'. The landfill use is an existing and ongoing use of the site. Section 11.14.2 of the current Meath County Development Plan (2021-2027) notes that "there are instances across the County of established uses that do not conform to the zoning objective for the particular location. Any proposals for the expansion, improvement, or alteration of such uses will be considered on their individual merits". In this regard, the proposed development is in-keeping with the policies and will assist in fulfilling objectives in the current Meath County Development Plan (2021-2027). In particular, the importance of Knockharley Landfill is identified at Section 6.17.3.6 (Disposal) of the County Development Plan which notes 'The Knockharley regional landfill, near Kentstown, accessed off the N2 National Primary Route is a privately operated landfill facility which has capacity beyond the lifetime of this Plan. It is recognised that a contingency capacity for landfill is required to facilitate emergency situations for example, the management of waste from a foot and mouth disease outbreak.' In relation to Waste Management and Infrastructure. Some of the relevant policies and objectives in the County Development Plan are listed below: • INF POL 61: To facilitate the implementation of National Waste Legislation, National and Regional Waste Management Policy and the circular economy. • INF POL 63: To encourage the development of waste infrastructure and associated developments in appropriate locations, as deemed necessary in accordance with the requirements of the current Eastern Midlands Region Waste Management Plan and the Draft Waste Facility Siting Guidelines 2016 (when finalised) or any subsequent replacement guidelines.

Criteria	Test
	• INF POL 65: To adopt the provisions of the waste management hierarchy and implement policy in relation to the County's requirements under the current or any subsequent Waste Management Plan. All prospective developments in the County shall take account of the provisions of the regional waste management plan and adhere to the requirements of the Plan. Account shall also be taken of the proximity principle and the inter-regional movement of waste. • INF POL 70: To encourage the recycling of construction and demolition waste and the reuse of aggregate and other materials in future construction projects. • INF OBJ 54: To facilitate the transition from a waste management economy to a green circular economy to enhance employment opportunities and increase the value recovery and recirculation of resources. • INF OBJ 55: To facilitate the provision of appropriate waste recovery and disposal facilities in accordance with the principles set out in the appropriate Waste Management Plan applicable from time to time made in accordance with the Waste Management Act 1996 (as amended). • INF OBJ 59: To seek to ensure, in cooperation with relevant authorities, that waste management facilities are appropriately managed and monitored according to best practice to maximise efficiencies to protect human health and the natural environment. • INF OBJ 68: To support the development of facilities to cater for commercial waste not provided for within the kerbside collection system such as the WEEE, C & D type waste and hazardous materials in accordance with the requirements of the Eastern Midlands Regional Waste Management Plan.
(2a) The proposal has been subject to an appropriate flood risk assessment that demonstrates: The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk.	The proposed extended landfill is not within the 1% or 0.1% AEP flood extents so will not have any influence on 1% and 0.1% AEP floods elsewhere. However, as mentioned above, Flood Zones A and B are present within the site, associated with the existing northern settlement pond and the southern wetland, respectively. These areas will not be altered by the proposed development.
(2b) The proposal has been subject to an appropriate flood risk assessment that demonstrates: The development proposal includes measures to minimise flood risk to people, property, the economy, and the environment as far as reasonably possible.	

Criteria	Test
(2c) The proposal has been subject to an appropriate flood risk assessment that demonstrates: The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access.	The High-Range Future Scenario 30% increase in extreme rainfall can be accommodated in the proposed attenuation ponds. The diversion of the Knockharley Stream will be unculverted with the exception of the projected culvert for the crossing of the access road. The proposed culvert was designed according to OPW standards and will be subject to the approval of the OPW, under Section 50 of the Arterial Drainage Act, 1945. It will have capacity to convey the design flood flow (1% AEP) with sufficient freeboard. The available freeboard at the culvert during the 1% AEP event, inclusive of climate change. It is not anticipated that the flood risk in the catchment area for the 1% AEP + climate change will increase as a result of the presence of the proposed new culvert.
(2d) The proposal has been subject to an appropriate flood risk assessment that demonstrates: The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to development of good urban design and vibrant and active streetscapes.	As mentioned above, the proposed development and is in-keeping with the policies and will assist in fulfilling objectives in the current Meath County Development Plan (2021-2027). This flood risk assessment has been prepared in line with these objectives.

4.5 Flood Mitigation Measures and Residual Risk

The proposed surface water system has been designed to meet the requirements set out in the Greater Dublin Regional Code of Practice for Drainage Works V6.0, in line with the Greater Dublin Strategic Drainage Study (GDSDS) and the CIRIA SuDS Manual C753.

The drainage system will include additional swales, petrol interceptors, and changes and expansion of the existing attenuation ponds to manage surface water effectively. In addition, a stream diversion with a new culvert is proposed to facilitate the landfill expansion.

The system has been designed to attenuate and convey the 1:100 AEP event. A 10% increase in the precipitation depth has been incorporated to allow for climate change. The drainage design has demonstrated that the High-Range Future Scenario (i.e., plus 30% increase in extreme rainfall) can be accommodated in the proposed attenuation ponds.

In addition, as mentioned in Section 3 above, the Proposed Development works includes the diversion of the existing Knockharley Stream to facilitate the extension of the existing landfill footprint. The diverted stream will be unculverted with the exception of existing access road crossing which will require a culvert to allow the road to passover. This culvert will have capacity to convey the design flood flow (1% AEP + 20% climate change) without significantly changing the hydraulic characteristics of the watercourse) with sufficient freeboard. It is not anticipated that the flood risk in the catchment area for the 1% AEP + climate change will increase as a result of the presence of the proposed new culvert.

Therefore, it can be concluded that the 1% AEP (plus climate change allowance) will be accommodated in the proposed drainage system.

In the event of the 0.1% AEP event, it is expected that, in the northern attenuation pond, this volume will be accommodated in the existing compensation flood footprint presented in Figure 4-3 above. With regard to the southern Flood Zone B in the wetland, as can be seen in the figures above, the extent associated with the 0.1% AEP would not differ significantly from the 1% AEP and therefore the wetland would have capacity to control this excess volume that the southern attenuation pond would not have capacity to convey (i.e., flow in excess of the 1% AEP).

According to the 2009 Guidelines, the residual risk remains after all risk avoidance, substitution and mitigation measures have been implemented, on the basis that such measures only reduce risk, not eliminate it.

The residual risk associated to climate change is considered to be low, based on CFRAM Mid-Range and High-End future models. The Mid-Range models show flood extent associated with the Knockharley Stream floodplain and the existing northern settlement pond and southern wetland, similar to the present-day scenarios and also show a coastal flood zone influenced by the rising levels at Nanny Estuary, Nanny River and Knockharley Stream. Figure 4-5 and Figure 4-6 below show that there would be no additional flooding extents for these conditions. It should be noted that the High-End scenarios do not show flood extents on the subject site.

Given the short time-frame over which active closure will occur, and the relatively short facility life-time, application of this more extreme climate change allowances in design was considered excessively conservative Reference has also been paid to the Flood Risk Management, Climate Change Sectoral Adaptation Plan (CCSAP), prepared by the OPW under the National Adaptation Framework, which recommends an increase of 20% in extreme rainfall depth for the Mid-Range Future Scenario (MRFS).

As mentioned above, the High-Range Future Scenario (1% AEP plus 30% increase in extreme rainfall) can be accommodated in the proposed attenuation ponds.

Figure 4-5. Extract from CFRAM MRFS Fluvial Flooding Map (Source: OPW, 2025)

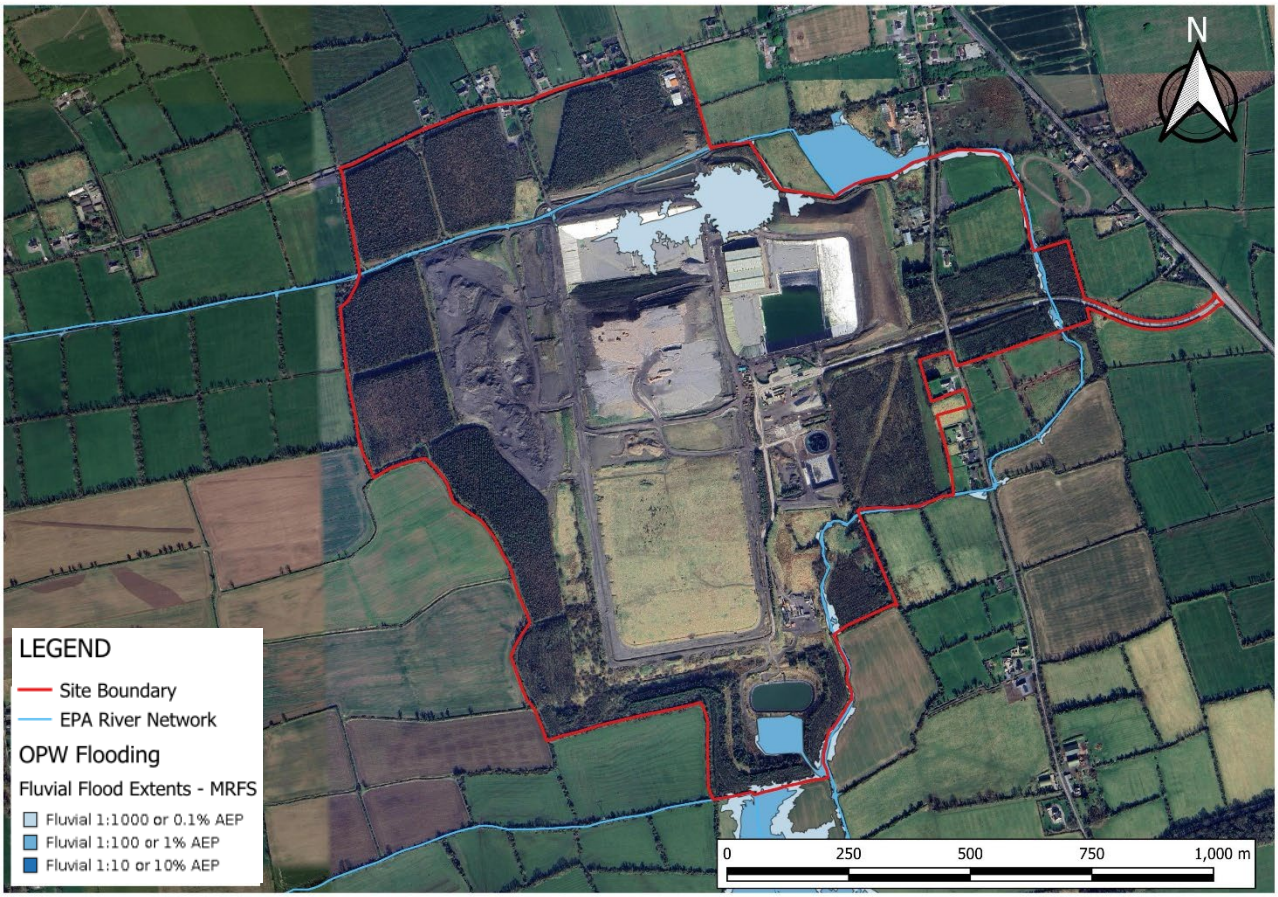
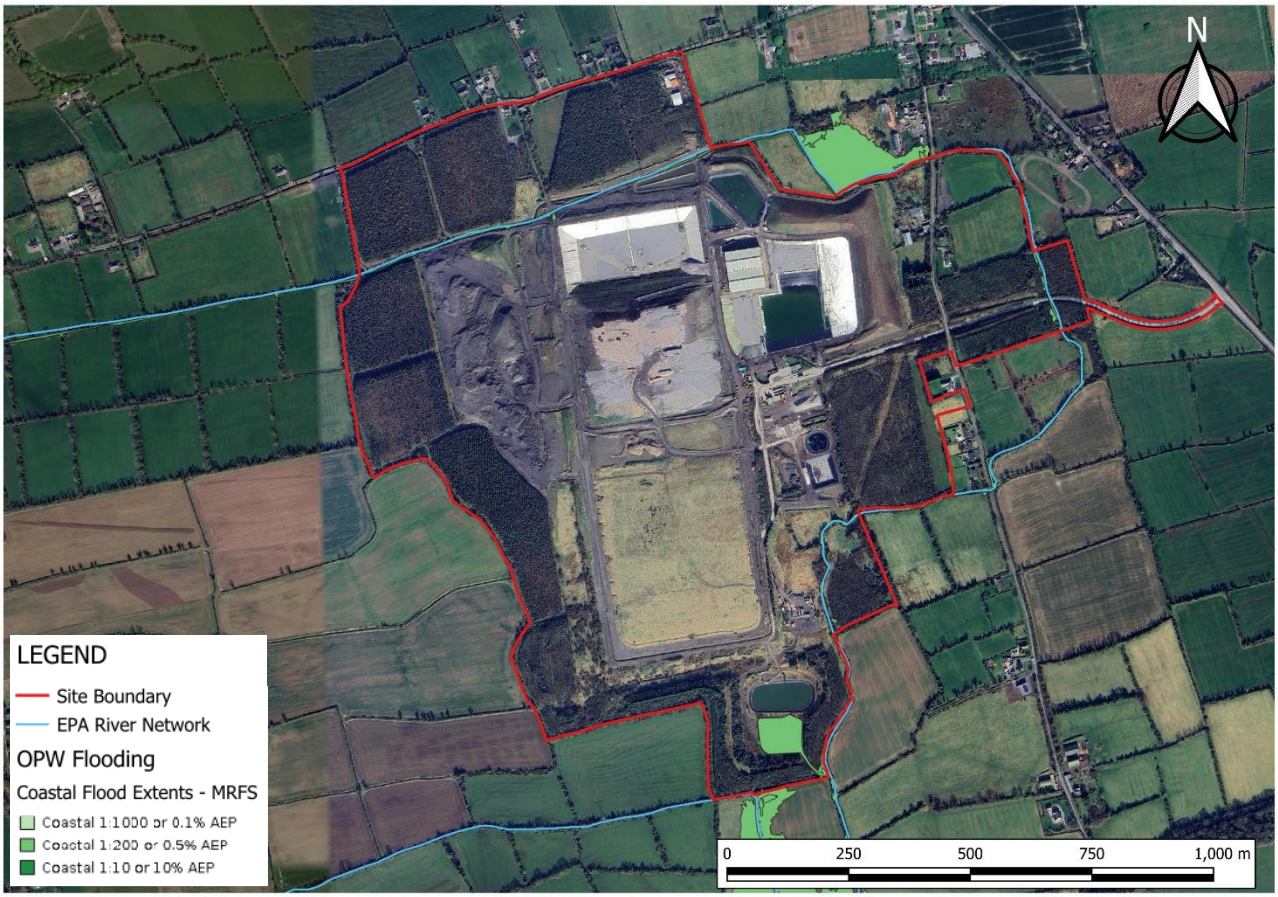


Figure 4-6. Extract from CFRAM MRFS Coastal Flooding Map (Source: OPW, 2025)



5. CONCLUSIONS

A Flood Risk Assessment has been undertaken for the proposed extension of the Knockharley Landfill facility. The assessment has identified that the proposed layout is located primarily in Flood Zone C. However, Flood Zones A and B extents are present within the site, associated with the existing northern settlement pond and southern wetland, respectively. Following the required Justification Test as required under DECLG/OPW Guidelines, it is concluded that no residual risk is foreseen as the proposed development will not affect the existing hydrological, morphological and hydraulic conditions that define the aforementioned Flood Zones.

The proposed drainage system has been designed to accommodate the 1% AEP plus climate change allowance. The proposed layout will also have capacity to control and attenuate the 0.1% AEP event without additional flooding risk.

The risk from pluvial, coastal and groundwater sources is considered low.