KNOCKHARLEY LANDFILL LTD.

ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIAR) FOR PROPOSED DEVELOPMENT AT KNOCKHARLEY LANDFILL

VOLUME 2 – MAIN EIAR

CHAPTER 6 – POPULATION AND HUMAN HEALTH

NOVEMBER 2018

Knockharley Landfill Ltd.
Kentstown, Navan,Co.Meath

FEHILY TIMONEY & COMPANY

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6 POPULATION AND HUMAN HEALTH

6.1 Introduction

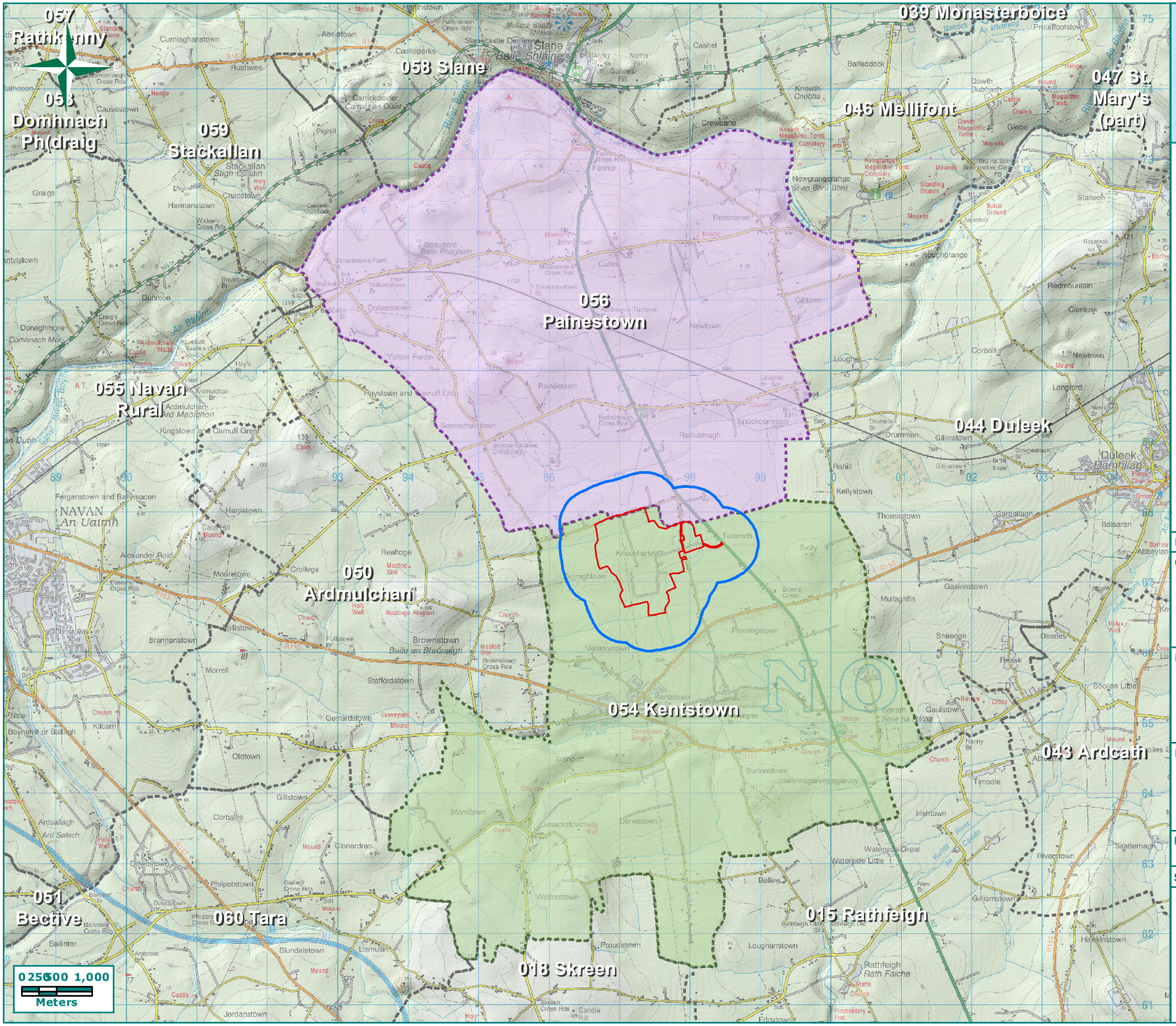
This section of this Environmental Impact Assessment Report (EIAR) assesses the likely significant effects of the proposed development on Population and Human Health, with reference to population, human heath, employment and socio-economics, land use, recreation, amenity and tourism.

There are additional potential significant effects from the proposed development on population and human health which are covered in separate chapters of this EIAR. These impacts include air and climate, traffic and transportation, noise, groundwater, surface water and landscape and visual impacts. These potential significant effects are considered in detail and are addressed separately in Chapters 7, 8, 9, 11, 12 and 13 respectively of Volume 2 of this EIAR, a summary of these significant effects is also provided in the human health section of this EIAR. Natural disasters such as flooding is assessed in Chapter 12 Hydrology and Surface Water of Volume 2 of this EIAR and land-slides are assessed in Chapter 11 Land, Soils and Geology in Volume 2 of this EIAR. This chapter includes a description of the existing environment and likely significant effects arising from the proposed development and proposed mitigation measures to include:

- Population Trends;
- Employment and Socio-Economics i.e. the interaction of social and economic factors;
- Land-Use;
- Tourism, Recreation and Amenity; and,
- Human Health.

6.2 Study Area

The study area for the population and human health chapter of this EIAR is identified in Figure 6.1 and is defined in terms of the District Electoral Divisions (DEDs) within 500 m of the proposed development site. The site of the proposed development is contained solely within the DED of 054 Kentstown, but also directly abuts the DED of 056 Painestown. For this reason, both DEDs are considered to define the context of this proposed development site and are considered pertinent in the consideration of population and human health. The total study area comprises a total land area of 6,368 hectares while the planning boundary of the proposed development site comprises a total area of 135.2 hectares.



Legend

- Planning Boundary
- 500m from Planning Boundary
- 056 Painestown ED Boundary
- 054 Kentstown ED Boundary

Date	18/05/2018
Client Name	Knockharley Landfill Ltd.
Project Title	Proposed Development at Knockharley Landfill
Figure Title	Study Area
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6.3 Methodology

This section of the EIAR regarding population and human heath has been prepared following a review of the Greater Dublin Area Regional Planning Guidelines 2010-2020 and the Meath County Development Plan 2013-2019. Population and general socio-economic data was sourced from the Central Statistics Office.

Regarding Tourism, Recreation and Amenity, Fáilte Ireland published a guideline on tourism and environmental impacts in 2011 entitled 'Guidelines on the treatment of tourism in Environmental Impact Statements'.

The methodology used in the assessment of Human Heath in this Chapter was guided by the US Environmental Protection Agency (US EPA) in their Human Health Risk Assessment process. This assessment methodology advised by the US EPA follows a 4-step process:

1. Hazard Identification - Examines whether an agent has the potential to cause harm to humans and if so, under what circumstances - The assessment includes a literature review outlining the findings of relevant medical findings/publications related to the proposed development and its potential effects.
2. Dose-Response Assessment - Examines the relationship between exposure and effects.
3. Exposure Assessment. Examines what is known about the frequency, timing, and levels of contact with an agent.
4. Risk Characterisation - Examines how well the data supports conclusions about the nature and extent of the risk from exposure to environmental agents.

It should be noted that in the preparation of this chapter, has been prepared to comply with the European Commission *Environmental Impact Assessment of Projects Guidance on the Preparation of the Environmental Impact Assessment Report*, 2017, regard was had to the EPA *Draft Guidelines for Preparing Environmental Impact Assessment Reports*, 2017 and that the above methodology (items 1-4) is consistent with these guidelines.

This methodology also encompassed a detailed literature review including the following documents:

- Crowley, D.; Staines, A.; Collins, C.; Bracken, J.; Bruen, M.; Fry, J; Hrymak, Victor; Malone, D.; Magette, B.; Ryan, M.; and Thunhurst, C, (2003) *Health and Environmental Effects of Landfilling and Incineration of Waste - A Literature Review.*
- Enviros Consulting and the University of Birmingham (2004) *Review of Environmental and Health Effects of Waste Management: Municipal Solid Waste and Similar Wastes*
- World Health Organisation (2007) *Population Health and Waste Management – Scientific Data and Policy Options.*
- Porta D1, Milani S, Lazzarino AI, Perucci CA, Forastiere F. (December 2009) *Systematic review of epidemiological studies on health effects associated with management of solid waste.*
- Ozonoff 0. Collen ME, Cupples A. Heeren T. Schatzin A. Mangione T. Dresner M. Colton T. (1987) *Health problems reported by residents of a neighborhood contaminated by a hazardous waste facility*. Am J lnd Med 11:581-597.

Health based standards by their nature are set to protect against human health effects. The level at which the standard is set is chosen to protect the vulnerable, not the robust. These standards are taken into direct consideration in Chapters 7 Air and Climate, Chapter 9 Noise, Chapter 11 Land, Soils and Geology and Chapter 12 Hydrology and Surface Water Quality of Volume 2 of this EIAR. Health standards have an in-built measure of significance in that they are set at levels where there will be no significant health effects. An example is Air Quality Standards set in the CAFÉ Directive 2008/50/EC. This standard based approach is consistent with the recommendations set out in the EPA *Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports,* (2017).

While every human being should be considered a sensitive receptor, clearly the vulnerable are the most sensitive. Older people and particularly younger children, for example constitute a vulnerable group.

Older people in general have greater sensitivity to air pollution and potential effects on the respiratory system and cardiovascular system. There are other vulnerable groups also, for example, the disabled or psychologically ill.

The significance criteria used in the assessment are set out in Table 6.1: Criteria Used in the Assessment of Human Health Effects as per the EPA, 2017 draft guidance.

Table 6-1: Criteria Used in the Assessment of Potential Significant Human Health Effects

Effect Level	Significant Criteria
Imperceptible	No significant human health impacts are apparent. An example is no measurable effect attributable to the proposed development.
Not Significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
Slight	A small impact on individual reported symptoms but no change in health status can be attributed to the proposed development. An example is a temporary increase in symptoms in an individual but no change in the severity of the underlying condition or treatment required.
Moderate	A small impact on health status of individuals but no change in morbidity or mortality can be attributed to the proposed development. An example is an individual increasing their use of a treatment attributable to the development but no change in underlying condition.
Significant	A proposed development has the potential to impact on individual health status. An example is an individual's condition becoming measurably more severe as a result of the proposed development.
Very Significant	A proposed development has the potential to impact on the health status of groups. An example is a group of individuals' conditions becoming measurably more severe as a result of the proposed development.
Profound	A proposed development has the potential to impact on the health status of communities. An example is a measurable increase in the incidence or severity of a condition in a community.

As outlined in Chapter 5 Scoping and Consultation in Volume 2 of this EIAR, prior to preparing this EIAR statutory authorities and other relevant bodies were consulted. Key items raised by these parties have been addressed in this EIAR.

6.4 Existing Environment

6.4.1 Existing Environment - Population

Population Trends

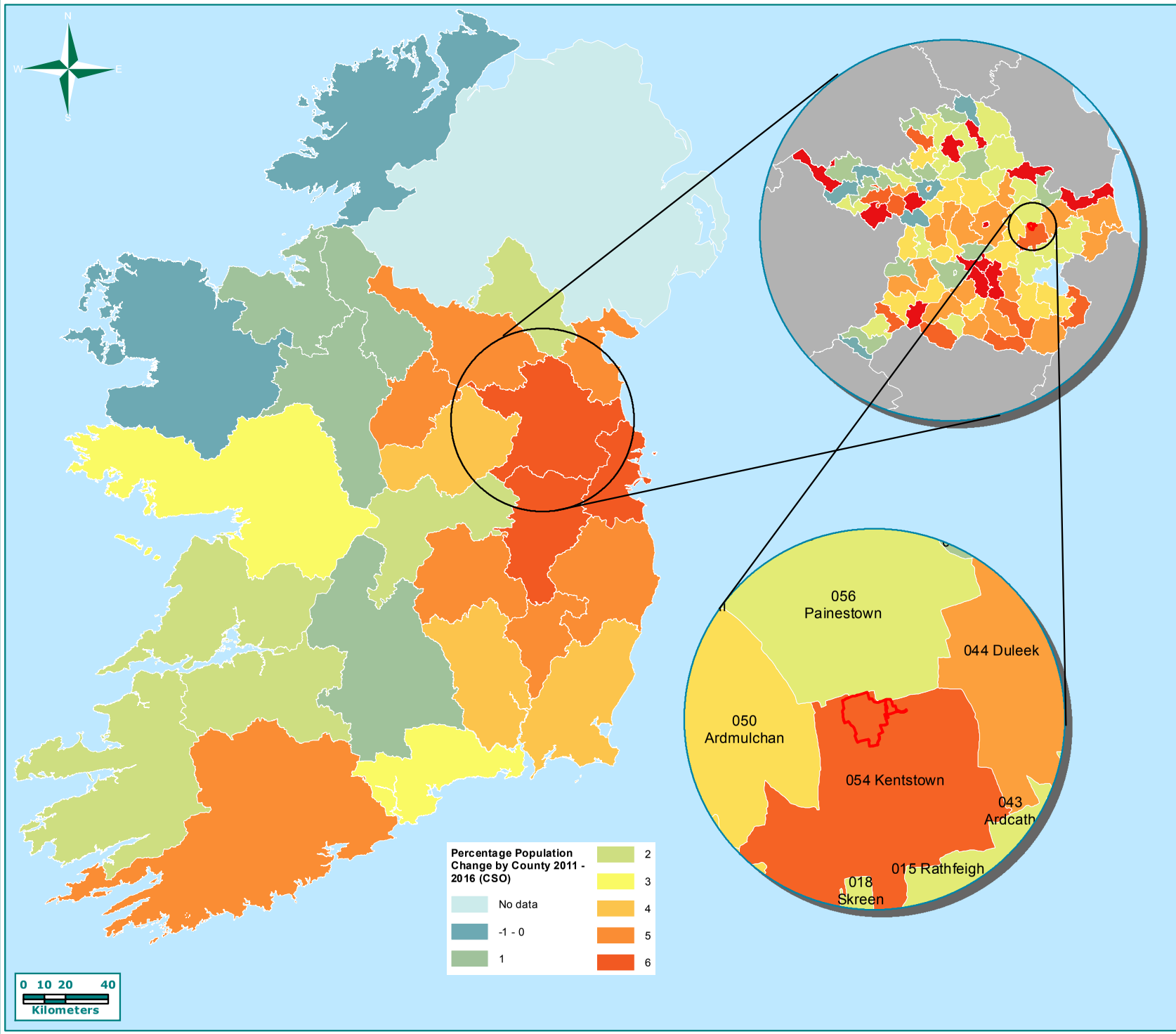
The proposed development is in north-east County Meath within an area predominantly characterised as rural. The village of Slane is located approximately 7 km north of the site, and the centre of the village of Kentstown is located 1.3km to the south of the site. Duleek is located approximately 7 km to the east and Navan is approximately 10 km to the west.

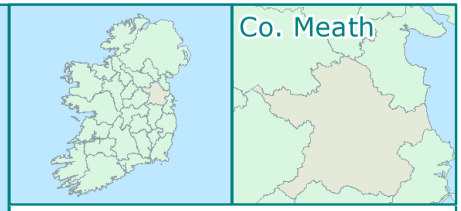
Meath is located within the Eastern and Midland Region of Ireland, and shares boundaries with Dublin, Kildare, Offaly, Westmeath, Cavan, Monaghan and Louth. In the five years between the 2011 and 2016 censes, the population of Ireland increased by 169,724 persons or 3.7%. During this time the population of County Meath grew by 10,909 persons or 5.9%.

Section 3.5 of the Meath County Development Plan 2013-2019 sets out the Settlement Hierarchy and Future Population Growth for Meath. This settlement hierarchy is consistent with the Regional Planning Guidelines as set out in Chapter 3 of Volume 2 this EIAR. Map 3.1 of the County Development Plan sets out the detailed settlement structure based on a five-tier structure.

The position of each settlement within the hierarchy coupled with the defined role of each tier provides an indication of the potential likely scale of population growth permissible over the period of the Plan. The proposed development is located between the Tier 1 Large Growth Town of Navan and the Tier 5 Village Settlement of Slane.

Population statistics for the State, County and Study Area have been obtained from the Central Statistics Office. These are set out in Figure 6.2.





Legend

Planning Boundary

Percentage Population Change by Electoral Division 2011 - 2016 (CSO)

- >-10.0
- -10.0 - -5.0
- -5.0 - 0.0
- 0.0 - 2.5
- 2.5 - 5.0
- 5.0 - 7.5
- 7.5 - 10.0
- 10.0 - 15.0

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Figure Title	Population Change
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Table 6-2: Population 2006-2016

	Population			Population Change	
Area	2006	2011	2016	2006-2011	2011-2016
State	4,239,848	4,588,252	4,761,865	8.2%	3.8%
County Meath	162,831	184,135	195,044	13.1%	5.9%
Study Area	2,845	3,133	3,337	10.1%	6.5%

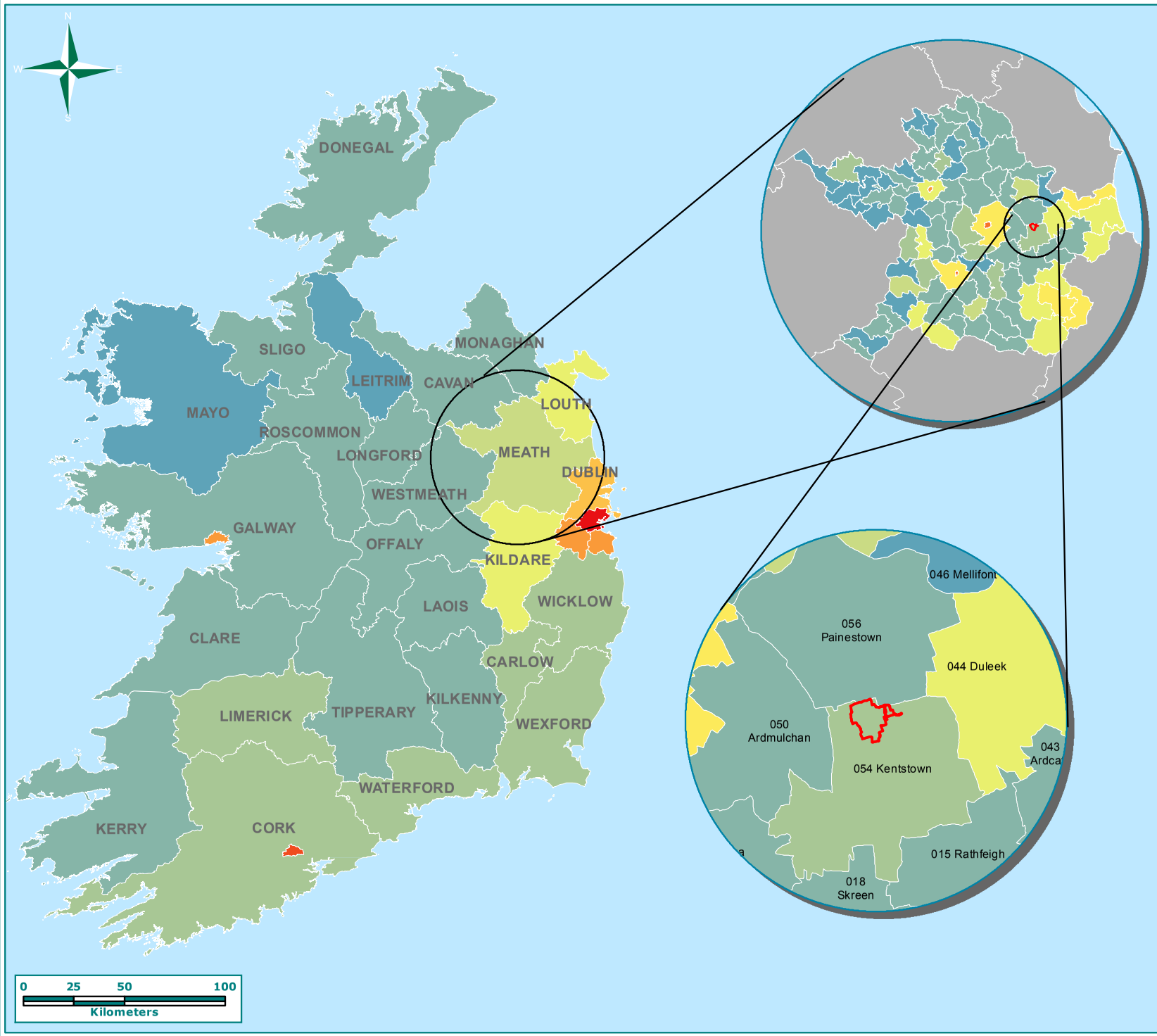
The data presented in Table 6.2 shows that the population of the study area increase between 2006 and 2011 by 10.1% and increased between 2011 and 2016 by 6.5%. This increase is higher than the national and county trends between 2011 and 2016 which were 3.8% and 5.9% respectively. It should be noted that the greatest percentage increase was experienced within the DED of 054 Kentstown.

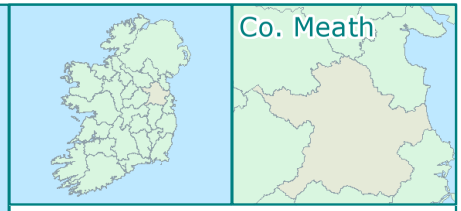
Population Density

The population densities recorded within the State, County Meath and the Study Area in the 2016 Census are set out in Table 6.3, and in Figure 6.3.

Table 6-3: Population Density in 2016

Area	Population Density (Persons per square kilometre)
State	70.0
County Meath	83.2
Study Area	53.6





Legend

Planning Boundary

Population Density By County

- 1 - 10
- 11 - 25
- 26 - 50
- 51 - 75
- 76 - 100
- 101 - 250
- 251 - 500
- 501 - 1000
- 1001 - 2000
- 2001 - 3000
- 3001 - 4000
- 4001 - 4500
- No Data

Date 18/05/2018

Client Name

Knockharley Landfill Ltd.

Project Title

Proposed Development
at Knockharley Landfill

Figure Title

Population Density

Figure No.	**Rev.**
6.3	A

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Household Statistics

A housing stock of 705 was identified in the DED of 054 Kentstown during the 2016 Census. The Meath County Development Plan 2013 - 2019 states that "*residential development has largely taken the form of low density residential estates, with houses being set in single plots with front and back gardens. This has caused the village to sprawl outwards from the crossroads at its core*".

The number of households by size recorded within the State, County Meath and the Study Area during the 2011 and 2016 censes is set out in Table 6.4.

Table 6-4: Number of Households and Average Household Size 2011-2016 (Source: CSO)

Area	2011		2016	
	No. of Households	Avg. Size (persons)	No. of Households	Avg. Size (persons)
State	1,654,208	2.8	1,702,289	2.9
County Meath	62,201	3.0	64,234	3.0
Study Area	1,024	3.1	1,046	3.2

There are currently 721 no. dwellings within 2 km of the site boundary, as identified in Eircode dataset. Most of the residential dwellings are detached residential single-family dwellings and are concentrated in ribbon type developments located along local roads in the vicinity of the site.

Meath County Councils' planning online search utility was used to search for planning permissions granted for developments in the Kentstown area. This search assessed permissions granted from the beginning of 2016 to July 2018. Most of notable grants of permission relate to planning applications for one- off residential dwellings, within 1 km of the site. Planning application references AA151165, AA160390 and AA171308 which sought permission for the development of single rural dwellings noted. Cumulatively however, these are not considered to have a significant effect on the population of the area.

Age Structure

The age category distribution between 2011 and 2016 has remained mostly consistent. The characteristics of the study area within each age category is similar to those recorded at the national and county level for most categories. Within the study area the highest population percentage occurs within the 25-44 age category (28%), which is broadly similar to that of County Meath (29%) and the State (30%). The greatest percentage difference occurs within the 0-14 age category where within the Study Area this comprises 24% of the overall population composition, in contrast to just 21% within the State. The percentage population per age category in 2011 and 2016 is shown in Table 6.5 and Table 6.6.

Table 6-5: Percentage Population per Age Category in 2011

Area	Age Category				
	0-14	15-24	25-44	45-64	65+
State	21%	12%	32%	23%	12%
County Meath	25%	11%	33%	21%	9%
Study Area	25%	11%	32%	23%	9%

Table 6-6: Percentage Population per Age Category in 2016

Area	Age Category				
	0-14	15-24	25-44	45-64	65+
State	21%	12%	30%	24%	13%
County Meath	25%	12%	29%	23%	11%
Study Area	24%	11%	28%	25%	12%

6.4.2 Existing Environment – Land Use

The existing facility comprises a landfill facility where waste disposal and recovery activities are undertaken. The landfill opened for waste acceptance in December 2004. The landfill accepts residual household, commercial and industrial wastes together with construction/demolition wastes and incinerator bottom ash (IBA) and is licensed under EPA Industrial Emissions (IE) Licence W0146-02. The site is licensed to operate from 07:30 to 18:30 Monday to Saturday inclusive and is licensed to accept waste between 08:00 and 18:00 (excluding public holidays). The licensed boundary of the licence facility is shown in red on LW14-821-01-P-Figure 2.1 Existing Site Layout in Volume 4 of this EIAR and the ownership boundary (of Knockharley Landfill Ltd.) is shown in blue. This figure identifies the licensed boundary, ownership boundary, landfill footprint, both built and permitted, screening berms, and infrastructure which comprises:

1. Administration building
2. Machinery/maintenance garage
3. Four portable cabins for storage
4. Weighbridge building
5. Two weighbridges
6. Inspection slab
7. Quarantine slab
8. Car parking
9. Landfill gas treatment compound
10. Leachate lagoon
11. Surface water attenuation lagoon and wetland

The facility is located on a 135.2 hectare (333 acre site). The existing landfill footprint is positioned near the centre of the landholding and the current planning permission permits the development of approximately 25 hectares of landfill cells. The landfill is being developed in seven phases. To date, Phases 1-4 (Cell 1 to Cell 16) of the seven planned cell phases have been fully constructed. At time of writing, Cells 13, 14, 15 and 16 are operational.

A permanent cap has been placed on all cells in Phase 1 and Phase 2 (Cells 1-8 inclusive). In relation to Phase 3, Cells 9 and 10 and half of Cells 11 and 12 are fully capped. The permanent lining of the final cap on Cells 11 and 12 is complete, the soil placement will take place in 2019. There is an intermediate cap on Cells 13 and 14.

The landfill development and waste placement is in a northerly direction. The leachate storage lagoon is located to the south of the administrative buildings and the surface water attenuation pond and wetland is situated to the south of the landfill.

To the north and the west of the existing landfill footprint and within the site boundary is agricultural land which is predominantly managed forestry. The site itself, while relatively flat, rises gradually northwards and westward from approximately 50 mOD at the south-east corner to almost 70 mOD at the western boundary.

Meath County Council permitted application reg ref AA180145 on the 21st of June 2018 for:

> *"The development will consist of a solar farm to be installed over reclaimed landfill with an export capacity of 3MW comprising photovoltaic panels on ground mounted frames, connection to existing single storey ESB Sub Station/ switch room building, installation of 3no. transformers, ducting & underground electrical cabling and all associated ancillary works and services."*

This development is permitted within the boundary of the landfill site.

The predominant land use in the wider area beyond the landfill site boundary is agricultural land, residential development and infrastructural services such as roads, power lines, etc. Individual small tree stands/woodlands are intermittent in the landscape and quarry developments are located near Slane and Duleek.

The existing site is bound immediately to the north by the local road and thereafter to the north, west and south by agricultural land. To the east, agricultural land leads to the local third-class road which has residential dwellings scattered along it.

The agricultural land is a patchwork of medium to large sized fields divided by hedgerows, which are mainly used for tillage and crop production and some animal grazing. Intensive pig farming and other agricultural industries area also present in the wider vicinity of the landfill.

The general topography of the area is low-lying which rises gently from the River Nanny (below 50 m OD) in the south.

Kentstown is located within a landscape area designated as the 'Central Lowlands', The Landscape Character Assessment set out in the Meath County Development Plan 2013-2019 identifies the proposed development location as being located within LCA 6 – Central Lowlands, which is of the "Lowland Areas" LCT.

LCA 6 is described as follows:

> *"The landscape character around settlements tends to be a well-managed patchwork of small pastoral fields, dense hedgerows and small areas of broadleaved woodland particularly in the Kildalkey environs where there are estate landscapes with large mature parkland trees. The landscape is predominantly rolling pastureland, although the landscape surrounding Castlerickard has greater diversity than elsewhere in the lowlands with estate landscape, large conifer plantations, and birch woodland around the Boyne river corridor.*
>
> *In more remote areas, away from settlements, single-track roads wind through less well-managed farmland with rough pasture, overgrown hedgerows and less woodland. Farmland is a variety of scales with square – rectangular fields divided by hedgerows, which are usually clipped to eye-level adjacent to road corridors but are less well managed away from roads. The agricultural landscape comprises a series of small farms rather than few large ones. Views within this area are generally limited by the complex topography and mature vegetation except at the tops of drumlins where panoramic views are available particularly of the Hill of Tara uplands and Skryne Church."*

According to the Corine 2012 landcover dataset, land cover in the vicinity of the proposed development primarily comprises a dump (132), non-irrigated lands (211), pastures (231), broad-leaved forest (311) and discontinuous urban fabric (112). A map of this 2012 CORINE land cover dataset, is identified in Figure 6.4.

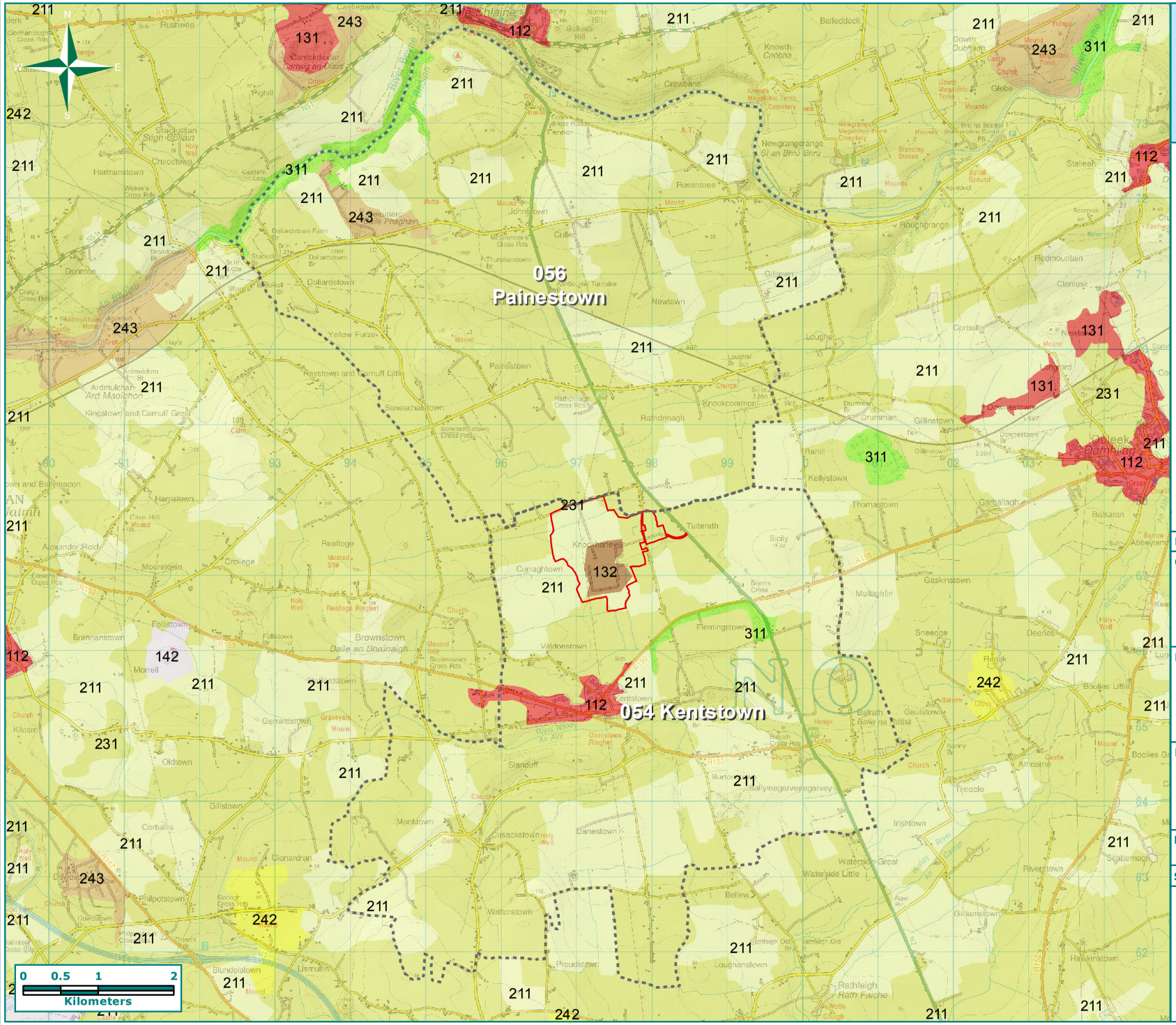
The land use zoning mapping for County Meath as set out in the Meath County Development Plan identifies the lands within the vicinity of the site as unzoned white lands.

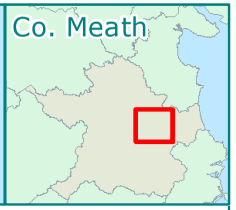
Map 10.1 Rural Area Types of the Meath County Development Plan 2013-2019 illustrates the Rural Area Types of the County based on Development pressure. The proposed development site is identified as being located within an area of *Rural Area under Strong Urban Influence.*

The County Development plan characterises this area as follows:

> *"This area exhibits the characteristics of proximity to the immediate environs of close commuting catchment of Dublin, with a rapidly rising population and evidence of considerable pressure for development of housing due to proximity to such urban areas. This area includes the commuter-belt and peri-urban areas of the county, and the areas that are experiencing the most development pressure for one-off rural housing."*

This growth in population is detailed above in Section 6.4.1. Meath County Council has put in place strategic land use policies to direct urban generated housing to areas zoned for new housing development in towns and villages in the area of the development plan.





Legend

- Site Boundary
- *Study Area*
- 056 Painestown& 054 Kentstown ED Boundaries

Corine Landcover Type

- 112 Discontinuous urban fabric
- 131 Mineral extraction sites
- 132 Dump
- 142 Sport and leisure facilities
- 211 Non-irrigated land
- 231 Pastures
- 242 Complex cultivation patterns
- 243 Land principally occupied by agriculture with areas of natural vegetation
- 311 Broad-leaved forest

Date	18/05/2018
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Project Title	Proposed Development at Knockharley Landfill
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Figure No.	6.4
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6.4.3 Existing Environment –Socio-Economics, Employment and Economic Activity

Socio-economics refers to the interaction between social and economic factors. Landfill developments by their nature have both economic and social impacts in their respective context.

The percentage of people ages 15 and over who participate in the labour force, as opposed to having another status such as student, retired or homemaker – is known as the labour force participation rate. It is measured as the number in the labour force (at work or unemployed) expressed as a percentage of the total population ages 15 and over.

The 2016 census indicated that the unemployment rate nationally is 7% while in County Meath it is 6.5%. Table 6.7 sets out the total population aged 15+ who were in the labour force during the 2016 census.

Local Employment

Table 6-7: Economic Status of the Total Population Aged 15+ in 2016

	Status	State	County Meath	Study Area
% of Population aged 15+		79%	74.9%	74.5%
% of which area:	At work	53%	57.1%	57.7%
	First time job seeker	0.8%	0.7%	0.7%
	Unemployed	7%	6.5%	5.2%
% of the population 15+ who are not in the labour force		30%	35.8%	36.3%
% of which are	Student	11%	10.9%	10.8%
	Home duties	8%	9.1%	10.9%
	Retired	15%	11.9%	11.3%
	Unable to work	4%	3.5%	3.1%
	Other	0.4%	0.3%	0.3%

Overall the principal economic status of those living in the study area (56.7%) is similar to that recorded at county level, and 4% greater than that recorded at state level. The number of retired people is in contrast, 4% lower than that at state level (15%).

The study area is near Dublin, Navan, Drogheda and other surrounding large urban centres which hold significant industry and commerce developments; therefore, it is likely that a considerable number of the local population commute daily to these centres of work. This is supported by the evidence of the CSO for the 054 Kentstown DED and 056 Painestown DED which shows that Commerce & Trade, Professional Services and Manufacturing Industries accounted for 43.5% of employment in the study area and up to all of which is likely to be provided at larger urban centres.

There are limited local businesses operating in Kentstown. Local businesses include Evan's Coaches, Kilmore Cars, Kentstown Country Store, Hazels Hair Store and Reilly Agri. & Plant Sales. Hillcrest Nurseries and Garden Centre is also located less than 0.5 km west of Kentstown village. The local shop and pub also contribute to the industry and commerce of the area.

Knockharley Landfill facility currently employs 12 no. permanent staff.

Agricultural employment was historically one of the main employers in the East Meath area. However, in recent years, along with national trends, there has been a decrease in the total number of farms as well as a decrease in employment in agriculture in the area, with Agriculture, Forestry and Fishing accounting for c. 6.6% of employment in the study area.

A tonnage-based community levy of €1.89 per tonne of waste per annum disposed of is currently paid into a Community Development Fund. This was initiated as part of the grant of permission for the existing Knockharley Landfill facility in 2002.

In July 2009, Meath County Council and the Knockharley Landfill Community Liaison Committee launched a Small Grants Scheme for the provision of environmental improvements to properties in the general vicinity of Knockharley Landfill. Such improvements include: landscaping, insulation, double glazing windows and doors, waste water treatment systems, biomass boiler and solar panels. The extent and households that can benefit from this scheme has been outlined in defined areas. The quantity of funding available to this scheme is determined by Meath County Council and the Knockharley Landfill Community Liaison Committee each year.

Knockharley Landfill Ltd. has contributed over €2,500,000 into the local Community Development Fund administered by Meath County Council through the Kentstown Village Project and the Small Grants Scheme. Increasing the landfill tonnage capacity will benefit the Community Development Fund.

Economic Activity in the Wider Area

There are several facilities in the surrounding wider area which provide employment including businesses in the surrounding towns of Navan, Duleek and Drogheda such as:

- Navan Sofa Factory
- Lir Chocolate (Navan)
- Irish Country Meats (Navan)
- Irish Cement (Duleek)
- Carranstown Waste to Energy Facility (Duleek)
- Dawn Paper (Drogheda)
- Boyne Valley Group (Drogheda)
- Cisco Engineering Ltd. (Drogheda)

There are 11 no. facilities located within 10 km of the proposed development site which are licensed by the EPA and which provide varying levels of employment.

6.4.4 Existing Environment – Recreation, Amenity and Tourism

The concept of amenity is not defined in Irish planning legislation but a non-legislative definition of amenity states that it is "*the pleasant or normally satisfactory aspects of a location which contribute to its overall character and the enjoyment of residents or visitors*" (Parker, 2012).

Amenity is generally taken to comprise of a number of elements that, in combination, create the attractive aspect of the location in question. These aspects include:

1. Visual appearance/landscape
2. Traffic levels
3. Noise levels
4. Air quality
5. Recreational options
6. Open spaces

Elements 1 – 4 above are addressed in further detail in Chapter 13 Landscape and Visual Impact, Chapter 8 Roads, Traffic and Transportation, Chapter 9 Noise and Vibration and Chapter 7 Air and Climate in Volume 2 of this EIAR. A summary of the elements 1-4 as they relate to this chapter is included hereunder. Elements 5 and 6 are discussed thereafter.

Visual appearance/landscape

The landfill site is generally characterised by the field network pattern of the wider landscape setting into which the landfill cells and associated infrastructure and facilities have been placed. While this has necessitated the removal of part of the hedgerow landscape infrastructure, significant sections of it remain on the site and additional planting has been undertaken since the commencement of landfill operations, particularly along the boundaries to provide screening and a suitable buffer between the site and the local road network.

There are 2 no. protected views within 2 km of the Knockharley Landfill location, classified as per Appendix 12 of the Meath County Development Plan 2013 -2019 and listed in Table 6.8.

Table 6-8: Protected Views within 2 km of the proposed development location *

View No:	Location	Direction	Description	Significance
36	County road to north of Brownstown Cross Roads on R153 I	North West	View to north west across working landscape with visual agricultural structures.	Local
37	County road to north of Brownstown Cross Roads on R153 II	South East	View to south east across working landscape with visual agricultural structures.	Local

* as per Appendix 12 of the CDP 2013 - 2019

These views are those visible from one single location i.e. one of the views being in a north-west direction and the other being the opposite view in the south-east direction from the same place. The proposed development location lies directly east of these view locations and, as such, the development location is not within the visual envelope of either of these views. Further detail is provided in Chapter 13 –Landscape and Visual Impact in Volume 2 of this EIAR.

Fáilte Ireland indicates the number of accommodation units available in County Meath in 2015, as shown in Table 6.9. There is a wedding and events venue located at Ballymagarvey Village at Balrath Cross, 3.5 km south east of the facility and there is a B&B adjacent on the R153 (Burtonstown House B&B), as well as self-catering accommodation at Balrath Courtyard on the eastern side of the N2 at Balrath Cross.

Traffic Levels

The N2 National Primary Road is the main artery to the site and to a lesser extent the R150 (east of O'Brien's Cross Roads) and the R153 (west of Balrath Cross Roads). The predominant weekday traffic flow is southbound in the morning (toward Ashbourne) and northbound in the evening. As is typical for commuter traffic. Peak traffic flows from 2015 and 2016, as the latest data available were studied.

This study identifies receiving road network traffic conditions together with the permitted traffic generation of the development and provides an assessment of the potential impact likely to arise directly from the current proposal. All sources of traffic generation are taken into consideration and include waste related transportation, construction traffic and traffic associated with the day to day operation of the landfill which includes for the removal of leachate off site and felled forestry.

To frame the traffic assessments in the context of previous applications determined for the site, reference is made to previous Traffic Impact Assessment reports and comparison is made with the assessment scenarios and the results of various sensitivity analyses which, from the perspective of traffic and transportation, the determination of the current permission is predicated. Road safety auditing was carried out in accordance with NRA standard HD/19.

Noise levels

Quarterly noise monitoring is ongoing in accordance with the IE licence and it is undertaken at four boundary locations. In the period Q1 2015 to Q3 2018, there have been no exceedances of the daytime noise limit at the facility.

Air Quality

From the perspective of air quality pollutants, the site is located in a Zone D area as defined within AG4 guidance (rural Ireland, including towns with a population of less than 15,000). The nearest EPA air quality monitoring station within a comparably rural location is located at Monaghan (Kilkitt) and this measures a range of air quality parameters. Review of the monitoring data collected at this station over the last 3 years indicates that the measured background concentrations of relevant pollutants are substantially below their applicable limit values and Air Quality Standards.

Under the existing IE licence conditions, there is a requirement to monitor dust deposition, PM_{10}, landfill gas, emissions from the landfill gas flares and utilisation plant, as well as volatile organic compounds (VOC) from the surface of the landfill. A monitoring location map illustrating the location of each of these existing monitoring points is provided in Volume 4 of this EIAR. Figure 7.1 shows the dust and PM_{10} monitoring location points.

There are 8 no. dust monitoring points. Dust deposition results for the facility from 2013- Quarter 3 2018 have been within the EPA limit value of 350 mg/m^2/day throughout 2013-Quarter 3 2018 except for two results in Quarter 2, 2014 and one result in Quarter 4 2015 where algal growth in the dust pots (as opposed to landfill operations) resulted in levels recorded above the licence limit. The elevated levels were not attributable to site activities.

PM_{10} (i.e. particulate matter less than 10 microns) monitoring is undertaken annually at six monitoring locations (PM1- PM6) at the facility. Monitored results are compared with the limit values for the protection of human health in SI No 180 of 2011 which sets a PM_{10} 24-hour limit value of 50 µg/m^3 for protection of human health. This limit value is not to be exceeded more than 35 times per year. There were no exceedances of the 50 µg/m^3 at Knockharley in the 5 year 2014-2018, all results were <10 µg/m^3.

Flare and engine stack monitoring is undertaken annually on site in accordance with Condition 6.3.2 and 6.3.3 and Schedule D of the licence. Stack testing results are available online on the EPA website. The results for the past 5 years (2014-2018) were within the Emission Limit Values (ELVs) set by the licence.

In accordance with the licence and the Odour Management Plan, odour assessments are carried out by the licensee. The landfill staff are trained to carry out odour impact assessment in accordance with AG5[1]. If odour nuisance is detected, or in response to an odour compliant, the potential source of odour is investigated and mitigated.

Recreational Options

In relation to recreation options, tourism is one of the major contributors to the national economy and is a significant source of full time and seasonal employment. In 2015 overseas tourist visits to Ireland grew by 13.1% to 8 million.

[1] Odour Impact Assessment Guidance for EPA Licensed Sites (AG5), EPA 2010.

Expenditure by tourists visiting Ireland is estimated to be worth €6 billion in 2015 (Fáilte Ireland, September 2016). In 2011, approximately 134,000 overseas visitors visited County Meath, contributing over €44 million to the economy (Fáilte Ireland, October 2016). The main visitor attractions in County Meath in 2012 were Tayto Park and Brú na Bóinne, Newgrange. There are a number of recreation, amenity and tourism features in the study area which are described below.

In the Meath County Development Plan 2013 -2019, County Meath has been identified as having a rich natural heritage, which includes scenic river valleys, rolling farmland, a network of mature hedgerows and diverse coastal habitats, all of which are influenced by land use and management.

It is a strategic policy of Meath County Council to ensure that features of Meath's natural heritage and green infrastructure that provide ecosystem services are protected, that biodiversity is conserved and where possible enhanced, that the character of landscapes are maintained and enriched, and that tourist and recreational uses are facilitated in a sensitive manner.

The Kentstown Local Area Plan also identifies the potential of Sommerville Demesne, located approximately 1.5 km south east of Knockharley Landfill site, from a tourism perspective in terms of encouraging further tourism related facilities in Kentstown. In addition, potential future expansion of Ballymagarvey Village, located at Balrath Cross, c. 3 km south east of the landfill site, as a tourism destination is supported by the LAP.

Table 6-9: Accommodation Units in Co. Meath

	Premises	Rooms	Beds
Hotels	18	1,117	2,614
Guesthouses	6	69	165
B&Bs	16	59	150
Self-Catering	76		527
Hostels	2		113

Meath's wealth of built heritage makes it exceptional in Ireland. It includes the UNESCO World Heritage Site of Brú na Bóinne, the seat of the High Kings of Ireland at Tara, the passage tombs of Loughcrew, the largest Anglo-Norman castle in Europe at Trim, the historic towns of Navan, Trim and Kells, great country houses, demesne landscapes, and a significant industrial heritage of canals and mills.

The proposed development is located c.5.3km from the Brú na Bóinne information centre. In 2013, 'The Boyne Valley Drive', a driving route encompassing 22 historic sites throughout County Meath and County Louth was launched in conjunction with Fáilte Ireland, Meath County Council and Louth County Council with a promotional programme aimed at the overseas market. The Boyne Valley is considered by Fáilte Ireland to be one of a number of priority destinations in Ireland. The Boyne Valley Drive presents several attractions and amenities to tourists and visitors. The Boyne Valley Drive traverses the Study Area for the purposes of this Chapter of the EIAR. The nearest of these sites to Knockharley Landfill is Brú na Bóinne which is 7 km to the north east. The Brú na Bóinne or Boyne Valley Drive includes the N51 from Navan to Drogheda and the N3 from Navan to Tara. The Boyne Valley Drive provides exceptional value landscape, which at its nearest point is approximately 5 km north east of the site

Plate 6-1 indicates the route of The Boyne Valley Walks. Balrath Woods is located c.2.8km south of the proposed development site. Plate 6-2 displays the Boyne Valley Drive in the context of Co. Meath. Plates 6-1 and 6-2 were sourced from the website www.discoverireland.ie.

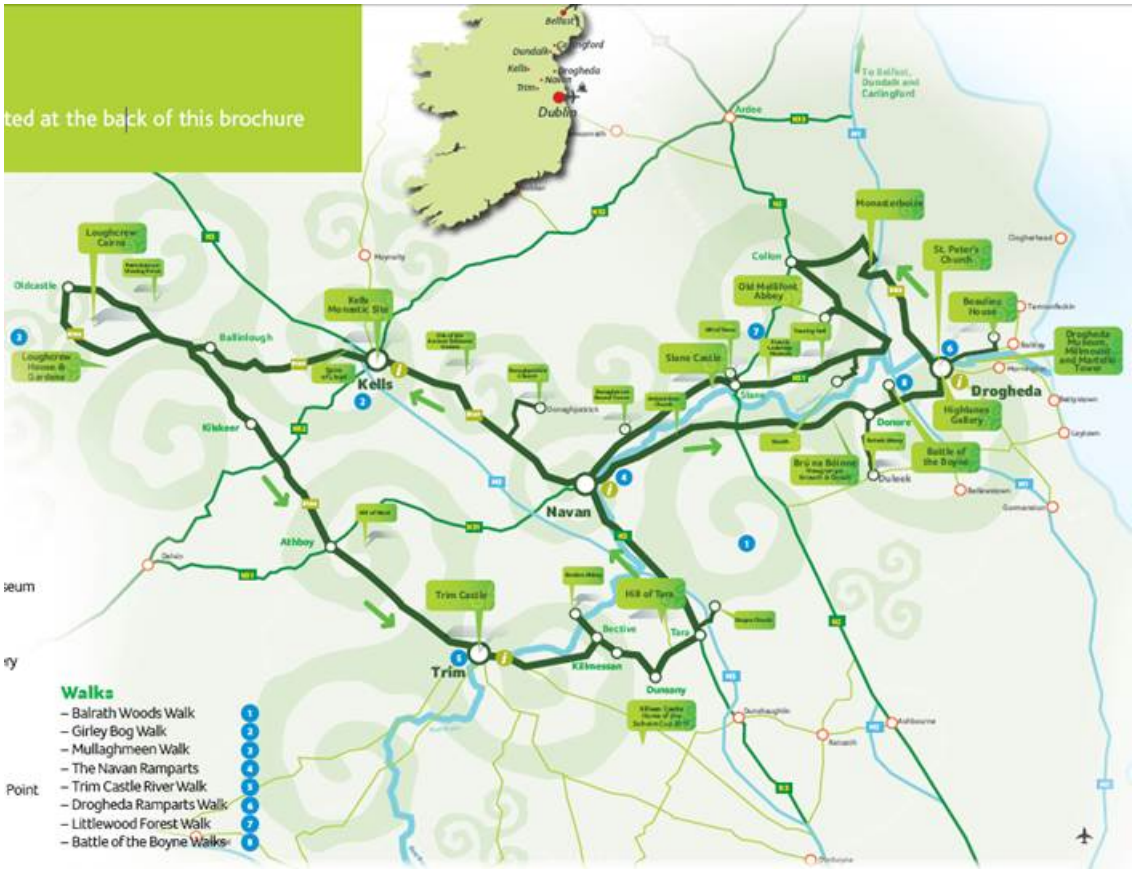


Plate 6-1: Map Extract of Boyne Valley Walks in counties Meath and Louth

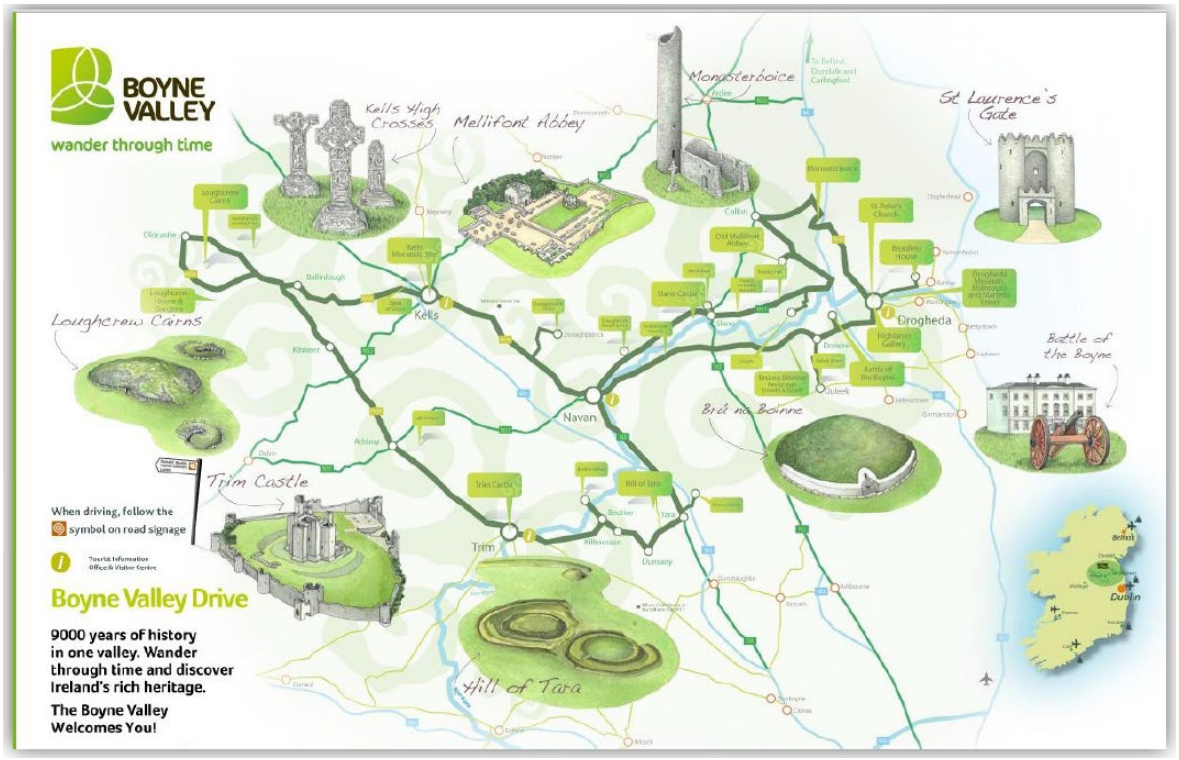


Plate 6-2: Map Extract of Boyne Valley Drive in counties Meath and Louth

Moynalty Steam Threshing is a community festival, located c.30 km from the proposed development, in its 40th year, attracting locals as well as tourists from throughout Ireland and overseas. Meath is also synonymous with Slane Castle, located c.6.6 km from the proposed development, which hosts one of the largest outdoor concerts in Ireland and which has attracted tourists from throughout Ireland and from overseas.

There is a long tradition of horse racing in County Meath with fixtures held regularly at Fairyhouse, Navan and Bellewstown Racecourses and along the beach at Laytown. Fairyhouse regularly hosts National Hunt and Flat racing and is home to the Irish Grand National. Tattersalls Ireland, located in Ratoath, is renowned for selling top class National Hunt and Flat horses and also hosts the annual Tattersalls International Horse Trials and Country Fair. Sport-horse enterprises generates considerable employment in the county, through to spin off industries such as tourism. However, none of these are located within 10km of the Site.

Recreational provision within the DEDs identified include walking, cycling, angling and various team sports at dedicated sports fields. This is addressed further in Chapter 13 Landscape and Visual Impact of Volume 2.

Open Spaces

The Kentstown Rovers Football Club pitch is located directly adjacent to the north-western boundary of the Knockharley Landfill facility. Other sports facilities in the area include the Knockharley Cricket Club which is located c.1.2 km south west of the facility in the townland of Veldonstown and Seneschalstown. A GAA Club is located approximately 5 km north west of the facility in Beauparc/Yellow Furze. Balrath Football Club pitch is located to the east of the facility off the local road. Moore Park Golf club also serves the local area and is located on the R153 to the west of the village. Planning permission was granted in June 2016 by An Bord Pleanála (reg ref: Pl17.246165) for development of community sports facilities, comprising playing pitches, tennis courts and children's playground within the centre of Kentstown village c. 1.5km to the south of the proposed development.

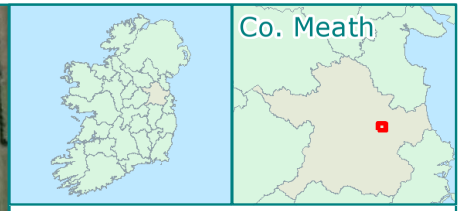
6.4.5 Existing Environment - Human Health

A human health risk assessment is the process to estimate the nature and probability of adverse health effects in humans in relation to the proposed development. This section of the EIAR considers this probability of adverse health effects. The assessment has regard to the findings of other chapters of this EIAR and provides a summary of each herein. The primary chapters of relevance to Human Health include:

- Chapter 7 Air and Climate;
- Chapter 9 Noise and Vibration;
- Chapter 11 Land, Soils and Geology; and,
- Chapter 12 Hydrology and Surface Water Quality.

Knockharley Landfill is an existing long-established facility operated by Knockharley Landfill Ltd. The existing Knockharley Landfill, operates is licensed by the EPA (Industrial Emissions Licence Register No. W0146-02). The existing facility encompasses an engineered lined landfill, environmental monitoring infrastructure, groundwater management infrastructure, leachate management system, surface water management system, gas management system, landfill capping, and landfill void. The waste acceptance hours of the site are 08.00 to 18.00 Monday to Saturday. The site does not operate on Sundays or Bank Holidays. This constitutes 312 no. working days per annum. A full description of the existing facility is provided in Chapter 2 Proposed Development of Volume 2 of this EIAR.

The surrounding environment is rural in nature. The nearest residential dwellings are located adjacent to the northern and eastern site boundaries. A map of surrounding residential properties is provided in Figure 6.5.



Legend

Site Boundary

Building Use

- Both Residential and Commerical
- Commercial
- Residential
- Unknown

Date	23/11/2018
Client Name	Knockharley Landfill Ltd.
Project Title	Proposed Development at Knockharley Landfill
Figure Title	Dwellings within the Vicinity of the Proposed Landfill
Figure No.	6.5
Rev.	A
Scale	1:15,000 @ A4

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6.5 Potential Significant Effects

6.5.1 Potential Significant Effects – Population

Construction Phase Effects (Direct & Indirect)

Construction of the proposed development will take place on a phased basis. The site will continue to operate during the construction process. During the construction phases of the proposed development, construction workers will travel daily to the site from the wider area. The impact of the construction phase is effect on the permanent population or settlement patterns will be imperceptible.

Operational Phase Effects (Direct & Indirect)

It is not envisaged that the operational phase of the proposed development will give rise to any direct or indirect effects on the population or settlement patterns in the study area through an increase or decrease in population or through the influencing of settlement patterns in the study area.

It is considered that the development of future residential dwellings will not be curtailed due to the proposed development as any new development will be within the existing site boundary. It should be noted that the lands within the vicinity of the site are unzoned white lands and have not on this basis has not been identified to accommodate specific residential or other development within the lifecycle of the Plan. The potential impact of the operational phase will be imperceptible.

6.5.2 Potential Significant Effects – Land Use

Construction Phase Effects (Direct & Indirect)

The construction phases associated with the proposed development will be undertaken on a phased basis, as described in Chapter 2 Description of the Development of Volume 2 of this EIAR. The construction of the proposed surface water management infrastructure, will be carried out first in a single phase, over an expected 3 – 6 month period.

These works will generate a direct, permanent effect on land use at the proposed development locations that will be realised from the construction phase onwards.

The impact on land use beyond the proposed development boundary will be imperceptible.

Operational Phase Effects (Direct & Indirect)

The proposed development will be located within the existing site boundary and will not directly or indirectly affect land use beyond the proposed development boundary during the operational phase of the development.

The land use at the proposed development will change from the existing undeveloped grasslands and vegetative habitats, to constructed lands and, as such, will be a direct effect. As the land is within the footprint of an existing waste facility, the potential for alternative land use is limited and therefore the potential impact will be not significant.

The land use in areas proposed for felling, to facilitate the development of screening berms, particularly along the western flank of the site, will be directly affected in changing from areas of mixed broadleaf and conifer plantations to constructed berms. Regardless of the proposed development, this is commercial forest which would be felled once it matures regardless of the proposed development. It is proposed to replant these screening berms as mixed broadleaf and conifer plantations.

The potential impact on land use in the forested areas of the site will therefore be slight in the short term and imperceptible in the long term.

6.5.3 Potential Significant Effects – Socio-economics, employment and economic activity

Construction Phase Effects (Direct & Indirect)

The proposed development will positively affect employment in the area through the provision of up to 30 temporary construction jobs over the different construction phases. This will benefit the economy of the area both directly through employment provision and indirectly through the purchase of construction materials from suppliers within Meath and beyond. This is positive, short term and Not Significant.

Operational Phase Effects (Direct & Indirect)

The proposed development will positively directly affect employment in the area through the provision of an estimated 10 further long-term employment positions, primarily associated with the extra staffing requirement to operate the IBA facility, the biological treatment facility and the leachate management facility.

The continued operation of the site will also provide the commercial and industrial sectors with an available outlet for the management of waste generated by these sectors, thus indirectly and positively supporting the economic activity of the Greater Dublin Area, and beyond, and contributing to meeting the needs of the Eastern & Midlands, and other regions in terms of waste management. This is positive, medium to long term and Not Significant.

6.5.4 Potential Significant Effects – Recreation, Amenity and Tourism

Potential significant direct and indirect construction and operations phase effects on identified elements of the amenity (visual appearance/landscape, and traffic) of the study area are addressed in individual chapters of this EIAR. A summary of potential significant effects of these elements as they relate to this chapter is included hereunder. Recreation options and open spaces are discussed thereafter.

Landscape and Visual Impact

The proposed development will continue the emerging trend within the site. The main landscape impacts associated with the proposed development will be the removal of existing woodland boundary planting and the construction of soil berms along boundaries to the north of the site. The proposed development will not result in significant changes in the size, elevation or landscape character and will continue to alter the landscape character in a same degree as before. In distant views the proposed biological treatment facility is well integrated due its low position on the site and the adjacent existing screen vegetation. In conjunction with the permitted solar farm, the highest visual impact of the proposed development is deemed to be Slight-Imperceptible.

Traffic

Traffic Levels – Construction Phase Effects (Direct & Indirect)

Traffic is assessed in this chapter on the basis of its potential impact on both safety and amenity in the area. The access road from the N2 to the administration area is approximately 900 m long running east to west. This is the only access point to the site for customers and construction vehicles. The existing site access geometry includes a ghost island right turn lane and nearside auxiliary turning lane which provide for the safe and efficient movement of development generated traffic with minimal disruption to N2 mainline flow. The site access has been designed in accordance with the requirements of the NRA and this design in turn has been confirmed satisfactory by the relevant planning authorities through the NRA road safety audit process at the initial design stage, at the detailed design stage and again after construction.

Construction plant is expected to mainly consist of rigid body vehicles, 8-wheel tippers, ready-mix HGV and articulated vehicles. The primary generators of traffic during construction will be construction staff and the delivery of construction materials. Construction materials are expected to be predominantly structural steel, cladding and concrete for the development of the biowaste facility building and leachate infrastructure. it is estimated that no more than 25No. HGV trips per day would be required to cater for the delivery of these materials to the site during the most intensive construction period.

This figure is considered to represent upper value or robust estimate of construction HGV traffic generation. Average construction HGV traffic generation is expected to be in the region of 15No. HGV trips per day.

Traffic generation during the construction of site infrastructure is considerably less than when such infrastructure is completed, is fully operational and receiving materials. Lesser volumes of traffic arise during the construction period and it follows that such traffic is likely to have a lesser impact than operational traffic. The local roads infrastructure has been assessed as having adequate capacity to cater for these traffic movement. The impact of construction traffic on recreation, amenity and tourism as well as road safety is therefore considered to be not significant.

Traffic Levels – Operational Phase Effects (Direct & Indirect)

Traffic is assessed in this chapter on the basis of its impact on both safety and its amenity in the area.

The road link which is expected to carry the most operational traffic is the portion of the N2 between the site access and Balrath Cross. The figures (as per Chapter 9 of Volume 2) show that the proposed development is unlikely to give rise directly to a significant increase in the number of vehicles using the regional and local roads in the vicinity of the site.

The forecast percentage incremental increases in traffic arising as a direct result of the development are considered to be within typical daily fluctuations in traffic volumes on the roads network.

In the context of the standard of access provided at the existing landfill it can be concluded that the potential incremental increase in traffic generation arising at the existing site are highly unlikely to compromise the capacity or the level of service provided by the existing local or strategic roads network serving the site. The impact of the traffic arising from the proposed development of the site will not give rise to significant impact upon the capacity and operational efficiency of the receiving road network principally the N2. The impact of operational phase traffic on recreation, amenity and tourism as well as road safety is therefore considered to be not significant.

Recreation and Open Spaces

Construction Phase Effects (Direct & Indirect) -

The construction phase of the proposed development will not affect recreation options and open spaces, given that the wider development site is a functional space for dedicated waste management activities. The impact is Imperceptible.

Operational Phase Effects (Direct & Indirect)

The operational phase of the development will have a positive, direct, medium to long term effect on recreation options and open spaces through the continued support provided to local sporting facilities and teams by Knockharley Landfill Ltd., either through the Community Development Fund and/or through direct sponsorship.
The potential impact on recreation options and open spaces in the local area is positive and slight.

6.5.5 Potential Significant Effects – Human Health

The process of estimating the probability of potential adverse health effects because of the proposed development is determined by undertaking human health risk assessment. The description of the proposed development is outline is Chapter 2 – Proposed Development.

According to the US EPA, conducting human health risk assessment includes four steps:

1. Hazardous Identification
2. Dose-Response Assessment
3. Exposure Assessment
4. Risk Characterisation

Step 1 - Hazard Identification

The operation of waste management facilities e.g.an engineered non-hazardous landfill, IBA storage and a biological treatment facility have the potential for a wide variety of exposures and exposure scenarios involving a variety of factors.

Factors which can affect the likelihood of potential harmful exposure include: engineering and containment, hydrogeology and topography, the type and quantity of waste accepted leachate and gas generation

In the absence of appropriated engineering controls and abatement, the primary risk to human health mainly associated with operation of waste facilities are discharges to air and water.

To inform the hazard identification assessment, a detailed literature review of health-related literature was undertaken in the context proposed development. The focus of this review is to identify, and review published scientific literature on the potential adverse effects of operating engineered waste facilities on human health particular those handling non- hazardous wastes and IBA.

In 2003 Dublin Institute of Technology (DIT) School of Food Science and Environmental Health undertook a review of the *Health and Environmental, Effects of Landfilling and Incineration of Waste – A Literature Review,* on the request of the Department of Environment and Local Government. The aim of this review was to inform policy makers of (a) the technical aspects of both landfill and incineration practices in Ireland and (b) and adverse effects that these practices may have on the environment and human health. This study concludes that interpretation of evidence from epidemiological studies is especially difficulty to determine and that while many studies have been undertaken, evidence from research shows that wide-ranging value judgement are often made. Evidence between specific health outcomes and landfill exposure is still inconclusive.

The DIT Report identified the main potential impacts on health arise from landfill gas and leachate emissions but that direct exposure requires human contact and that much of the existing evidence on emissions relate to sites using older technologies that are not directable comparable to the emission control technologies in place at Knockharley which are considered the Best Available Techniques (BAT).

In 2004, the University of Birmingham/Enviros Consulting Limited published a review entitled *Review of Environmental and Health Effects of Waste Management: Municipal Solid Waste and Similar Wastes.* This report was commissioned by the Department of Environment, Food and Rural Affairs. The focus of the report was to improve understanding of emissions from operations involving MSW and understand the health impacts of managing MSW. The information in the report can be used to support a "source-pathway-receptor" model for risk assessment of an individual facility, or of a waste management strategy.

The possible sources, pathways and receptors associated with management of MSW are summarised in Table 6.10 over.

Table 6-10: Possible Sources, pathways, emission and potential effects of waste management

Waste Disposal Method	Emission(s)	Pathway(s)	Receptor(s)	Potential Effects	
				Human	Environmental
Landfill	Dust; odour; microorganisms; litter; landfill gas (CH_4, CO_2 and numerous trace compounds); exhaust gases from combustion of landfill gas (including carbon dioxide, carbon monoxide, oxides of nitrogen, sulphur dioxide, and other trace components).	Air- emissions of materials to air directly from the landfill during tipping, compacting, covering and storage activities; emissions to air of fugitive landfill gas; emissions to air of products of landfill gas combustion.	Nearby sensitive receptors in the vicinity of the landfill site; nearby sensitive habitats.	Potential for exposure to a variety of potentially harmful materials which have been investigated in connection with birth defects, asthma, respiratory disease and cancer.	Potential for soil acidification due to deposition of acid gases; increases in soil metals; vegetation damage due to oxides of nitrogen (NO_x) and sulphur dioxide (SO_2).
	Leachate containing salts, heavy metals, biodegradable and persistent organics to groundwater, surface water and sewer.	Water- leaching of materials into groundwater and surface waters due to fugitive escapes of leachate; emissions of treated and untreated leachate via permitted routes.	Nearby sensitive receptors, groundwater users and surface water users; nearby sensitive habitats.		Potential for contamination of ground and surface water with metals, organic compounds, bioaccumulation of toxic materials.
	Metals (Zinc (Zn), lead (Pb), copper (Cu), arsenic (As)), and various organic compounds.	Land contamination of land during postoperative phase.	Nearby sensitive receptors and users of postoperative site.		Potential for contamination of flora and fauna in contact with contaminated land, and possible bioaccumulation of toxic materials in flora and fauna.

In 2007, World Health Organisation (WHO) undertook a review of a wide range of waste management options entitled *Population Health and Waste Management – Scientific Data and Policy Options.*

The report considered landfills under three primary themes including:

- Emissions and Exposure;
- Scientific Evidence; and
- Critical Case Studies

In relation to emissions and exposure the 2007 report WHO notes that:

> *"With regard to landfills a wide variety of exposures, exposure pathways and exposure scenarios are involved, entailing a large complexity and difficulty in estimating the health risks and possibility involved. Only few epidemiological studies have evaluated sites with respect to the types of chemicals they contain and release; most studies on the health effects of waste landfills in fact lack direct exposure measurement and rely on residential distance from the site or sometimes on exposure modelling. Many health endpoints have been considered in epidemiological studies, including cancer incidence and mortality and reproductive outcomes such as birth defects and low birth weight. Despite the methodological limitations, the scientific literature on the health effects of landfills provides some indication of the association between residing near a landfill site and adverse health effects. The evidence, somewhat stronger for reproductive outcomes than for cancer, is not sufficient to establish the causality of the association. However, in consideration of the large proportion of population potentially exposed to landfills in many European countries and of the low power of the studies to find a real risk, the potential health implications cannot be dismissed."*

The 2007 WHO Report prepared a number of studies on waste management facilities most of which were not directly comparable to the Knockharley site.

In 2009 a *Systematic Review of Epidemiological Studies on Health Effects Associated with Management of Solid Waste* was undertaken by academics Porta D*, et al*. Because of the wide range of pollutants, the different pathways of exposure, long-term low-level exposure, and the potential for synergism among the pollutants, concerns remain about potential health effects but there are many uncertainties involved in the assessment. The aim of the review was to systematically review the available epidemiological literature on the health effects near landfills and among workers at waste processing plants to derive usable excess risk estimates for health impact assessment.

The review reported that:

> *"In most cases the overall evidence was inadequate to establish a relationship between a specific waste process and health effects; the evidence from occupational studies was not sufficient to make an overall assessment. For community studies, at least for some processes, there was limited evidence of a causal relationship and a few studies were selected for a quantitative evaluation. In particular, for populations living within two kilometres of landfills there was limited evidence of congenital anomalies and low birth weight with excess risk of 2 percent and 6 percent, respectively."*

In summary the main difficulties about reviews of epidemiological evidence is that they are by their nature, historical. While the literature and scientific evidence may reflect the situation as it was, with far lesser engineering controls. Current management of emissions and higher levels of supervision at landfills including EPA licensing of landfills ensures much stricter controls.

While there are anecdotal reports of increased risk of respiratory, skin, nose, eye and gastrointestinal illnesses, fatigue, headaches, allergies and psychological disorders are based mainly on self-reported symptoms, which scientific research has not supported. Although this evidence must not be dismissed, consideration should be given to the strong possibility of bias and the influence of fears and worry related to the waste. In the survey by Ozonoff *et al*., residents who indicated they were worried about neighbourhood pollution reported more symptoms than those who were not worried, both in the exposed and the control area.

The literature review did not identify any studies that examined IBA storage.

With respect to the biological treatment facility, a study title "*Exposures and health outcomes in relation to bioaerosol emissions from composting facilities: a systematic review of occupational and community"* as reviewed. This study reviewed published information and database from 1960 to 2014. The study concluded that exposure information was limited and evidence based on health effects of bioaerosol emissions from composting facilities is still limited, although there is sufficient evidence to support a precautionary approach for siting facilities 250m from the nearest residence. The proposed facility in Knockharley is greater that 250m from the nearest residences.

In the context of major accidents of natural disaster, the potential sources of pollution onsite during the construction and operational phases of Knockharley Landfill are limited. The primary sources of pollution with the potential to cause significant environmental pollution and associated negative effects on human health include the bulk storage of hydrocarbons and leachate. In the case of the proposed development onsite the storage of hydrocarbons will be very limited. The leachate management system is designed in accordance with the Landfill Directive and relevant EPA guidance and operated in accordance with the IE licence, therefore the potential to cause significant negative effects on human health is very low.

There is limited potential for significant natural disasters to occur at Knockharley. Ireland does not suffer from the extremes of temperatures experiences by many countries at a similar latitude due to the dominant influence of the Gulf Stream. This provides Ireland with a mild temperate climate. Potential natural disasters that may occur are therefore limited to:

- Flooding; and
- Fire;

Should a major accident of natural disaster occur the potential sources of pollution onsite during the construction and operational phases of Knockharley are limited. The primary sources of pollution with the potential to cause significant environmental pollution and associated negative effects on human health include the bulk storage of leachate.

The risk of flooding is addressed in Chapter 12 Hydrology and Surface Water Quality of Volume 2 of this EIAR which concludes that the increase in flood levels as a result of the proposed development is considered low in significance.

Major industrial accidents involving dangerous substances pose a significant risk to human health and to the environment both on and off the site of the accident. The proposed development is not close to any site, nor is the site itself regulated under the Control of Major Accident Hazards Involving Dangerous Substances Regulations i.e. SEVESO.

Step 2 - *Dose Response Principal*

In principal, the term dose response suggests that the greater the dose to which an individual is exposed the greater either the likelihood of health response and/or the greater the severity of that response. Inbuilt to this term is the principle of a threshold. The threshold is the level of an agent below which one would expect no adverse response. This is a concept on which many health-based standards are based. The thresholds for these exposures are set out primarily in Chapter 7 Air and Climate and Chapter 9 Noise in Volume 2 of this EIAR. For example, in the case of noise, while there is no statutory Irish guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project The appropriate emission criteria relating to permissible construction noise levels for a development of this scale may be found in the British Standard BS 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites – Noise, sets out methods and thresholds for the assessment of the significance of noise effects. Minimum criteria that are applicable to construction noise where existing noise levels are low and construction activities continue for more than one month. These are 45, 55 and 65 dB LAeq,1hr, for night-time (23:00-07:00), evening and weekends, and daytime (07:00-19:00) including Saturdays (07:00-13:00) respectively, to be applied at any nearby dwelling. Beyond this threshold, noise levels could be considered a nuisance.

Step 3 - *Exposure Assessment*

Health based standards therefore rely on the dose response concept and try to identify by scientific means the threshold below which no significant health effects would occur.

When standards are scientifically set by reliable and recognised or statutory agencies, they are a useful method in assessing the effect of any proposed change.

For example, in order to protect our health, vegetation and ecosystems, EU Directives have set out air quality standards for Ireland and the other member states for a wide variety of pollutants. These Directives include how we should monitor, assess and manage ambient air quality. The European Commission set down the principles to this approach in 1996 with its Air Quality Framework Directive. Four "daughter" directives lay down limits for specific pollutants:

- 1st Daughter Directive: Sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead;
- 2nd Daughter Directive: Carbon monoxide and benzene;
- 3rd Daughter Directive: Ozone;
- 4th Daughter Directive: Polyaromatic hydrocarbons, arsenic, nickel, cadmium and mercury in ambient air.

With regards to particulate matter, for example, the standards relate to relatively smaller particles that is, for example, PM_{10}, which is particulate matter with a diameter of less than 10µm. Larger particles which are greater than 10 µm but less than 30 µm are potentially inhaled, that is enter the nose or mouth but do not enter the alveoli and are not respired. These are usually swallowed and do not have effects on the respiratory system. Under the existing IE licence conditions for Knockharley landfill, there is a requirement to monitor dust deposition, PM_{10}, landfill gas, emissions from the landfill gas flares and utilisation plant, as well as volatile organic compounds (VOC). Monitored results are compared with the Ambient Air Quality Standard (SI. 271 of 2002) which sets a PM_{10} 24-hour limit value of 50 µg/m^3 for protection of human health. This limit value is not to be exceeded more than 35 times per year.

Dust particles which are greater than 30 µm are not inhalable so do not have an effect on human health hand typically fall to the ground. It is only if the smaller particles are increased that human health issues may arise. High sensitivity receptors to the health effects of PM_{10} are:

- Locations where members of the public are exposed over a time period relevant to the air quality objective for PM_{10}

The residential dwellings located on the local roads to the immediate north and east of the landfill are considered to be sensitive receptors. Table 7.6 in Chapter 7 of Volume 2 of this EIAR sets out the sensitivity of the surrounding area to human health impacts by PM_{10} concentration. PM_{10} monitoring is undertaken annually at six monitoring locations (PM1- PM6) at the Knockharley facility. The monitoring frequency was reduced from quarterly to annually in the 3rd quarter of 2013. Monitored results are compared with the Ambient Air Quality Standard (SI. 271 of 2002) which sets a PM_{10} 24-hour limit value of 50 µg/m^3 for protection of human health. This limit value is not to be exceeded more than 35 times per year. Monitoring results are submitted annually to the EPA. There were no exceedances in the period 2013-2018.

Step 4 - *Risk Characterisation*

Risk assessment seeks to characterise the nature and magnitude of human health or environmental risk. In this step, data on the dose-response relationship of an agent are integrated with estimates of the degree of exposure in a population to characterise the likelihood and severity of potential impact. The potential primary human health impacts arise from air and noise emissions and emissions to water in the absence of mitigation. Each potential significant effect is considered hereunder.

Air Emissions

The main issues examined with respect to the potential impacts from the proposed development on air quality and climate are:

- vehicle emissions
- dust/particulate emissions
- landfill gas utilisation emissions
- process emissions
- odour emissions

The appraisal of the potential impact of dust has been carried out in accordance with guidance produced by the UK Institute of Air Quality Management (IAQM)[2]. The appraisal of vehicle emissions has been carried out using the UK Highways Agency's DMRB[3] model to predict vehicle emissions. Air dispersion modelling was carried out using AERMOD.

Climate

A desktop assessment of the potential impacts on climate was carried out. During the construction phase of Knockharley Landfill there will be an imperceptible impact on the general and national climate. During the operational phase, the proposed development will positively impact the local and national climate. Benefit to the climate will be by reducing the emission of greenhouse gases by diverting biodegradable waste from landfill for treatment and by the generation of energy in the landfill gas utilisation plant and the subsequent savings of fossil fuels at a power plant.

Air

Dust Emissions

The risk posed from earthworks, construction and track out activities during the construction phase and operational phase is deemed to be Low Risk.

Mitigation measures to be implemented during the construction and operational phases are outlined in detail in Volume 2 of this EIAR. Examples include a dust control plan, covered loads, use of vehicle wheel wash, the spraying of access roads and internal site roads during periods of dry weather to prevent dust migration from the site, monitoring in accordance with IE licence, the implementation of a speed limits on facility roads and regular inspections to mitigate dust nuisance.

Following the implementation of mitigation measure, no adverse impacts on receptors will arise from dust generation. The residual effects of dust generation at the site are considered to be 'not significant.'

Vehicle Emissions

Predicted vehicle emissions associated with the proposed development during the construction phase will be comfortably within the relevant air quality guidelines and will have an imperceptible impact on ambient air quality. During the operation phase there will be an imperceptible impact the N2 national road and an imperceptible/negligible impact on the R150 regional road. No mitigation measures are required.

[2] IAQM.2014. Guidance on the assessment of dust from demolition and construction version 1.1.www.IAQM.co.uk

[3] Design Manual for Roads and Bridges (DMRB) (Volume 11, Section 3 Air Quality, May 2007), UK Highways Agency

Landfill Gas Utilisation Emissions

The results of the modelling assessment indicate that predicted emissions are compliant with the statutory limits set out in the EU Ambient Air Quality Directive (EU 2008/50/EC) and other relevant standards (2004/107/EC, the Air Quality Standards and Environment Agency guidance) at any nearby sensitive receptors and will not impact significantly on the ambient air quality of the area. On this basis the significance of impact of emissions from the gas utilisation plant on human health is considered to be 'Not significant'

Biological Treatment Facility Emissions

Emissions from the proposed biological treatment facility will be discharged to air through a biofilter. Potential emissions from the biofilter will include ammonia, hydrogen sulphide and bioaerosols. The predicted impact of emissions from the biological treatment facility is predicted to be low.

Odour Emissions

No odour generation will be associated with the construction phase of the proposed development. No mitigation measures are therefore proposed for this phase.

The proposed changes in operation to Knockharley landfill to accept 440,000 tpa of varying types of waste has the potential to influence odour emissions generated from the site in three fundamental ways:

1. The construction of a biological waste treatment facility will introduce new sources of odour to the site which may act in combination with emissions generated from landfilling activities.
2. The quantity and quality of the waste received at the site will change and over time the location of the operational area will change as the site develops. This includes construction of an IBA facility.
3. The construction of leachate storage tanks to store the increased leachate generated from the increased acceptance of waste.

For the purposes of comparing the impact risk between the various operational scenarios studied in this case and evaluating the potential significance of impact in EIA terms, the following criteria for assessing potential have been applied:

- Landfilling operations (high offensive odours) threshold: $C_{98,\ 1\text{-hour}} \geq 1.5\ ou_E/m^3$.
- Biological treatment facility emissions (moderately offensive odour) threshold: $C_{98,\ 1\text{-hour}} \geq 3\ ou_E/m^3$.

It is noted in Chapter 7 of this EIAR, that whilst examples are provided of the industries which may generate odours that fall into each offensiveness category, the guidance does not specify specific criteria for all industrial sectors. It is also important to note that the criteria are intended as indicative benchmarks for development of odour impact *risk*, but are not absolute standards and may vary due to local factors such as population density, complaint behaviour, receptor sensitivity etc. Selection of an appropriate criteria is therefore a matter of specialist judgement.

IAQM guidance states that based on the current evidence available, odour annoyance can develop at odour exposure levels of between $C_{98,\ 1\text{-hour}} = 1\ ou_E/m^3$ to $C_{98,\ 1\text{-hour}} = 10\ ou_E/m^3$ depending upon the offensiveness of the odour and local conditions.

Matrices are provided in Chapter 7 which outline the possible effect of odour exposure on receptors with different sensitivities (i.e. odours that are classified as 'most offensive' and 'moderately offensive'). In these matrices the likely effect is considered at different exposure levels and receptor sensitivities, ranging from negligible to substantial.

The odour impact assessment considered the odour emissions and exposure levels under the following operational scenarios:

- Scenario 0: Baseline conditions in 2018.
- Scenario 1: Year 4 'do nothing'. The situation which is likely to occur in the final active deposition stages of the landfill if it continues to operate in line with current planning and licence conditions (i.e. the development does not go ahead).
- Scenario 2: Year 4 of proposed development.
- Scenario 3: Year 6 of proposed development. The situation which will occur in the final stages of the landfill if permission is granted.

Under baseline conditions (Scenario 0), emissions from landfilling activities are predicted to be higher than for the future operational scenario (year 4) under current licence conditions (Scenario 1). This is linked to the current gas generation rates and number of cells currently with intermediate capping in place. Going forward, it is assumed that all cells will have permanent capping applied within a year of filling thus reducing potential fugitive emissions released to atmosphere.

The total emissions generated from the landfilling operations are predicted to decrease as a result of the proposed development in comparison to the current operational scenario (Scenario 0) and year 4 operation if the proposed development does not go ahead (Scenario 1). This is due to the enhanced containment of landfill gas emissions which will be achieved by the proposed development.

In overall terms, the emissions from the proposed development are predicted to increase due to the inclusion of a new biological treatment facility (Scenario 2 and 3). However, enhanced odour control techniques provisions will be provided to ensure any odours from this facility are treated prior to release through an elevated stack which will serve to disperse residual odours in the atmosphere. The offensiveness of the odours released will also be lower due to the nature of the treatment process and treatment of the air prior to release in a biofilter.

It is therefore evident that the development will lead to an overall reduction in offsite odour exposure and impact risk in comparison to the baseline and the 'do nothing' situation, up until 2022, when the existing planning approval expires. A potentially significant risk of odour impact will remain to a handful of properties to the north of the site during the remaining life of active deposition and subsequent completion of permanent capping which is estimated to be in the order of 2 no. years. Although an odour exposure of $C_{98,\ 1\text{-hour}} \geq 1.5$ is considered 'significant' according to IAQM planning guidance criteria, and in Odournet's experience it is possible for a significant adverse odour impact to develop at exposure levels as low as $C_{98,\ 1\text{-hour}} \geq 1.5\ ou_E/m^3$, it should be noted that such instances are relatively rare and hence the thresholds should be considered as precautionary.

The overall conclusion of the odour impact assessment is that the development will have a beneficial effect on odour exposure and impact risk in comparison to the do-nothing scenario in the next four years. A residual risk of impact will remain to up to 4 no. properties during this period and up to 6 no. properties until the landfill is completed, based on application of the precautionary indicative odour impact criteria applied in the study.

Noise Emissions

By comparing the predicted noise emissions as detailed in Chapter 9 Noise & Vibration in Volume 2 of this EIAR, with reliable noise standards, we can determine if any health impacts are likely as a result.

The construction phases have been assessed with regard to BS 5228-1:2009+A1:2014 while the operational noise limits are assessed the limits set out the IE Licence. The two phases will occur simultaneously the cumulative impact of the construction and operational phases are assessed with regard to BS 5228-1:2009+A1:2014.

Construction Phase Effects (Direct & Indirect)

During the construction phase a conservative assumption was made that mobile plant will operate for a percentage on-time of 80% for the purpose of the noise impact assessment, mobile plant is located such that the distant between the respective construction activity and the nearest receptor is at a minimum. In practice, all mobile plant will not operate simultaneously and the distance between the plant and the nearest receptor will often be greater than the distances used in the noise model. Construction activities will be below the construction noise limit of 65 dB $L_{Aeq,1hr}$ at noise sensitive locations.

Operational Phase Effects (Direct & Indirect)

During the operation phase, a number of operational scenarios were modelled. For the majority of the scenarios modelled and the majority of receptors, the predicted noise levels are below the daytime noise limit as outlined in the sites IE Licence. However, there are 3 no. scenarios (2b, 3a and 3b) where the predicted noise levels are above the daytime noise limit at 4 no. receptors (2 no. ground floor receptors and 2 no. first floor receptors). One of the receptors is within the ownership boundary. These predicted exceedances are predominantly attributed to felling of trees (1-week duration) and construction of earth berms A and B (2-3 weeks each). These works will ultimately serve to protect the noise sensitive locations in the long term but given the close proximity of these activities to some of the noise sensitive locations there is potential for short term elevated noise levels. In the long term, once these activities are completed, no significant effects are predicted.

The cumulative impact of the combined construction and operational phases was determined to be within the relevant assessment criteria and is addressed in detail in Chapter 9 Noise and Vibration, Volume 2.

Emissions to Surface Water and Groundwater

The potential effect on water is assessed in Chapter 11 Soils, Geology and Hydrogeology, with regard to groundwater and Chapter 12 Hydrology and Surface Water Quality, with regard to surface water.

Construction Phase Effects (Direct & Indirect)

During the construction period, the development has the potential to impacts on groundwater, hydrology and surface water quality unless appropriate mitigation is applied. The proposed development at Knockharley Landfill has the potential in the absence of mitigation measures to have a Slight to Not Significant impact during the construction phase. These potential impacts include:

- Increased run-off
- Flooding
- Sediment loading
- Nutrient loading
- Exposure of groundwater
- Spills

Operational Phase Effects (Direct & Indirect)

During the operational period, the development has the potential to impact on groundwater, hydrology and surface water quality unless appropriate mitigation is applied. The proposed development at Knockharley Landfill has the potential in the absence of mitigation measures to have a Slight to Not Significant impact during the operational phase. These potential impacts include:

- Increased run-off
- Flooding
- Sediment loading
- Nutrient loading

- Uncontrolled leachate breakout
- Spills

6.5.6 Do Nothing Impact

If the proposed development does not proceed, the existing facility will continue to operate under its current consents. A direct negative impact in the form of no increased contribution to the Community Development Fund will result.

6.6 Mitigation Measures

6.6.1 Mitigation Measures– Population

No mitigation measures are proposed in relation to population, given the lack of significant direct construction and operational phase effects resulting from the proposed development.

No traffic mitigation measures are required to facilitate the proposed development, save for a commitment to adhere to the existing HGV routing arrangements.

6.6.2 Mitigation Measures – Land Use

No mitigation measures are proposed in relation to land use, given the lack of significant direct and indirect effects on land-use beyond the proposed development boundary.

6.6.3 Mitigation Measures – Socio-Economics, Employment and Economic Activity

No mitigation measures are proposed in relation to local employment and economic activity as the proposed development is considered as having positive, direct and indirect effects during the construction and operational phases.

6.6.4 Mitigation Measures – Recreation, Amenity and Tourism

No specific mitigation measures are proposed in relation to recreation, amenity and tourism given the lack of significant direct or indirect construction and operational phase effects resulting from the proposed development on recreational activity and open spaces.

6.6.5 Mitigation Measures – Human Health

Appropriate mitigation measures for potential significant effects on population and human health associated with noise, air, surface water, groundwater and soil are identified in full in their respective chapters of this EIAR.

6.7 Residual Effects after Mitigation

There are no specific mitigation measures proposed with regard to population, land use, socio-economics, employment and economic activity or Recreation, Amenity and Tourism. The residual impacts for these sections are therefore the same as those detailed in section 6.5. However, as stated previously human health also interacts with many other aspects of the environment.

The residual and cumulative impact in relation to these aspects are detailed in the individual chapters as follows:

- Chapter 7 Air and Climate
- Chapter 8 Roads, Traffic and Transportation
- Chapter 9 Noise and Vibration
- Chapter 11 Soils, Geology and Hydrogeology
- Chapter 12 Hydrology and Surface Water Quality a
- Chapter 13 Landscape and Visual Impact Assessment.

6.8 Monitoring

There is no specific monitoring proposed with regard to population, land use, socio-economics, employment and economic activity or recreation, amenity and tourism. However, monitoring requirements in relation to the following aspects are detailed in the individual chapters as follows:

- Chapter 7 Air and Climate
- Chapter 9 Noise and Vibration
- Chapter 11 Soils, Geology and Hydrogeology
- Chapter 12 Hydrology and Surface Water Quality a
- Chapter 13 Landscape and Visual Impact Assessment.

6.9 References

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