3 ENVIRONMENTAL CONSIDERATION

The following sub-sections are intended to assess and describe specific areas of the existing baseline environment, to identify potentially significant impacts of the proposed development in respect of these areas, and to detail any proposed mitigation measures and on-going monitoring programmes, where appropriate.

3.1 HUMAN BEINGS

3.1.1 INTRODUCTION

All projects and developments that require an EIS *by virtue of their nature, size and location*, have the potential to have an impact on the environment. The impact on human's beings forms one of the most important aspects to be considered in an EIS. Any likely significant impact on human beings, including their community and activities, must therefore be comprehensively addressed. The principal concern in respect to this proposed development is that human beings should experience no significant unacceptable diminution in an aspect, or aspects of 'quality of life' as a consequence of the construction and operation of the proposed development.

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This section of the EIS has been prepared in order to establish the human environment in the vicinity, and to assess the potential impact, if any, arising from the continued operation of a Waste Recovery Facility (WRF) at Thornberry quarry, on the existing environment in respect of human beings. Matters related to water, air quality, noise, landscape and other such environmental impacts are not considered here, as these are more appropriately dealt with in their respective sections of the EIS. Thus, the impacts of the proposed continuation of operations at the WRF on human beings in relation to particular issues are addressed in the following sections:

- Water – Section 3.4
- Air Quality – Section 3.6
- Noise – Section 3.7
- The Landscape – Section 3.8
- Cultural Heritage – Section 3.9
- Material Assets – Sections 3.10
- Traffic – 3.11

The issues considered here include, land use, population, economy & employment, social infrastructure, amenity, tourism and recreation and health and safety. The potential impact on human beings resulting from the proposed development is assessed, and possible mitigation measures proposed to reduce any significant impacts.

3.1.2 STUDY METHOD

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The human environment was assessed by undertaking a desktop study and conducting visits to the site and the area. The desktop study was undertaken to compile, review and interpret available information and data pertaining to the human environment of the site and area.

The desktop study involved the assessment of all relevant demographic and socio-economic data for the area, much of which was sourced from the Central Statistics Office (CSO 2014). The Kildare County Development Plan (2011-2017) was also reviewed, as was Variation No. 1 (Kildare County Council 2012), which includes the Local Area Plan for Kill, which is relevant as the most proximate town to the development site (i.e., c. 2km). Prior planning reports on the Thornberry quarry (See http://webgis.kildarecoco.ie/PlanningEnquiry/), and a 2006 EIS, and several AER for the adjoining Arthurstown site (South County Dublin Council 2006, and 2008 to 2013, respectively) provided much of the site- and area-specific information. In addition, the desktop study used: (a) maps and site layout plans of the existing quarry development; (b) a copy of the current planning permission for the quarry (P.A. Reg. Ref 771/85, PL 9/5/70970); (c) copy of the waste management permit for the WRF (Ref. No. WMP 30/2001B); (d) Greater Dublin Area Regional Planning Guidelines 2010-2022; (e) the National Spatial Strategy 2002-2020; and (f) the National Development Plan 2007-2013.

In preparing this section, regard was given to the relevant guidelines and recommendations set out in 'Guidelines on Information to be contained in Environmental Impact Statements' (EPA 2003). It is considered that there is a wealth of available data and information, which is sufficient to adequately assess the local environment with respect to human beings.

The assessment of impacts on the human environment were considered using criteria such as: (a) location of nearest sensitive receptors; (b) disturbance to the general amenity of the local environment; and (c) pre-existing use of the land and area. The construction and operational phases of the proposal were both considered. In carrying out the assessment both positive and negative impacts were considered in each case, and the significance of the impacts are rated as being either: imperceptible; slight; moderate; significant; or profound (See Table 3.2.3).

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3.1.3 PROPOSED CONTINUATION OF WRF OPERATIONS

This EIS pertains to a proposal to continue operation of a WRF at Thornberry quarry in the Townland of Thornberry, Kill, Co. Kildare. The lands have a history of sand and gravel working. Planning Permission P.A. Reg. Ref. No. 771/85, PL 9/5/70970 was granted on 05/09/1985 for development comprising the restoration of derelict land to agricultural use by managed land fill scheme using dry non-industrial toxic waste. It should be noted that the only material imported to site has comprised inert soil and stones, and recovery of construction and demolition waste (concrete, bricks, tiles and ceramics).

The quarry site has being progressively restored using imported inert soil and stone subject to successive Waste Management Permits granted by Kildare County Council (e.g., Ref. No. WMP 30/2001B).

Changes in Waste Management legislation which came into effect in June 2008 (S.I. No. 821 of 2007), now require a Waste Management Licence issued by the Environmental Protection Agency (EPA) in order to operate a WRF with a lifetime total intake volume in excess of

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100,000 tonnes. An application for a Waste Management Licence was originally submitted on the 13th February 2009 (EPA Reg. No. W0264-01). Pursuant to Article 3(4) of the 2007 Regulations, the WRF has continued to operate under the existing Waste Permit (Reg. No. WMP 30/2001B), until such time as a decision is rendered in respect of the application for a Waste Management Licence.

The application area refers an area of c. 10ha which comprises the entire area of the quarry, which is being progressively restored, on a leasehold of 11.4ha. Ultimately, the entire quarry site at Thornberry will be fully restored to agricultural use on closure of the quarry and WRF.

The nature of the development is the continued phased restoration of a sand and gravel pit using imported inert soils, stone, and recovery of inert construction and demolition waste. Up to 70,000 cubic metres per annum is being accepted to the site and circa 25,000 cubic metres is required to complete the restoration of the site.

The original void space was estimate to be c. 180,000 cubic metres on submission of the Waste Management Licence application in 2009. It has been calculated that the void space remaining is only c. 25,000 cubic metres based on the original scheme submitted with the Waste Management Application.

Any small quantities of timber, plastic, paper and steel will be separated for recovery and/or disposal offsite. Once licenced, it is proposed that the operation will continue to use the existing site infrastructure, and to operate to the current standards for such facilities. Now new facilities or infrastructure are planned, nor are any new waste streams or processes envisaged.

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3.1.4 RECEIVING ENVIRONMENT

In this section, land use, recent demographic trends, employment characteristics, social infrastructure and amenity and tourism are examined.

3.1.4.1 LAND USE

The site of Thornberry quarry and WRF is located in a rural area in the townland of Thornberry, c. 2km southeast of Kill. The site of the WRF occupies the entire the quarry of c. 10ha, which is L-shaped, being c. 700m in length, c. 100m wide, and c. 300m wide at the base of the L. The site is located on lands immediately east of, and with direct access to local road L2019.

The site lies c. 2km southeast of Kill, whilst the next nearest settlements are Naas at c. 6.5km to the west, Sallins c. 7km to the west, Blessington c. 7.5km to the southeast, Rathcoole c. 8km to the northeast, Clane c. 10.5km to the west northwest, Cellbridge c. 12km to the north, Tallaght c. 15km to the northeast, Leixlip c. 15.5km to the east northeast, Maynooth c. 16.5km to the north, Kilcullen c. 17.5km to the southwest, Newbridge c. 17.5km to the west southwest, and Dublin City c. 25km to the northeast. Access to the site is gained from local road L2109 adjoining the western site boundary. The site lies c. 2km south of Junction 7 on the N7 dual carriageway (north of Kill), and c. 6km northwest of the N81 (north of Blessington).

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The western boundary of the quarry and WRF site terminates adjacent to the L2019 local road, whilst the eastern and northern boundaries abut agricultural land, and the southern boundary abuts the largely restored Arthurstown landfill. The Thornberry area is located in the plain of the Kill River within the larger Liffey River Catchment. The Kill River flows in a roughly SE-NW direction c. 500m north of the site, whilst a tributary stream of the Kill River flows immediately east of the site. The Kill River merges with the Painestown River north of Kill, and in turns flows into the Morell River c. 3km south of Straffan. The Morell River drains into the Liffey c. 1km south of Straffan village.

The site is situated at approximately 135-150m AOD in a predominantly rural area of northeast County Kildare. The surrounding landscape constitutes a transition from lowlands developed on limestones to the west, to the foothills of the Wicklow Mountains developed on more indurated Lower Palaeozoic siliceous metasediments. The sand and gravel workings at the Thornberry site, and at the adjoining Arthurstown site, were developed on Quaternary glacial moraine deposits. Initial quarrying at Thornberry exploited the long, narrow, steep-sided topographic ridge of a moraine occurring along the southern boundary of the property, and subsequently worked the resource northwards.

The predominant land use within the application site, which is co-located within the quarry site, is by definition that of quarrying activities related to the extraction of sand and gravel and associated operations such as placement of soil and stone in quarry restoration. Land-use in the area consists of a patchwork of agricultural fields that are classed as pasture and subordinate non-irrigated arable land, reflecting medium-high intensity agricultural. Areas of industrial and commercial use occur at Arthurstown, Thornberry, as well as nearby at Hartwell Lower and Oldmilltown, whilst areas of discontinuous urban fabric occur at Kill and Naas. There are relatively low levels of forest cover in the area, restricted largely to the hedgerows, river corridors, some afforestation, and extensive parkland in the Forenaughts and Rathmore areas.

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The WRF comprises the entirety of the quarry site of c. 10.4ha, and most of the existing applicants lease holding of c. 11ha, which is shown on EIS Figure B2.2 - Rev A, *EIS Section 2 Figures*. The eastern section of the quarry site (i.e., Phase 1) site has largely been completed with final grading and capping with topsoil now taking place. The western and central sections, designated as Phase 2, which houses all of the site infrastructure, constitute the current active backfilling operations, and remain in a disturbed and degraded state, typical of active quarry workings.

The development will also continue to use the established quarry infrastructure including internal roads, crushing and screening plant and other ancillaries (Refer to EIS Figure B 2.1 – Rev A, *EIS Section 2 Figures*).

The settlement pattern in the Thornberry area can be described as low-intensity rural settlement, albeit peripheral to the towns of Kill and Naas and settlements of Kilteel and Rathmore. Residential property in the area typically comprises one-off single residences and farmsteads along public roads or at the end of lanes off the latter (Refer to Figure B 2.2 – Rev A, *EIS Section 2 Figures* for locations of residences). Although there are no residences within the leasehold, there is a single farmstead within the landholding (i.e., landowners residence), whilst there are six residences within 500m of the site (i.e., one on the landholding, two

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adjacent to the site entrance, and three on the L2019 north of the site: Refer to Figures Nos. A1.0, B 2.2, *EIS Section 2 Figures* for site location details).

3.1.4.2 POPULATION AND SETTLEMENT

Analysis of the 2011 Census indicated that in the 2006–2011 period, Kildare experienced one of the highest population increases amongst the 26 counties (i.e., from 186,335 to 210,312 or 12.9%). Kildare is the second most populace county in Leinster after Dublin (i.e., 1,273,069). A population of 134,992 was recorded in 1996, 163,944 in 2002, 186,335 in 2006, and 210,312 in 2011, representing increases of 21.4%, 13.7% and 12.9% for the three inter-censal periods. The average inter-censal increase in population is 16.0%, whilst annual rate of population growth in the period was 3.72%. Births far outpace deaths, with a 2006-2011 inter-censal count of 19,670 births versus 4,308 deaths, adding 15,362 to the population. Thus, the increase in the population of Kildare between 2006 and 2011 (i.e., 23,977) is principally due to natural increase (births over deaths), and secondarily due to net migration.

Since 2006, the population of Leinster increased by 9.14%, while the population of the State increased by 8.22%. Thus, despite this significant population growth in both the Province and State, the population growth of Kildare (12.7%) was only exceeded by that of Meath (i.e., 13.1%), Longford (i.e., 13.4%) and Laois (i.e., 20.1%). Nonetheless, Kildare's share of the provincial population (i.e., 2,504,814 in 2011) grew from 8.12% in 2006 to 8.40% in 2011.

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Kildare, along with Dublin, Louth, Meath and Wicklow, comprise the "Functional Area of the Dublin City Region" (FADCR), and with a population of c. 1.8 million, accounts for 42% of the population of the State (Walsh & McNicholas 2008). The latter authors noted a contrast between areas of population decline in the inner suburbs of Dublin and various rural parts, compared to areas of high increase in northeast Kildare, southeast Meath and Fingal. This is reflected in County Dublin having the lowest population growth rate (i.e., 7.24%) in Leinster for the 2006-2011 inter-censal period, whilst the population of the FADCR increased by 8.64% in the same period.

Kildare's population represents an increasing proportion of the population of the FADCR from 10.5% in 2006 to 10.9% in 2011. Similarly, Kildare's population as a percentage of the population of the Greater Dublin Area (GDA – includes Dublin, Meath, Kildare and Wicklow, but excludes Louth), also increased to 11.7% in 2011.

There are myriad large to medium towns with legally defined boundaries in Co. Kildare, namely Naas (pop. 20,713), Newbridge (pop. 17,127), Environs of Newbridge (pop. 4,434), Cellbridge (pop. 19,537), Leixlip (pop. 15,542), Maynooth (pop. 12,510), Athy (pop. 9,587), Kildare (pop. 8,142), Clane (pop. 6,702), Kilcock (pop. 5,533), Sallins (pop. 5,283), Monasterevin (pop. 3,710), Kilcullen (pop. 3,473), Kill (pop. 3,095), Prosperous (pop. 2,248), Rathangan (pop. 2,374) and Derrinturn (pop. 1,541).

In their settlement hierarchy, the Dublin Regional and Mid-East Regional Authorities (2010) designated Naas as a Large Growth Town I; Newbridge, Maynooth and Leixlip as Large Towns II; and Celbridge, Kildare, Monasterevin, Kilcullen, Kilcock and Athy as Moderate Sustainable Growth Towns. Because of differences in the way boundaries between urban and rural areas are incorporated into the 2006 and 2011 censuses, it is difficult to give a

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consistent statement on the population growth of these towns. However, by including both urban and rural components in the comparisons, it is apparent that the population growth in the 2006-2011 period for Naas was 3.3% (i.e., 20,044 versus 20,713), compared to Newbridge at 0.5%, Maynooth at 16.8%, Leixlip at 5.3%, Cellbridge at 13.2%, Kildare at 8.0%, Monasterevin at 23.0%, Kilcullen at 16.3%, Kilcock at 35.0%, and Athy at 20.7%. Interestingly, this data suggests that proximity to Dublin is not the principal determinant in the population growth.

The nearest town to the Thornberry site is Kill at c. 2km to the northwest, followed by Naas at c. 6.5km to the west. As a Large Growth Town 1, the county town of Naas is a key destination, economically active town supporting surrounding areas, located on Multi Modal Corridor in metropolitan hinterland. Kildare County Council (2011) designated nearby Kill a Small Town and nearby Kilteel and Rathmore as Rural Settlements. Kill is thus a small town within the hinterland of the GDA, with a population of 1,500–5,000, intended to develop as a key local centre for services with levels of growth to cater for local need at an appropriate scale and to support local enterprise to cater for local demand.

The National Spatial Strategy (NSS) recognizes the strong functional interrelationships between the Dublin and the Mid-East regions as the GDA (DOELG 2002). There are a large number of towns in the GDA, and these are largely located on the main transport corridors radiating out from Dublin, such as the M4 (Leixlip, Maynooth and Kilcock), the M7 (Naas, Newbridge, Kildare and Monasterevin), and the N9 (Kilcullen).

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The NSS also identifies Dublin as the only Gateway within the Dublin and Mid-East Region or GDA, and does not identify any Hubs. Within the south central sector, which includes all of Kildare and the wider area around Thornberry, there are four Primary Development Centres identified, namely Naas, Newbridge, Kilcullen and Wicklow. These centres are strategically placed, strong and dynamic urban centres, located on major transport corridors, where development in the hinterland of Dublin should be concentrated. With a proximity of c. 6.5km, Thornberry clearly falls within the natural catchment of Naas. Thornberry also falls inside the large swathe of Kildare that is identified as a *Rural Area under Strong Urban Influence* (i.e., includes northern half of the county; See Kildare County Council 2011). This pattern represents an unsustainable trend away from the principle of building critical mass in the Primary Development Centres and larger towns in order to facilitate balanced regional development.

The quarry and WRF site is located in the townland of Thornberry within the civil parish of Kill, and the Electoral Division (ED) of Kill (Refer to Figure 3.1.1). The surrounding electoral divisions include Oughterard, Bodenstown, Naas Rural, Rathmore and Kilteel. The Thornberry area is located in a rural area of east Kildare under strong urban pressure, and the Kill ED includes the towns of Kill and Johnstown. Thus, the Kill ED, with an area of 19.38 km^2 and a population of 4,449 persons, has a relatively high population density of 229.6 persons per km^2. This compares to the population densities of 124.2 and 67 persons per km^2 for County Kildare and the State, respectively, which themselves constitute relatively low population densities relative to that in the neighbouring UK (i.e., 255 persons per km^2).

The sex ratio for Kildare is 0.991 (i.e., more females than males), whilst the sex ratio for the Kill ED is 0.969 (i.e., 2,189 males versus 2,260 females), reflecting the large urban component

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in the population of the Kill ED, as females preferentially migrate to the towns. The average age of the population in Kildare is 33.5, which is significantly below the national average of 36.1, and is the youngest in the State, albeit Fingal local authority has the youngest population (i.e., 32.9). The average age in the Kill ED in 2011 is approximately 31.5 (See Figure 3.1.2), and is thus markedly younger than Kildare in general. The age profile suggests a bimodal distribution with a distinct peak at the approximate age of 10, reflecting a mini "baby boom" in the electoral district. This is reflected in Kill's rapid population growth rate of 19.1% in the 2006-2011 inter-censal period.

Age dependency shows the ratio of the old and young segments of the population to that of working age. Notably, the total age dependency ratio in the State increased by 3.5% from 45.8% in 2006 to 49.3% in 2011, whilst the ratio in Kildare increased by 5.8% from 42.7% to 48.5% in the same period. The young dependency ratio is the number of young people aged 0-14 as a percentage of the population of working age. In 2011, the ratio was 31.9% for the State overall, whilst Kildare had the moderate to high ratio at 36.3%, reflecting a young and fast growing population. In contrast, the old dependency ratio is the number of people aged 65 and older as a percentage of the population of working age. In 2011, the old dependency ratio in the State was 17.4%, whilst the ratio in Kildare was 11.7%, the lowest for any county, except the local authorities of Fingal (10.6%), Galway City (12.6%), and South Dublin (12.7%). Thus, while Kildare has a moderately high total age dependency ratio, it reflects a very young, growing population versus an ageing population.

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Table 3.1.1 gives population data for the electoral divisions in the vicinity of Thornberry, as well as for County Kildare, the GDA, and the State from 2002-2011 (CSO 2013). Notably, the populations of the six electoral divisions that comprise the local area around, and including Kill, showed widely differing growth rates between 2002-2011 (i.e., 8.7% to 107.5%), although the combined population increased by almost a half in the decade. Much of this growth is related to the burgeoning populations of Kill, Sallins and Naas, with urban sprawl from the latter into Naas Rural. In contrast, the strongly rural electoral divisions of Oughterard, Rathmore and Kilteel, which envelope the Kill ED to the north, east and south, exhibit populations that are comparatively stagnant, with growth rates ranging from 8.7% to 19.5%. Kildare's population grew at the rate of 28.3% between 2002-2011, significantly higher than the more modest growth rates of 17.5% and 17.1% for the GDA and the State, respectively.

There are several large residential settlements in the wider area around the site, with Kill c. 2km to the northwest, Naas at 6.5km to the west, Sallins 7km to the west, Blessington 7.5km to the southeast, Rathcoole c. 8km to the northeast, Clane c. 10.5km to the west northwest, Cellbridge c. 12km to the north, Tallaght c. 15km to the northeast, Leixlip c. 15.5km to the east northeast, Maynooth c. 16.5km to the north, Kilcullen c. 17.5km to the southwest, Newbridge c. 17.5km to the west southwest, and Dublin City c. 25km to the northeast. There is a substantial rural settlement at Kilteel c. 2km to the east, and at small hamlet c. 2km south at Rathmore. Nonetheless, residential development in the vicinity of Thornberry is sparse and consists predominantly of isolated farm dwellings and of owner occupied bungalow/houses along public roads (Refer to EIS Figures 1.2 and 2.1). There are six residences in the immediate area (i.e., within 500m) of the quarry and WRF site at Thornberry, one of is the landowner's residence, which is located on the landholding, adjacent to the application site.

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Table 3.1.1 Population in the Local Area 2002-2011

District	2002	2006	2011	%Change 2002-2011
Oughterard	668	690	726	8.7%
Bodenstown	3,193	3,734	4,643	45.4%
Naas Rural	1,134	1,717	2,353	107.5%
Rathmore	1,045	1,025	1,157	10.7%
Kilteel	483	552	577	19.5%
Kill	1,711	2,510	3,095	80.9%
Total Local Area	8,234	10,228	12,551	52.4%
County Kildare	163,944	186,335	210,312	28.3%
Dublin & Mid-East Region	1,535,446	1,662,536	1,804,156	+17.5
State	3,917,203	4,239,848	4,588,252	+17.1

Note: Data from CSO (2013).

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3.1.4.3 ECONOMY & EMPLOYMENT

Historically, Kildare's location within the Pale, access to the port of Dublin, and abundance of productive agricultural land bestowed great advantage on Kildare. Today, Kildare's strategic advantage is its proximity to Dublin and location within the capital city region or GDA, which is the most economically dynamic and progressive area of the country. Kildare benefits from this proximity to Ireland's primary economic hub and National Gateway, and the largest market in the State. The excellent, multi-modal transport infrastructure (i.e., road and rail), which provides ready access to Dublin Airport and Dublin Port, as well as to the other gateway cities of Limerick, Cork and Waterford, also delivers strong connectivity throughout the county with three national primary routes, all of which are motorways (i.e., M4, M7 and M9). The fertile soils of Kildare also provide the basis for a thriving agricultural and food sector, as well as a world class equine industry that helps support the rural economy and communities.

Currently, Kildare contains a number of important employers, particularly in the ICT and biotechnology sectors, such as Intel, HP, NUI Maynooth and Pfizer in north Kildare, which has become Ireland's "Silicon Valley". In addition, there are, Bord na Mona (in both Newbridge and rural County Kildare), the equine industry and the defence forces at the Curragh. Kildare has 145 stud farms, whilst racecourses are located at Punchestown, Naas and The Curragh. Furthermore, Kildare is home to the State owned National Stud Farm, a National Equestrian Centre and Goff's Equine Auction Centre, all of which are important economic contributors to the county.

Kildare boasts a varied tourism portfolio with a position of excellence in heritage, golf, equine and horse racing. The natural environment, landscape and built heritage play a key role in supporting tourism. Significant natural attractions include the Curragh plains, the bogs to the

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west, the rolling hills of the eastern uplands, the waterways of the River Liffey, the River Barrow and the Royal and Grand Canals. Kildare's rich array of cultural and heritage assets offer a variety of heritage attractions to sustain a vibrant cultural tourism sector. Sport tourism, particularly equine and golfing, are significant contributors to the local economy. The Curragh and Punchestown racecourses hold festivals that attract global audiences and international tourists, whilst golf courses such as the K Club, which hosted the 2006 Ryder

Although urban areas of Kildare are home to a greater fraction of the population of Kildare (i.e., 142,171 or 67.6% in 2011), rural areas are home to a substantial population (i.e., 68,141 or 32.4% in 2011). This urban/rural split in Kildare (i.e., 2.08) is highest of any county outside of the Dublin local authorities, and contrasts with that in the State, the Mid-East Region, and Dublin County (i.e., 1.64, 1.74 and 43.6, respectively). Although rural areas account for 32.4% of the population, only 5.06% are employed in agriculture, forestry and fishing in 2011. Nonetheless, agriculture is the primary land-use in the county and the economy benefits significantly from the sector. The rural areas are also the location of major natural resources as well as major recreational, amenity, tourist and archaeological resources.

From Table 3.1.2, it is apparent that the dominant employment sectors in Kildare are commerce and trade (25.9%), professional services (24.2%), and manufacturing (19%), with all other sectors combined accounting for only 31%.

Examination of the CSO Live Register figures for County Kildare during the recession (CSO 2104) shows that unemployment levels rose dramatically from the end of 2007 to 2013, and remained a factor of about 3½ times the pre-recession levels, essentially fluctuating between 17,500 and 20,000 during 2010 and 2013 (See Figure 3.1.3). In the 2011 census, unemployment stood at 17.9% in Kildare compared to 19% nationally. The unemployment level in Kildare began to fall gradually in 2013, and fell below the 17,500 mark in late 2013. In July 2014, the figure stood at 17,599. The dramatic increase in unemployment has been largely associated with the collapse of the construction industry and the associated service industries. The recent improvement in unemployment figures reflects stabilisation in job losses and an improving economic outlook, combined with the historical pressure valve of emigration.

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'Commerce and Trade', which includes wholesale and retail trade, banking and financial services, real estate, renting and business activities, is the single largest sectoral employer (30.2%) in the Kill ED, with 'Professional Services' being the second largest (17.9%). Given that approximately 40% of the workforce in Kildare works outside of county, and given the proximity of the Kill ED to Dublin, it is probable that the dominance of 'Commerce and Trade' reflects the large fraction of the workforce in the Kill ED that works outside both the electoral division and county, in Dublin City. The third most important sector is 'Manufacturing' (12.9%) followed by 'Transport & Communications' (11.5%). 'Agriculture, Forestry and Fishing' is the smallest employer (2.01%) in the Kill ED, despite its rural character. 'Building and Construction' (7.08%) is the second smallest employer, reflecting the catastrophic contraction of the industry during the economic downturn (See Table 3.1.2).

Table 3.1.2 Employment by Industry in County Kildare and Kill ED in 2011

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Industry	County Kildare		Kill ED	
Agriculture, forestry and fishing	2,828	5.06%	39	2.3%
Building and construction	1,860	3.33%	137	7.08%
Manufacturing	10,644	19.0%	249	12.9%
Commerce and trade	14,494	25.9%	585	30.2%
Transport and communications	2,795	5.00%	222	11.5%
Public administration	3,536	6.32%	149	7.70%
Professional services	13,521	24.2%	346	17.9%
Other	6,240	11.2%	209	10.8%
Total	55,918	100.0%	1,936	100.00%

Note: Excludes 33,493 workers who work outside Kildare. Data from CSO (2013).

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Historically, agriculture and businesses supporting agricultural production would probably have been the main source of employment in the area and nearby villages and towns. The nearby rural settlements of Kilteel and Rathmore offer few employment opportunities, and the nearest commercial and industrial centres are in Kill and Naas. These include the Kill International Equestrian Centre and Goffs Bloodstock Sales in Kill, and the Naas Industrial Estate, Maudlins Industrial Estate, Monread Industrial Estate, Osberstown Business Park, M7 Business Park, Southern Link Business Park, and Newhall Retail Park in Naas. There are also some employment opportunities Bam Contractors and Balcas in Hartwell Lower in the Kill ED, and at PDM Ltd, Oman Storage, and Roankabin in Oldmilltown in the adjoining Kilteel ED. However, outside of the above, major employment opportunities for the workforce resident in the Kill ED are probably in the Dublin Metropolitan area.

Facilitated by easy access to quality public transport on the primary transport routes, such as the N7 and N81 and mainline rail services, east Kildare, including the Kill ED, recorded moderate transport energy consumption (Walsh & McNicholas 2008). Although the average journey times to work, school or college of c. 30.5 minutes for the Kill ED in 2011, the relatively low transport energy is consistent with higher use of public transport for commuting to work in the Dublin Metropolitan area.

The company employs up to 3 people directly on site (currently 2 due to recent economic recession

As the WRF is currently operational under the Waste Permit, it is not envisaged that any additional employees will be hired, if and when the WRF is licensed.

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3.1.4.4 SOCIAL INFRASTRUCTURE

Thornberry is located in a rural area, which is under strong development pressure for residential and economic uses associated with its proximity to Dublin. Nonetheless, there are few residences in the immediate area, indeed only 6 within 500m. Residential development consists of isolated farm dwellings and of owner occupied bungalow/houses along public roads (Refer to EIS Figures B 2.1 – Rev A and B 2.2 – Rev A, EIS Section 2 Figures).

There are many residential settlements close to the site, with the settlement of Kiltale c. 2.5km to the east, and Rathmore c. 2.5km to the south, and the towns of Kill c. 2km to the northwest, and Johnstown c. 4km to the west. Further afield, Naas is c. 6.5km to the west, Sallins c. 7km to the west, Blessington c. 7.5km to the southeast, Rathcoole c. 8km to the northeast, Clane c. 10.5km to the west northwest, Cellbridge c. 12km to the north, Tallaght c. 15km to the northeast, Leixlip c. 15.5km to the east northeast, Maynooth c. 16.5km to the north, Kilcullen c. 17.5km to the southwest, Newbridge c. 17.5km to the west southwest, and Dublin City c. 25km to the northeast. Of these, Cellbridge, Rathcoole, Maynooth, Leixlip, Tallaght belong to the Dublin Metropolitan area, whilst nearby Kill, Naas and Newbridge lie on a Strategic Radial Transport Corridor. The concentration of towns in the area reflects the higher population densities in the Metropolitan northeast, and also within areas with good quality access to Dublin.

With exception of the M7 and the N81, the roads in the immediate area are of a local character and typical of a rural location. The M7 motorway (at Junction 7) lies c. 2km to the north, whilst the N81 National Secondary Road is c. 6km to the southwest, just north of Blessington. The Dublin-Limerick and Cork mainline railway runs north of Kill, with the nearest station at Naas c. 6.5km to the west.

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The nearest Post Office outlet is on Main St., Kill, whilst the nearest ATM is located at Eurospar, also on Main Street, Kill. The nearest bank is located in Naas, where a large range of shops is also available.

The nearest National School is Saplings, Kilwarden, Kill, c. 2km to the northeast, which caters for the primary education of 24 pupils, whilst Scoil Bhride, Kill caters for over approximately 600 boys and girls, and is c. 2.5km to the northwest. Several primary schools are also available in Naas, such as Mercy Convent National School, St. Corban's CBS Primary, Holy Child School, Ballycane, Naas Community National School, and Gael Scoil Nas na Riogh, Killashee. Secondary schools are available at St. Mary's College Naas, Naas CBS Méanscoil Iognáid Rís, Gael-Choláiste Chill Dara, Pipers Hill College, Killashee. Clongowes Wood College in Clane offers exclusive, private schooling for boys.

The nearest third level Institutions are located in Tallaght (i.e., Institute Technology Tallaght or ITT), Blanchardstown (i.e., Blanchardstown Institute of Technology or BIT), Dublin (i.e., Dublin Institute of Technology or DIT), and Dun Laoghaire (i.e., Dun Laoghaire Institute of Art, Design & Technology or IADT), whereas the nearest universities are National University of Ireland in Maynooth, University College Dublin (UCD) at Belfield, Dublin, Trinity College Dublin (TCD) in Dublin city centre, and Dublin City University (DCU) in Glasnevin.

The nearest Roman Catholic church to Thornberry is the Church of St. Laurence O'Toole, Kilteel, followed by St. Brigid's Church, Kill, Church of Our Lady of Mercy, Crosschapel, and

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Church of Our Lady & St, David, Naas, Church of the Irish Martyrs, Ballycane, and St. Benignus, Staplestown. The nearest churches or houses of worship of other major denominations are: Church of Ireland: St. John's Church of Ireland, Kill; Presbyterian: Naas Presbyterian Church in Ireland Main St., Naas; Methodist; Episcopalian: Episcopalian Church, Rathmore West; and Baptist: the Redeemed Church of God Christian Church, Naas.

The Johnstown Health Centre is the Primary Health Care Centre for the environs of Kill and including Thornberry, and is 4km to the west, whilst the Naas Health Centre is also relatively close at c. 6.5km. The nearest public hospital is Naas General Hospital at c. 6.5km, followed by Clane General Hospital at c. 10.5km.

The nearest Fire Station is located in Naas, with next closest located in Leixlip, and Tallaght and Rathfarnham in Dublin, where the two Kildare stations are retained services. The Kildare Fire Brigade is headquartered at the Central Fire Station, Newbridge. The Garda Station in Kill closed on the 31st December 2013. The nearest Garda Station is located on the Kilcullen Rd. (R448) in Naas, which is also the divisional headquarters, followed by the Garda Station, Main St. in Clane, both of which fall within the Kildare Division of An Garda Síochána's Eastern Region. Other facilities in the wider area, include the community centres and sports and leisure centres in Kill, Johnstown, and Naas.

Power to local residences is provided by over-head lines. Most residential properties in the area are serviced by a mains supply, which is operated by the local group water scheme. Most houses are serviced by septic tank systems and proprietary effluent treatment systems.

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3.1.4.5 AMENITY, TOURISM AND RECREATION

Kildare is one of the most affluent counties in Ireland, and has developed a brand as the home of high tech industry, of a global thoroughbred industry, boutique hotels and shopping, and a wealth of natural and architectural heritage. Kildare envisions extending the marketing brand of "The Thoroughbred County" to wide range of tourism products in order to establish a clear identity, one of quality and excellence, particularly in heritage, golf, equine and horse racing.

Thornberry is located in northeast County Kildare, c. 25km from Dublin Airport and c. 30km from Dublin Port, whilst the nearby settlements are Kilteel (c. 2km), Kill (c. 2.5km), and Naas (c. 6.5km). There are community and recreational facilities in Kilteel, which include a community hall and the Church of St. Laurence O'Toole, whilst Kill has Scoil Bhride N.S., St. Brigid's Catholic Church, which is also used as a community centre, and St. John's Church of Ireland. Kill also boasts Kill GAA club and Kill Celtic AFC. The Johnstown Health Centre is the Primary Health Care Centre for the environs of Kill, including Thornberry. Naas has five National Schools, four Secondary Schools, a library, three Catholic Churches, a Community Centre, a Primary Health Centre, and the Naas General Hospital. Naas also boasts three soccer clubs, GGA club, rugby club, hockey club, lawn tennis club, athletics club, gymnastics club, the Naas Sub Aqua club, and the Naas Racecourse. Swimming and gym training are available at K Leisure Naas, and Killashee Leisure Centre, Naas, and many of the Spa Hotels in northeast Kildare.

Located at Farmersvale c 3.5km northeast of the site, Buggy World offers motorsports, karting, archery and adventure activities. Mondello Park Racing Track & Racing School is located c.

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7.5km northwest of Naas, and the Off-Road Driving Centre at Killashee, Naas, both offer a fast-paced experience for motoring enthusiasts.

Thornberry benefits from the myriad amenities and attractions located within the county, as well as being within easy reach of the vibrant Capital City of Dublin. The Thornberry area contains numerous historical and archaeological sites, with clusters of Protected Structures at Kilteel, including Kilteel Castle, Rathmore, Paynestown and Killhill. Further afield, Ireland's greatest stately home, Castletown House, built in 1972 by William Conolly, Speaker of the Irish House of Commons, is located in Cellbridge. Carton House, once the ancestral seat of the Earls of Kildare and Dukes of Leinster is located in Maynooth, and reincarnated as a luxury Spa and Golf Hotel. Other heritage attractions in Kildare include: Barberstown Castle, Leixlip Castle, Maynooth Castle, the Wonderful Barn, the Moone High Cross, Castledermot Round Tower, Harristown House, Ballitore Quaker Museum, Kildare Town Heritage Centre, and Athy Heritage Centre. Kildare Town offers a cluster of tourist attractions, including; St Brigid's Cathedral and Round Tower, the Irish National Stud, Japanese Gardens, St. Fiachra's Garden, Kildare Town Heritage Centre and Kildare Outlet Village.

The natural environment and landscape of Kildare contains many natural attractions, such as the Curragh plains, the bogs to the west, the rolling hills of the eastern uplands, the waterways of the River Liffey, the River Barrow and the Royal and Grand Canals, which include 75 miles of navigable waterways for the more leisurely pursuit of cruising.

Sport tourism, particularly equine and golfing, are major attractions in Kildare. Kildare has racecourses located at Punchestown, Naas and The Curragh. The Curragh and Punchestown racecourses hold festivals that attract global audiences and international tourists. Kildare is home to the State owned National Stud Farm in Kildare town, a National Equestrian Centre and Goff's Equine Auction Centre, both in Kill. There are equestrian activities at numerous nearby equestrian centres, such as the Kill International Equestrian Centre, the Old Mill Riding Centre, Kill, Abbeyfield Farm Country Pursuits, Richardstown, Clane, Coilog Eventing, Kilmeague, Naas, and Pitfield Equestrian, Castledermot.

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Golf enthusiasts visiting the area can enjoy a wide choice of excellent golf courses within short driving distance. Across north Kildare there are numerous courses, including golf courses such as, Castlewarden Golf Club, Killeen Golf Course, Palmerstown House Golf Club, Naas Golf Club, Craddockstown Golf Club, Newbridge Glof Club, Millicent Golf and Country Club, and Woodlands Golf Club. There is also the Kildare Hotel and Golf Club (K Club) is a golf and leisure complex at nearby Straffan, which hosted the 2006 Ryder Cup and incorporates two golf course designed by Arnold Palmer. It is one of only 5 Red Star hotels in Ireland. Carton House, outside Maynooth, is a 4 Star Spa and Golf Hotel with two golf courses on a magnificent 1,100 acre Parkland Demesne.

3.1.4.6 HEALTH & SAFETY

Operations within the quarry site, which includes the WRF, are carried out in accordance with all relevant legislation / regulations and with the best work practices for the industry. The policy of the operator is to ensure the health and welfare of its employees by maintaining a

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safe, clean and tidy working environment, and employing safe working procedures. The policy has been extended to include the WRF, and is in accordance with the requirements of employment legislation, including the provisions of the "Safety, Health and Welfare at Work Act, 2005", and the relevant Regulations.

The wearing of protective clothing such as footwear, helmets and high visibility clothing is mandatory in operational areas. Careful attention is paid to safe practices when carrying out machinery maintenance and ensuring appropriate guarding of moving parts.

Adequate fencing, signage and other barriers have been erected around the quarry site, which will also corresponds to the WRF, for the safety of the general public and to prevent livestock straying into the development. Large lockable gates are in place to guard against unauthorised and unsupervised entry to the site outside of working hours.

3.1.5 ASSESSMENT OF IMPACTS

3.1.5.1 INTRODUCTION

The proposed continued operation of the WRF at Thornberry arises from: (1) from the continued demand of human beings to have their buildings, roads and structures, modified and improved, resulting in the generation of large volumes of inert C&D waste, including soil and stone; and (2) the requirement to restore land, previously disturbed and degraded by sand and gravel extraction at the Thornberry quarry, through backfilling with recovered inert soil and stone. The recycling and recovery of C&D waste is essential to reduce resource utilisation and divert reusable inert waste from landfill.

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Although Thornberry is a rural location, it is strategically located within a catchment area with numerous large settlements, such as Kill, Naas, Sallins, Blessington, Clane, Kilcullen, Newbridge and the southern sector of the Dublin Metropolitan area, rendering the WRF well positioned to recover large volumes of inert soil and stone. This will contribute to the diversion of greater volumes of waste from disposal in landfill, as required under the Waste Framework Directive 2008 (2008/98/EC), and the European Communities (Waste Directive) Regulations, 2011 (S.I. 126 of 2011). There is also a preference for the deposition of soil and stone to be underpinned by a beneficial use in order to be considered waste recovery. Consequently, co-location of a waste recovery facility at Thornberry quarry has significant positive impacts, and is thus environmentally preferred.

The impact on human beings resulting from the proposed continued use of the WRF is assessed here, and possible mitigation measures proposed to reduce any significant impacts. Table 3.1.3 identifies the levels of impacts which are used here in order to evaluate the significance of potential impacts resulting from the proposed continuation of the WRF. These impact ratings are in accordance with impact assessment criteria provided in EPA's "Advice Notes on Current Practice in the Preparation of Environmental Impact Statements" (2003).

It is expected that the potential negative impacts on human beings and amenity of the area arising from the WRF, above those already arising from the quarry, relate mainly to nuisance from noise, dust and traffic.

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There are a number of potential environmental impacts associated with the WRF that may directly, or indirectly, affect the local "human" environment. These potential impacts and the mitigation measures proposed are described in the following sections of this report under the headings detailed below:

- Flora & Fauna – Section 3.2
- Water – Section 3.4
- Air Quality – Section 3.6
- Noise– Section 3.7
- Landscape – Section 3.8
- Cultural Heritage – Section 3.9
- Material Assets – Sections 3.10
- Traffic – 3.11

Table 3.1.3. Glossary of Impacts following EPA Guidance Documents.

Impact Characteristic	Term	Description
Quality	Positive	A change which improves the quality of the environment
	Neutral	A change which does not affect the quality of the environment
	Negative	A change which reduces the quality of the environment
Significance	Imperceptible	An impact capable of measurement but without noticeable consequences
	Slight	An impact which causes noticeable changes in the character of the environment without affecting its sensitivities
	Moderate	An impact that alters the character of the environment in a manner consistent with existing and emerging trends
	Significant	An impact, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment
	Profound	An impact which obliterates sensitive characteristics
Duration	Short-term	Impact lasting one to seven years
	Medium-term	Impact lasting seven to fifteen years
	Long-term	Impact lasting fifteen to sixty years
	Permanent	Impact lasting over sixty years
	Temporary	Impact lasting for one year or less
Type	Cumulative	The addition of many small impacts to create one larger, more significant impact
	'Do Nothing'	The environment as it would be in the future should no development of any kind be carried out
	Indeterminable	When the full consequences of a change in the environment cannot be described

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	Irreversible	When the character, distinctiveness, diversity, or reproductive capacity of an environment is permanently lost
	Residual	Degree of environmental change that will occur after the proposed mitigation measures have taken effect
	Synergistic	Where the resultant impact is of greater significance than the sum of its constituents
	'Worst Case'	The impacts arising from a development in the case where the mitigation measures may substantially fail

3.1.5.2 LAND USE

As a quarry currently exists at the Thornberry site, the use of the quarry for an WRF, in which the recovery of inert C&D waste (i.e., soil and stone) will occur, versus further sand and gravel extraction, is considered a positive impact in the context of the decreasing resource utilisation and landfill exhaustion. The quarry has put in place a number of mitigation measures with respect to environmental management and monitoring to ensure that operations do not result in significant impacts on the surroundings, including the human environment.

The area has an established history of sand and gravel working, and these activities have co-existed with other land uses in the area, particularly medium to high intensity agriculture. On completion of site activities, the site of the quarry and WRF will be decommissioned and left safe and secure. Furthermore, the site will be reinstated in accordance with the phased restoration scheme for the quarry, and thus integrated back into the surrounding landscape with the attendant improvement to the visual amenity of the area.

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3.1.5.3 POPULATION AND SETTLEMENT

It is not anticipated that the proposed continuation of WRF operations will result in any change in population. However, by supporting and maintaining the workforce living in the area, it is considered that the WRF will have a positive impact on sustaining the population.

3.1.5.4 ECONOMY & EMPLOYMENT

Sand & Gravel Merchants Ltd has an established small family run business based in Thornberry, Kill, Co Kildare. The company employs up to 3 people directly on site (currently 2 due to recent economic recession). The company has been in business for approximately 25 years.

The quarry has contributed indirectly to sustaining and developing the local and regional economy through the supply of building products, and has provided employment for local people, both directly and indirectly.

The WRF requires one person operating a bull-dozer/back-hoe excavator, one general foreman to monitor and inspect the quality and suitability of imported materials being brought to the site for recovery and one other general site operative. It is expected that the existing staff will continue in these roles, if and when the WRF is licensed.

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3.1.5.5 SOCIAL INFRASTRUCTURE

The proposed continuation of the WRF would provide a valuable and necessary resource to the county and wider region, providing a beneficial use for the recovery of inert soil and stone as an alternative to landfill. The WRF already exists and has an established record of meeting its regulatory obligations and current environmental standards.

There are no community facilities within close proximity of the WRF, with the nearest church, national school or community centre or parish hall located at Saplings N.S., Kilwarden, Kill, c. 2km to the northeast, or the Church of St. Laurence O'Toole at Kilteel c. 2km to the east, which constitutes a very significant standoff distance. Thus, it is expected that there will be imperceptible impact on local community facilities as a result of the continued use of the WRF at Thornberry.

3.1.5.6 AMENITY, TOURISM AND RECREATION

There are no major tourism attractions in the immediate vicinity of the WRF, with the exception of the Kill International Equestrian Centre and Goff's Bloodstock Sales, both in Kill, c. 2.5km to the northwest, such that there may be a slight to imperceptible, short-term negative impact on local tourism. There are numerous other attractions in northeast Kildare, however all of these are very remote to the WRF and therefore will be not be impacted upon.

Traffic entering and leaving the site will use the existing established quarry site access. The L2019 road servicing the site is generally in good condition, and is considered suitable for the expected volumes of HGV traffic. Further details with respect to the impact and mitigation of traffic are contained within this report (Refer to Section 3.11).

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As the WRF is co-located within the existing quarry, there is negligible additional visual intrusion. There are no Protected Views and Prospects near or oriented towards the site (Kildare County Council 2011). The visual impact of the WRF is discussed in more detail in Section 3.8 - Landscape. Upon decommissioning, the site will be restored in accordance with the approved restoration scheme for the quarry. Therefore in the long term, the site will be assimilated back into the landscape in a planned manner.

3.1.5.7 CONSTRUCTION

As the WRF is already in operation under an existing Waste Permit (Reg. No. WMP 30/2001B), there are no future adverse impacts on human beings arising from the construction and establishment of the WRF. There are however potential impacts arising from the operational phase of the WRF, and these include dust, noise and traffic (Refer to EIS Sections 3.6, 3.7 & 3.11 respectively). As no additional construction related to the WRF is envisaged, construction will thus have an imperceptible impact on the human environment.

3.1.5.8 OTHER

There are no recorded archaeological, architectural or cultural heritage features within the area of land take, but there are 2 structures (i.e., a burial and architectural fragment) in the surrounding environment within c. 500m standoff. Despite the proximity of these protected

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structures and monuments, the WRF will have imperceptible impacts on recorded archaeological, architectural or cultural heritage features, such that mitigation measures are considered unnecessary. The proposed continued operation of the WRF will lead to the restoration of the lands and an improvement in the amenity of the area, and therefore to the context of these monuments.

The impact of inert waste recovery on this site will be considerable in local terms but will not result in any loss of heritage values in the locality.

3.1.5.9 'DO-NOTHING' IMPACTS

If the proposed continuation of the WRF did not proceed, the recovery of inert soil and stone at the WRF would not occur, and result in the failure to divert these volumes from disposal in landfill, as required under the Waste Framework Directive 2008. Furthermore, the Thornberry site would be unable to complete the phased restoration of the quarry void and the proper reinstatement of the land. Additionally, the existing WRF would be forced to cease operations resulting in the loss of employment. This would have a significant and direct negative impact on the local human environment.

3.1.6 MITIGATION & MONITORING

Proposed mitigation measures with regard to environmental issues such as air quality, noise, traffic and visual impacts are provided for and are described in detail under the relevant sections (See above list in Section 3.1.5.1). Any impact on the natural environment will be mitigated against to the greatest degree practical, thereby minimising any associated impact on the "human" environment.

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Sand & Gravel Merchants Ltd. has established an on-going environmental monitoring programme for the Thornberry quarry and WRF site. The programme will allow on-going monitoring of environmental emissions (e.g., noise, dust, water) from the site, thereby assisting in ensuring compliance with any future requirements or regulations. The results of this monitoring will be made available to the EPA and the Local Authority on a regular basis, where members of the public may examine it. The future monitoring programme will be revised accordingly, subject to compliance with any conditions attached to a decision to grant a Waste Management License.

The development can be controlled and regularised in accordance with the scheme as outlined in this document, through continued environmental monitoring and by planning conditions imposed by the relevant regulatory authority. The proposal will have no major and/or long-term effect on the human environment.

3.1.7 RESIDUAL IMPACTS

Once the proposed continued operation of the WRF is authorized with a Waste Management License, and mitigation measures provided for, there are no significant residual impacts envisaged in terms of community and other socio-economic issues.

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3.1.8 REFERENCES

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3.1.9 FIGURES

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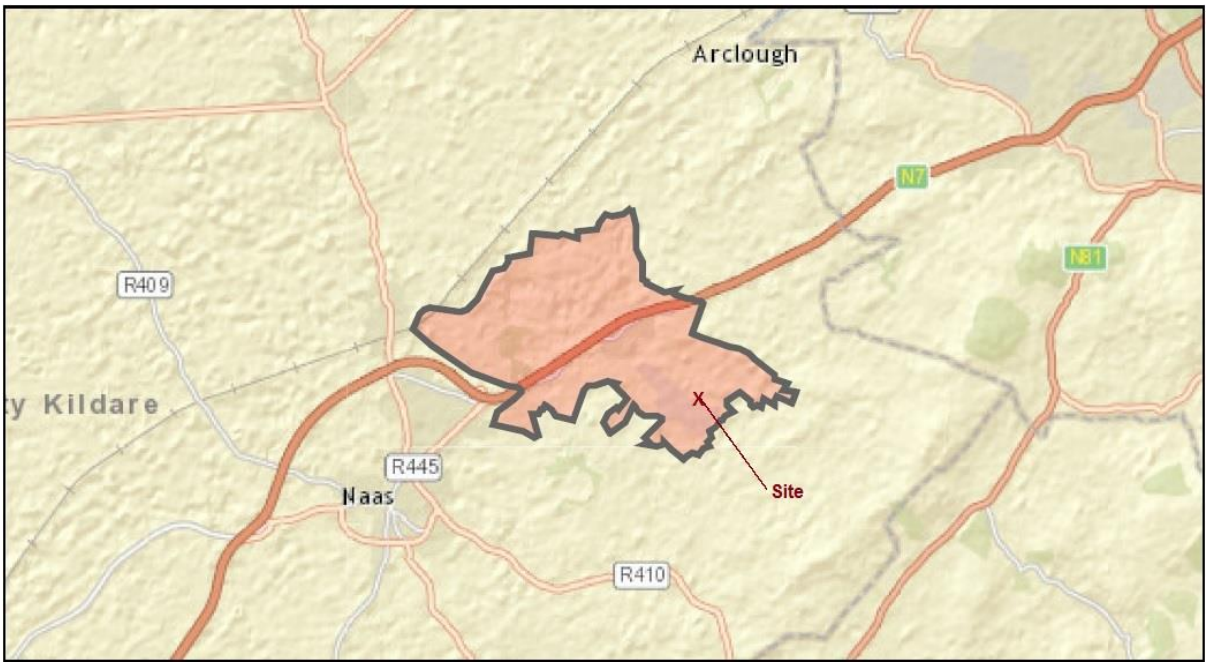

Figure 3.1.1. Electoral Division of Kill, showing Thornberry site (marked X), c. 2km southeast of Kill and c. 6.5km east of Naas . Redrawn from CSO Census 2011 SAPMAP Viewer.

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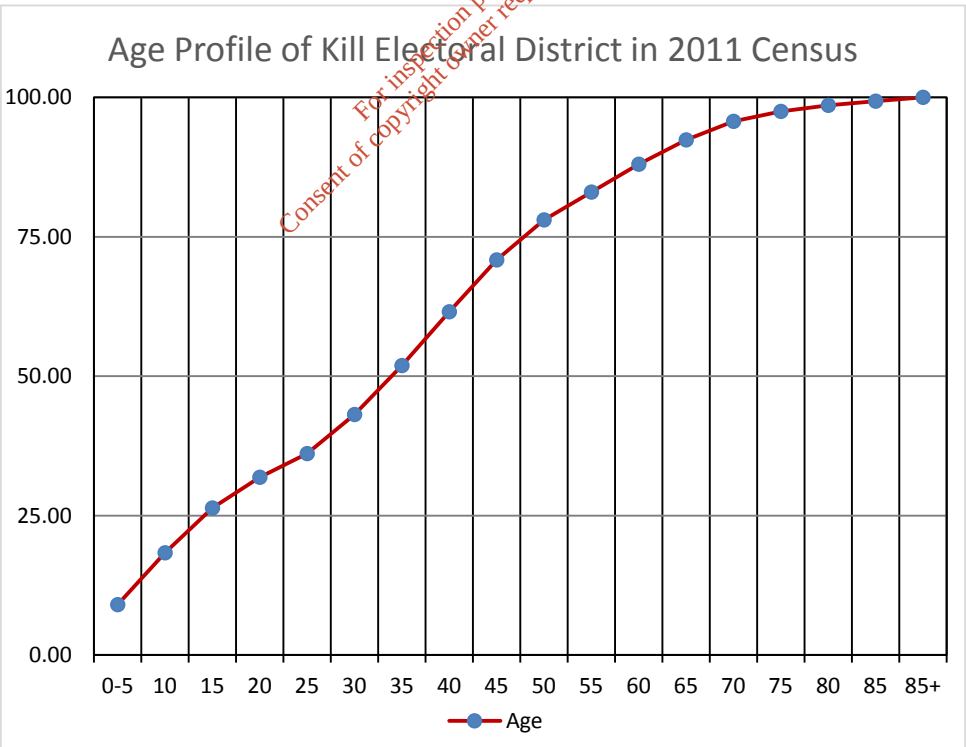

Figure 3.1.2. Age profile of population in the Kill Electoral Division in 2011. Note average age is approximately 31.5 years. The Census 2011 data was sourced from the CSO.

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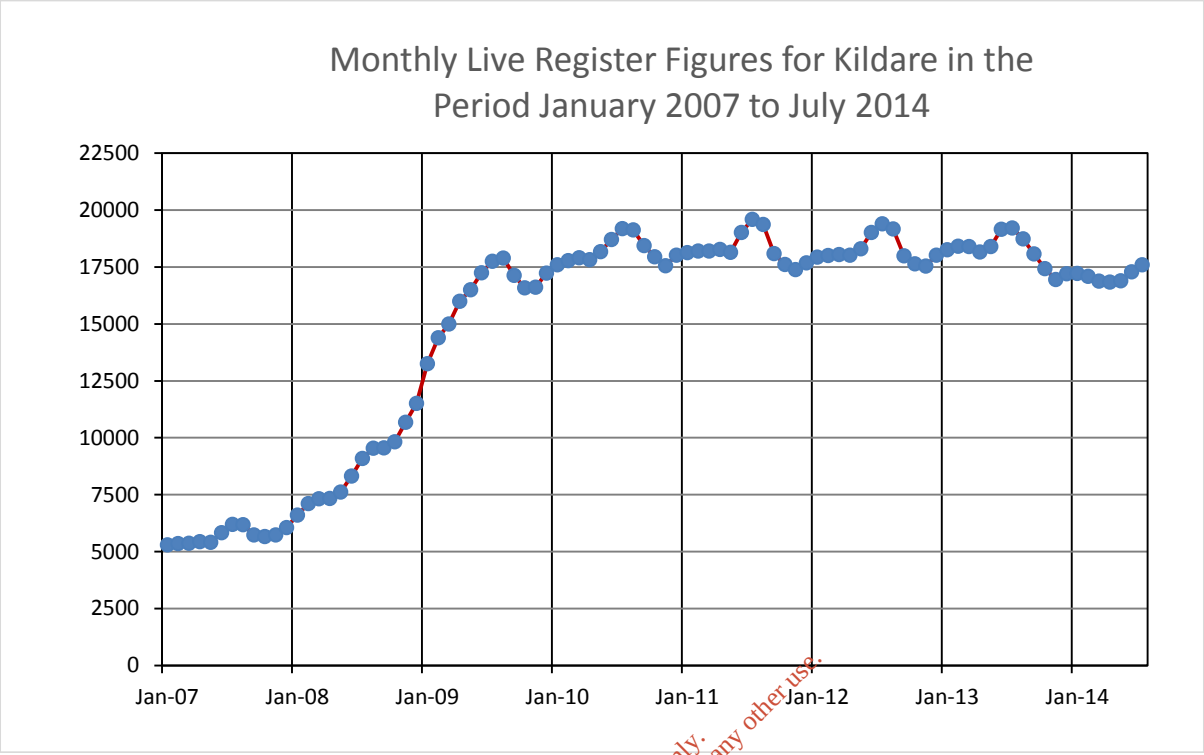

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Figure 3.1.3. Live Register figures for Kildare in the period from January 2007 to July 2014. Data from CSO Statbank Database (2014).

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3.2 FLORA AND FAUNA

3.2.1 INTRODUCTION AND METHODOLOGY

The purpose of this section is to describe and assess the ecological effects of the development and to comment on the mitigation measures that have or will be undertaken.

It is based on a site visit in June 2014 and a study of existing aerial photographs. The field investigation followed the methodology of the Heritage Council guidelines (Smith et al 2011) though mapping was not digitised in the field. Habitats are classified as in Fossitt (2000). Signs of mammals and birds were searched for at all times.

3.2.2 EXISTING ENVIRONMENT

3.2.2.1 HABITATS AND VEGETATION

The site is an extensive sand and gravel quarry in glacial material south-east of Kill. It was dug at various times in the past so that there are 'sub-quarries', separate extracted sections accessed off a central roadway. The most recent (or driest) of these create a habitat of exposed sand, gravel or till (ED1in Fossitt 2000) whereas the areas which are now accepting inert waste are spoil & bare ground (ED2). Some little-used land is more vegetated and either recolonising bare ground (ED3) or dry meadows & grassy verges (GS2). This includes a section at the NW end, previously used for the disposal of sediment from washings. A south-facing bank of scrub (WS3) follows much of the southern boundary and it is crowned by an overgrown hedgerow (WL1).

The following Figure 3.2.1 shows the habitats and vegetation relating to the site.

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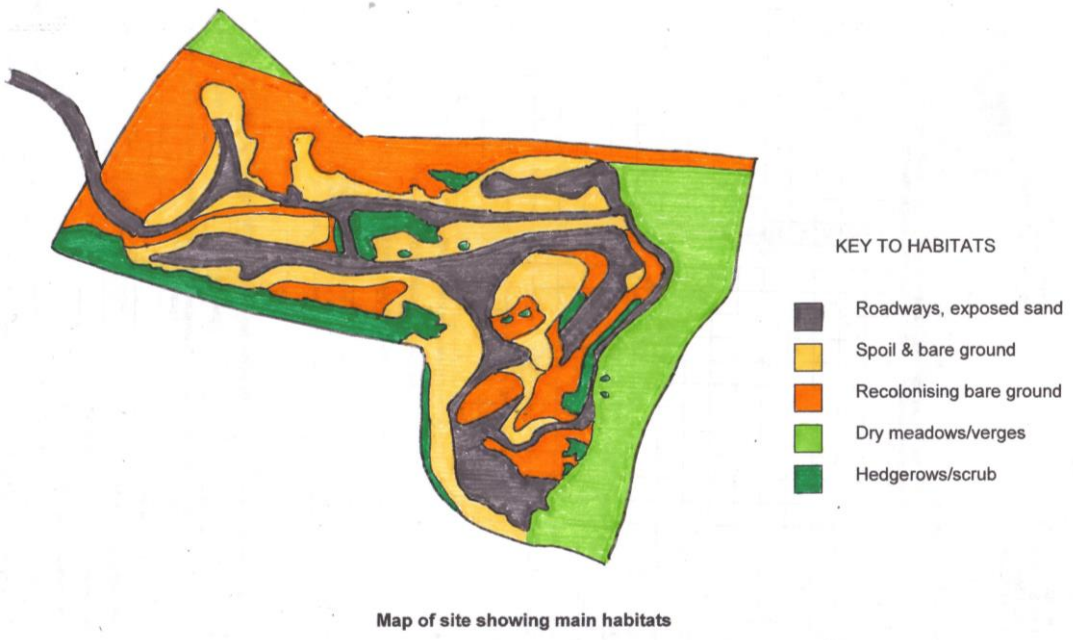

Figure 3.2.1 Habitats & Vegetation

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The barest areas are slopes and piles of gravel and these are often characterised by a growth of butterfly bush *Buddleja davidii*, beaked hawksbeard *Crepis vesicaria*, opium poppies *Papaver somniferum*, dyer's rocket *Reseda luteola* or hoary mustard *Hirschfeldia incana* with a variety of other ruderal (weedy) species. These include

Epilobium ciliatum	American willowherb
E.parviflorum	hoary willowherb
Mercurialis annua	annual mercury
Tripleurospermum inodorum	scentless mayweed
Brassica rapa	wild turnip
Sisymbrium officinale	hedge mustard
Papaver dubium	long-headed poppy
Arenaria serpyllifolia	sandwort
Cerastium glomeratum	sticky mousse-ear
Coronopus didymus	swine's cress
Centranthus ruber	wall valerian
Lactuca serriola	prickly lettuce
Conyza cf *multiflora*	hispid fleabane
Myosotis arvensis	field forget-me-not
Cymbalaria muralis	ivy-leaved toadflax
Cirsium vulgare	spear thistle

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Locally there are 'garden' or introduced species such as snapdragon *Antirrhinum majus*, canary grass *Phalaris canariensis*, melilot *Melilotus* sp, evening primrose *Oenothera* sp, marigold *Calendula officinalis*, caper spurge *Euphorbia lathyrus* and narrow-leaved ragwort *Senecio inaequidens*. Welted thistle *Carduus crispus* is noticeably associated with the western end and is partly off-site.

A cover of grass gradually becomes established on level surfaces, consisting of crested dogstail *Cynosurus cristatus* and red fescue *Festuca rubra* in the nutritionally-poor places but more generally of meadowgrass *Poa trivialis*, false oat *Arrhenatherum elatius*, Yorkshire fog *Holcus lanatus* and cocksfoot *Dactylis glomerata*. Broadleaved species often included are

Cirsium arvense	creeping thistle
Plantago lanceolata	ribwort plantain
Trifolium repens	white clover
T.pratense	red clover
Ranunculus repens	creeping buttercup
Senecio jacobaea	ragwort
Lotus corniculatus	birdsfoot trefoil
Medicago lupulina	black medick
Potentilla reptans	cinquefoil
Chamerion angustifolium	rose-bay
Vicia sativa	early vetch

Shrub species invade such ground naturally and there are thickets of willow *Salix cinerea*, elder *Sambucus nigra* and rose *Rosa canina* in various places as well as brambles and Japanese knotweed *Fallopia japonica*. Both the species and its hybrid with *F.sachalinesis*

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seem to occur. Gorse *Ulex europaeus* is widespread also and, with blackthorn *Prunus spinosa*, covers the southern boundary bank above the road to the adjoining Arthurstown landfill. Willows have recently been planted as a southward continuation of this belt on the edge of the higher ground that is currently accepting fill.

The hedge on the top of this slope consists of overgrown hawthorn *Crataegus monogyna*, elder *Sambucus nigra*, blackthorn *Prunus spinosa* and wild rose *Rosa canina*. Bittersweet *Solanum dulcamara* grows at its base but there are few woodland plants because of shading.

Several of the pits have dampness or ponds in their bases. The largest is just off-site at the western end where spike rush *Eleocharis palustris* implies semi-permanent water. Here it grows with

Veronica beccabunga	brooklime
Agrostis stolonifera	creeping bent
Juncus inflexus	hard rush
Carex remota	remote sedge

Two areas in the NW corner (the western off-site) have been used for the disposal of silt and with this fine material have a high water-retaining capacity. They support a number of plants associated with marshy or trampled ground such as field horsetail *Equisetum arvense*, toad rush *Juncus bufonius* and water speedwell *Veronica anagallis-aquatica*. A few other species are also present, e.g.

Hypericum tetrapterum	square-stemmed St John's wort
Rorippa nasturtium-aquaticum	watercress
Samolus valerandi	brookweed
Rumex crispus	curled dock
Veronica serpyllifolia	thyme-leaved speedwell
Marchantia polymorpha	common liverwort

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3.2.2.2 FAUNA

The site holds a large population of rabbits and evidence of their grazing and digging activities is ubiquitous. There were also signs of foxes but none of badgers though these could occasionally visit. Stoats would also be expected.

Bats are not likely to occur (except at the western end) as there is so little tree cover.

The birds seen included both open ground species such as meadow pipit, skylark, pied wagtail, sand martin and lapwing and those of treed or bushy surroundings. The latter were woodpigeon, stock dove, magpie, rook, blackbird, song thrush, robin, wren and goldfinch. There was a tiny sand martin colony (3 nests) at the NW end just off-site while a young lapwing was seen on the equivalent area within the site.

The vegetation is diverse enough to support a good range of insects, including solitary bees. The common blue is a likely butterfly as there are records in Nash et al (2012) for adjacent 10km squares. The more frequent species such as small tortoiseshell, small white and meadow brown were seen on site.

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3.2.2.3 EVALUATION

The overall site is relatively diverse, having typical habitats of sand quarries including some damp areas. Parts of the site have been disused for many years so are developing scrub and small trees. The species list is correspondingly varied with characteristic native species of light soils (cf Preston *et al* 2002) but also many introduced plants which are partly derived from the wasterecovery activities. The ragwort *Senecio inaequidens* is the least common of these, occurring so far in only a handful of places in the country (BSBI website). Such species have no heritage value but may be future invasive aliens. On this subject, the frequency of small clumps of Japanese knotweed suggests that this species could come to dominate the site in future years.

Three of the bird species are of interest (cf Balmer *et al* 2013). The lapwing and meadow pipit are red-listed by Colhoun & Cummins (2013) having declined by 50% in recent years while the sand martin is amber-listed and suffering a European decline.

3.2.3 DESIGNATIONS

There are two Natura 2000 sites located within 15km of the site, Poulaphuca Reservoir SPA (Site Code 004063) and the Red Bog cSAC (Site Code 000397). Both are many metres higher in altitude and there is no pathway by which impacts from Thornberry could be felt by their habitats or species.

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In addition there are four downstream sites in Dublin Bay; North Dublin Bay (0206) and South Dublin Bay (0210) are cSAC's while North Bull Island (4006) and South Dublin Bay (4024) are SPA's.

At national level, the Wildlife Act 1976 and the Wildlife (Amendment) Act 2000 are the principal statutory provisions for the protection of wildlife (both flora and fauna) and the control of activities which may impact adversely on the conservation of wildlife. Under the Wildlife (Amendment) Act 2000, Natural Heritage Areas (NHAs) are designated to conserve species and habitats of national importance and sites of geological interest. The designation of these sites is the responsibility of the National Parks and Wildlife Division of the Department of the Environment, Heritage and Local Government and is an ongoing process as boundaries are revised and adjusted and new sites added.

The nearest designated site to the Thornberry WRF is the pNHA (Site Code 001394) at Kilteel Wood c. 2km to the east, Other pNHA's within 15km of the site are;

Ballynafagh Bog pNHA (Site Code 000391); Ballynafagh Lake pNHA (Site Code 001387); Grand Canal pNHA (Site Code 002104); Mouds Bog pNHA (Site Code 000395); Liffey Valley Meander Belt pNHA (Site Code 000393); Poulaphouca Reservoir pNHA (Site Code 000731); Red Bog pNHA (Site Code 000397).

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3.2.4 IMPACT OF DEVELOPMENT

3.2.1.1 COUNCIL POLICY & POSSIBLE IMPACTS

The Kildare County Development Plan (2011-2017) contains policies and objectives concerning conservation. The following policy statements are considered most relevant with respect to the site at Thornberry.

Natural Heritage/Biodiversity Policies

Natural Heritage

NT 3: To promote the carrying out of basic habitat assessments to inform the design of new developments in order to ensure that proposals for development integrate the protection and enhancement of biodiversity and landscape features wherever possible, by minimising adverse impacts on existing habitats (whether designated or not), by including mitigation and/or compensation measures, as appropriate,

Designated Sites and Species

DS 4: To ensure an Appropriate Assessment in accordance with Article 6(3) and Article 6(4) of the Habitats Directive and in accordance with DoEHLG guidance, is carried out in respect of any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect on a Natura 2000 site, either individually or in combination with other plans or projects.

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DS 6: To ensure that development does not have a significant adverse impact on plant species, animals and birds listed in the Flora Protection Order, Wildlife Act 1976- 2000, those listed in Annex IV of the Habitats Directive, and those listed in Annex I of the Birds Directive.

Invasive Non-Native Species

IS 1: To promote best practice with respect to minimising the spread of invasive species in the carrying out of development.

IS 2: To support measures for the prevention and / or eradication of invasive species as appropriate within the county as opportunities and resources allow. Targeted invasive species control should be informed by the current distribution of that species, the degree of threat posed and the resources available to control and/or eradicate them.

The quarry site at Thornberry, which includes the application site, is not included in any area with an ecological designation (NHA, cSAC or SPA).

The site does not have a direct ecological connection with any of the Natura 2000 areas except for the Dublin Bay sites. Since no outflows are expected from the operation of the project and, if this was to occur, the dilution factor in river water and in Dublin Bay is so vast, no impacts on ecology or on Natura 2000 sites can be reasonably expected.

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Appropriate assessment was introduced by the EU Habitats Directive as a way of determining if a planned project is likely to have a significant effect on one of the Natura 2000 sites so far designated (i.e. the candidate SAC's and SPA's), or their conservation objectives.

Screening for Appropriate Assessment was carried out with respect to the licence application and a copy of this report was previously submitted to the EPA. The findings of the screening for Appropriate Assessment were that the activity, individually or in combination with other plans or projects is not likely to have a significant effect on the Natura 2000 network, or the conservation objectives of the sites. A Stage 2 Appropriate Assessment is therefore not required.

As noted the nearest designated site to the Thornberry WRF is the pNHA (Site Code 001394) at Kilteel Wood c. 2km to the east. There will no direct or indirect impact on it or any pNHA as a result of the continued operation of the WRF at Thornberry.

3.2.5 POTENTIAL IMPACTS

The impact of the continued recovery of inert waste in the quarry and its restoration to farmland is considerable in local terms as it will lead to the disappearance of most of the existing flora and fauna. The plants and animals that require open soils and disturbance to grow will diminish though the lapwing may persist on nearby arable farmland given the right conditions. On the other hand the development of scrub and on the edges of the site will tend to diversify the larger fauna such as birds and mammals unless this becomes dominated by Japanese knotweed. Therefore there will be gains as well as losses.

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Apart from the physical impacts there is little likelihood of sediment and/or chemical loss to surface waters. All run-off is contained on site because of the good drainage of the deposit and makes its way through groundwater to the Kill River 500m to the north. There is a tributary stream at the eastern edge of the site but a buffer zone of 60m occurs on this side (including a berm of topsoil).

Dust pollution, if any, will not cause ecological change in the surroundings as there is no great difference in pH between the substrate and the incoming fill.

3.2.6 MITIGATION MEASURES

Monitoring of groundwater and aerial emissions will be continued so that compliance with standards can be maintained.

Actions to ensure dust abatement include spraying of haul roads in wet weather and their upkeep and drainage to prevent ponding. In addition re-vegetation will be carried out on completed sections on an on-going basis.

Restoration will include the removal of all machinery and structures and the smoothing of the contours to facilitate the establishment of grassland and grazing animals.

Action will be taken to control the spread of Japanese knotweed (a statutory invasive alien). Most clumps will be left in situ and covered by fill. When this is reclaimed to grassland any persisting shoots can be mown for several years and killed in this way. More active measures

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of control will be pursued on marginal ground where shrubs/ trees have been planted or are developing. These will be carried out as early as possible before the clumps attain large size.

3.2.7 CONCLUSIONS

The impact of inert waste recovery on this site will be considerable in local terms but will not result in any loss of heritage values in the locality. The changes will be both negative (loss of open habitats) and positive (gain of woody species, control of Japanese knotweed).

3.2.8 REFERENCES

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3.3 SOIL & GEOLOGY

3.3.1 INTRODUCTION

All projects and developments that require an Environmental Impact Statement (EIS) *by virtue of their nature, size and location*, have the potential to have an impact on the environment. This section of the EIS has been compiled in order to establish both the regional and local geological setting of the proposed Waste Recovery Facility (WRF) with respect to the soil, subsoil and geological bedrock environment. Furthermore, this section also assess the potential impact, if any, of the WRF on this existing baseline geological environment.

The section was prepared following a desktop study, which included research of relevant maps and data on the Geological Survey of Ireland (GSI) online mapping website (GSI 2014), and on the Environmental Protection Agency (EPA) Envision geoportal website (EPA 2014). Additional documents that were researched comprised geological maps and bulletins published by the GSI (GSI 1994), prior EIS and Annual Environmental Reports (AER) for the adjoining Arthurstown Landfill, a previous hydrogeological report for the Thornberry Quarry (Cullen 1985), the Geology of Ireland monograph edited by Holland & Sanders (2009), as well as other miscellaneous publications. The available information is considered sufficient to adequately characterise the geological environment of the site and its environs.

The potential impact on the geological environment resulting from the proposed development is assessed and possible mitigation measures proposed to reduce any significant impacts.

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3.3.2 STUDY METHOD

No fieldwork other than a site walkover was undertaken as part of this geological assessment. The desktop study was undertaken to compile, review and interpret available information, data and literature pertaining to the natural environment of the site, its immediate environs and regional setting. The desktop study included the following:

1. Examination of physiographic and other maps, and aerial photography (e.g., Google Images (Google 2014), and EPA Ortho Photos 1995-2005: (EPA 2014));
2. Examination of the GSI datasets and maps pertaining to geological bedrock, soil and subsoil maps (GSI 2014);
3. Examination of EPA soil and subsoil maps (EPA 2014);
4. Observations made during the site walkover.

In the preparation of this geological assessment, all available regional and site specific information was compiled, assessed and interpreted. The geological maps and literature provide the regional geological context of the site, whilst prior Planning and Environmental Reports provide site-specific information. The geological assessment of the site is considered sufficiently detailed to adequately characterise the geological setting of the site. This section was prepared with consideration to the guidelines and recommendations set out in Guidelines on Information to be contained in Environmental Impact Statements (EPA 2002), and the

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Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements - A Guide, published by the Institute of Geologists of Ireland (IGI 2013).

3.3.3 TOPOGRAPHY

The site is located within the Townland of Thornberry c. 2km southeast of Kill, in a predominantly rural area of northeast County Kildare, on the east side of a local road designated here as L2019 (Refer to Figure A1.0). The L2019 runs from Rathcoole c. 12.5km in a southwesterly direction to Beggars End crossroads, and follows the southwesterly oriented topographic contours, which parallel the orientation of the leading edge of the Eastern Uplands and the Wicklow Mountains. The site lies in an area characterised as rural in nature, but which is peripheral to the urban area of Kill and Naas, and in addition to agricultural, exhibits land uses such as extractive, waste recovery, landfill, industrial, and single dwelling residential.

The lands have a history of sand and gravel working. The sand and gravel workings at the Thornberry site were developed on Quaternary glacial moraine deposits, initially quarrying the long, narrow, steep-sided topographic ridge of a moraine occurring along the southern boundary of the property. Subsequently, the resource was worked northwards, resulting in the current L-shaped quarry workings. The site of the quarry and WRF comprises c. 10ha of a leasehold of 11.4ha, being c. 700m in length, c. 100m wide, and c. 300m wide at the base of the L-shape.

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Both the soils and bedrock geology have an important role in determining the environmental characteristics of an area. The underlying bedrock has a major influence on the landform that develops, and the constituent rocks provide the parent material from which the soils are derived. The natural characteristics of the rock help determine the nature of the derived soil, as well as the rate at which it forms, whilst the soil strongly affects both the natural vegetation that emerges, and the type of agriculture that can be sustained.

The topography of the area is a reflection of the underlying geology, which is described in the succeeding subsections. The site is at an elevation of c. 130-150m AOD in an area identified as the Eastern Transition by Kildare County Council (2011), and is dominated by calcareous greywacke siltstones and shales of the Carrighill Formation. The landscape constitutes a transition from lowlands developed on limestones to the west, to the foothills of the Wicklow Mountains developed on more indurated Lower Palaeozoic siliceous metasediments to the east. Thornberry sits near the headwaters of the Kill River, which flows off the uplands to the lowlands in a roughly west northwest direction. The waters of the Kill River ultimately drain into the Liffey, c. 1km south of Straffan village.

The wider landscape around Thornberry is generally of undulating topography and rolling low hills (elev. c. 100-200m AOD), with views of the lowlands (c. 70-80m AOD) to the west, and the uplands and Wicklow Mountains to the east. The landscape is characterised by mature hedgerows with many hedgerow trees, whilst the land is predominantly in pasture, used mostly for stock rearing, and some mixed tillage. Areas of coniferous forestry, some new deciduous forestry and some successional woodland also occur in this landscape area. Mature hedgerows with many trees tend to create enclosed rural road corridors with restricted views. The workings are effectively screened from views on local road L2019 by intervening mature

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and heavily wooded hedgerows, but are open to distant views from elevated ground to the east.

The Thornberry quarry was developed on a meandering, glacial ridge known as a moraine, in order to extract the constituent sand and gravel. The moraine forms an irregular ribbon of sand and gravel that was deposited at the terminus of the ice sheet as it stalled against the foothills of the Wicklow Mountains in the waning stages of the Late Midlandian Ice Age c. 18,000 years before present (BP). The topography of the site and immediate surroundings to the south and east, incorporating Arthurstown, is disturbed or modified due to quarrying, landfill, waste recovery and land restoration operations. This differs from the topography of the wider area within c. 1km, particularly to the north, where the landform is relatively flat to undulating, and seems to reflect the nature of the Eastern Transition area as a 'bench' within a regional scale "ridge and bench" landform. The unrestored sections of the quarry have a typically irregular, but concave topographic profile reflecting the quarry void (min. elev. ≥ 135m AOD), with stockpiles of aggregate products and intact materials. The restored section of the quarry (i.e., Phase 1 or P1) is being restored back to a convex or domed profile (max. elev. ≤ 150m AOD). The existing topographical contours are shown in EIS Figure B 2.1 Rev A - Site Plan.

3.3.4 SOIL

Soil is an essential natural resource and is intrinsically valuable to the environment, and all life within it. Soil encompasses topsoil and subsoil, which together provide for several important functions, including:

- Contributes to the hydrological cycle in the filtration/recharge, storage and discharge of rainwater;
- Supports all terrestrial ecology, including all flora and fauna;
- Protects and enhances biodiversity;

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Topsoil and subsoil may derive from parent geological material and organic matter under the influence of numerous processes, including weathering and erosion. In terms of subsoil, the profound influence of glaciation in Ireland is seen in the glacial till, which blankets much of the underlying rocks.

Visual assessment of the soils within the quarry site suggests that the soils are shallow, naturally well drained, with no indication of waterlogged soils. Unconsolidated material, that has been stripped-off the quarry site has been stockpiled for use in capping during restoration.

3.3.4.1 TOPSOIL

The 2nd Edition of the General Soil Map of Ireland with accompanying Soil Survey Bulletin No. 36 was published by Gardiner & Radford (1980). The map has a publication scale of 1:575,000, which results in generalised features that provide inadequate geographic reference to allow useful spatial data on the scale of the property. The soil map of Co. Kildare with accompanying Soil Survey Bulletin No. 22 was published by Conry et al. (1970), and was similarly compiled by surveying and mapping using direct visual inspection, profile pits and laboratory analysis. The soil map was developed on a nominal working scale of 1:10,560,

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condensed down to a publication scale of 1:126,720, and maps the distribution of soil types based on the classification of the Great Soil Groups of Ireland.

Teagasc and the EPA initiated a nationwide Soil and Subsoil Mapping Project, the final report for which was published by Fealy & Green (2009). The soil map of every county in Ireland were compiled by a remote sensing and GIS-based methodology. Soil type was predicted using key soil factors (e.g., vegetation) and geology (e.g., parent material) and topography (e.g., slope), and using a qualitative, expert-based classification system. In order to map all the soil variants in a single national soil map, the classification system of soil types had to be simplified relative to previous soil surveys, but retain a close relationship to the Great Soil Groups in Ireland. Although the maps have a maximum online scale of 1:2,000 (See EPA 2014), the nominal working scale of 1:100,000-150,000 was used during map preparation. Although the Teagasc/EPA Soil Maps are categorically simplified, they are cartographically detailed, and thus offer superior spatial definition. The distribution of the soil types at Thornberry is assessed by reference to Teagasc/EPA Soil/Subsoil Maps, with supplementary interpretation based on the Soil Map of Kildare (Conry et al. 1970).

Extracts from the three soil maps of the area including the site are shown in Figure 3.3.1 Soil Map of Thornberry Area from Gardiner & Radford (1980), Figure 3.3.2 Soil Map of Thornberry Area from Conry et al. (1970), and Figure 3.3.3 EPA/Teagasc Soil Map of Thornberry Area.

The general soil map of Ireland by Gardiner & Radford (1980) shows that the predominant topsoil or soil type across the application area is Grey Brown Podzolics (30), derived mainly from limestone morainic gravels and sands, and has associated soils of Brown Earths (20), Gleys (5) and Basin Peat (5). The Grey Brown Podzolics occur as a lobe shaped area largely enveloped in Gleys, which form an arc across the lowlands of west and north County Dublin. The Uplands immediately to the east of the area are dominated by Brown Podzolics (8 and 9) and Grey Brown Podzolics (10). The scale of the map results in generalised or lost features, and thus provides inadequate geographic reference.

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The soil map of County Kildare by Conry et al. (1970) show a similar pattern of a lobe of Athy Complex (117) extending south from the N7 to include Arthurstown and Thornberry, and enveloped largely in Straffan Complex (133) with subordinate Elton Series Grey Brown Podzolics (59). Kennycourt Series Grey Brown Podzolics (122) dominate the uplands immediately to the east. Conry et al. (1970) report that the parent material of the Athy Complex consist of calcareous, fluvioglacial coarse gravels and sands, which are composed mainly of limestone with a small proportion of sandstone, schist, shale and conglomerate. These authors also report four major soils are recognized in the Athy Complex, but that most consist of Grey Brown Podzolics. This has developed as moderately deep, well-drained, friable, gravelly sandy loams on the flattish to undulating topography, and on the lower slopes of the glacial features (e.g., hummocks and eskers). Subordinate Brown Earths have developed on the crests of such glacial features, where the soils are very shallow, excessively drained, and of stony or gravelly coarse sandy loam texture. Notably, the Straffan Complex is principally composed of poorly drained Gley soils. Thus, both maps indicate that the soil type occurring on the area of the Thornberry site is Grey Brown Podzolics, or possibly Brown Earths, derived mainly from morainic, fluvioglacial limestone sands and gravels.

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The soil types occurring at the site and in the wider area were also assessed by reference to the Teagasc/EPA soil map (EPA 2014), which indicates very different soil types and spatial relationships. The dominant soil occurring at the Thornberry quarry site according to the Teagasc/EPA soil map are identified as:

1. BminSW - Rendzinas / lithosols derived mainly from calcareous parent material
2. BminSP – Shallow Surface water and Ground water Gleys derived mainly from calcareous parent material

Other soil types in the wider area are:

1. BminDW – Grey Brown Podzolics / Brown Earths derived mainly from calcareous parent material
2. BminPD – Surface Water / Groundwater Gleys derived mainly from calcareous parent material
3. AminPD - Surface Water / Groundwater Gleys derived mainly from non-calcareous parent material
4. AminDW – Acid Brown Earth / Brown Podzolics derived mainly from non-calcareous parent materials
5. AminSW – Lithosols / Regosols derived mainly from non-calcareous parent material
6. AlluvMIN - Mineral Alluvium derived from modern riverine systems
7. Made – Man-Made Ground reflecting urban fabric and industrial land

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Grey Brown Podzolics are usually derived from a calcareous parent material, which counteracts the effects of leaching. These contrast with Podzols, which are heavily eluviated by heavy rainfall leaching through the organic layer in a process known as podzolisation. Rendzinas are shallow soils derived from calcareous parent material, whilst Lithosols are predominantly shallow soils derived from calcareous rocks or gravels with/without peaty surface horizons, and tend to be stony mineral soils.

It is considered that the Rendzinas / Lithosols identified in the Teasgasc/EPA maps correspond to the Grey Brown Podzolics of Athy Complex as indicated by Conry et al. (1970), consistent with the Grey Brown Podzolics derived mainly from limestone morainic gravels and sands indicated by Gardiner & Radford (1980). In that Conry et al. (1970) determined soil type at a finer working scale, and by mapping using direct visual inspection, profile pits and laboratory analysis, it is considered that the identification of Grey Brown Podzolics of Athy Complex as the dominant soil type on site prior to quarrying operations is indicated. These soils developed on fluvioglacial sand and gravel derived from nearby Carboniferous limestones. Soils exhibiting characteristics of, or transitional with, Rendzinas and Lithosols, and which could be identified using remote sensing methods as Rendzinas/ Lithosols, might be expected where shallow soils have developed on calcareous gravels and sands.

The quarry resource has been extensively worked and the quarry void is in the process of being backfilled with imported soil and stone, capped with topsoil, as per the phased

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restoration scheme. Most of the original topsoil has been stockpiled together with imported topsoil for the purpose of restoring previous sections of the site.

3.3.4.2 SUBSOIL

The subsoil types occurring at the site and in the wider area were determined by reference to the EPA subsoil map (EPA 2014). The dominant subsoil types are identified as:

1. GLs – Limestone sands and gravels (Carboniferous)
2. TLs – Limestone till (Carboniferous)
3. TLPSsS - Sandstone and shale till (Lower Palaeozoic)

Other minor suboils types in the wider area are:

4. A – Alluvium (undifferentiated)
5. Rck – Bedrock at surface
6. Made – Man Made Ground
7. L – Lake sediments (undifferentiated)

The subsoil in the quarry site is identified as fluvioglacial sands and gravels derived from Carboniferous limestone (i.e., GLs) that comprised morainic deposits that extended across the Thornberry, Arthurstown, Upper Hartwell and Lower Hartwell Townlands. The dominant subsoil types in the wider area include till derived from Carboniferous limestone (i.e., TLs) in the lowlands to the west, and till derived from Lower Palaeozoic sandstone and shale (i.e., TLPSsS) in the uplands to the east. The subsoil map of the area including the site is shown in Figure 3.3.4 Subsoil Map of Thornberry Area.

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The last Ice Age, known as the Late Midlandian, peaked at approximately 20-25,000 years before present (BP), with total deglaciation of Ireland around 13,000 years BP. Soils would have begun to develop after deglaciation, around the beginning of Holocene epoch at 12,000 years BP. Thus, the origin of the subsoil is associated with deposition related to ice movement during glaciation, particularly during the glacial maxima, and later glacial retreat and melting during deglaciation. Ice sheets grind and pulverise the underlying bedrock, reducing it to fragments ranging from boulders to clay particles. Sediments and features formed during the glaciation are commonly treated under the general term Quaternary Geology.

The area of northeastern County Kildare was overlain by a thick ice sheet at the glacial maxima, which moved in a general south-easterly direction. The powerful erosive force of the ice sheet is considered to have sculpted the landscape in the region, as evidenced by many preserved glacial features. Glacial till represents the most common and areally extensive glacial deposits, and is comprised of poorly sorted boulder clay dumped in the zone of wastage beneath the glacier or ice sheet, which can be associated with one or more of the advancing ice sheets prior to the final Midlandian retreat c. 20-18,000 years BP. As ice sheets melt, the meltwaters sort and deposit fluvioglacial sands and gravels in the form of characteristic glacial features, such as eskers and moraines.

The Thornberry quarry was developed on a glacial moraine ridge, in order to extract the constituent sand and gravel. The moraine forms an irregular ribbon of sand and gravel that

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was deposited at the terminus of the ice sheet as it stalled against the foothills of the Wicklow Mountains in the waning stages of the Late Midlandian Ice Age c. 18-20,000 years BP. Such moraines form transverse ridges, marking where the ice front halted temporarily during the retreat of the ice sheet, and are composed of unconsolidated, commonly well sorted and stratified debris, consisting largely of sand and gravel.

Observations made as part of a visual assessment during a site visit indicate that the quarry pit excavations extend to a depth of only c. 5-6m, and thus represent a relatively thin resource of sand and gravel. The deposit consists of fine sand and gravel, where the latter predominantly occurs in the pebble and cobble size ranges, and exhibits pronounced stratification with some lateral pinching of beds. There is a notable increase in thickness of beds of fine sand to c. 3-4m at the top of the sequence in the northwest corner of the site.

The sand and gravel deposit has been largely extracted, leaving a thick sequence of boulder clay up to 15m thick at the base of the quarry pit. Importantly, Cullen (1985) notes that the black boulder clay acts as an impermeable layer (i.e., aquaclude) beneath the quarry floor, and effectively isolates the groundwater in the upper silt, sand and gravels from the groundwater below. Bedrock was not encountered at the base of the excavations, other than by drilling, which is described as “Slate Bedrock”, and which most likely corresponds to greywacke of the Carrighill Formation (See Section 3.3.2 Bedrock Geology). The following generalised stratigraphy of the overburden within the quarry site, as shown in Figure 3.3.5, was reported by Cullen (1985):

1. Sand and Gravel: 3.6 - 7.6m
2. Sand: 0.5 - 1.2m
3. Sand and Gravel/ Brown Boulder clay: 0.5 - 2.5m
4. Black Boulder Clay: 4.0 - 6.6m
5. Gravel/Silt and Sand: 0 - 4.4m
6. Brown Boulder Clay: 2.3 - 5.1m

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The GSI Groundwater Protection Scheme maps for Co. Kildare and the borehole database held by the GSI indicate depths to bedrock of 25.3m at the landowners residence in Thornberry, 15.5m at Porterstown c. 1km northeast of the site, 23m at Blackdown c. 1.5km east northeast of the site, 3.7m at Arthurstown c. 1.5km southwest of site, 3.1m at Rathmore c. 2km south of the site, 7.8m at Furryhill c. 2km southeast of site and 9.9m at Furryhill c. 2km east of site. Thus, the depth to bedrock varies from 3.1m south of the site to 25.3m adjacent to the site, and with relatively deep overburden extending to the east northeast at Blackdown.

3.3.5 BEDROCK GEOLOGY

This subsection is based largely on GSI (1994), but without explicit individual references in the text. The 1:100,000 scale maps of the Geology of Kildare-Wicklow (Sheet 16) with accompanying geological report (GSI 1994) indicates that all of the units within c. 5km of the site are Lower Palaeozoic or Mississippian (or Lower Carboniferous) in age. These are shown in chronological order in Table 3.1 below.

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Table 3-1 Bedrock Units of the Thornberry Area

Bedrock Unit	Group or Succession	Epoch	Substage
Ballysteen Formation (BA)	Carboniferous Limestones	Mississippian	Courceyan
Feighcullen Formation (FE)	Carboniferous Limestones	Mississippian	Courceyan
Old Red Sandstone (ORS)	Terrigenous	Mississippian	Courceyan
Carrighill Formation (CZ)	Kilcullen Group	Silurian	Llandovery-Ludlow
Tipperkevin Formation (TK)	Kilcullen Group	Silurian	Llandovery-Ludlow
Glen Ding Formation (GD)	Kilcullen Group	Silurian	Llandovery-Ludlow

During the Ordovician and Silurian Periods (c. 490-415Ma), the Iapetus Ocean closed bringing Laurentia (including northwest Ireland) and Avalonia (including southwest Ireland) into collision and culminating in the Caledonian Orogeny c. 425-395Ma. During the Devonian Period (c. 417-354Ma) Ireland was part of the Laurasian super continent, also known as the Old Red Sandstone continent. The latter underwent extensive subaerial erosion, whilst laying in arid southern subtropical latitudes, giving rise to the characteristic red coloured, continental facies sandstones. During the early Carboniferous (c. 354-327Ma), a marine transgression advanced northward across the eroded and flat-lying continent (i.e., peneplain), and deposited a sequence of carbonate rocks that cover much of the Irish Midlands.

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The rocks of the wider Thornberry area belong to the Silurian Kilcullen Group, the Old Red Sandstone, and a subsequent Mississippian (formerly the Lower Carboniferous) Limestone Succession. The Kilcullen Group was deposited as a sequence of greywackes in the Leinster Basin off Avalonia, on the southern margin of the Iapetus Ocean, and have depositional ages of c. 440-410Ma. The Old Red Sandstone (ORS) reflects extensive subaerial erosion of the ORS Supercontinent during the Devonian and earliest Carboniferous (c. 350Ma). This is followed by a limestone succession of Courceyan age (c. 354-345Ma) laid down largely as a retrograding sequence due to the northward advancing marine transgression across the Laurasian continent.

The Kilcullen Group consists of a succession of greywackes and shales deposited primarily as turbidites, which fine upwards with increasing internal complexity of the turbidite beds. Turbidite beds form by the settling of suspended sediment that was entrained in subaqueous density currents that flow downslope into and spread out across deep marine basins. The succession is divided by the Athgarrett Fault with the Tipperkevin and Carrighill Formations (Fms.) to the west, and Glen Ding, Slate Quarries and Pollaphuca Fms. to the east. A set of regional fold axis parallel the fault on its western side, with folds overturned and upward-facing to the northwest so that the strata dip to the southeast. Crumpling into folds and movement along faults, whose axes assumed a SW-NE alignment, reflects collision and uplift during the Caledonian Orogeny.

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The bedrock of the Thornberry area including the site, is shown in Figure 3.3.6: Bedrock Geological Map of Thornberry Area. The base of the sequence in the wider Thornberry area is taken as the Glen Ding Fm. (GD). The Glen Ding Fm. lies east of the Athgarrett Fault, and dips and youngs to the northwest. This unit consists of distinctly chloritic and feldspathic greywackes. The top of the Glen Ding is a fault contact with the Tipperkevin Fm., and the age relations across the fault are unknown. The Tipperkevin Fm. (TK) consists of medium- to fine-grained greywackes and shales, where the base of the Tipperkevin is not observed.

The Carrighill Fm. (CZ) is the most westerly, the most extensively exposed, and considered the youngest unit of the Kilcullen Group. The Carrighill consists of greywacke, siltstones and shales, and is the finest-grained formation in the Kilcullen Group. The greywackes are distinctive in having a calcareous matrix, principally of Fe-rich dolomite, with a higher matrix to framework ratio than the other formations. The Carrighill Fm. underlies the entire application site, and is heavily folded along SW-NE oriented axes. The geology map (GSI 1994) and the GSI online mapping show a synclinal axis traversing near the centre of the Thornberry site, suggesting that the dip of the strata varies from to the southeast in west of the site, to flat-lying near the centre, and to the northwest in the east of the site.

The Carrighill Fm. is bounded to the west, and unconformably overlain by the Old Red Sandstone (ORS) of earliest Courceyan age. The ORS consists of reddish conglomerates, sandstones, siltstones and mudstones, with minor greenish equivalents. In the vicinity of Kill, the ORS comprises a sequence of yellow and red sandstones c. 10m thick, although the full thickness is inferred to be 108m.

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A northward advancing marine transgression covered most of the map area, and resulted in the deposition of shallow and then progressively deeper water marine sediments. The next youngest unit is the Feighcullen Fm. (FE), which is shown as conformably overlying the ORS in the Kill area consists mainly of clean, shallow water, limestones, including oolites, skeletal calcarenites and micrites with minor shale and sandstone. The Feighcullen Fm. is conformably overlain by the Ballysteen Fm. (BA) with a transitional contact. The lower part of the Ballysteen Fm. consists of well-bedded, relatively clean calcarenitic limestones, which grades up into finer grained more muddy limestones. The Ballysteen Fm. is conformably overlain by Waulsortian Mudbank Limestone west of the map area, as shown in Figure 3.3.6. Geological Bedrock Map of the Thornberry Area.

Bedrock was not encountered at the base of the quarry excavations within the application site, but bedrock described as “slate bedrock” was observed during drilling within the quarry site (Cullen 1985). Bedrock was not observed during the site visit, because of the complete lack of exposure on site.

Although no faults are identified as occurring in the site, several faults have been identified within 5km of the site according to the above geology map (GSI 1994) and the GSI online mapping (GSI 2014). The Athgarrett Fault of Caledonian trend lies c. 2.5km to the east, and is offset by a series of west northwest faults (possibly Variscan), one of which pass c. 500m north of the site, and is the locus of the Kill River. A second such fault passes c. 1.25km south of the site. A Caledonian SW-NE trending fault, and a near N trending fault occur c. 2.5km west, near Kill.

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The spatial distribution of aquifers in the vicinity of the site is shown in Figure 3.3.7: Aquifer Map of Thornberry area. Importantly, only the ORS, Feighcullen and Ballysteen Fms. are identified as a Locally Important Bedrock Aquifer (LI) which are moderately productive only in local zones, all of which lie >2km to the west of the site. The Tipperkevin Fm. is identified as a Poor Bedrock Aquifer (PI), which is generally unproductive, except in local zones. The Carrighill Fm., which underlies the site, and the Glen Ding Fm. are identified as Poor Bedrock Aquifer (Pu), which are generally unproductive. Because the Carrighill underlies the entire site and is a poor aquifer, the sensitivity of the geological and groundwater interest of the site is determined to be very low.

3.3.6 GEOLOGICAL HERITAGE

The Irish Geological Heritage (IGH) programme identifies and selects a complete range of sites that represent Ireland's geological heritage. The programme is operated by the Geological Survey of Ireland (GSI), and selected sites are proposed as County Geological Sites, for inclusion within the respective County Development Plan. County Geological Sites do not receive statutory protection afforded Natural Heritage Areas (NHA), but receive an effective protection from their inclusion in the planning system. The GSI may also propose to the National Parks and Wildlife Service (NPWS) that specific sites identified as important for conservation are designated as NHA's, and thus receive statutory protection.

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As part of its preparation for the County Development Plan (CPD), Kildare County Council commissioned an audit of the geological heritage of the county (Parkes & Sheehan-Clarke 2005). The audit recognises areas of conservation value, which include twenty one County Geological Sites. A search of the GSI Geological Heritage Database demonstrates that no County Geological Sites occur within the quarry and WRF site, although six such designated sites occur within c. 15km. The nearest site of geological interest is the Slate Quarries Site (i.e., Site Code KE004) near Blessington, which is c. 4km southeast of the Thornberry site. The next nearest site is the Glen Ding Dry Glacial Channel Site (i.e., Site Code KE006) c. 5.5km southeast of the site. The other four sites are: (3) Liffey Oxbow c. 9.5km to the north; (4) St. Patrick's Well 2 c. 10.5km to the north; (5) Liffey Valley c. 11.5km to the north; and (6) St. Patrick's Well 1 c. 13km to the west. The full listing of geological heritage sites within c. 15km is as follows:

1. Slate Quarries (Site Code: KE004; Theme: IGH 4)

Irish National Grid:	299454, 218435
Location:	County: Kildare
Site Description:	A series of quarries on the hillside
Geological Feature:	The townland of Slate Quarries in east Kildare, near Blessington is notable for its Slate Quarries.

2. Glen Ding (Site Code: KE006; Theme: IGH 7)

Irish National Grid:	296191, 215116
Location:	County: Kildare
Site Description:	A dry glacial channel

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Geological Feature:	This heavily wooded glacial spillway displays a pronounced curved channel running approximately north south along the R410 road for about 1.5km. The surrounding area is reported to have extensive deltaic deposits.

3. Liffey Oxbow (Site Code: KE013; Theme: IGH 14)

Irish National Grid:	295045, 230734
Location:	County: Kildare
Site Description:	Abandoned oxbow lake of a River Liffey meander
Geological Feature:	This site, situated 3km southwest of Celbridge displays both an existing oxbow lake as well as a remnant oxbow lake, which are within 300m of one another.

4. St. Patrick's Well 2 (Site Code: KE020; Theme: IGH 16)

Irish National Grid:	294258, 231613
Location:	County: Kildare
Site Description:	A warm spring
Geological Feature:	This site is located at the base of St. Patrick's Hill in Ardrass Lower, approximately 5 km southwest of Celbridge town. The spring is contained in a circular stone chamber, which is half covered with a large stone plinth.

5. Liffey Valley (Site Code: KE014; Theme: IGH 14)

Irish National Grid:	299546, 210193
Location:	County: Kildare
Site Description:	Floodplain and meander formations
Geological Feature:	Broad floodplains and large-scale meanders of the Liffey Valley east of Ballymore Eustace.

6. St. Patrick's Well 1 (Site Code: KE019; Theme: IGH 16)

Irish National Grid:	283002, 219163
Location:	County: Kildare
Site Description:	A warm spring
Geological Feature:	This warm spring 5km west of Naas is almost completely covered by a holy well chamber.

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3.3.7 ASSESSMENT OF IMPACTS

3.3.7.1 DIRECT IMPACTS

The nature of the WRF involves the importation and placement of inert soil and stone as backfill in the quarry void. The application site for the WRF occupies the existing worked-out quarry area, and as such will have no impact on virgin soils, sands and gravels, which have already been stripped, disturbed or extracted. As a result of backfilling using inert soils and stones, the WRF will continue to progress the reinstatement of the quarry back to land suitable for agriculture, and thus will have a positive impact.

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Consideration had been given to soil and overburden management. For the placement of subsoil and topsoil, the machinery will work from the haulage track or the exposed subsoil surface and away from the reinstated part of the site.

Soils will only be handled in dry weather conditions. Soils will not be placed when the moisture content is high, such as after heavy rainfall. Soils will not be moved in unusually dry and windy weather conditions. All temporary storage mounds will have slope angles not greater than 1:1.5 and will be re-vegetated as quickly as possible to avoid soil erosion by air and water. Further details with respect to the management of topsoil and overburden soils are outlined in EIS Section 2.4.3.1.

3.3.7.2 INDIRECT IMPACTS

The WRF will have no indirect impact on the local or regional geology, as placement of the inert soil and stone will not release contaminants onto the lands, whilst dust from the WRF will be tightly controlled (Refer to EIS Section 3.6).

3.3.7.3 'DO NOTHING' IMPACTS

The WRF recovers significant quantities of inert soil and stone through backfilling in the quarry void, which if discontinued, might be landfilled in contravention of the Waste Framework Directive 2008. Failure to recover soil and stone for the beneficial use of land improvement, specifically reinstatement of a quarry, could result in unnecessary exhaustion of landfill space. Thus, it is considered that the proposed continuation of the WRF will have a positive impact.

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3.3.7.4 INTERACTION WITH OTHER IMPACTS

The interaction of the quarry and WRF is seen as 'symbiotic' and positive, with no negative cumulative impacts on the geological environment identified.

3.3.8 MITIGATIONS & MONITORING

There is no bedrock exposed within the quarry or the site of the WRF, and as such no impact on bedrock geology as a result of the WRF is expected. The WRF is also not expected to have any significant negative impact on the surficial geology of the site or surrounding area, and thus no mitigation measures are proposed. Ultimately, after final land reclamation of the quarry site, with the land restored to agriculture, there will be no residual impact on the surrounding environment from the WRF.

3.3.9 REFERENCES

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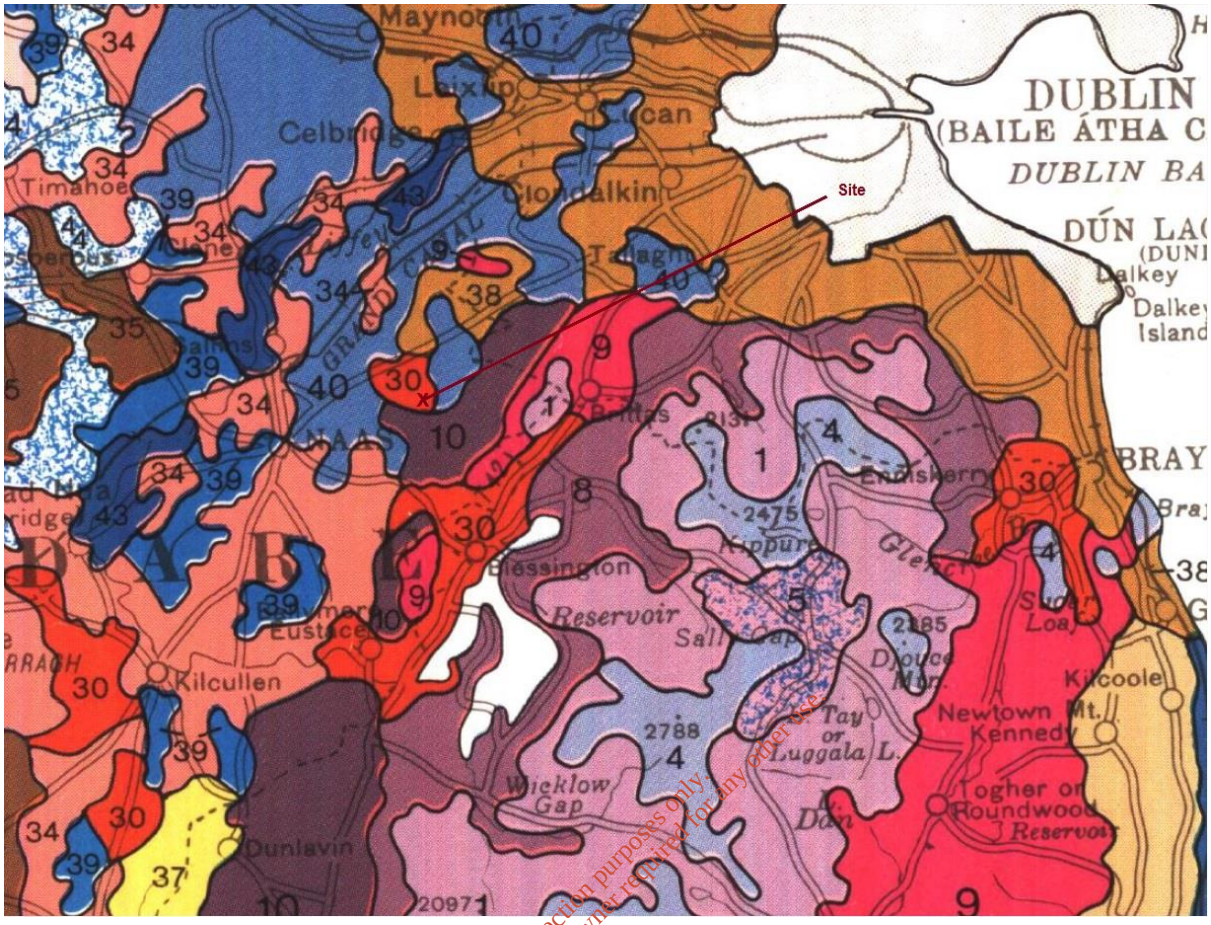

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Figure 3.3.1. Soil Map of Thornberry Area.

Redrawn extracts from Soil Map of Ireland by Gardiner & Radford (1980). Scale: Width of Field = c. 60km.

Soil Map Legend:

Red Orange (30): Grey Brown Podzolics derived from limestone morainic gravels and sands

Medium Blue (40): Gleys derived from Irish Sea till with limestone and shale

Dark Blue (43): Gleys derived from alluvium

Light Orange (34): Minimal Grey Brown Podzolics derived from Limestone glacial till

Light Brown (38): Grey Brown Podzolics derived from Irish Sea till with limestone and shale

Dark Purple (10): Grey Brown Podzolics derived mostly from limestone and shale

Red (9): Brown Podzolics derived from shales and mica schist

Medium Purple (8): Brown Podzolics derived mainly from granite

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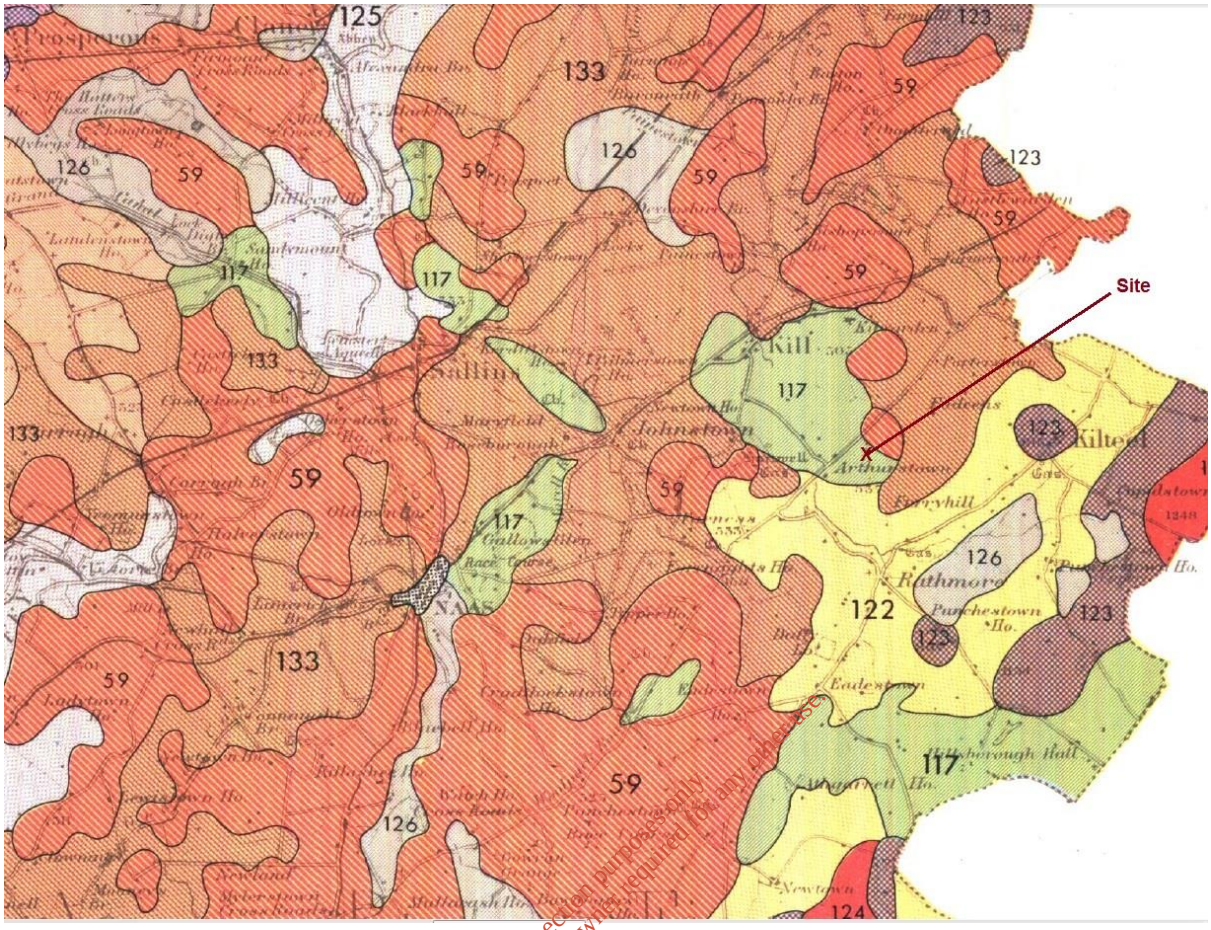

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Figure 3.3.2. Soil Map of Thornberry Area.

Redrawn extracts from Conry et al. (1970). Scale: Width of Field = c. 17.5km.

Soil Map Legend for major soil units in the vicinity of site:

59: Elton Series Grey Brown Podzolic (Red with Cross-Hatching)

117: Athy Series Complex (Mainly Mineral Soils) (Light Green)

122: Kennyscourt Series Grey Brown Podzolics (Yellow)

123: Hughstown Series Brown Earths (Mauve Brown with Cross-Hatching)

126: Dunnstown Series Gleys (Light Mauve)

133: Straffan Series Complex (Mainly Mineral Soils) (Orange)

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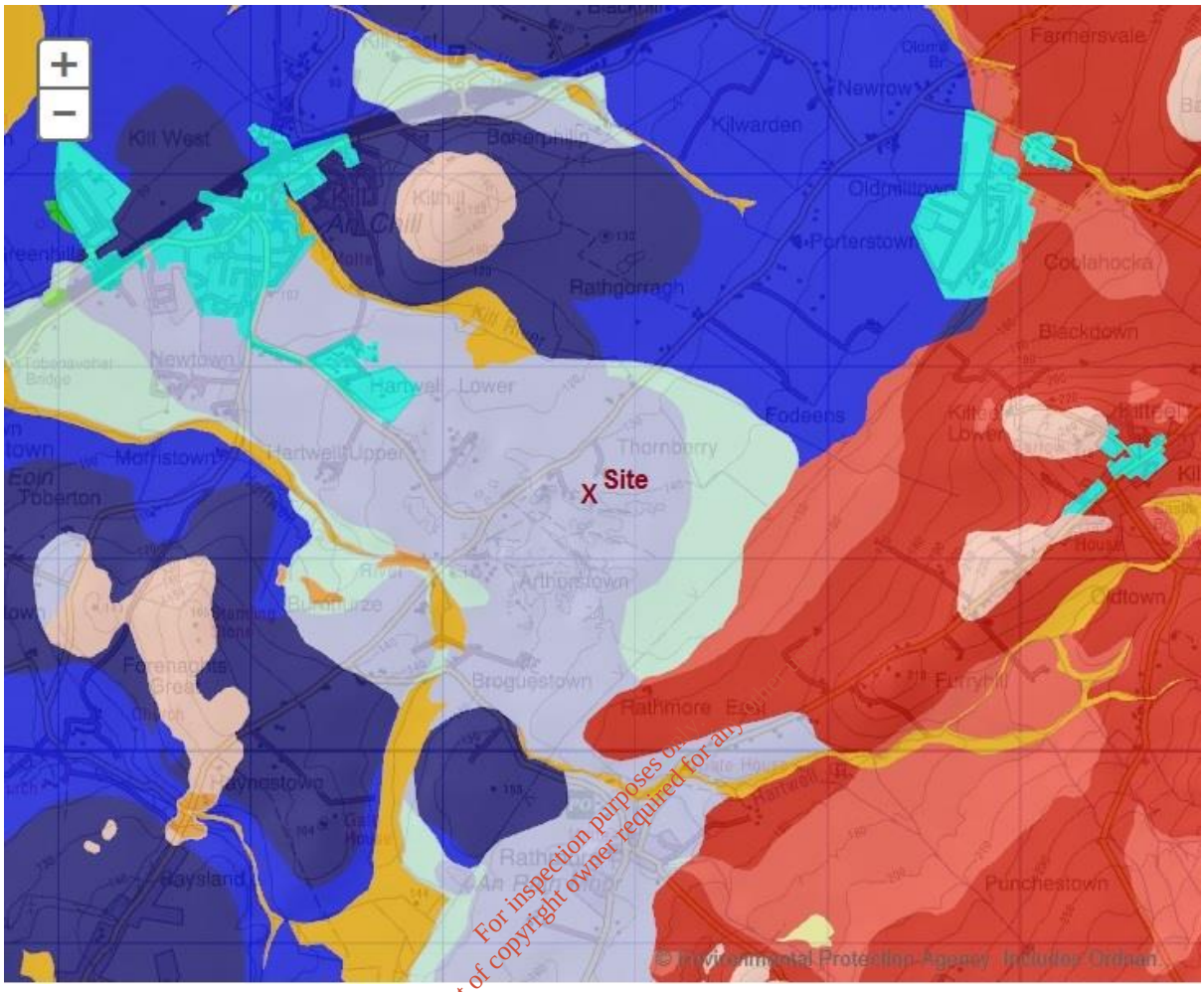

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Figure 3.3.3. Soil Map of Thornberry Area.

Redrawn extracts from EPA (2014). Scale: Grid Spacing = 1km.

Soil Map Legend:

Light Mauve: BminSW - Rendzinas / lithosols derived mainly from calcareous parent material

Dark Blue: BminDW – Grey Brown Podzolics / Brown Earths derived mainly from calcareous parent material

Medium Blue: BminPD – Surface Water / Groundwater Gleys derived mainly from calcareous parent material

Light Green: BminSP – Shallow Surface water and Ground water Gleys derived mainly from calcareous parent material

Light Red: AminPD - Surface Water / Groundwater Gleys derived mainly from non-calcareous parent material

Dark Red: AminDW – Acid Brown Earth / Brown Podzolics derived mainly from non-calcareous parent materials

Pink: AminSW – Lithosols / Regosols derived mainly from non-calcareous parent material

Orange: AlluvMIN - Mineral Alluvium

Turquoise: Made – Man Made Ground

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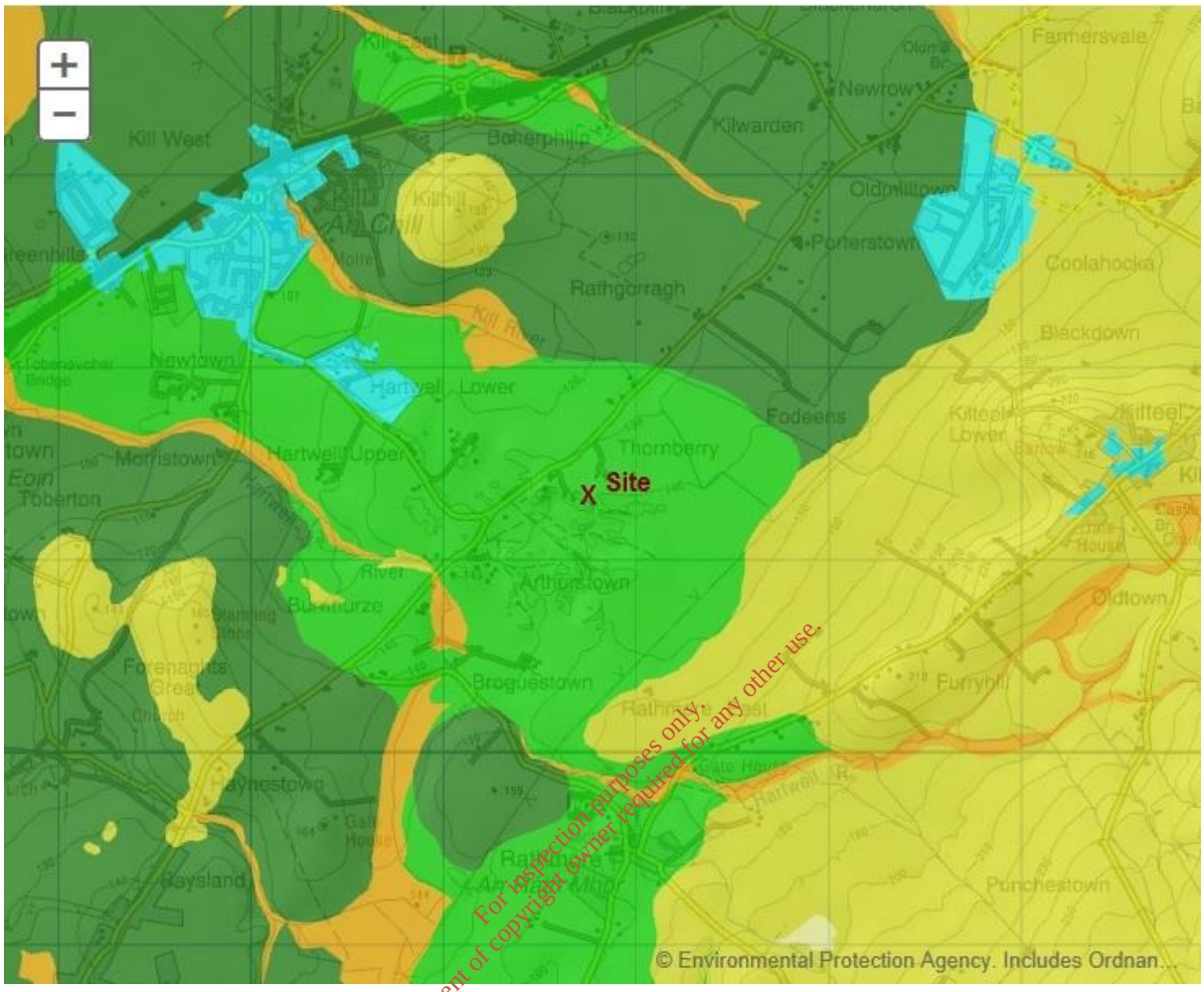

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Figure 3.3.4. Subsoil Map of Thornberry Area.

Redrawn extracts from EPA (2014). Scale: Grid Spacing = 1km.

Subsoil Map Legend:

Medium Green: GLs – Limestone sands and gravels (Carboniferous)

Dark Green: TLs – Limestone till (Carboniferous)

Light Brown: TLPSsS - Sandstone and shale till (Lower Palaeozoic)

Orange: A – Alluvium (undifferentiated)

Light Beige: Rck – Bedrock at surface

Turquoise: Made – Man Made Ground

Pink: L – Lake Sediments (Undifferentiated)

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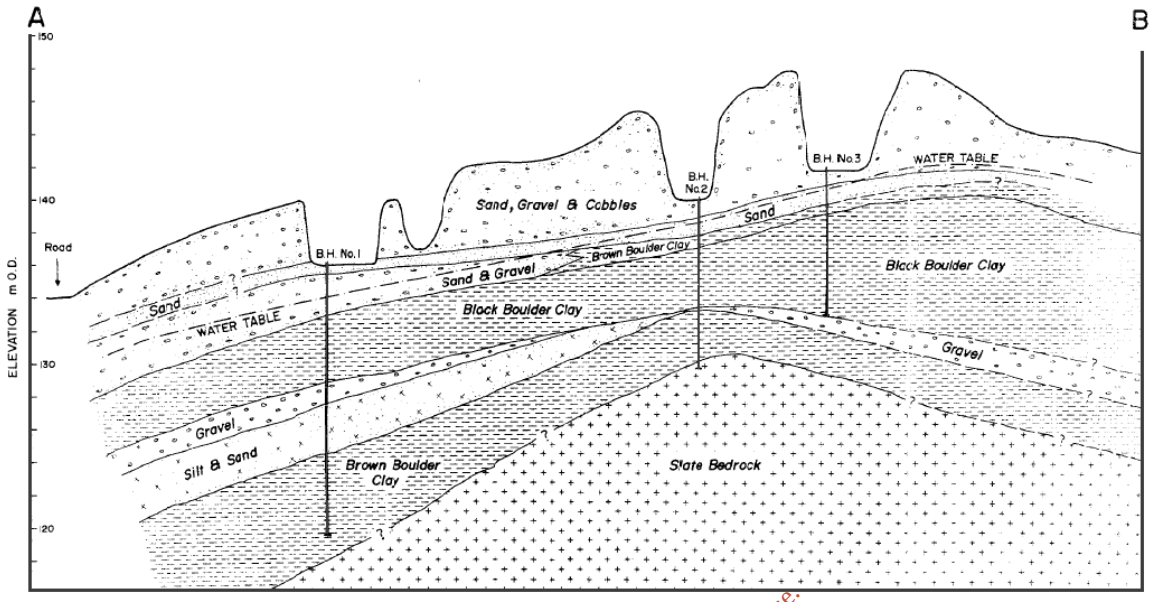

Figure 3.3.5. Section of the Thornberry Sand & Gravel Deposit.

Cross-section through the surficial deposits at Thornberry site, showing a simplified stratification between sand and gravel at surface, underlain principally by boulder clay overlying slate bedrock. Extract from Cullen (1985).

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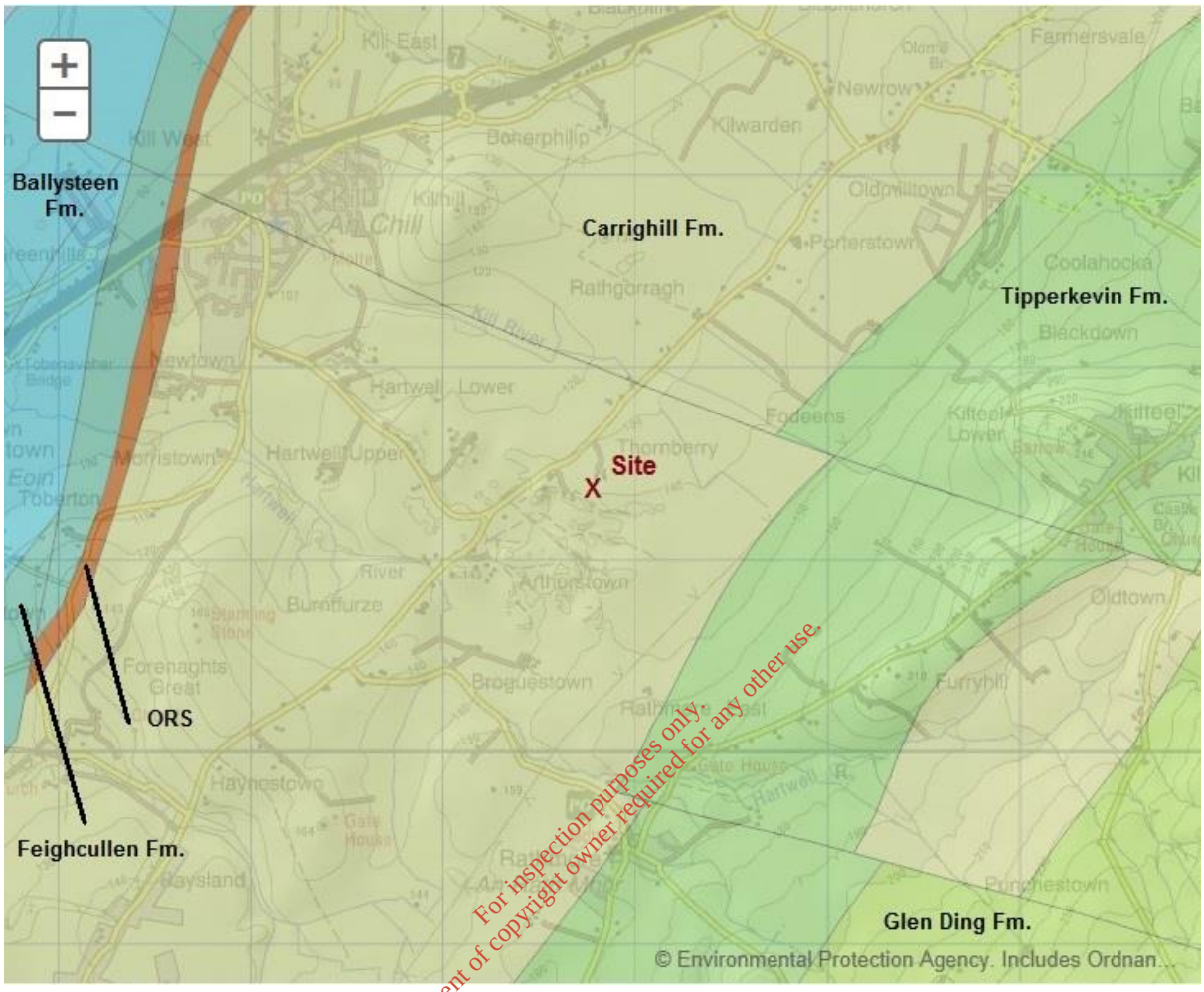

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Figure 3.3.6. Geological Bedrock Map of the Thornberry Area.

Redrawn extracts from EPA (2014). Scale: Grid Spacing = 1km (Width of Field = c. 6km).

Bedrock units in the wider area are:

Light Blue: Ballysteen Formation – fossilferous dark-grey muddy limestone

Grey Blue: Feighcullen Formation – skeletal, oolithic and micritic limestone

Red: Old Red Sandstone – Red conglomerate, sandstone and mudstone

Light Brown: Carrighill Formation – Calcareous greywacke siltstone and shale

Green: Tipperkevin Formation - Greywacke and shale

Light Green: Glen Ding Formation – Chloritic, feldspathic greywacke

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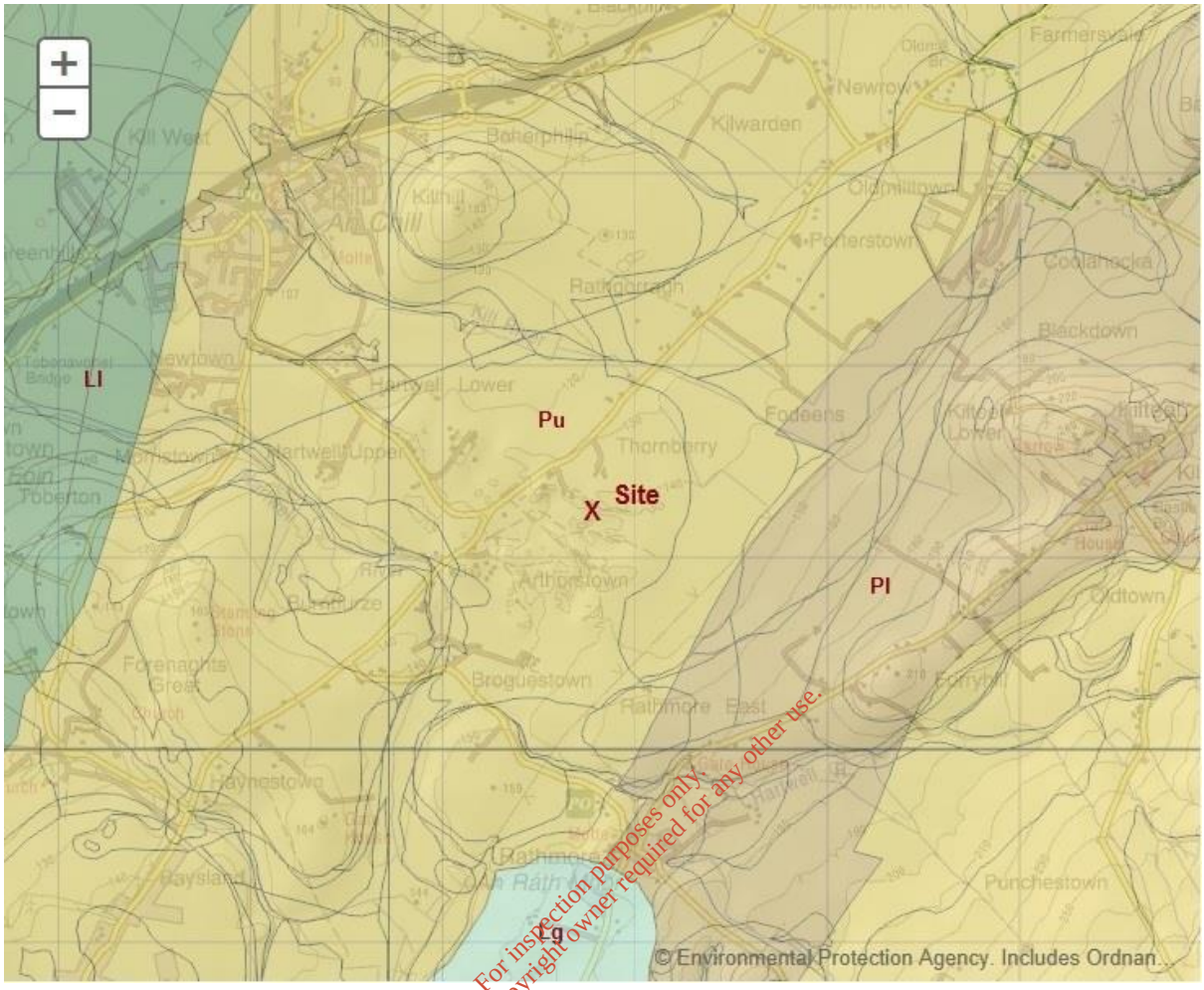

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Figure 3.3.7. Aquifer Map of Thornberry Area

Medium Green: LI – Locally important Aquifer – bedrock which is moderately productive only in local zones

Light Brown: Pl – Poor Aquifer - bedrock which is generally unproductive, except for local zones

Beige: Pu – Poor Aquifer – Bedrock which is generally unproductive

Light Blue: Lg – Locally Important Aquifer – Sand & Gravel

Redrawn extracts from EPA (2014). Scale: Width of Field = c. 6km.

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3.4 WATER

3.4.1 INTRODUCTION

This section of the EIS describes the hydrological and hydrogeological setting in a regional and local context. It provides a risk assessment of the potential impacts of the proposed WRF development on surface water features and groundwater in the vicinity of the site. The primary objective of this hydrological and hydrogeological risk assessment is to assess the impact posed to surface water and groundwater in the area by the proposed WRF activities. Where appropriate, mitigation measures are recommended. The hydrological and hydrogeological assessment has been prepared in accordance with guidelines on Geology in Environmental Impact Statements issued by the Institute of Geologists of Ireland.

3.4.2 SCOPE OF WORKS

The scope of works for the assessment undertaken comprised the following:

- Desk Study
  - Collation of existing regional information regarding the geology, hydrology and hydrogeology of the site and surrounding area;
  - Review of other available site information.
- Field Work
  - Site walkover and mapping of salient features, where present, on 23rd July 2014.
- Reporting
  - Preparation of a surface water and groundwater risk and impact assessment report.

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Reference was made to the following documents:

- Department of the Environment, Heritage and Local Government (2004) *Quarries and Ancillary Activities – Guidelines for Planning Authorities*.
- Environmental Protection Agency (2006). Environmental Management in the Extractive Industry (Non-scheduled minerals).
- Institute of Geologists of Ireland (2007). Recommended Collection, Presentation and Interpretation of Geological and Hydrogeological Information for Quarry Development.
- Institute of Geologists of Ireland (2013) Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements.

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3.4.3 SITE LOCATION

The site of the proposed continuation of WRF operations is Thornberry Quarry, located in the townland of Thornberry, c. 2km southeast of Kill, Co. Kildare (See EIS Figure A1.0 and B 2.1 – Rev. A). The site of the quarry and WRF comprises c. 10ha of a leasehold of an L-shaped 11.4ha, being c. 700m in length, c. 100m wide, and c. 300m wide (at the base of the L-shape).

The site lies in an area characterised as rural in nature, but which is peripheral to the urban area of Kill and Naas. According to the EPA Corine Landuse Map 2006, in addition to agricultural use, land use in the area is identified as extractive, waste recovery, landfill, industrial, and single dwelling residential. The lands of the application site have a history of sand and gravel extraction, which along with operations at adjoining Arthurstown and Hartwell Upper, were developed within Quaternary glacial fan and delta deposits.

A few detached residential dwellings are located in the area. There is a single farmstead within the landholding (i.e., landowners residence), whilst there are six residences within 500m of the site (i.e., one on the landholding, two adjacent to the site entrance, and three on the L2019 north of the site: Refer to Figures Nos. A1.0, B 2.1 – Rev A, and B 2.2 – Rev A, for site location details).

3.4.4 EXISTING ACTIVITIES ON THE APPLICATION SITE

The site is primarily used as a WRF for the recovery of inert C&D waste, primarily soil and stone, in the restoration of the quarry void. The land in the southern section of the site is currently being restored to agricultural use, whilst the unrestored quarry area is dominated by bare, exposed ground with hedgerows and fragments of scrub at the edges of the site. Most of the original topsoil has been stockpiled together with imported topsoil for the purpose of restoring previous sections of the site. There are also stockpiles of sand and aggregate products, as well as of intake C&D waste.

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3.4.5 TOPOGRAPHY

The site of the quarry and WRF is located in an area with a long history of sand and gravel working, with the consequential disturbance to the natural landform and landscape. As stated above, the southern section of the site is being restored, whilst the northern and central sections, which house all of the site infrastructure, are yet to be restored and remain in a disturbed and degraded state, typical of quarry workings.

The site is located at an elevation of c. 135-150m AOD in an area identified as the Eastern Transition by Kildare County Council (2011). The wider area generally consists of undulating topography and rolling low hills (elev. c. 100-200m AOD), with extensive lowlands (c. 70-80m AOD) to the west, and the uplands and Wicklow Mountains to the east. The largely restored Arthurstown Landfill is located immediately to the west, and represents a significant local topographic high.

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The application site has had a detailed land survey carried out on it that has shown the site to be an area of sloping land, ranging from c. 150m AOD in the south to c. 135m AOD along the northern boundary.

3.4.6 METEOROLOGY AND WATER BALANCE

Rainfall and long term Potential Evaporation (PE) data for the Casement Aerodrome, the closest synoptic station to the site (i.e., c. 10km to the northeast), was obtained from Met Eireann. The average annual rainfall (AAR), based on mean monthly rainfall data during the period 1981-2010, is given as 754.2mm/yr. The average PE (based on 1981-2010 average monthly data) is 529mm/year. A conservative estimate of the Actual Evaporation (AE) is taken to be 0.9 of PE in conformance with the WGGW (2005). Therefore, the AE at the Casement is estimated at 476mm/yr.

An average surface water balance for the total site area of c.10ha is presented in Table 3.4.1 below. This calculation assumes that site area is bunded so that water ingress from outside of the existing site footprint does not enter the pit/quarry area.

The Effective Precipitation (EP) is the amount of precipitation that is available to form recharge or runoff. The EP in the vicinity of the site boundary based on the Casement Aerodrome data is estimated as follows:

$$EP = AAR - AE.$$

$$= 754mm/yr - 476mm/yr$$

$$EP = 278mm/yr$$

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Meteorological data are also available from the adjoining Arthurstown Landfill for the period 2008 to 2015 (South Dublin County Council 2008 to 2013). These data indicate average annual rainfall of 928mm and potential evaporation of 520mm, giving an effective precipitation of 460mm/yr, which is approximately 50% greater than indicated from the Synoptic Station at Casement Aerodrome. Given the local character of the Arthurstown meteorological data, and applying the precautionary principal of adopting the data with more conservative or adverse outcomes, the Arthurstown data for AAR, PE and EP are applied here, despite being averaged over a significantly shorter period (i.e., 7 Vs 30 years).

Based on the EP value determined above, the volume that is available for runoff or recharge directly on the application area is 46,000m^3/yr and is given by:

Application area run-off = Area x EP

= (100,000m^2)*(0.460m/yr)

= **46,000m^3/yr (126m^3/d or 1.46 l/s)**

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Table 3.4.2 Mean Water Balance for the Existing Excavation Area and Ancillary Activities Area

Existing Quarry Area (m^2)	Average Annual Rainfall (mm)	Mean Annual Potential Evaporation (mm)	Actual Evaporation (mm)	Effective Annual Precipitation (mm)	Annual Volume of Water Available for Recharge or Runoff (m^3)	Annual Volume of Water Available for Recharge or Runoff (m^3/day)
100,000	**928**	**520**	**468**	**460**	**46,000**	**126**

3.4.6.1 RECHARGE

The term 'recharge' refers to the amount of water replenishing the groundwater flow system. The recharge rate is generally estimated on an annual basis, and assumed to consist of input (i.e., annual rainfall) less water loss prior to entry onto the groundwater system (i.e., annual evapotranspiration and runoff).

All effective precipitation formed within the site area recharges into the ground or runs off site. That which does not recharge to groundwater runs off. The hydrogeological controls determining the rate of groundwater recharge at the site, as suggested by the Geological Survey of Ireland (GSI) are provided in Table 3.4.2. The GSI National Recharge maps suggest that the average recharge in the vicinity of the site is between 50 – 100mm/yr (See Figure 3.4.1).

For aquifers classed as poor (Pu/Pl) (or locally important (Ll)), there is an upper limit to the amount of recharge that they can accept. When that natural capacity is achieved all subsequent recharge will be rejected. It is recommended that recharge caps of 100 mm/yr should be applied to poor aquifers (and 200mm/year for locally important aquifers). When the natural recharge capacity is exceeded then rejected recharge occurs and this adds to surface runoff (or interflow) (Hunter-Williams et al. 2008).

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Hydrogeological Controls	
Hydrogeological Setting:	2.ii (source: WGGW 2005)
Hydrogeological Setting Description:	Sand & gravels subsoil overlain by well drained soil
Soil Drainage:	DRY
Subsoil Type:	GLs
Subsoil Description:	Limestone sands and gravels Carboniferous
Subsoil Permeability:	H
Subsoil Permeability Description:	High
GW Vulnerability:	H
GW Vulnerability Description:	High
Aquifer Category:	Pu

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Hydrogeological Controls	
Aquifer Category Description:	Poor Aquifer – Bedrock which is generally unproductive
Recharge Coefficient (%):	85
Maximum Recharge Capacity (mm/yr):	100
Average Recharge (mm/yr):	100
Effective Rainfall (mm/yr)	527

Table 3.4.2 Hydrogeological Control Determining Groundwater Recharge for the Site

3.4.7 HYDROLOGY

In a regional context, the site is situated in the Kill River Sub Basin, within the catchment of the Liffey River, in the Eastern River Basin District. The Kill River rises in the Uplands east of the site near Kilteel and flows in a west northwesterly direction approximately 500m north of the site. The Kill River merges with the Painestown River north of Kill, and in turns flows into the Morell River c. 3km south of Straffan. The Morell River is a tributary of, and drains into, the Liffey River, c. 1km south of Straffan village. The Liffey flows in a northeasterly direction to Leixlip, at which point it turns in an easterly direction, ultimately discharging into Dublin Bay, where several SACs, SPAs and pNHAs occur.

A surface water stream, which is essentially a wet drainage ditch, skirts around the eastern boundaries of the Arthurstown Landfill site and the application site, before turning to flow in a northwesterly direction north of the site before flowing into the Kill River. The eastern boundary of the application site is set back on the landholding to create a >30m buffer zone from the stream (See EIS Figure B.2.1 – Rev. A).

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3.4.8 GEOLOGICAL SETTING

3.4.8.1 BEDROCK GEOLOGY

Reference to the 1:100,000 scale map of the Geology of Kildare-Wicklow (Sheet 16) (GSI 1994) suggests that the entire quarry site is underlain by rocks of the Carrighill Formation (Fm).

The Carrighill Fm. is the most westerly, the most extensively exposed, and considered the youngest unit of the Silurian-age Kilcullen Group. The latter was deposited as a sequence of greywackes in the Leinster Basin off Avalonia, on the southern margin of the Iapetus Ocean, c. 440-410Ma. The Carrighill Fm. is the finest-grained formation in the Kilcullen Group, and consists of greywackes, siltstones and shales. The greywackes are distinctive in having a calcareous matrix, principally of Fe-rich dolomite, with a higher matrix to framework ratio than the other formations. The Carrighill Fm. underlies the entire application site and the area within c. 500m radius, and is heavily folded along SW-NE oriented axes. The geology map (GSI 1994) and the GSI online mapping (GSI 2014) show a synclinal axis traversing near the

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centre of the Thornberry site, suggesting that the dip of the strata varies from to the southeast in west of the site, to flat-lying near the centre, and to the northwest in the east of the site.

According to the GSI online maps, the major Athgarrett Fault of Caledonian trend lies c. 2.5km to the east of the Thornberry site, and defines the contact between the Tipperkevin and Glen Ding Fms. The Athgarrett Fault is offset by a series of west northwest faults (possibly Varsican), one of which pass c. 500m north of the site, and is the locus of the Kill River. A second such fault passes c. 1.25km south of the site.

Further details of the geological background of the area are given in Section 3.3 of this EIS.

3.4.8.2 SOILS AND SUBSOILS

3.4.8.2.1.1Regional Data

Interpretation of the Teagasc/EPA Soil Map (Fealy & Green 2009), the Soil Map of Kildare (Conry et al. 1970) and the General Soil Map of Ireland (Gardiner & Radford 1980) indicates that the dominant soil type on site prior to quarrying operations was Grey Brown Podzolics of Athy Complex (See EIS Figures 3.3.1 to 3.3.3). These soils developed on fluvioglacial sand and gravel derived from nearby Carboniferous limestone rocks. Grey brown podzolics comprise deep, well-drained soils derived from mainly calcareous parent material.

The subsoil in the quarry site is identified as fluvioglacial sands and gravels derived from Carboniferous limestone (i.e., GLs), which comprised fan and delta deposits that extended across the Thornberry, Arthurstown, Upper Hartwell and Lower Hartwell Townlands (See EIS Figure 3.3.4). The GSI Groundwater Protection Scheme maps for Co. Kildare and the borehole database held by the GSI indicate that within a c 1.5-2km radius, depths to bedrock vary from 3.1m south of the site to 25.3m adjacent to the site, and with relatively deep overburden extending to the east northeast at Blackdown. Bedrock was not encountered at the base of the excavations, other than by drilling, which is described by Cullen (1985) as “Slate Bedrock”, and which most likely corresponds to greywacke of the Carrighill Formation. Maximum indicated depth to bedrock on site is c. 22m.

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3.4.9 HYDROGEOLOGICAL SETTING

The Silurian bedrock underlying the site is indurated and dominated by fissure permeability. The rock is impermeable and can be considered a poorly productive aquifer. Most groundwater in this area will move in the upper weathered zone of the bedrock, fault zones, and the overlying Quaternary deposits where permeable. The hydrogeological significance of the Quaternary sediments is variable and is largely a function of their permeability, thickness and extent. Areas with a glacial till cover have increased runoff and less recharge; areas with gravel exposed at the surface will have higher recharge and where sufficiently thick and laterally extensive will form aquifers.

3.4.9.1 AQUIFER CLASSIFICATION

Groundwater is water beneath the ground surface contained in void spaces, such as pore spaces between rock and soil particles, or in bedrock fissures (Han 2010). Groundwater is

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stored and moves through geological strata, where the direction of flow follows the topography. An aquifer is an underground layer of water-bearing permeable rock or unconsolidated materials (i.e., gravel, sand silt or clay) from which groundwater can be usefully extracted using a water well. The aquifer potential of a bedrock unit is determined by the groundwater productivity of that rock and the productivity is based on hydraulic characteristics compiled from borehole data throughout the country.

The Thornberry locality and its' underlying aquifer has been characterised by the GSI as being part of the Kilcullen Groundwater Body (GWB). The Kilcullen GWB comprises bedrock aquifers that are classified as poorly productive bedrock aquifers, which are either: (1) locally important aquifers, moderately productive only in local zones (LI); (2) poor aquifers, generally unproductive except for local zones (PI); or (3) poor aquifers, generally unproductive (Pu) (See EIS Figure 3.3.7). Some of the key characteristics of the Kilcullen Groundwater Body have been identified by the GSI as follows:

- The boundary of the GWB is defined to north and west by the geological contact between the Lower Paleozoic rocks and the limestones of the Dublin Basin. The GWB is composed primarily of low permeability rocks, although localized zones of enhanced permeability do occur. Groundwater flow occurs mostly in a shallow upper weathered zone, deeper groundwater flow is possible along fractures, joints and major faults. Recharge occurs diffusely through the subsoils and via bedrock outcrops.
- The Silurian rocks are classified as PI or Pu aquifers. The Ordovician rocks classified as LI aquifers are known to have moderately good transmissivities (~30m^2/d), whilst the Silurian rocks are expected to be less permeable, except in local zones. The topographic slope will influence the hydraulic gradient in the aquifer, which in turn will determine the velocity and volume of groundwater flow.
- The dominant recharge process in this area will be diffuse recharge from water percolating through the overlying tills and in to the aquifer. High rates of potential recharge are expected in the hilly areas where there are very thin subsoils and high rainfall. A large portion of this potential recharge will be rejected because the rocks are poor aquifers and hence do not have a high enough storativity to accept all the water. Therefore, the runoff component to streams will be higher in these areas.
- The majority of groundwater flow will occur in the top few metres of the bedrock, mostly in along a weathered zone in a lateral direction towards rivers and springs. Structural deformation may provide a fracture network that will allow groundwater movement at greater depths. Only flow in isolated fractures is expected below 30m.
- Regional groundwater flow paths are not considered to develop, as the rocks do not have sufficient transmissivity to transport water over long distances. Typical groundwater flow paths will be in the order of a couple of hundred metres, with discharge occurring to the closest surface water stream or river.
- There are a large number of small springs in the area, which are located at the foot of hills at the break in slope, where the water table comes to the surface.

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- The aquifers within the GWB are generally unconfined, but may become locally confined where the subsoil is thicker and/or lower permeability. Groundwater flow is considered to recharge and discharge on a local scale. Groundwater discharges to the numerous small streams crossing the aquifer from springs and seeps.
- Vulnerability in the lowlands is more commonly Moderate and Low.
- Large deposits of sand and gravel are located to the southwest of the GWB overlying much of the lowland Silurian rocks in Kildare.
- The hydrochemical analyses show that the groundwater has very low alkalinity, with most recorded values below 50 mg/l, and most recorded values of pH are below 7, but do not drop below 6.

The aquifer map of Ireland produced by the GSI has classified the rocks of the Carrighill Fm. under the Thornberry site as a poor aquifer, which is generally unproductive (Pu). The rock has low inter-granular permeability, and it is expected that groundwater flow will be concentrated in the relatively poorly connected network of fractures, fissures and joints, giving a low fissure permeability, which tends to decrease further with depth. Most groundwater flux is likely to be in the upper part of the aquifer, comprising three broad zones: (1) a shallow zone of higher permeability may exist within the top few metres (i.e., c. 3m) of more fractured/weathered rock; (2) interconnected fissuring up to 30m-50m thick; and (3) a zone of isolated poorly connected fissuring typically less than 150m. Higher permeability may also occur along fault zones.

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In general, the lack of connection between the limited fissures results in relatively poor aquifer storage and flow paths that may only extend a few hundred metres. Any flow that does occur will be confined to fissure zones, which may have limited amounts of water. Thus, the Carrighill Fm. is capable of supplying small abstractions (e.g., domestic supplies, small group schemes) of “moderate” to “poor” yields (<100 m^3/d).

Within this aquifer, diffuse recharge occurs via rainfall percolating through the subsoil and rock outcrops. However, the Carrighill Fm. has a low ‘recharge acceptance’ due to its low permeability and poor storage capacity. A proportion of the effective rainfall will discharge to the streams in the groundwater body, especially where thicker, low permeability subsoil is present. Also, some recharge in the upper, more fractured/weathered zone is likely to flow along the relatively short flow paths and rapidly discharge to streams, small springs and seeps.

The moraine deposit on which the Thornberry quarry was developed consists of fine sand and gravel, where the latter predominantly occurs in the pebble and cobble size ranges, and exhibits pronounced stratification. This sand and gravel deposit has been largely extracted from within the application area, leaving a thick sequence of boulder clay up to 15m thick at the base of the quarry void. Glacial tills or boulder clays do not contain water and are not productive. Thus, the black boulder clay acts an impermeable layer (i.e., aquaclude) beneath the quarry floor, and effectively isolates the groundwater in the upper silt, sand and gravels from the groundwater in the bedrock aquifer beneath.

Gravels deliver sustainable yields, although lenses of clay and silt reduce the overall yield. A sand/gravel deposit is classified as an aquifer, if the deposit is highly permeable, has a saturated thickness greater than 5m, and is greater than 1km^2 in areal extent. The GSI classify

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the sand and gravel deposit at Rathmore, to the south of the Thornberry site, as a Locally Important Aquifer (Lg). However, the site at Thornberry is not considered to form part of this gravel aquifer.

3.4.9.2 KARST FEATURES

Reference to the GSI karst database indicates that no karst features have been mapped in the vicinity of the site. The closest mapped karst feature, described as caves and springs, are located in the Maynooth-Leixlip area, c 16.5km north of the site.

It would not be expected that karst features would be present around the Thornberry site as the rocks of the Carrighill Formation under it are considered non-calcareous.

3.4.9.3 GROUNDWATER ABSTRACTIONS AND BOREHOLE DRILLING

Reference to the GSI well database indicates that there is no record of a public groundwater supply in close proximity to the site. The nearest recorded public groundwater supply is in the townland of Kilteel, approximately 3km east of the site (i.e., the Kilteel Group Water Scheme), and has a designated a public supply source protection area, which is distant from the Thornberry site. A second public groundwater supply is in the townland of Blessington, approximately 6km south southeast of the site, and also has a designated a public supply source protection area. Again, this zone is distant from the Thornberry site. Historically, a public supply well owned by Kildare County Council occurred in the townland of the Burntfurze, southwest of Thornberry, but this has been decommissioned. Therefore, the Thornberry site is not subject to the restrictions or requirements of any groundwater source protection zone.

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The GSI well database indicates 32 no groundwater wells within a c. 2km radius of the site (location accuracy varies from 20m to 2km), the details of which are given in Table 3.4.3. None of these are currently a public supply well, and many are monitoring wells. Most residential properties in the area are serviced by a mains supply, which is operated by the local group water scheme. The landowner's property and farm is serviced by a well (PW2) which is included in the groundwater monitoring programme for the adjoining Arthurstown landfill site. Thus, the level of water abstraction in the area is probably relatively minor, and insufficient to affect groundwater conditions within 100-200m.

There are 22 groundwater monitoring wells at the Arthurstown Landfill site adjoining the Thornberry site, seven of which are routinely sampled for chemical analysis, and therefore are of interest here. Four of the Arthurstown monitoring wells (MW1 to MW4) are actually located within the application site at Thornberry, but only MW2 and MW3 (i.e., GW2 and GW1, respectively) were capable of being monitored in 2008-2009. Furthermore, GW1 is in an area of the site currently being backfilled and restored, and thus has now been decommissioned. Finally, analysis of MW2/GW2 indicates significant contamination, which was attributed to agricultural activity on adjacent lands, and not to the Arthurstown Landfill or Thornberry WRF (South Dublin County Council 2013).

The water table is the surface of the underground saturated zone, below which all soil pores or rock fractures are filled with water. The Thornberry pit floor is typically maintained at a depth of 1.5 to 2m above the winter water table level (Refer to Table 3.4.4). The groundwater

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beneath the boulder clays is confined, but the trend of the hydraulic gradient is also from the southeast to the northwest. There is little vertical movement of groundwater through the boulder clays at depth because of their low permeability.

The Arthurstown Landfill is serviced by a mains water supply, which is operated by the local group water scheme, and sourced from the River Liffey at Pollaphuca. However, Thornberry is not serviced by a mains water supply, and small quantities of potable water are brought on site as and when needed. Also, 5-10m^3 loads of water are occasionally brought on site and used to fill a water bowser for dust suppression during dry weather. The average water usage for the Thornberry site is unrecorded and was unavailable at the time of writing, but it is expected that water usage is minimal in general.

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Table 3.4.3. Inventory of Groundwater Wells within 2km of Thornberry Application Site (Source: GSI Groundwater Database)

GSI Code	Well Type	Original Name	Owner	Drill Date	Locational Accuracy	Townland	Depth	Depth to Rock	Easting	Northing	Well Use	Comment
2921SWW221	Dug Well				50m	Rathmore	3.1m		295840	219730	Unknown	
2921NWW116	Borehole				2km	Furryhill	12.2m	0.0m	297340	220520	Unknown	Good yield Bedrock at Surface
2921NWW117	Borehole	WTB/KLD 113		1967	2km	Rathgorragh	30.5m		295940	222440	Unknown	Yield of 27.3 m^3d
2921NWW118	Unknown				1km	Kilteel	13.1m	4.9m	298610	221470	Unknown	Good yield
2921NWW125	Borehole				1km	Furryhill	91.4m	4.6m	297480	220520	Domestic	
2921NWW152	Borehole	MW3	Forbairt	1997	10m	Oldmilltown	14.6m	8.5m	297840	222440	Monitoring	
2921NWW153	Borehole	MW4	Forbairt	1997	10m	Blackdown	23m	13m	297660	222330	Monitoring	
2921NWW155	Borehole	BH 3		2000	10m	Furryhill	6m		298220	220100	Monitoring	Very little water
2921NWW158	Unknown				20m	Hartwell Upper	12m		294000	221000	Unknown	
2921NWW164	Borehole	ILC No. 5104		1981	2km	Arthurstown	30.1m		295230	220990	Monitoring	Bailed. 163.7m^3d
2921NWW165	Borehole	ILC No. 5115		1981	2km	Arthurstown	4.9m		295230	220950	Monitoring	
2921NWW166	Borehole	ILC No. 5116		1981	2km	Arthurstown	14.6m		295240	220890	Monitoring	
2921NWW167	Borehole	ILC No. 5117		1981	2km	Arthurstown	17.4m	16.8m	295410	220990	Monitoring	
2921NWW168	Borehole	ILC No. 5105		1981	2km	Arthurstown	3.9m		295420	220940	Monitoring	
2921NWW169	Borehole	ILC No. 5106		1981	2km	Arthurstown	4.6m		295430	220900	Monitoring	
2921NWW170	Borehole	ILC No. 5107		1981	2km	Arthurstown	7.3m		295590	220970	Monitoring	
2921NWW171	Borehole	ILC No. 1508		1981	2km	Arthurstown	12.2m	11.6m	295610	220940	Monitoring	
2921NWW172	Borehole	ILC No. 5109		1981	2km	Arthurstown	4.9m		295610	220900	Monitoring	
2921NWW173	Borehole	ILC No. 5110		1981	2km	Arthurstown	4.3m		295780	220980	Monitoring	
2921NWW174	Borehole	ILC No. 5111		1981	2km	Arthurstown	14.3m		295780	220930	Monitoring	
2921NWW175	Borehole	ILC No. 5112		1981	2km	Arthurstown	3.1m		295790	220900	Monitoring	
2921NWW241	Dug Well				50m	Morristown	6.6m		293860	221560	Unknown	
2921NWW242	Spring				50m	Morristown	0.0m		293770	221360	Unknown	
2921NWW245	Borehole				50m	Burntfurze	25.6		294040	220100	Unknown	
2921NWW246	Borehole		Kildare		50m	Burntfurze			294370	220360	Public	Decommissioned
2921NWW248	Borehole				50m	Thornberry	25.3m		295800	221450	Unknown	Trouble with silt
2921NWW250	Borehole				50m	Porterstown	15.5m		296730	222450	Unknown	
2921NWW251	Dug Well				50m	Kilteel Upper	3.9m		298470	221460	Unknown	
2921NWW252	Dug Well				50m	Furryhill	9.9m		297780	220760	Unknown	
2921NWW253	Dug Well				50m	Furryhill	7.8m		296850	220150	Unknown	
2921NWW255	Borehole	MW5		2000	20m	Oldmilltown	19m		297730	222480	Monitoring	

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Well	Well Collar at Ground Level (m AOD)	Base of Well in 2006 (m AOD)	Depth of Borehole (m)	Groundwater Level (m AOD)	Date of Measurement
GW1	-	-	-	137.26	May 2008
GW2	137.00	130.22	6.78	132.79	May 2008
MW2	137.00	130.22	6.78	132.80	July 2013
MW8	149.20	115.19	34.01	141.51	July 2013
MW9	139.50	110.01	29.49	131.61	July 2013
MW14	129.40	125.13	4.27	126.50	July 2013
MW16	135.54	112.84	22.70	129.12	July 2013
MW20	156.50	147.51	8.99	149.89	July 2013
MW22	145.00	140.64	4.36	141.60	July 2013

Note: Arthurstown monitoring wells MW2 and MW3 correspond to Thornberry monitoring wells GW2 and GW1, respectively. Thus, GW2 and MW2 are the same. Data from Arthurstown 2013 AER, and Thornberry 2009 WML Application.

Table 3.4.4 Summary of Principal Groundwater Monitoring Wells of Interest around the Thornberry Site

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3.4.9.4 GROUNDWATER LEVELS AND FLOW DIRECTION

The water level measured in monitoring wells around the site allows the direction of groundwater flow beneath the area of interest to be determined. The water table is rarely horizontal and tends to follow local variations in topography, as groundwater flow is influenced by topography. Geological structures can also exert sufficient influence to cause the water table to deviate from following the topography. The slope of the water table or hydraulic gradient indicates changes in hydraulic head, and depends on the rate at which water is recharged or discharged from the aquifer, and its permeability and the permeability of overlying sediments. The slope of the water table gives the direction of groundwater flow, as groundwater will flow in the direction of maximum change in water table elevation.

The water levels in the 8 wells of interest are given in Table 3.4.4, and indicate an approximately northwest direction of groundwater flow in the area (See also Figure 3.4.2). This finding concurs with South Dublin County Council (2006), who concluded from data collected in 2004 that the groundwater flow in the bedrock aquifer at Thornberry was in a northwesterly direction, with a horizontal hydraulic gradient of 0.02.

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3.4.9.5 GROUNDWATER VULNERABILITY

Groundwater vulnerability is a term used to represent the intrinsic geological and hydrogeological characteristics that determine the ease with which groundwater may be contaminated by human activities. The vulnerability of an aquifer is defined as the ease with which infiltrating water and potential contaminants may reach groundwater in a vertical or sub-vertical direction. The vulnerability of the aquifer is dependent on the permeability and thickness of the overburden. The criteria for vulnerability classification are presented in Table No. 3.4.56. Where the subsoil thickness is <3m, the vulnerability is rated as Extreme (the highest risk situation). Where the subsoil thickness is >3m, the vulnerability is rated as High, Moderate or Low (depending on the permeability and thickness of the subsoil).

The GSI Vulnerability Map indicates that groundwater in the bedrock aquifer beneath the entire application site has been assigned a vulnerability rating of **High (H)** (See EIS Figure 3.4.3). This suggests that the sands and gravels in the area are greater than 3.0m deep, and of high permeability, and concurs with the depth to bedrock recorded in the three boreholes drilled on-site by Cullen (1984). The boreholes indicated depths to bedrock of between 9.4m to 22m (See EIS Figure 3.3.5).

Using a conservative approach, the general Groundwater Protection zone for the Thornberry site is therefore Pu/H across the site. This classification is a combination of the aquifer class and the groundwater vulnerability category, and refers to the poor bedrock aquifer (Pu), with a high (H) groundwater vulnerability. It should be noted that this GSI vulnerabiliy rating is based on regional data only, and has not considered and used in the mapping detailed, site-specific information.

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Based on the data from GSI, the development is thus situated on a highly vulnerable aquifer, and because of the nature of the extractive industry, much of the protective subsoil deposits have been removed, which would suggest the groundwater vulnerability has been increased further. However, although up to 6m of sand and gravel has been removed, between 9-15m of impermeable boulder clay remains below the floor of the quarry void, which acts as an aquaclude (Cullen 1985), isolating the bedrock aquifer from any possible contamination by preventing infiltration to lower levels. The boulder clay provides natural protection to the bedrock aquifer, and as such the actual vulnerability within the site is considered to be moderate to low. In addition, as the quarry is backfilled and restored, additional low permeable material is being built up over the boulder clay within the quarry void, reducing the actual groundwater vulnerability. Furthermore, all potential sources of contamination on the site are managed.

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Table 3.4.5. General GSI Vulnerability Mapping Criteria (Adapted from DELF/EPA/GSI, 1999)

Subsoil Thickness	Hydrogeological Requirements				
	Diffuse Recharge			Point Recharge	Unsaturated Zone
	Subsoil Permeability & Type				
	High permeability (sand & gravel)	Moderate permeability (sandy subsoil)	Low permeability (clayey subsoil, clay, peat)	(Swallow holes, losing streams)	(sand & gravel aquifers *only*)
0-3m	**Extreme**	**Extreme**	**Extreme**	**Extreme (30m radius)**	**Extreme**
3-5m	**High**	**High**	**High**	**N/A**	**High**
5-10m	**High**	**High**	**Moderate**	**N/A**	**High**
>10m	**High**	**Moderate**	**Low**	**N/A**	**High**

Notes: (i) N/A = not applicable
(ii) Permeability classifications relate to the material characteristics as described by the subsoil description and classification method
(iii) Release point of contaminants is assumed to be 1-2m below ground surface

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3.4.10 WATER QUALITY

3.4.10.1 OVERVIEW

The Water Framework Directive (WFD) of 2000 (Directive 2000/60/EC) represents a new approach to the protection and improvement of water resources and aquatic ecosystems across the EU. The WFD aims to protect all waters and water-dependent ecosystems: groundwater, rivers, lakes, transitional waters (estuaries), coastal waters and wetlands. A primary environmental objective of the WFD for surface waters is that the ecological and chemical status of all water bodies will be good or high by 2015, and that there will be prevention of any deterioration in status.

The WFD was transposed into Irish Law as the 2003 Regulations (i.e., SI 722 of 2003). The competent authorities responsible for implementing the regulations are the local authorities acting jointly and the EPA. The main unit of management is the River Basin District (RBD), which comprises one or more neighbouring river basins together with their associated wetlands, groundwaters and coastal waters. A river basin is an area of land from which all surface run-off flows through a series of streams, rivers and possibly lakes into the sea at a single river mouth or estuary. The applicable RBD in the Thornberry case is the Eastern RBD.

The definition of good status in the case of surface waters is based on: (1) ecological status, (i.e., the composition of the faunal and floral communities and the natural chemical and physical characteristics); and (2) chemical status, which refers to a number of specified toxic and/or bioaccumulative substances. In the case of groundwaters, good status relates to the

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natural chemical composition of the water and to these same chemical substances as well as to quantitative status (i.e., extent to which annual recharge to aquifers is depleted by abstractions).

In addition to the setting stringent quality targets, the WFD promotes the sustainable use of water resources, the progressive reduction and prevention of pollution of groundwater, the elimination of the discharge of specified hazardous substances, and the mitigation of the effects of floods and droughts.

Water quality data was obtained from annual sampling of the MW2/GW2 monitoring well between 2009-2013. The sampling locations are shown in Figure 3.4.2. and are summarised as follows:

- Groundwater quality
  - MW2/GW2 between 2009-2013, and MW3/GW1 in 2009
- Surface water quality
  - Surface water downstream of Arthurstown Road / L2019 in the Kill River

The water quality results were compared with the 'Maximum Allowable Concentration' (MAC) in groundwater, and the 'Interim Guideline Values' for surface water from the relevant legislation and/or guidance.

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3.4.10.2 GROUNDWATER QUALITY

Groundwater is an important source of water for industry, agriculture and drinking water, and because it moves slowly through the ground, the impact of human activities lasts for a relatively long time. Groundwater also provides baseflow to surface water systems and accordingly its quality influences the amenity and recreational value of surface water and its potential use for water supply purposes. Agricultural, industrial and other human activities are posing increasing risks to groundwater quality, and both EU legislation and national regulations require that pollution must be prevented as part of sustainable groundwater quality management.

Reference to the water data on the EPA Envision online mapping facility (EPA 2014) indicates that the rocks of the Carrighill Formation underlying the Thornberry site are classified as a poorly productive bedrock aquifer. The Kilcullen Ground Waterbody (GWB), of which the site at Thornberry forms part, is assessed as having Good groundwater status in terms of Water Framework Directive (WFD) Status 2007-2009, but also as being 'at risk of not achieving good status' in 2015 (i.e., risk score of 1b).

Seven groundwater monitoring wells at the Arthurstown Landfill site are routinely sampled for chemical analysis, of which 4 (MW1 to MW4) are actually located within the adjoining application site at Thornberry. Only MW2 and MW3 (i.e., GW2 and GW1, respectively) were available for sampling in 2008 and 2009, whilst only MW2 was available for sampling after 2009. In addition, there are 5 no. private wells (i.e., PW1 to PW5) belonging to nearby residences that are used as groundwater monitoring wells for the Arthurstown Landfill. PW2 is located on the Thornberry landholding, and corresponds to the landowners domestic supply well. The chemical analyses of groundwaters from MW3 in 2008-2009, MW2 in 2008-2013,

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PW2 for 2013, and the interim guideline levels set by the EPA (2003) are presented in Table 3.4.6.

The results of the chemical analyses of groundwaters from MW3 in 2008-2009 and MW2 for 2008-2013 are relatively consistent with values generally exceeding the relevant MAC for ammoniacal nitrogen, chloride, conductivity, calcium, iron, manganese, potassium, sodium, orthophosphate, and total dissolved solids. In addition, MW3 also shows elevated values for lead, magnesium, sulphate and zinc.

These chemical analyses of MW2 and MW3 indicate significant contamination, which South Dublin County Council (2013) attributed to agricultural activity on adjacent lands, and not to the Arthurstown Landfill or Thornberry WRF. MW3 has been decommissioned, whilst utility of MW2 to assess the impact of the WRF is compromised by the agricultural contamination.

PW2 is located down-gradient of the quarry and WRF site and adjacent to the landowners farmyard and residence. PW2 is compliant in respect of all hydrochemical parameters, but the microbiological analysis showed elevated faecal coliforms levels, suggesting contamination by organic wastes.

It is our understanding that the Facility Management at Arthurstown are relocating a number of the groundwater boreholes and that results will soon be made available to the EPA as part of the 2014 Annual Environmental Report (AER) for the facility.

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Parameter	MAC	MW3	MW3	MW2	MW2	MW2	MW2	MW2	MW2	PW2
		2008	06 May 2009	2008	06 May 2009	02 Nov 2010	02 Aug 2011	19 July 2012	23 July 2013	23 July 2013
Groundwater Level (mAOD)		137.26		132.79	132.55	132.97	132.4	133.53	132.8	
Ammoniacal Nitrogen (mg/l)	0.15	0.03	0.43	0.05	0.16	0.55	0.31	1.6	7.6	<0.2
Chloride (mg/l)	30	25	4234	38	70	474.96	370	324	219	13
Conductivity (µS/cm)	1000	561	11650	538	866	2363	2106	1986	1764	578
Dissolved Oxygen (mg/l)								4.12	2.44	
pH (pH units)	9.5	7.9	7.2	7.7	7.3	7.3	7.1	7.2	7.3	7.4
Temperature (C)	25	10.1	9.8	10	9.6	11.4	11.9	11.6	12	
Boron (µg/l)	1000	29	13	35	11	18	22	24	26	11
Cadmium (µg/l)	5	<0.4	<2	<0.4	<2	<2	<2	<2	<2	<2
Calcium (mg/l)	200	104.1	1281	187.7	139	201	222	257	214	91
Chromium (µg/l)	30	<1	7	<1	<2	<2	<2	<2	<2	<2
Copper (µg/l)	30	4	6	3	<2	2	<2	4	<2	3
Iron (mg/l)	0.2	<2	2.1	0.11	<0.1	0.4	<0.1	1	<0.1	<0.1
Lead (µg/l)	10	1	81	1	<2	2	<2	10	<2	<2
Magnesium (mg/l)	50	7.5	77	12.96	9.1	14	17	15	15	15
Manganese (µg/l)	50	4	5014	129	42	140	4	235	155	
Mercury (µg/l)	1	<0.05	<1	<0.05	<1	<1	<1	<1	<1	<1
Nickel (µg/l)	20	3	<2	5	<2	2	<2	3	3	<2
Potassium (mg/l)	5	1.9	15	8.1	8	7	8.1	7.6	13	0.89
Sodium (mg/l)	150	15.6	2244	28.9	27	214	239	286	151	13
Sulphate (mg/l)	200	79.81	224.27	66.48	45.98	113.8	116.9	104	118	14
Total Alkalinity $CaCO_3$ (mg/l)		190	113	344	280	358	423	438	472	
Zinc (µg/l)	100	25	128	33	79	44	<2	25	3	24
Nitrate (mg/l)	25	5.2		8.7		3.3	6.31	5.2	4.8	
Nitrite (mg/l)	0.1	<0.02		<0.02		<0.03	<0.03	0.44	0.03	
Total Oxidised Nitrogen (mg/l)		4.4	<0.2	8.7	6.3	3.68	5.9	5.6	4.8	
Orthophosphate (mg/l)	0.03	<0.01	<0.01	0.01	0.08		0.07	0.04	0.52	<0.01
Total Phosphorous (mg/l)		<0.05		0.08		0.15			0.6	
Total Organic Carbon (mg/l)		1.6	6.93	2.4	3.12	5.4	6	<5	<5	<5
Fluoride (mg/l)	1	0.14	<0.1	<0.1	<0.1	<0.10	<0.1	<0.1	<0.1	
Total dissolved solids (mg/l)	1000	358	8658	326	624	1422	1344	1156	1044	322
Faecal Coliforms (cfu/100ml)	0	<1	<1	<1	<1	>100	>100	6	259000	2419.6
Total Coliforms (cfu/100ml)	0	<1	20	<1	<1	>100	>100	3230	>2419.6	
Semi-volatile VOCs (µg/l)				<1	<1					
Pesticides (µg/l)				<0.01	<0.01					
Cyanide (total)(mg/l)	0.1	<0.01	<0.01	<0,01	<0.01	<0.01	0.01	<0.01	<0.01	<0.1

MAC: Maximum Allowed Concentration - (values exceeded are shaded in yellow).
The MACs are taken primarily from the European Communities Drinking Water (No. 2) Regulations, 2007 and where not available from the Interim Guideline Value-Towards Setting Guideline Values for the Protection of Groundwater in Ireland Interim Report (EPA 2003) (pH, T, Ca, Mg, K, Zn, TDS, PO4, Faecal Coli.). The limit is set for Ammonium at 0.15 mg/l. This is reported as Ammoniacal Nitrogen, so the IGV standard has been converted.
Results marked with < indicate that it is below the level of detection of the measuring instrument.

Table 3.4.6 Summary of Groundwater Monitoring Results for MW2, MW3 and PW2 Wells

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3.4.10.3 SURFACE WATER QUALITY

Reference to the water data on the EPA Envision online mapping facility (EPA 2014) indicates that the Kill River has two staff hydrometric gauges, but no recorder. The Kill River has a Moderate status (Q3-4) in respect of River Water Quality from 2004 to present, whereas the Hartwell River, adjacent to the Arthurstown Landfill, is assessed as having a Good Status (Q4). The Kill River is not assessed in terms of River Waterbody Risk, whereas the Hartwell River is assessed as 'possibly at risk of not achieving good status' in 2015. However, the Hartwell River is assessed as having a Good status in terms of WFD Status 2007 to 2009, whilst the Kill River is not assessed in terms of WFD Status.

As the only material imported on site is "soil and stone" and inert construction and demolition waste, it should not represent a source of possible contamination of surface water. The nearest watercourse to the application site is the Kill River (c. 500 m to the north), a smaller tributary of this river forms the eastern boundary of the landholding. The natural drainage pattern existing on site means that a proportion of the rainwater falling on the site percolates through the existing soil strata (sand and gravel, and underlying glacial till) to the underlying bedrock.

A buffer zone of 30m has been provided to the nearest surface watercourse to the site. A further 30m strip has either been restored and/or used to store indigenous soils for final restoration along the eastern site boundary. On site activities will not discharge to any sewerage system, and it is proposed to use a portable chemical toilet.

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The Thornberry site is located on the southern flank of, and within, the Kill River Sub-basin of the Liffey River Catchment. The water quality of the Kill River at sampling point SW4, downstream of the L2019 road, is analysed as part of an annual assessment of surface water quality in the vicinity of the Arthurstown Landfill by South Dublin County Council (2009-2013). A comparison of the chemical analysis of the surface water in 2013 with the threshold levels set in the relevant legislation is presented in Table 3.4.7. A biological assessment of the SW4 water sample was also done.

It is apparent from the surface water data that none of the parameters exceed the threshold levels set in the relevant legislation, and that the existing quarry and WRF are not having a significant impact on surface water quality downstream of the site. In particular, the sample exhibits High Status on the 4 key hydrochemical parameters Biological Oxygen Demand (BOD), ammonium, ortho-phosphate and Total Oxidised Nitrogen (TON).

Given the activities on site, it is considered that the parameters likely to be indicative of risk associated with these activities are Suspended Solids (due to moving and handling soil and stone) and VOC's (due to storage and use of petroleum fuels and products). Both of these parameters are below the relevant limit of detection, and are thus clearly in compliance.

The Kill River received a Q rating of 4 in the biological assessment, using the Q rating system, which recognises five macro-invertebrate communities ranging from A to E (i.e., most sensitive to most tolerant of pollution) and relates to their relative abundance to a quality rating – the Q Index. The current water quality status at the SW4 monitoring point is "Good", indicating that the quarry is not negatively impacting on the Kill River.

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Parameters	Surface Water Quality Standard	Kill River
pH (pH units)	6.0 – 9.0 Note 1	8.1
Conductivity (µS/cm @ 250C)	1000 Note 2	586
BOD (TCMP) (mg/l)	High Status: ≤ 2.2 Good Status: ≤2.6 Note 1	<2
COD (mg/l)	40 Note 2	13
Ammonia as N (mg/l) (Konelab)	High Status: ≤ 0.04 Good Status ≤0.065 Note 1	<0.02
Suspended Solids (mg/)l	25Note3	<5
Total Alkalinity (CaC03) (mg/l)	-	291
Chloride (mg/l)	250 Note 2	13
Sulphate (mg/l)	200 Note 2	14
Total Phosphorous (mg/l)	-	0.1
Ortho-phosphate as P (mg/l)	High Status:≤0.025 Good Status:≤0.035 Note 1	0.02
Nitrate as N (mg/l)	11.29* Note 2	0.59
Nitrite (mg/l)	0.015 Note 3	<0.02
TON as N (mg/l)**	-	0.59
Cyanide (free) (mg/l)	-	<0.01
VOC's	-	<1

Note 1: *Water Quality Standard = Water Quality Standards set in the European Communities (Quality of Surface Water Intended for the Abstraction of Drinking Water) Regulations, 1989. Limit values for A1 waters are shown.*

Note 2*: European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009).*

Note 3: *Water Quality Standard = 1988 Statutory Instrument No. 293, European Communities (Quality of Salmonid Waters) Regulations 1988.*

* Converted GTV for Ammonia as N mg/l, Nitrate as N mg/l and Nitrite as N mg/l.

** Combined Nitrate (50mg/l) and Nitrite (3mg/l) as TON (EPA 2001).

Table 3.4.7a Surface Water Monitoring Results of Kill River for 2013

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Parameters	Surface Water Quality Standard	Kill River
Boron (total) (µg/l)	2,000	13
Calcium (total) (mg/l)	200 Note 2	114
Chromium (total) (µg/l)	50	<2
Cadmium (total) (µg/l)	5	<2
Copper (total) (µg/l)	50	<2
Iron (total) (mg/l)	0.20	<0.1
Potassium (total) (mg/l)	5	3.5
Magnesium (total) (mg/l)	50 Note 2	8.2
Manganese (total) (µg/l)	50	6
Sodium (total) (mg/l)	200 Note 2	10
Nickel (total) (µg/l)	20	<2
Lead (total) (µg/l)	50	<2
Zinc (total) (µg/l)	3,000	<2
Mercury (total) (µg/l)	1	<1

Note 1: S.I. 294 of 1989: Water Quality Standard = Water Quality Standards set in the European Communities (Quality of Surface Water Intended for the Abstraction of Drinking Water) Regulations, 1989. Limit values for A1 waters are shown.

Note 2: European Communities (Quality of Salmonid Waters) Regulations, 1988 (S.I. No. 293 of 1988) < Indicates less than the laboratory detection limit.

Table 3.4.7b. Surface Water Monitoring Results of Kill River for 2013

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3.4.11 CONCEPTUAL MODEL OF THE AQUIFER

The Silurian-age Carrighill Fm. is mapped as underlying the entire site. These rocks are the most westerly, finest-grained and the most extensively exposed unit of the Kilcullen Group. These rocks consist of greywacke, siltstones and shales, where the greywackes are distinctive in having a calcareous matrix, principally of Fe-rich dolomite.

The rocks of the Carrigihill Fm. are indurated and impermeable, and in the absence of inter-granular permeability, groundwater flow is expected to be concentrated in upper fractured and weathered zones and in the vicinity of fault zones.

An estimated 460mm/yr effective rainfall is available for recharge or runoff in the vicinity of the Thornberry site. Excavation of the gravels does not affect the volumes of recharge, as the rainfall continues to infiltrate downwards. However, poor aquifers, such as the Carrighill Fm. underlying the entire site, are not considered to be capable of accepting all the recharge that may be available due to the limited capacity of the bedrock to both store and transmit the infiltrated water. Therefore, it is considered that a maximum 100mm of effective rainfall contributes to groundwater recharge in the bedrock. This may be even lower at the Thornberry site as a thick layer of boulder clay rests between the sands and gravels and the bedrock.

The vulnerability of the site and surrounding land is classified by the GSI as High (H), because of the deposits of sand and gravel within the overburden at Thornberry. However, the sand and gravel has been largely removed from the site during quarrying, leaving between 9 and 15m of boulder clay beneath the floor of the quarry. This boulder clay acts as an impermeable layer (i.e., aquaclude) beneath the quarry floor, and effectively isolates the groundwater in the remaining upper silt, sand and gravels from the groundwater below. Thus, the effective groundwater vulnerability is probably in the moderate to low range.

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The groundwater flow direction in the site area has been determined to be to the northwest, which is consistent with the regional topography and flow system in the GWB. The quarry floor is typically maintained at a depth of 1.5 to 2m above the winter water table level, whilst the groundwater quality, as measured at monitoring wells MW2 and MW3, is significantly impacted by agricultural activities, but not those of the existing quarry and WRF. The Thornberry landowners well (PW2) shows evidence of contamination by sewage.

3.4.12 SITE WATER MANAGEMENT

The sand and gravel deposits have been worked dry with no extraction below the water table. The sand and gravel in recent times has been dry screened only with no washing of aggregates. The only requirement for water for the operation of the WRF is for dust suppression, and a water bowser is mobilised to site as required and the water use is considered to be minimal. Potable water is brought on site as required. There will be a portable chemical toilet on-site, and on-site activities will not discharge to any sewerage system or to groundwater thereafter. Water management within the site can be divided into the components summarised in Table 3.4.8.

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Component	Description
Direct Input	*Effective precipitation falling onto the site within the site boundary.
Uses	*Dust suppression.
Outputs	*Evaporation from reinstated land and unrestored quarry floor. *Seepage to ground on reinstated land and unrestored quarry floor.

Table 3.4.8 Summary of Site Water Management Components

3.4.13 SURFACE WATER RUNOFF

There will be no requirement to discharge water from the site as it is proposed that the quarry and WRF will continue to be worked dry. There are no surface water features on the site, including settlement lagoons or ponds. The majority of surface water run-off on-site will be allowed to percolate to the underlying water table or allowed to discharge to the existing land drainage system.

Other than rainfall, the only other water on site involve small quantities of potable water, and the occasional importation of 5-10m^3 loads used in a water bowser for dust suppression during dry weather.

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3.4.14 RISK ASSESSMENT

3.4.14.1 INTRODUCTION

The concepts of Risk, Risk Assessment and Risk Management have become important tools in the area of environmental protection. The philosophical basis and language of risk is useful in that it provides a logical framework for considering the impact of potentially polluting activities on the environment.

This framework enables a more rigorous systematic approach to decision making. In reality it is putting a recognised framework to what is done intuitively, but by being systematic. In addition, it is an aid in conceptualising the potential impact of the discharge of effluent on the wider environment.

A **hazard** (**source**) presents a risk when it is likely to affect something of value (the **target/receptor**), which in this case is groundwater and/or surface water, which in turn may impact on humans. It is the probability of the hazard occurring and its consequences that is the basis of Risk Assessment.

The conventional Source-Pathway-Receptor model for environmental management can be applied to identify potential sources, receptors and pathways, and hence potential pollutant linkages relating to the site.

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For a particular contaminant to present a risk to receptors, three components must be present:

Source An entity or action that releases contaminants into the environment

Pathway A mechanism by which receptors can become exposed to contaminants

Receptors The human or ecological component at risk of experiencing an adverse response following exposure to a contaminant

The qualitative risk assessment presented in Table 3.4.12 below is based on the hydrological and hydrogeological information collected to date in relation to the site, and incorporated into previous sections of this report.

3.4.14.2 SOURCES

The potential sources of groundwater/surface water contamination that are likely to be associated with the proposed site activities are presented in Table 3.4.9. Nitrates and Faecal Coliforms are not considered as there is no wastewater treatment system on site, and use of a portable chemical toilet is proposed going forward.

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Contaminant	Associated Activities
Hydrocarbons Diesel Fuel Oils	Refuelling of machinery. Accidental spillages. Machinery maintenance/repair.
Silt	Arising from backfill material placed into the quarry. Surface water runoff.
Low permeability inert backfill material	Infilling with low permeability inert fill material could create a low permeability zone altering groundwater flow patterns. Reduction in recharge due to the potentially low permeability inert infill material.

Table 3.4.9 Potential Site Contamination Sources

3.4.14.3 PATHWAY

The pathways into the groundwater and surface water and the likelihood of potential groundwater contamination occurring associated with a particular pathway are presented in Table 3.4.10.

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Pathway	Description
Infiltration through quarry floor	Infiltration of standing water (rainfall) in unrestored quarry void through remaining subsoils. Infiltration of standing water (rainfall) through newly backfilled area. Runoff from stockpiled material from the WRF.
Surface water drainage	Runoff from compacted hardcore areas. Runoff from stockpiled topsoil material. Backfill material into sub-surface drainage system. Runoff from current restoration area into field drainage system

Table 3.4.10 Possible Site Pathways

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3.4.14.4 RECEPTORS

The potential receptors to contamination sources from the quarry are presented in Table 3.4.11.

Receptor	Description
Groundwater	Groundwater directly beneath the site, which flows off-site.
Third Party Wells	Third party wells down-gradient of the site (i.e., landowner's well).
Surface water	Kill River is located approximately 500m to the north of the site. No discharge of surface waters to watercourse, but there may be some surface run-off to stream of east of site.

Table 3.4.11 Potential Receptors to Site Contaminants

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3.4.14.5 SOURCE-PATHWAY-RECEPTOR MODEL

A summary of the Source-Pathway-Receptor model for the site, in the absence of mitigation measures in place, is presented in Table 3.4.12.

Source	Pathway	Receptor	Risk
Hydrocarbons Diesel Fuel Oils	Infiltration to ground	Groundwater beneath site	Moderate to Low owing to the presence of deep, low permeability till.
	Direct pathway from base of pit floor		High during periods of seasonally high water table
	Discharge to drainage network	Drainage Channel to east of site	High where adequate preventative, maintenance and control measures are not in place
Silt	Surface water runoff from the site	Surface water	No direct path, except overland flow. At least 30m buffer zone to stream to be maintained
	Infiltration to ground	Groundwater beneath site	High where unsuitable backfill material is placed at base of restoration area
Unsuitable low permeability inert backfill material	Direct pathway from base of pit restoration area	Groundwater beneath the site	High where unsuitable low permeability inert backfill material is placed at base of restoration area

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Table 3.4.12 Qualitative Risk Assessment

3.4.15 DO NOTHING SCENARIO

The “do nothing scenario” would result in the failure of the WRF development to continue operations. Thus, the recovery of inert C&D waste, mainly soil and stone, at the WRF would not occur, and the restoration works would proceed with only the materials available on site, and without any additional mitigation measures in place. This would leave the underlying aquifer more vulnerable than if the quarry void was backfilled with inert soil and stone, and appropriately capped.

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3.4.16 POTENTIAL IMPACTS

3.4.16.1 SURFACE WATER

There are no surface water features on the site, including settlement lagoons or ponds. The majority of surface water run-off on-site will be allowed to percolate to the underlying water table or allowed to discharge to the existing land drainage system.

The implementation of mitigation measures specified in Section 3.4.17.2 will reduce the overall risk of surface water contamination in the Kill River during operation of the WRF, including quarry restoration works.

3.4.16.2 GROUNDWATER

The ongoing operation of the WRF has the potential to impact on groundwater in terms of both the groundwater quality and the groundwater flow regime within the subsoils. The groundwater quality on site is poorly defined, as three of the monitoring wells have been decommissioned, whilst the fourth (i.e., MW2) is contaminated by agricultural activities nearby. In the absence of monitoring wells providing representative water samples, the exact extent of the groundwater quality beneath the site cannot be assessed.

Accidental spillages of on-site fuels, oils, etc. may result in contaminant residuals entering the groundwater via direct percolation.

Implementation of mitigations measures specified in Section 3.4.17.3 will reduce the overall risk of groundwater contamination beneath, and downgradient of the quarry, in addition to reducing the risk of altering the groundwater flow regime beneath the site during operation of the WRF, and restoration works at the quarry.

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3.4.17 MITIGATION MEASURES

3.4.17.1 OVERVIEW

In order to reduce the impact of the ongoing restoration works on groundwater and surface water receptors, the following are details of remedial measures/procedures to be implemented at the site in order to ensure that the source and/or the pathway is removed. In this way, the potential risk for groundwater/surface water contamination at site is minimised.

Many of these recommendations are in accordance with the publication "*Environmental Management Guidelines – Environmental Management in the Extractive Industry (Non-scheduled Minerals)*" (EPA 2006).

The most effective means by which to implement the proposed measures is to condition the mitigation measures as part of a granting of license at the site. In general, the most effective mitigations measures for the site are:

- Adequate containment of site fuels and oils, to prevent any accidental spillages which may migrate to the subsoils and underlying groundwater;

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- Dedicated maintenance and refuelling locations;
- Good work practices to provide adequate control measures for accidental spillages;
- Strict control measures to ensure only suitable material is allowed onto the site, i.e. thorough inspection of waste loads entering the site to confirm inert nature prior to deposition on-site;
- Only granular wastes should be deposited into areas immediately above the groundwater table to prevent the influx of suspended solids into groundwater;
- Ensuring that surface run-off is free from contaminating substances and suspended solids;
- Maintain existing buffer zone between restoration areas and surface drainage to east of site;
- The specific mitigation measures could be included in an Environmental Management Plan as part of the conditions for the site waste licence.

3.4.17.2 SURFACE WATER

There are no surface water features on the site, including settlement lagoons or ponds. The majority of surface water run-off on-site will be allowed to percolate to the underlying water table or allowed to discharge to the existing land drainage system.

It is proposed to maintain the existing (30m) buffer zone between restoration areas and surface drainage to east of site. There will be no requirement to discharge surface water run-off directly from the site to adjacent watercourses.

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3.4.17.3 GROUNDWATER WATER

Groundwater monitoring on-site is reduced to a single well that is contaminated by nearby agricultural activities. It is proposed that groundwater monitoring be carried out during the operation of the WRF and quarry restoration. It is our understanding that the Facility Management at Arthurstown are relocating a number of the ground water boreholes and that results will soon be made available to the EPA as part of the 2014 Annual Environmental Report (AER).

3.4.17.4 STOCKPILING AREA

High absorbency mats, pig tails and drums are to be added/ maintained in the stock-piling area and in WRF/ quarry vehicles to clean up any leaks from plant or machinery.

3.4.17.5 MACHINERY MAINTENANCE AND REPAIR

No servicing or maintenance of any plant or machinery takes place within the restoration area or WRF area.

High absorbency mats will be provided to contain any spills that may occur.

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3.4.17.6 STORAGE OF FUEL/CHEMICALS

A mobile double skinned (i.e., integrated bunding) fuel bowser is proposed to be used to refuel mobile plant on site. High absorbency mats are provided to contain any spills that may occur.

Oil, lubricants and waste oil products are stored under cover. All oil barrels and lubricants will be stored on spill pallets/ spill trays. Spill kits and drip trays will also maintained on site and the company will put in place an emergency response procedure for hydrocarbon spills and appropriate training of site staff in its implementation.

All waste oils are collected and removed offsite by an approved licensed waste collection contractor in the area.

3.4.17.7 RESTORATION

All material to be used for the restoration of the quarry should be inspected to ensure only suitable material is deposited. Only granular and high permeability material should be placed in low lying areas or within the areas where water is ponding at the base of the pit.

3.4.17.8 WATER QUALITY MONITORING

It is proposed that groundwater monitoring be carried out for the standard set of parameters. As the Facility Management at Arthurstown are relocating a number of the ground water boreholes, and as results will soon be made available to the EPA as part of the 2014 Annual Environmental Report (AER), it is proposed that an assessment of the results of relevant wells is incorporated with respect to any future monitoring regime for the WRF at Thornberry. This is recommended to ensure that the proposed continuation of the WRF and the restoration of the site is not impacting on the groundwater beneath the site.

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3.4.17.9 WASTEWATER TREATMENT SYSTEM

There is no septic tank, mechanical aeration unit, infiltration area or cesspit on site, and it is proposed that a portable chemical toilet will be provided on site. The operators will enter a regular maintenance contract with a reputable supplier to be serviced as required. This is detailed in Section 2.4.2.12.

Potable water will be brought on site as and when needed.

3.4.18 CONCLUSIONS

The evidence to date indicates that the existing excavation and restoration area has not impacted significantly on surface water quality downstream of the site.

Reliable information on groundwater quality on site is currently not available. The Facility Management at Arthurstown are relocating a number of the ground water boreholes and that results will soon be made available to the EPA as part of the 2014 Annual Environmental Report (AER). It is proposed that an assessment of the results of relevant wells is incorporated with respect to any future monitoring regime for the WRF at Thornberry.

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Any potential risks to groundwater and surface water from operating the WRF will be minimised/prevented through the adherence to the proposed mitigation measures detailed in Section 3.4.17.

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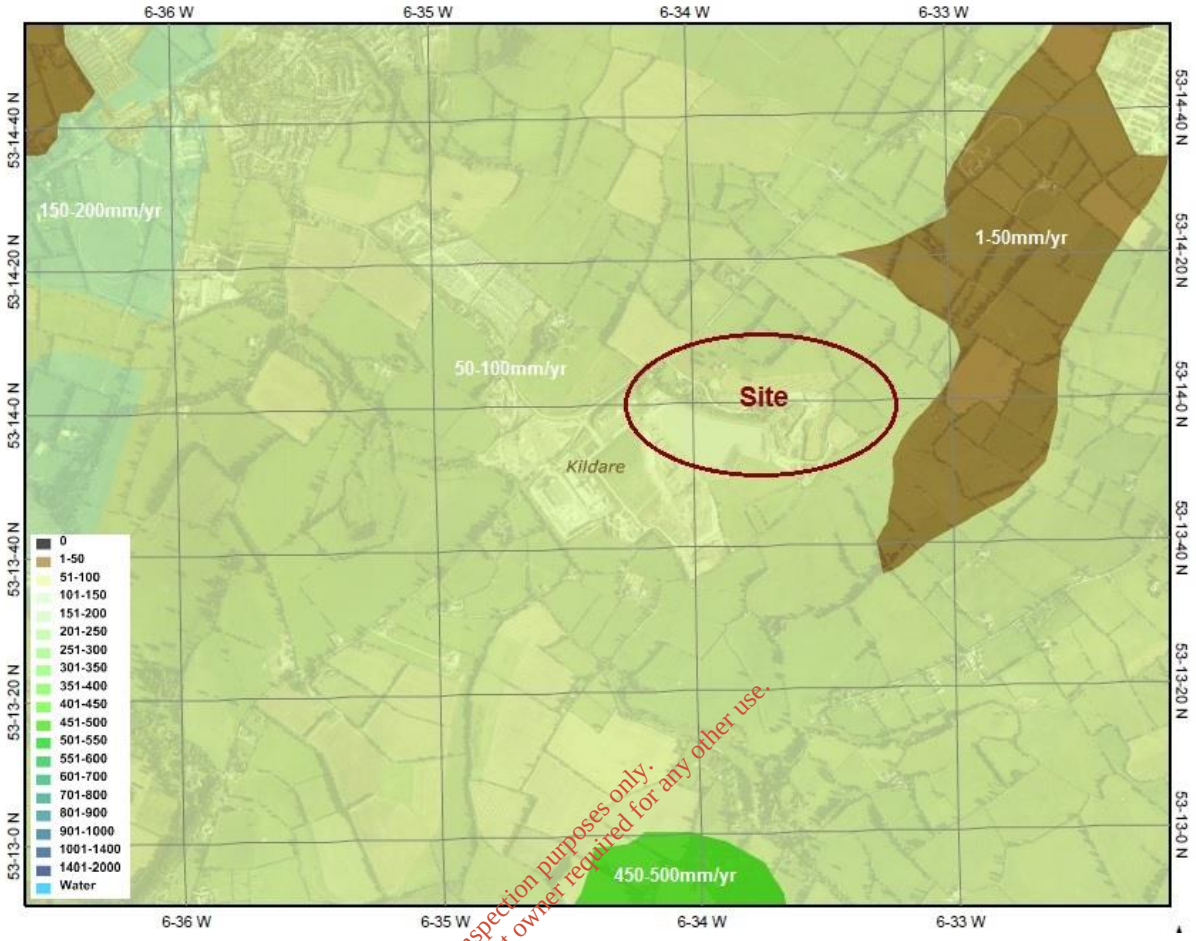

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Figure 3.4.1. Recharge Map of Wider Area around Thornberry. Site is indicated by an ellipse. Modified from GSI online Groundwater Data Viewer. See http://spatial.dcenr.gov.ie/GeologicalSurvey/Groundwater/index.html (GSI 2014).

Legend:

Brown: Average Recharge 1-50mm/yr

Light Green: Average Recharge of 50-100mm/yr

Light Green-Blue: 150-200mm/yr

Green: Average Recharge of 450-500mm/yr

Scale: Width of Graticules = c. 1.3km

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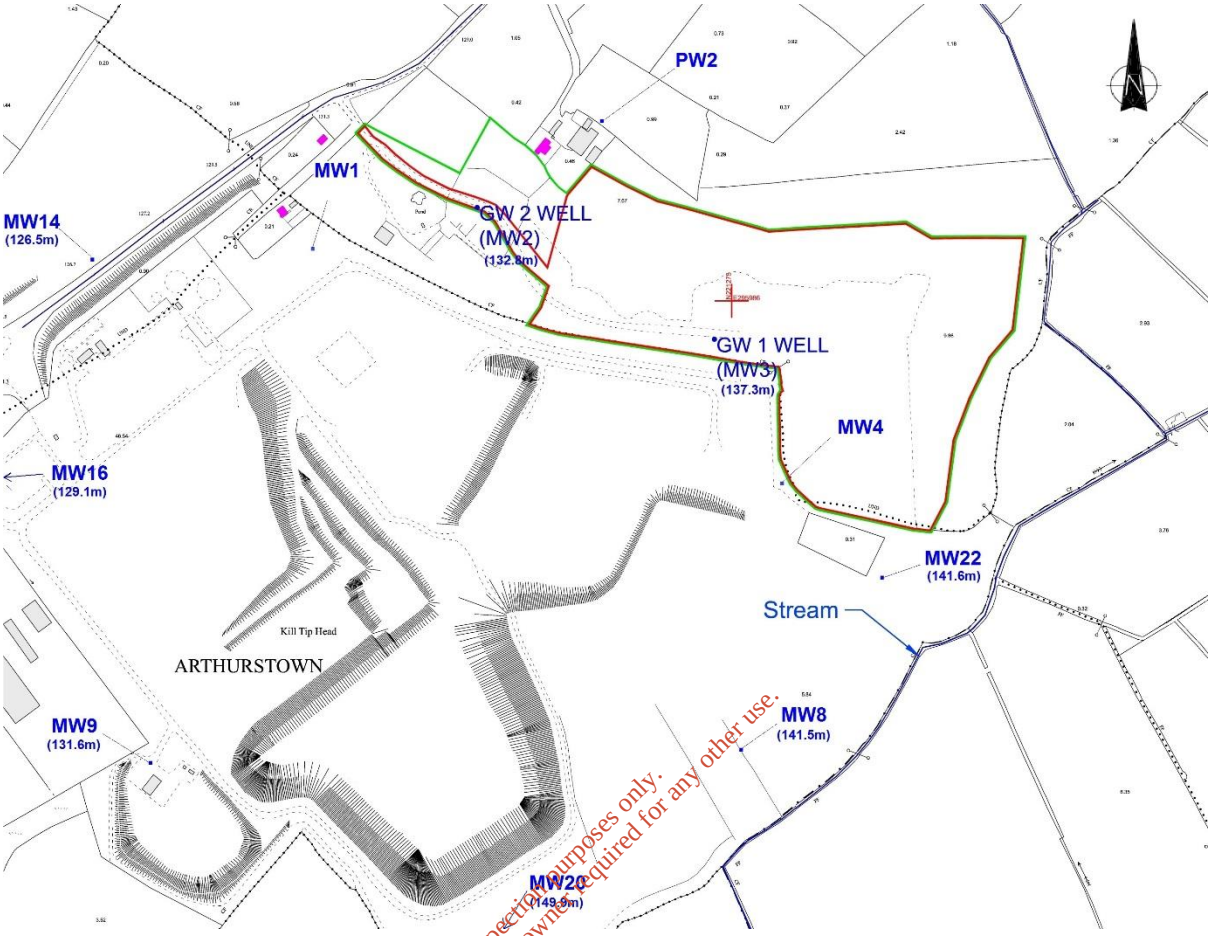

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Figure 3.4.2. Map of Arthurstown Landfill and Thornberry sites, showing location of monitoring wells with measured water levels in m AOD. Arthurstown monitoring wells MW2 and MW3 correspond to Thornberry Monitoring wells GW3 and GW1, respectively. MW16 and MW20 are slightly off map area as indicated by arrows. The well at the Thornberry landowner's residence is shown as private well PW2 (at top centre). Note water levels in wells clearly show water table sloping to the northwest, which is therefore the direction of groundwater flow. Application site is delineated by red boundary. Scale: Map Width = 1,300m.

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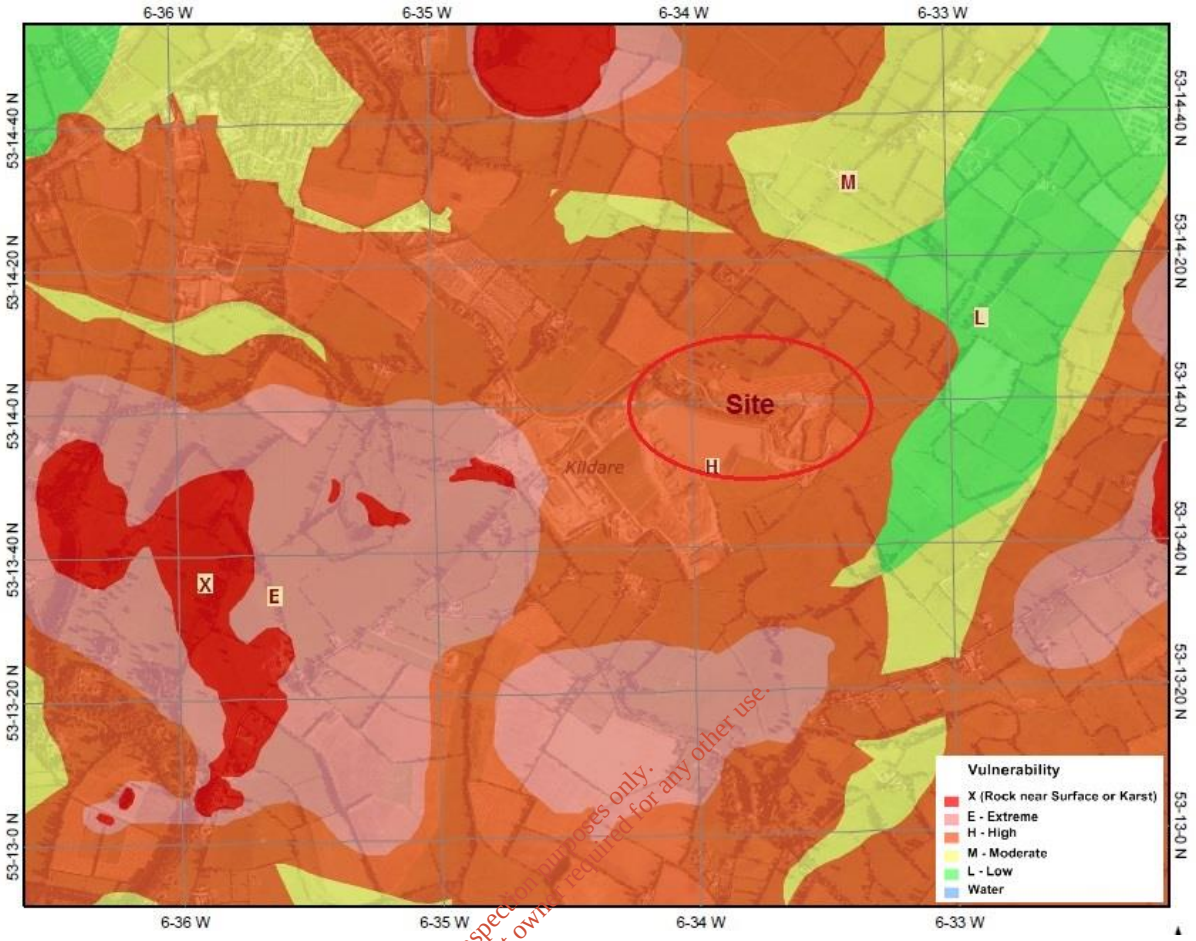

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Figure 3.4.3. Groundwater Vulnerability Map of Wider Area around Thornberry. Site is indicated by an ellipse. Modified from GSI online Groundwater Data Viewer. See http://spatial.dcenr.gov.ie/GeologicalSurvey/Groundwater/index.html (GSI 2014).

Legend:

Dark Red (X): Extreme. Rock at or near surface, or Karst

Pink (E): Extreme

Light Red-Orange (H): High

Yellow (M): Medium

Green (L): Low

Scale: Width of Graticules = c. 1.3km

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3.5 CLIMATE

3.5.1 INTRODUCTION

The Brundtland Commission stated "Sustainable development is the kind of development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (UN 1987). There is no greater challenge to meeting the latter obligation than the issue of human-induced global climate change. Developments can have implications on a national or global scale, where for example, it may represent a significant proportion of the national contribution of greenhouse gases. In the context of most Environmental Impact Statements however, climate is restricted in scope to the local climatological conditions or "microclimate" of an area, such as local wind flow, temperature, rainfall or solar radiation patterns.

For the purposes of Environmental Impact Assessment, a development may be seen to have potential climatic implications if its emissions are likely to alter meteorological conditions with possible weather effects.

This section of the EIS addresses the issues related to climate for the proposed continued operation of the Waste Recovery Facility (WRF) at Thornberry Quarry, and its impact on the climate of the application site and its environs as a result of the activities been undertaken.

The prevailing weather systems are described with emphasis on the long term patterns and trends. It involves an assessment of the prevailing climatic conditions, and assesses the potential impact of the development on the latter.

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3.5.2 BASELINE ENVIRONMENTAL STUDY

3.5.2.1 OUTLINE OF THE BASELINE STUDY

The objective of this study was to:

- Assess the prevailing climatic conditions of the development area on a local and regional level.
- Determine the impact, if any, of the development on the local microclimate and regional macroclimate.
- Determine any interaction between other aspects of the development and the climate of the area.

3.5.2.2 CLIMATE

The Fifth Assessment Report of the Inter-Governmental Panel on Climate Change (IPCC 2013) states that "Human influence has been detected in warming of the atmosphere and the ocean, in changes in the global water cycle, in reductions in snow and ice, in global mean sea level rise, and in changes in some climate extremes. It is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century. Cumulative emissions of CO_2 largely determine global mean surface warming by the late 21st century and beyond. Most aspects of climate change will persist for many centuries even if

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emissions of CO_2 are stopped. This represents a substantial multi-century climate change commitment created by past, present and future emissions of CO_2".

As a member of the EU, Ireland is a signatory nation to the Kyoto Protocol, and is obligated to cut CO_2 emissions to 13% above 1990 levels. There have been substantial reductions in Ireland's Greenhouse gases (GHG) emissions in recent years, due in significant part to the impact of the economic downturn. Under the Kyoto Protocol, Ireland's total emissions are limited to an average of 62.8 Mt CO_{2eq} per annum for the first commitment period 2008-2012. By 2012, Ireland was 5.68 Mt CO_{2eq} below the Kyoto commitment for the period, and thus broadly on track to meet its commitment under the Kyoto Protocol first commitment period. However, when the impact of the EU Emissions Trading Scheme and forest sinks are taken into account, Ireland exceeded the Kyoto limit by 2.1 Mt CO_{2eq} (EPA 2104a).

Although Ireland is currently on track to meet its Kyoto second commitment period 2013-2030 targets, there remains significant risk that these will not be met, even under the most ambitious emission reduction scenario. Total national GHG emissions are projected to decrease by an average of 0.4% per annum out to 2020, if all national policies are implemented and delivered. Emissions are projected to increase in 2020-2030 (12% in total), with strong growth in emissions from transport and agriculture, indicating that Ireland is not on a pathway to a low-carbon economy (EPA 2014b). Thus, rather than rely on economic recession, Ireland needs to develop as a low carbon economy in order to meet future targets.

Air quality in Ireland is of a high standard across the country and is among the best in Europe, meeting all EU air quality standards in 2010. This is due largely to prevailing clean Atlantic air and a lack of large cities and heavy industry. Over the past decade, levels of particulate matter have decreased in cities and large urban areas, arising principally from improvements in vehicle engine technology.

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With regard to air emissions, the strategies implemented to achieve compliance with the EU National Emissions Ceilings Directive have successfully controlled emissions of sulphur dioxide, ammonia and volatile organic compounds. Emissions of all three are expected to remain below the prescribed ceilings. However, levels of nitrogen oxides are expected to remain above Ireland's national emission ceiling in the short term due to sustained emissions from road transport.

For Ireland to comply with its international commitments on air quality and air emissions, industrial emissions of pollutants to air must continue to be rigorously controlled; policies must be implemented to increase the use of alternatives to the private car and improve efficiencies of motorised transport, which accounts for 40% of national energy consumption (SEI 2009). Government departments, national agencies and local authorities must make air quality an integral part of their traffic management and planning processes. Households and businesses must use more efficient methods to burn fuel, and shift from solid fuel to cleaner alternatives including gas.

The World Meteorological Organization (WMO) recommends that climate averages are computed over a 30 year period of consecutive records. The period of 30 years is considered long enough to smooth out year to year variations. By collecting weather data from around the country every hour and by analysing these records over a long period of time, 30 year average values are calculated. Met Éireann now reference 1981 to 2010 as the baseline period for day-to-day weather and climate comparisons (Met Éireann 2012). The closest

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synoptic station to the Thornberry site with 30 year averages for the 1981 to 2010 period is Casement Aerodrome, c. 10km to the northeast.

Ireland has a typical temperate maritime climate, with relatively mild, moist winters and cool, cloudy summers. The prevailing winds are westerly to south-westerly. For the greater part of the year, warm maritime air associated with the Gulf Stream helps to moderate the climate from the extremes of temperature experienced by many other countries at similar latitude. The average humidity is high. Annual average precipitation is highest on the west coast and in inland areas of high relief.

3.5.2.2.1 Rainfall

Rainfall in Ireland normally arises from Atlantic frontal systems, which travel in a north-easterly direction delivering cloud and rain. Highest rainfall occurs in the Western half of the country and on high ground; rainfall generally decreases towards the Northeast (See Figure 3.5.1). Averaged over all Ireland, the average annual rainfall is approximately 1,230mm. The driest seasons are spring and summer, with an all Ireland average of approximately 260 mm, autumn and winter have all Ireland averages of approximately 350mm. The driest months are April, May, June and July, with an all Ireland average of approximately 80mm each month. February, March, August and September have average rainfall totals of approximately 100mm, while October, November, December and January have all Ireland averages of approximately 130mm.

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On an annual basis, averaged over the country, there has been an increase of approximately 5% in rainfall totals between the two normal periods (1961-1990 and 1981-2010), with the higher increases in the Western half of the country. All seasons show an overall increase in rainfall but there are regional differences. There are decreases of up to 10% in rainfall in the South and East in winter, with corresponding increases in the West and Northwest. Spring and summer show increases of 5-10%. While most months show an increase in rainfall of 5-10%, January and February had decreases of 5-10% in the South and East, while September had a general decrease of up to 10%. In July, the average increase in rainfall was in the order of 15%.

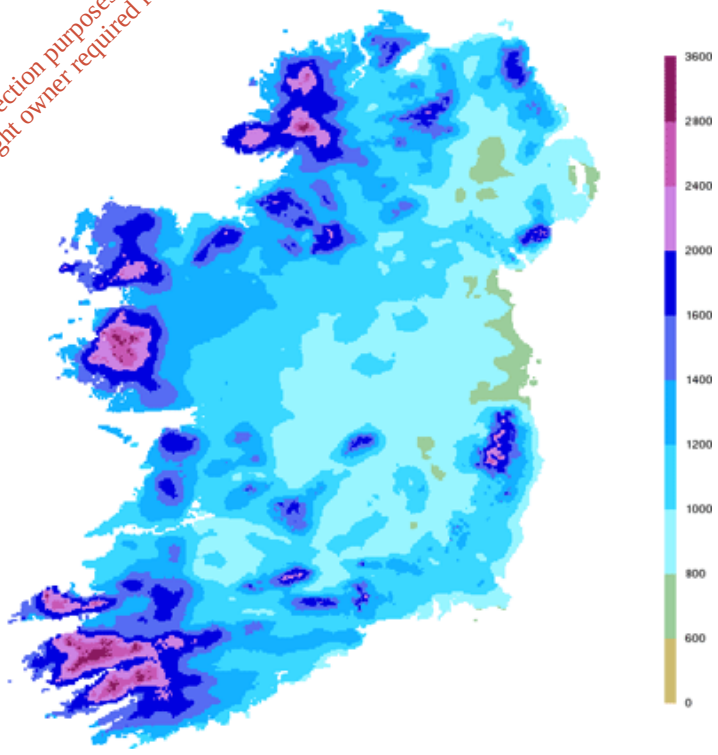

Figure 3.5.1 1981-2010 Mean Annual Rainfall (mm). Redrawn from Met Eireann (2014).

Rainfall data for the area was obtained from Met Eireann (2014). The average annual rainfall (AAR), based on mean monthly rainfall data during the period 1981-2010, is given as 754.2mm/yr. Long term Potential Evaporation (PE) data was also obtained for the synoptic

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station Casement Aerodrome, and considered as the best estimate of PE on the site. The average PE for this synoptic station (based on 1981-2010 average monthly data) is 529mm/yr. A conservative estimate of the Actual Evaporation (AE) is taken to be 0.9 of PE. Therefore, the AE at the Thornberry is estimated at 476mm/yr. The Effective Rainfall (ER) at the site is thus calculated to be 278mm/yr. Further details with respect to the water balance for the site are included in EIS Section 3.4 Water.

3.5.2.2.2 Temperature

The temperature regime in Ireland is greatly affected by the moderating effect of the sea, and height above sea level. Mean annual temperatures generally range between 9°C and 10°C with the higher values in coastal regions. Summer is the warmest season, followed by autumn, spring and winter. Highest temperatures occur inland during the summer, with mean seasonal maxima between 18°C and 20°C while highest values occur in coastal regions during the winter. July is the warmest month, followed by August and June; the coldest month is January followed closely by February and then December.

Generally, there has been an increase of approximately +0.5°C in mean temperature between the 1961-1990 and the 1981-2010 periods, with the highest increases in the Southeast. Maximum and minimum temperatures have also increased by approximately +0.5°C. All seasons show a rise in mean temperature with the spring and summer seasons displaying the largest differences between the two periods of approximately +0.7°C. Almost all mean monthly temperatures show an increase, except October and December, which show small decreases of up to -0.2°C in the West and Northwest.

The average daily air temperatures at Casement Aerodrome (1981-2010) range from 5.1ºC to 15.7ºC. These values can be considered comparable to those expected at the application site.

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3.5.2.2.3 Wind

The prevailing wind direction over Ireland is between south and west. Average annual wind speeds range from 3m/s in parts of south Leinster to over 8m/s in the extreme north. On average there are less than 2 days with gales each year at some inland places like Carlow, but more than 50 a year at northern coastal locations such as Malin Head.

During the course of a typical day, the range (difference between the highest and lowest) of mean hourly wind speed is considerable. At Belmullet, a western coastal station, the mean diurnal range is 11.5m/s in January and is still as high as 8.4m/s in July. At Clones, a typical inland station the mean diurnal range is 8.4m/s in January and 6.2m/s in July. The diurnal

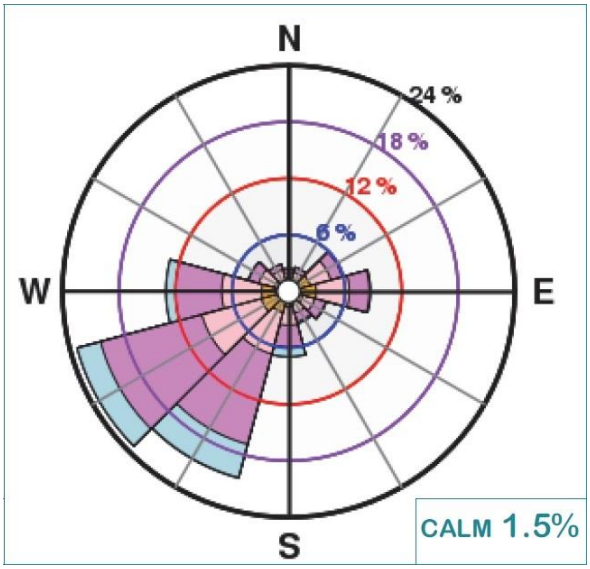

Figure 3.5.2. Casement Aerodrome Wind Rose based on 1981-2010 Averages. Redrawn from Met Eireann (2014).

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variation is much more pronounced in summer than in winter.

Wind blows most frequently from the south and west for open sites while winds from the northeast or north occur least often. In January the southerly and south-easterly winds are more prominent than in July, which has a high frequency of westerly winds. Easterly winds occur most often between February and May and are commonly accompanied by dry weather.

The prevailing winds in this area are from southwest as illustrated by the Wind Rose for the synoptic weather station at Casement Aerodrome, approximately 10km northeast of the site (See Figure 3.5.2).

3.5.3 ASSESSMENT OF IMPACTS

3.5.3.1 DIRECT / INDIRECT IMPACTS

The quarry development, including a co-located WRF handling inert soil and stone, is not of sufficient scale to have any direct or indirect impacts on the regional or local climatic conditions.

3.5.3.2 DO NOTHING' IMPACTS

If the WRF is not licensed to continue operations, then inert soils and stone waste materials may have to be transported further afield with a consequential impact in terms of increased exhaust emissions for transport of materials to more removed WRF facilities and/or landfill sites. It is considered that the proposed continued operation of the WRF will have a slight to imperceptible positive impact with respect to climate due to restoration to agriculture.

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3.5.3.3 INTERACTION WITH OTHER IMPACTS

The effect of climatic conditions (e.g., rainfall, wind, etc.) on other potential impacts of the development (e.g., dust deposition, drainage, etc.), are dealt with in the relevant sections of this EIS. The cumulative impact with respect to the operation of the WRF has also been taken into consideration throughout the preparation of the EIS.

3.5.4 MITIGATION & MONITORING

As the development is not expected to affect the local climate or microclimate of the area, there is no requirement for mitigation or monitoring within this development proposal in respect of climatic issues.

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3.6 AIR QUALITY

3.6.1 INTRODUCTION

This section of the report deals with the issue of air quality associated with the development of a Waste Recovery Facility (WRF) at Thornberry quarry. It will assess the level of airborne dust and particulate matter in the vicinity of the site, the impacts and appropriate mitigation measures, if required, by the applicant to remedy any significant adverse effects on the environment.

3.6.2 METHODOLOGY

The baseline study comprised a desktop review of relevant policy, legislation including guidance with respect to air quality and emissions. Existing dust monitoring results were analysed to evaluate the current air quality conditions. From these results an assessment can be made of the impact of the development on the existing air quality of the area.

3.6.3 POLICY & LEGISLATION

3.6.3.1 AIR QUALITY

The principal national legislation for the control of air pollution is the Air Pollution Act, 1987 (SI No. 6 of 1987). This Act provides a comprehensive statutory framework for the control of air quality by Local Authorities, specifically through 'orders' or 'plans' produced under Part IV Special Control Areas and Part V Air Quality Management Plans and Standards to which Local Authorities must have regard to in planning. Part V of the Act also makes provision for transposing Air Quality Standards into law.

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The Act also has relevance to potential nuisance emissions of dust and or odours. Section 24(2) of the Act states 'The occupier of any premises shall not cause or permit an emission from such premises in such a quantity, or in such a manner, as to be a nuisance'.

In order to protect our health, vegetation and ecosystems, EU Directives set down air quality standards for a wide variety of pollutants. The current standards are contained in the Clean Air for Europe (CAFE) Directive (EP & CEU, 2008) and the Fourth Daughter Directive (EP & CEU, 2004). These Directives also include rules on how Member States should monitor, assess and manage ambient air quality.

The CAFE Directive was transposed into Irish legislation as the Air Quality Standards Regulations 2011 (S.I. 180 of 2011), which revoked and replaced three earlier statutory instruments (S.I. 33 of 1999, S.I. 271 of 2002 and S.I. 53 of 2004).

These regulations set limit values/ target values for a range of pollutants, including sulphur dioxide; nitrogen dioxide and other oxides of nitrogen; particulate matter (PM10 and PM2.5); lead; benzene; carbon monoxide; and ozone.

The above directives require that Member States divide their territory into zones for the assessment and management of air quality. The zones adopted in Ireland are Zone A,

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the Dublin conurbation; Zone B, the Cork conurbation; Zone C, comprising 21 large towns in Ireland with a population >15,000; and Zone D, the remaining area of Ireland.

Under the EU Directives, Ireland is required to monitor a number of air pollutants that have an impact on health and vegetation. These include NO_X, SO_2, carbon monoxide (CO), ground level ozone (O_3), particulate matter (PM_{10} and $PM_{2.5}$), benzene, heavy metals and polycyclic aromatic hydrocarbons (PAHs). Across Europe the most problematic pollutants have consistently been NO_X, PM and O_3. Recently PAHs have also been identified as pollutants of concern.

NO_X refers to the two pollutants nitric oxide (NO) and nitrogen dioxide (NO_2). The main sources of these pollutants are vehicle exhausts and combustion sources. Exposure to NO_2 is harmful to health, while NO_X contributes to the formation of ground-level ozone and acid rain. NO_2 levels across Ireland have remained relatively static since 2002; however, an increasing trend at traffic-impacted sites in Dublin and Cork is emerging. These sites are approaching the 2010 limit value for NO_2 with one exceedance of the limit value recorded in 2009 at Winetavern Street, Dublin. This exceedance occurred before the limit value came into force on 1 January 2010. Figure 3.6.1 below shows annual mean nitrogen dioxide concentrations from 2002 to 2010 for monitoring sites across Ireland (EPA 2012).

PM_{10} and $PM_{2.5}$ are particles with diameters less than 10 micrometres and less than 2.5 micrometres, respectively. The health impacts of these small particles relate to their ability to penetrate deep into the respiratory tract. In Ireland the main sources are domestic use of solid fuel and vehicular traffic.

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PM_{10} concentrations show a decreasing trend in cities and large urban areas since 2003. This is mainly due to the decreases in particulate emissions from traffic arising from improvements in vehicle engine emissions. However, this decrease is not seen in smaller towns, where domestic solid fuel emissions are more significant than traffic emissions. Many towns do not benefit from the ban on smoky coal, and often do not have access to cleaner fuel alternatives such as natural gas (EPA 2012).

Under the CAFE Directive, Ireland is required to achieve reductions in levels of $PM_{2.5}$ of 10% between 2012 and 2020. This reduction is challenging, as it will require an integrated approach across a number of sectors including industrial, transport and residential emissions. Figure 3.6.2 below shows annual mean PM_{10} concentrations 2002–2010 for monitoring sites across Ireland.

The sources of PAHs include industry, traffic emissions and domestic use of solid fuels such as wood and coal. Long-term exposure to low levels of PAHs may cause a number of diseases including lung cancer.

PAHs were monitored in Ireland for the first time in 2009 at five monitoring stations. In 2010, levels at two of the stations were at the limit value of 1 ng/m^3. Reductions in emissions from traffic and from domestic use of solid fuels are required to reduce ambient levels of PAHs.

Ozone is a gas that is formed as a secondary pollutant at ground-level by the reaction of a mixture of other chemicals – NO_X, CO and vOCs – in the presence of sunlight. Ozone is a powerful oxidising agent and can affect health and vegetation.

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Short acute ozone pollution episodes are infrequent in Ireland; however, they have happened in the past, and will happen in the future. They are most likely to occur in summer months when a stable anti-cyclone is established over Ireland, bringing settled, warm weather combined with transmission of polluted air masses from other European countries. Reducing ozone requires limiting emissions of its precursors locally, regionally and globally. The objectives of both the Convention on Long-range transboundary Air Pollution (CLrtAP) and National Emissions Ceilings (NEC) Directive include addressing ground-level ozone. (EPA 2012).

The other health-relevant pollutants measured are SO2, CO, benzene, lead, arsenic, cadmium, nickel and mercury. Levels of all these pollutants are low in Ireland and below all relevant limit and target values (EPA 2012).

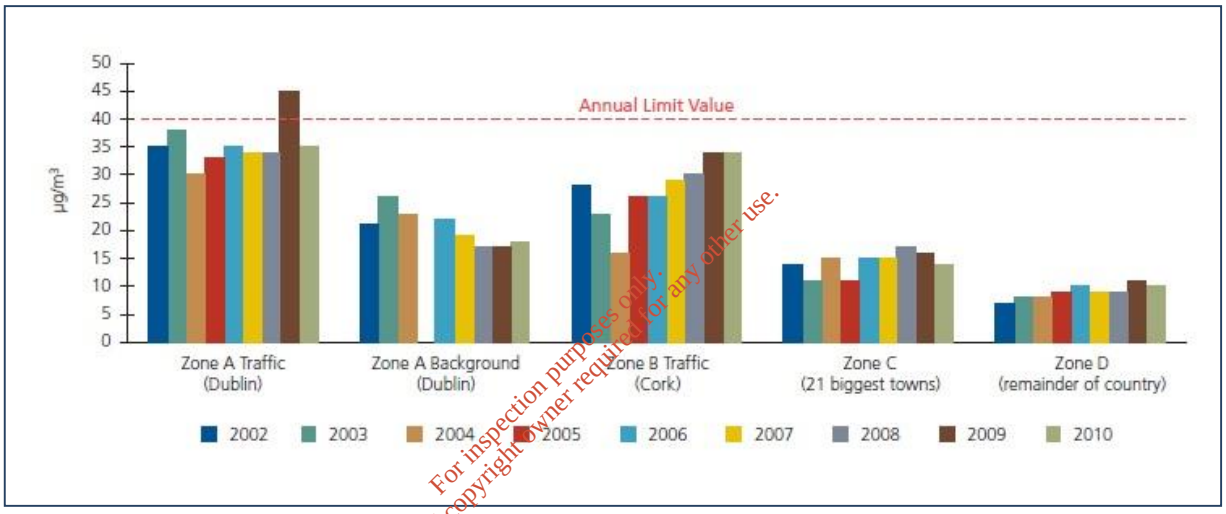

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Figure 3.6.1 Annual Mean Nitrogen Dioxide Concentrations 2002-2010 (Source: EPA)

Figure 3.6.2 Annual Mean PM_{10} Concentrations 2002-2010 (Source: EPA)

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Table 3.6-1 Emissions of the Four NEC Pollutants 1990-2010 (Source: EPA)

	1990 (kt)	1995 (kt)	2000 (kt)	2005 (kt)	2006 (kt)	2007 (kt)	2008 (kt)	2009 (kt)	2010 (kt)	2010 Emissions ceiling (kt)	Ceiling achieved?
SO_2	182.5	161.1	139.7	71.2	60.7	55.1	45.3	32.7	26	42.0	Yes
NO_X	129.2	129.5	125.1	116.6	113.4	113.0	106.2	88.8	72.6	65.0	No
vOCs	88.0	81.1	73.4	59.7	58.4	56.9	55.2	52.2	44.9	55.0	Yes
NH_3	**105.5**	**112.9**	**120.9**	**113.3**	**112.4**	**107.6**	**107.4**	**107.8**	**106.2**	**116.0**	Yes

Air quality in Ireland is of a high standard across the country and is among the best in Europe, meeting all EU air quality standards in 2010. This is due largely to prevailing clean Atlantic air and a lack of large cities and heavy industry. Over the past decade, levels of particulate matter have decreased in cities and large urban areas, arising principally from improvements in vehicle engine technology.

With regard to air emissions, the strategies implemented to achieve compliance with the EU NEC Directive have successfully controlled emissions of sulphur dioxide, ammonia and volatile organic compounds. Emissions of all three are expected to remain below the prescribed ceilings. However, levels of nitrogen oxides are expected to remain above Ireland's national emission ceiling in the short term due to sustained emissions from road transport.

For Ireland to comply with its international commitments on air quality and air emissions, industrial emissions of pollutants to air must continue to be rigorously controlled; policies must be implemented to increase the use of alternatives to the private car and improve efficiencies of motorised transport, which accounts for 40% of national energy consumption. Government departments, national agencies and local authorities must make air quality an integral part of their traffic management and planning processes. Households and businesses must use more efficient methods to burn fuel, and shift from solid fuel to cleaner alternatives including gas.

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3.6.3.2 DUST DEPOSITION

The impact of dust is usually monitored by measuring rates of dust deposition (DoE, 1995). There are currently no Irish statutory standards or EPA guidelines relating specifically to dust deposition thresholds for inert dust. There are a number of methods to measure dust deposition but only the German TA Luft Air Quality Standards specify a method of measuring dust deposition – The Bergerhoff Method (German Standard VDI 2119, 1972).

On this basis, the DoEHLG(2004) recommended that the following TA Luft dust deposition limit value be adopted at site boundaries associated with quarry developments – total dust deposition (soluble and insoluble): 350 mg/m^2/day (when averaged over a 30-day period).

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3.6.4 EXISTING ENVIRONMENT

3.6.4.1 BACKGROUND

The principle concern in respect of potential airborne dust emissions from the proposed development is the effect on residential amenity. Properties within the vicinity of the development are shown on Figures B.2.1 – Rev A and B.2.2 – Rev A, *EIS Section 2 Figures*.

The materials to be recovered are principally “soils and stone” and inert construction and demolition waste. Any dust generated by the operation will comprise inert particulate matter.

Experience of reclamation workings indicates that mechanical activity is the most significant factor in material erosion and dust generation. Dust emanates from the placement of materials, the movement of vehicles on internal roads, loading and processing operations. However the effect of wind is also an important factor in dust generation and problems may arise at reclamation workings when both factors arise simultaneously.

The impact of fugitive dust will be direct, temporary and non-cumulative and largely confined to the application site.

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3.6.4.2 AIR QUALITY

The Environmental Protection Agency (EPA) manages the National Ambient Air Quality Network. For monitoring purposes, the country is divided into four air quality zones as follows: 'A' (Dublin); 'B' (Cork); 'C' (Large Towns) and; 'D' (Rural). The Thornberry area falls into zone D.

As stated previously (Refer to Section 3.6.3.1 above) under the EU Directives, Ireland is required to monitor a number of air pollutants that have an impact on health and vegetation.

The EPA's Air Quality Index for Health (AQIH) is a scale from one to 10 that ranks air quality, and is applied to characterise the current air quality in each zone. A reading of 10 means the air quality is very poor and a reading of one to three inclusive means that the air quality is good. The current air quality index for the Rural East AQIH Region in which Thornberry is situated in is “2 - good” (Refer to Figure 3.6.3 below).

The AQIH is based on measurements of five air pollutants, all of which can harm health. The five pollutants are:

- Ozone gas
- Nitrogen dioxide gas
- Sulphur dioxide gas
- $PM_{2.5}$ particles and
- PM_{10} particles

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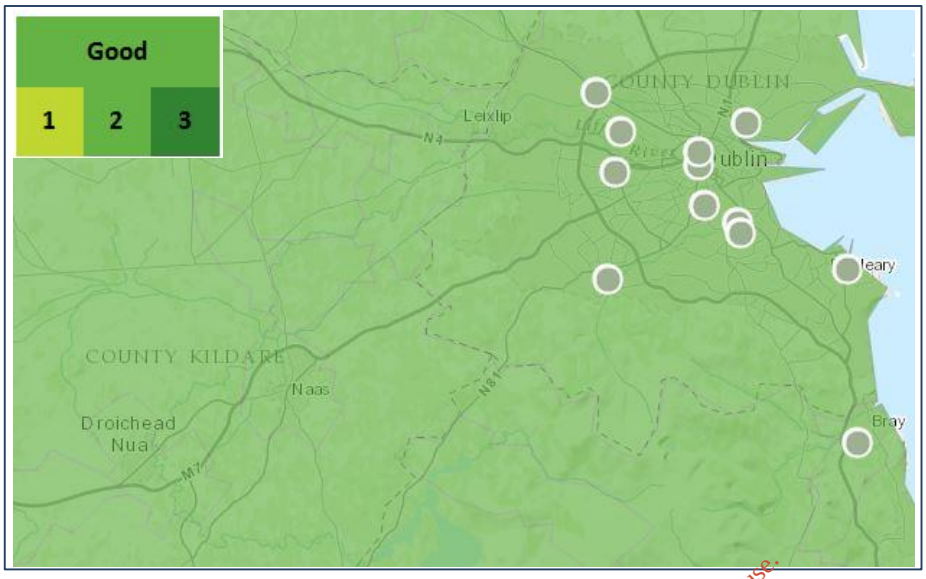

Figure 3.6.3 Air Quality Index for Health Map (EPA October 2014)

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3.6.4.3 ENVIRONMENTAL MONITORING

The existing waste management permit (WMP 30/2001B) does not specifically set any limits on dust for the site *"The permit holder shall take adequate precautions to prevent undue noise, fumes, dust, grit, untidiness, and other nuisances during the course of the works which would result in a significant impairment of or a significant interference with amenities or the environment beyond the site boundary.* "

It is proposed that the operator set up a dust monitoring programme using Bergerhoff Dust Gauges. Two dust monitoring stations (A2-4, A2-5) have been established at the site boundary (Refer to Environmental Monitoring Plan Figure F 1.0 – Rev A, *EIS Section 2 Figures*). The results of dust monitoring are provided in Table 3.6.2 below.

Dust fall is measured using the Bergerhoff method as set out in German Standard VDI 2119. The normal recommended standard for dust emissions for this type of development is that "dust deposition shall not exceed 350 mg/m^2/day measured at the site boundaries and averaged over 30 days". This limit refers to total dust (using DIN method).

The above standard is also in accordance with guidance issued by both the Department of the Environment and the EPA in relation to dust deposition monitoring for these types of developments and will continue to be applied.

This programme will allow on-going monitoring of fugitive dust emissions from the site, thereby assisting in ensuring compliance with any future requirements or regulations.

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Table 3.6-2 Dust Deposition Results (mg/m^2/day)

Monitoring Period	A2-4	A2-5
20/06/14 to 28/07/14	*	36

* *Dust Sample contaminated with organic matter (Bird droppings)*

The results show that the dust levels at the site boundary are within the recognised TA Luft dust deposition limit value of *350 mg/m^2 per day*.

3.6.5 ASSESSMENT OF IMPACTS

3.6.5.1 DIRECT IMPACTS

Fugitive dust emissions are generated wherever there is movement of dust relative to the air. The emission of fugitive dust from inert soils and stone backfilling site activities is very dependent on weather conditions. Where nuisance complaints from activities arise, they are generally as a result of a combination of specific site activities and particular weather conditions (e.g. dry, windy).

Within the application area, the following site activities may give rise to potential fugitive dust emissions:

- Internal movement of vehicles
- Tipping and levelling of placed materials
- Loading and Unloading of Vehicles
- Processing Area

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They are generally dispersed sources rather than specific point sources, and this dictates the measures required to mitigate potential dust related impacts.

The impact of fugitive dust will be direct, temporary and non-cumulative and largely confined to the application site.

The following flow diagram shows the sources of fugitive dust emissions arising on site and the methods of treatment/ abatement employed.

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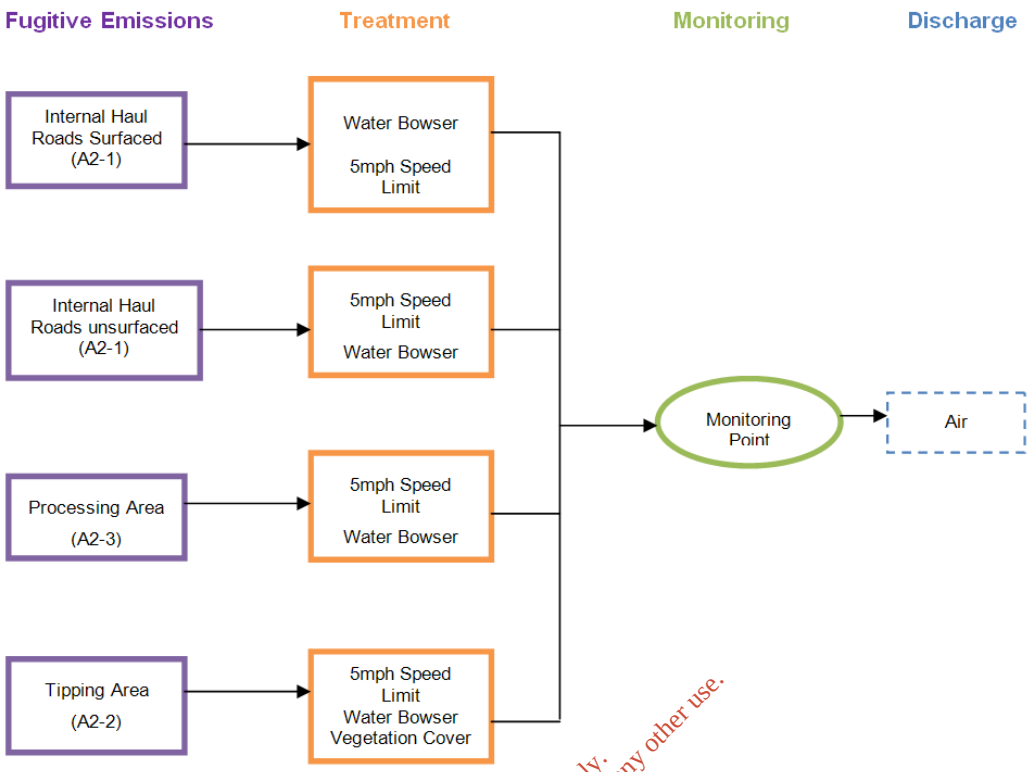

Figure 3.6.4 Operational Activities

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The impacts of any dust deposition from the operations will be direct, of short duration, temporary and largely confined to the site area. Various mitigation measures have and will continue to be implemented to minimise any impacts as much as practical (Refer to Section 3.6.6 **Error! Reference source not found.**).

The recent dust monitoring results for the operation are given above (Refer to Table 3.6-2 above). These results show that the dust levels at the site boundary are within the recognised TA Luft dust deposition limit value, and are considered typical of dust levels in the quarry area. The existing operation has in place a number of mitigation measures to ensure the continued operation of the quarry and WRF will not result in any significant impact on residences or local amenities (Refer to Section 3.6.6 **Error! Reference source not found.**).

The Air Quality Standards Regulations (2002 S.I. No. 271 of 2002) sets limit values for sulphur dioxide, nitrogen dioxide, particulate matter and lead in ambient air. The regulations apply to ambient air quality in the vicinity of land use/development types including quarries. The development requires movement of materials by road, and transport by other methods is not practical in this situation. Given the proximity of the site to the National Road network fuel consumption and therefore exhaust emissions will be reduced relative to more removed locations. The current air quality in the region is known to be “good” (Refer to Section 3.6.4.2 above), and thus the impact on air quality with respect to the existing quarry/WRF is considered to be negligible.

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3.6.5.2 INDIRECT IMPACTS

Apart from the direct impact of the deposition of particulate material, there may be an associated visual impact with fugitive dust generation. This impact will be minimised by both the mitigation measures described to minimise dust in Section 3.6.6 below and those described to minimise visual impacts in Section 3.8.

3.6.5.3 INTERACTION WITH OTHER IMPACTS

There are no interactions with other impacts associated with air quality issues.

3.6.5.4 CUMULATIVE IMPACT

The quarry at Thornberry lies directly to the north of the Arthurstown Landfill site. The Arthurstown landfill recently ceased operation (August 2014). The dust monitoring results shows that there has been no significant cumulative impact with respect to the operation of both developments.

The restoration works using imported "soil and stone" are no different from normal quarry restoration operations. As such there is no cumulative impact with respect to the movement and placement of materials during the progressive restoration of the quarry development.

The proposed development will also be operated within acceptable standards for this type of development.

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3.6.6 MITIGATION & MONITORING

A number of measures have been adopted to minimise dust emissions to the atmosphere from general site activity, internal haulage, processing and tipping operations as follows

- During dry weather the haul roads are sprayed with water to dampen any likely dust blows. A water bowser will be available on site as required for this purpose.
- Consideration will be given to location of mobile plant so as to ensure that any principle dust sources cannot adversely affect sensitive off-site locations.
- Static and mobile wet dust suppression systems will be located at strategic points in the process if required.
- Drop heights are kept to a minimum by using short conveyors and maintaining stocks under the head drum load out points.
- Main site haulage routes within the site shall be maintained with a good temporary surface, as is the case at present.
- All internal roadways will be adequately drained, to prevent ponding.
- Suitable vegetation is to be provided on restored areas at the earliest opportunity.
- Ongoing dust monitoring to ensure threshold limits are not exceeded.

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Dust emissions from the facility will be controlled and monitored. Dust emissions and their management will be addressed in the 'Environmental Management System' (EMS) for the Thornberry site.

It is considered given the nature of the activity, control and abatement measures and management of the existing quarry that emissions of pollutants (as defined in Waste Management Acts 1996 to 2003 and Air Pollution Acts 1992 and 1987 respectively) to the atmosphere are not likely to degrade the environment (i.e., be injurious to public health, or have a deleterious effect on flora or fauna or damage property, or impair or interfere with amenities or with the environment).

The active working area of the site will be inspected frequently during dry, windy weather to assess the potential for dust blows, and when necessary, appropriate dust suppression and control measures will be implemented in response.

These measures are considered sufficient to ensure that dust emissions will remain below recognised thresholds for this type of development.

3.6.7 RESIDUAL IMPACT

Given the low inherent potential for dust generation and dispersion from the proposed development, the rural location, and the mitigation measures incorporated in the design, it is anticipated that the effect on the existing air quality will be negligible, and no residual impacts are predicted.

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3.6.8 REFERENCES

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6. Quarries and Ancillary Activities Guidelines for Local Authorities 2004, Department of the Environment, Heritage and Local Government (DoEHLG) 2004

Internet Sources

http://epa.ie EPA

http://ec.europa.eu/environment/eia/eia-guidelines/g-screening-full-text.pdf European Commission (2001) Guidance on EIA Screening

http://www.irishstatutebook.ie/home.html Irish Statute Book, Office of the Attorney General

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3.7 NOISE

3.7.1 INTRODUCTION

This section of the EIS deals with the issue of noise associated with the development of a Waste Recovery Facility (WRF) at Thornberry quarry.

The section will determine the existing environment with respect to noise by assessing the level of noise in the vicinity of the site, the potential impacts on the environment, and propose appropriate mitigation measures, if required, by the applicant to avoid, reduce or remedy any significant adverse impacts on the environment.

3.7.2 METHODOLOGY

The baseline study comprised a desktop review of relevant policy, legislation including guidance with respect to noise emissions.

The purpose of the baseline study was to assess existing levels of noise associated with the Thornberry site. Noise measurements surveys were undertaken at a number of noise sensitive locations and the results analysed to determine noise conditions. From these results, an assessment can be made of the impact of the development on the existing noise levels of the area.

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The following has been taken into consideration with respect to noise monitoring surveys:

- Measurement of noise levels was undertaken using Type 1 instrumentation;
- Cognisance was taken of the EPA's 'Guidance Note for Noise: Licence Applications, Surveys and Assessments in relation to Scheduled Activities (NG4);
- The surveys were carried out in accordance with 'ISO 1996 Acoustics - Description and Measurement of Environmental Noise: Parts 1/2/3'.

The following parameters were recorded during the noise monitoring surveys:

$L_{Aeq, T}$ is the equivalent continuous A-weighted sound pressure level, in decibels, determined over a time interval *T* (the sampling interval).

$L_{A10,T}$ the A weighted level of noise exceeded for 10% of the specified measurement period (T). It gives an indication of the upper limit of fluctuating noise such as that from road traffic.

$L_{A90,T}$ the A weighted noise level exceeded for 90% of the specified measurement period (T). It is typically used as a descriptor for background noise, giving an indication of the underlying noise level or the level that is almost always their between intermittent noise events.

The "A" suffix denotes the fact that the sound levels have been "A-weighted" in order to account for the non-linear nature of human hearing.

L_{eq} is recommended by the International Organisation for Standardisation (ISO) for measuring and rating noises for traffic areas and for the description of environmental noise.

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3.7.2.1 EMISSION LIMIT VALUE

In accordance with the EPA (2012) Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4):

Typical Limit Values for Noise from Licensed Sites
Daytime (07:00 to 19:00hrs) – 55dB LAr,T; Evening (19:00 to 23:00hrs) – 50dB LAr,T; Night-time (23:00 to 07:00hrs) – 45dB LAeq,T

Under the above guidelines quarrying is considered a specific activity. Detailed guidance in relation to noise and vibration associated with these activities is provided in the Agency publication Environmental Management in the Extractive Industry (Non-Scheduled Minerals) Environmental Management Guidelines (2006). Section 3.5 Noise & Vibration of this document sets out appropriate Emission Limit Values (ELV's) and deals with control of noise, vibration and air overpressure. i.e.

In relation to quarry developments and ancillary activities, it is recommended that noise from the activities on site shall not exceed the following noise ELVs at the nearest noise-sensitive receptor:

Daytime:	08:00–20:00 h	LAeq (1 h) = 55 dBA
Night-time:	20:00–08:00 h	LAeq (1 h) = 45 dBA

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It is therefore considered that the above EPA threshold should be applied for this development as this limit is a recognised standard within the industry and is a limit that is set by most of the Local Authorities. These levels are consistent with guidance issued by the Department of the Environment: "Quarries and Ancillary Activities – Guidelines for Planning Authorities (2004) DOEHLG".

3.7.3 EXISTING ENVIRONMENT

The lands are being restored to agricultural use by importation and recovery of inert materials in accordance with a phased restoration scheme. Designated internal haul roads are used to direct site traffic to the current tipping area. A bulldozer is used to appropriately grade and compact the material to the desired profile as shown by the detailed plans and sections (Refer to Figures B.2.4 – Rev. A and B.2.5, *EIS Section 2 Figures*). There is also intermittent noise associated with the sand and gravel pit and Construction and Demolition processing operations.

The principle concern in respect of potential noise emissions from the development is the effect on residential amenity. Properties within the vicinity of the development are shown on Figure B.2.2 – Rev A, *EIS Section 2 Figures*. As shown the nearest noise sensitive locations

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are to the north and west. The residence to the north belongs to the landowner of the application site.

The main noise sources in the area are from the Local L2019 Road and adjacent Arthurstown Landfill Facility (*recently closed, August 2014*). Noise monitoring to date has shown that site activity at the existing facility are within accepted thresholds for this type of development (Refer to Section 3.7.3.1 below).

3.7.3.1 NOISE MONITORING

Noise monitoring is carried out at nearby residences and site boundaries adjoining same (Refer to Figure F.1.0 – Rev A, *EIS Section 2 Figures*).

3.7.3.1.1 Noise Monitoring Survey 23/07/14

A baseline noise monitoring survey was undertaken at the site to determine the existing noise levels. The noise monitoring survey was carried out on the 23/07/14. The results of the noise survey are provided in Table 3.7.1 below.

Table 3.7.1 Noise Monitoring Results – 23/07/14

Location	Sampling Interval	L_{Aeq} dB	L_{A10} dB	L_{A90} dB	Sampling notes
N4	12:56-13:57hrs *23/07/14*	49.1	45.96	31.05	The weather conditions prevailing at the time were warm and sunny (20°C) with very light easterly breeze. 2 loads delivered during period. Bulldozer grading.
N5	-	-	-	-	Not measured on day. Location is removed from residences and directly adjoins Arthurstown Landfill. Arthurstown Landfill was undergoing final restoration and noise levels at location reflected adjoining operations and not the Site at Thornberry.
N6	14:03-15:08hrs *23/07/14*	46.61	48.33	34.32	The weather conditions prevailing at the time were warm and sunny (20°C) with very light easterly breeze. 4 loads delivered during period. Bulldozer grading.

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The noise levels measured on site are in compliance within the accepted EPA threshold for this type of development (Refer to Section 3.7.2.1 above).

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3.7.3.1.2 Noise Monitoring Survey 26/01/09

Noise monitoring was also undertaken on 26th January 2009 on the site boundaries adjoining the two nearest noise sensitive residences (including the landowner's) as shown by the attached Environmental Monitoring Plan Figure F.1.0 – Rev A, *EIS Section 2 Figures*.

Table 3.7.3 Noise Monitoring Results - Location N4 – 26/01/09

Station	Sound Pressure Levels		
	$L(A)_{eq}$	$L(A)_{10}$	$L(A)_{90}$
N4 1030-1130 hrs	51.2	54.7	46.7
N6 Site Entrance 1200-1300 hrs	43.8	50.6	36.3

Notes: 1. Weather Conditions – dry and overcast with sunny spells, Wind < 5 m/s, 5-6ºC.

2. Sand & Gravel Pit & Recovery Operations were taken place for all monitoring periods

The noise levels measured on site were in compliance within the accepted EPA threshold for this type of development (Refer to Section 3.7.2.1 above).

It is considered that the noise monitoring results from 2009 could be regarded as a worst case scenario with both quarry operations including restoration activities ongoing at the time. The current backfilling quarry restoration operations as shown by the monitoring results of 23/07/14 are at a much lower intensity. Furthermore, the adjoining Arthurstown Landfill site has ceased operations.

The results of monitoring to date shows that the development can comply with the noise level threshold as specified and as a consequence the development will have no significant effects regards noise levels in the area.

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3.7.4 ASSESSMENT OF IMPACTS

3.7.4.1 DIRECT IMPACTS

The main source of noise and vibration on site is from:

- Movement of trucks on internal haul roads and tipping of material
- Bulldozer placing and grading the infill material
- Processing Plant

Given the nature of the development the location of the above will vary dependent on area of site being restored (Refer to Figure B.2.1 – Rev A, *EIS Section 2 Figures*).

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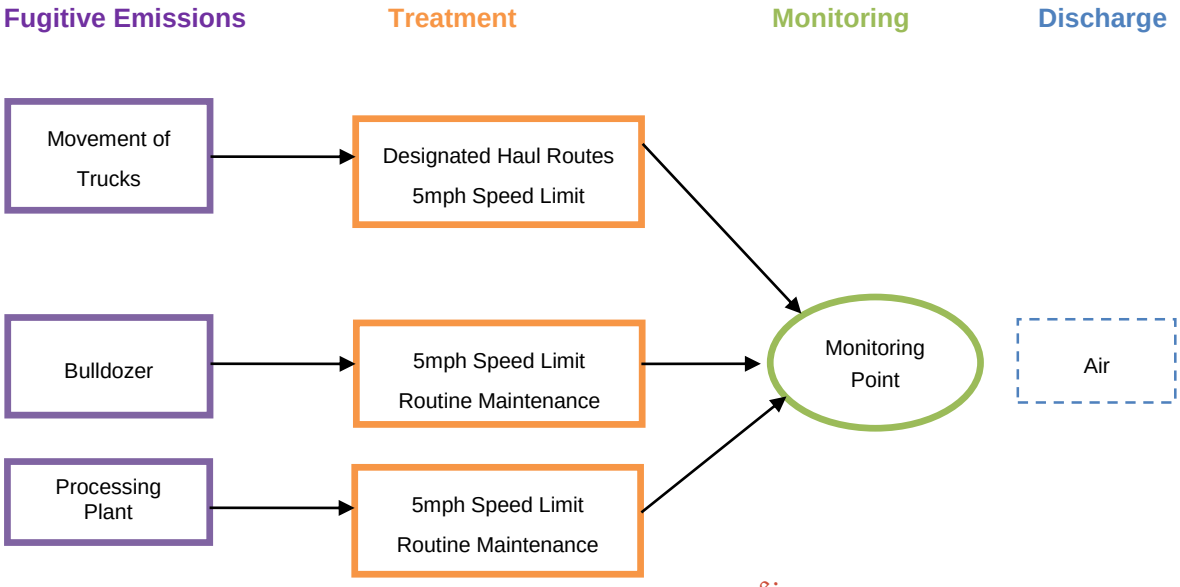
The following flow diagram shows the main sources of noise emissions arising on site and the methods of treatment/abatement employed.



The existing facility has been in operation under Waste Management Permit since 2001. Noise monitoring to date has shown that noise levels due to site activity are within acceptable thresholds for this type of development.

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3.7.4.2 INDIRECT IMPACTS

The main noise sources in the area are from the associated sand and gravel extraction operation, Local Road and the adjacent Arthurstown Landfill Facility.

Noise monitoring to date has shown that site activity at the existing facility including the influence of the above extraneous sources are within accepted thresholds for this type of development (Refer to Section 3.7.3.1 above). As stated previously, the current backfilling quarry restoration operations are at a much lower intensity than in previous years. Furthermore, the adjoining Arthurstown Landfill site has ceased operations.

The restoration works using imported “soil and stone” are no different from normal quarry restoration operations. As such there is no cumulative impact with respect to the movement and placement of materials during the progressive restoration of the quarry development.

The proposed development will also be operated within acceptable standards for this type of development.

3.7.4.3 INTERACTION WITH OTHER IMPACTS

There are no interactions with other impacts at the site. As regards disturbance, few if any animals are sensitive to noise from this sort of operation. Furthermore, as this is an established operation all species have had time to adjust.

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3.7.5 MITIGATION & MONITORING MEASURES

3.7.5.1 MITIGATION

Noise resulting from the operations can be kept to acceptable levels by the implementation of good design, effective operation and management and by the adoption of 'best practices'. Reducing noise at source wherever possible is the most effective way of minimising the impact but barriers and screens between noise source and receptor can also be used to very good effect.

The type of mitigation techniques implemented to reduce noise are detailed below:

- The provision of temporary peripheral screen banks to screen site activities from outside views as necessary.
- General site activity will be within the existing pit and below the level of the nearest residences.
- The use of designated haul roads to ensure that site traffic is removed from nearest noise sensitive receptors.
- Regular maintenance of all plant and machinery is an integral part of site management and is important in helping to minimise noise impact.
- All plant and equipment will conform to noise emission limits set out in Statutory Instrument No. 320 of 1998 European Communities Construction Plant and Equipment-Permissible Noise Levels (Regulations, 1998) and amendment set out in Statutory Instrument No. 359 of 1996.

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3.7.5.2 MONITORING

The operator has established an environmental monitoring programme to include noise monitoring.

It is proposed to continue to carryout noise monitoring at the three locations (N4 to N6) which includes the nearest noise sensitive locations (Refer to Figure F.10 – Rev A, *EIS Section 2 Figures*). It is proposed to carryout noise monitoring on a bi-annual basis.

The results of monitoring to date shows that the development can comply with the noise level threshold as specified and as a consequence the development will have no significant effects regards noise levels in the area. Noise emissions and their management will be addressed in the 'Environmental Management System' (EMS) for the Thornberry site.

This programme will allow on-going monitoring of noise emissions from the site, thereby assisting in ensuring compliance with any future requirements or regulations.

Through implementation of the proposed mitigation measures it is considered the development will continue to have no significant effects with regard to noise levels on the local residences, their property, livestock and amenity.

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3.7.6 RESIDUAL IMPACT

Through implementation of these mitigation measures it is considered the development will have no significant effects with regard to noise levels on the local residences, their property, livestock and amenity.

Based on the impact assessment and existing mitigation measures in place, no additional remediation measures are considered necessary with respect to noise.

3.7.7 REFERENCES

1. British Standard 5228: Noise and vibration control on construction and open sites, British Standards Institute (BSI) 1997
2. Environmental Management in the Extractive Industry, Environmental Protection Agency (EPA) 2006
3. Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4), Environmental Protection Agency (EPA) 2012
4. Quarries and Ancillary Activities Guidelines for Local Authorities 2004, Department of the Environment, Heritage and Local Government (DoEHLG) 2004

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3.8 LANDSCAPE

3.8.1 INTRODUCTION

All projects and developments that require an Environmental Impact Statement (EIS) *by virtue of their nature, size and location*, have the potential to have an impact on the environment. This section of the EIS is essentially an overview of the landscape and visual amenity within the vicinity of the proposed development, coupled with an assessment of the potential impact, if any, of the proposed development on the existing environment in respect of these issues. The section addresses the landscape and visual impacts with respect to the proposed continued operation of a Waste Recovery Facility (WRF) at the Thornberry quarry site.

The application site is located within the Townland of Thornberry, County Kildare, 2km southeast of Kill, and c. 6.5km east of County Town of Naas. The site is located on the east side of the local L2019 road (Refer to EIS Figure A1.0, EIS Section 2 Figures). The L2019 road runs from Rathcoole c. 12.5km in a southwesterly direction to Beggars End crossroads, and follows the southwesterly oriented topographic contours, which parallel the orientation of the leading edge of the Eastern Uplands and the Wicklow Mountains.

Most site traffic serving the WRF is either off the N7 dual carriageway at Junction 7 north Kill, c. 2km north of the site, or off the N81 north of Blessington, c. 6km southeast of the site. The site lies c. 2km southeast of Kill, whilst the next nearest major settlements or towns are Naas at c. 6.5km to the west, Sallins c. 7km to the west, Blessington c. 7.5km to the southeast, Rathcoole c. 8km to the northeast, Clane c. 10.5km to the west northwest, Cellbridge c. 12km to the north, Tallaght c. 15km to the northeast, Leixlip c. 15.5km to the east northeast, Maynooth c. 16.5km to the north, Kilcullen c. 17.5km to the southwest, Newbridge c. 17.5km to the west southwest, and Dublin City c. 25km to the northeast. Thus, the WRF is well positioned to deliver recovery of inert soil and stone from a populous catchment area that includes numerous large towns and settlements. The site location is highlighted on EIS Figure A1.0, EIS Section 2 Figures whilst the WRF, which covers an area of c. 10ha, and which comprises the bulk of the applicants leaseholding (i.e., 11.4ha) are shown edged red and green, respectively on EIS Figure B 2.2, Rev. A, EIS Section 2 Figures.

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The landscape consists of the visible characteristics of an area or region, including those elements that are physiographic (e.g., mountains and rivers), biological (e.g., vegetation and animals), transient (e.g., weather and climate), and human (e.g., built structures and land use). Landscapes variously combine human cultural influences superimposed on nature, creating places of unique character and identity, and by contributing to individual and social wellbeing and quality of life, are important in human fulfilment and in reinforcement of identity. Landscape also constitutes a resource favourable to economic activities, particularly tourism.

The European Landscape Convention 2000 states that landscape is “an area as perceived by people, whose visual features and character are the result of the action of natural and / or cultural (that is human) factors…landscapes evolve through time as a result of being acted upon by natural forces and human beings”.

EPA (2003) offers guidance on the description of the landscape in terms of context, character, significance and sensitivities, the analysis of the potential impacts on the landscape, and any

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proposed mitigation measures. This section also indicates the associated sections within the EIS that consider these impacts and any proposed mitigation measures.

The assessment of the landscape and visual impacts of the WRF has been prepared in accordance with the Advice Notes on Current Practice (in the preparation of Environmental Impact Statements), published by the EPA (2003).

3.8.2 METHODOLOGY

3.8.2.1 BASELINE STUDY METHODOLOGY

The landscape and visual baseline study comprised a desktop study with follow-up field survey in the vicinity of the site. Analysis of the visual baseline information was used to identify the extent and nature of the existing views of the site from the principal representative viewpoints, and the nature and characteristics of the visual amenity of the potentially sensitive visual receptors.

3.8.2.2 METHODOLOGY FOR ASSESSMENT OF LANDSCAPE ASPECTS

Landscape effects consist of the changes in the landscape, its character and quality that might result from development. The effect that these changes have on the landscape reflects the sensitivity of that landscape to change and the magnitude of that change.

The assessment methodology was conducted in accordance with the EPA '*Guidelines on the Information to be contained in Environmental Impact Statements'* (EPA 2002). During the assessment, consideration was given to both the importance of an attribute and the magnitude of the potential environmental impacts of the proposed activities on that cited attribute. These impact ratings are in accordance with impact assessment criteria provided in the afore-mentioned EPA (2002) publication (Refer to Table 3.1.3 - Glossary of Impacts following EPA Guidance Documents).

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For the purpose of assessment a matrix has been developed (Refer to Table 3.8.1) to define the significance of the landscape impacts. In completing the matrix the landscape resource is considered in terms of magnitude of change in landscape characteristics and sensitivity of the landscape to accommodate change or intervention without suffering unacceptable effects to its character and values. The significance of impact is the relationship between magnitude and sensitivity.

The sensitivity of the area was devised by consideration of designations such as Special Protection Areas, Natural Heritage Areas, by reference to Ordnance Survey 1:50:0000 discovery sheet mapping, aerial photography and any distinctive features of interest within the study area.

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3.8.2.3 METHODOLOGY FOR ASSESSMENT OF VISUAL ASPECTS

Visual impact is the result of a change in view from receptors such as residences, prospects, public pathways and roads with views of the site. The magnitude of impact is assessed according to the scale of the effect, which will depend largely upon the size and type of the development and the distance of the receptor from the site.

Residential properties are considered the most sensitive receptors to changes in view whereas road users are the least sensitive as their experience is transient. The significance of visual impact depends upon the sensitivity of the receptor and the magnitude and duration of the effect.

The visual study consisted of a number of steps:

1. Examination of the Kildare County Development Plan (CDP) 2011-2017 and supporting documentation was undertaken.
2. Ordnance Survey Ireland (OSi) Discovery Series 1:50,000 and OSi 1:5,000 raster mapping and aerial photography were examined (Refer to Figures A 1.0 and B 2.2 – Rev. A, *EIS Section 2*).
3. Visual impacts are best assessed from specific viewpoints. Principal viewpoints were mapped and these views illustrated by photographs with annotations to describe any important characteristics, and the changes that have arisen as a result of the development (Refer to Figure 3.8.1 and Plates 3.8.1 to 3.8.6).
4. For the purpose of assessment a matrix has been developed (Refer to Table 3.8.2) to define the significance of the visual impact with respect to the principal viewpoints identified.

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3.8.3 PLANNING POLICY CONTEXT

Kildare possesses a diverse range of landscapes, including extensive lowlands in the north and south, uplands at the foothills of the Wicklow Mountains in the east, tracts of boglands in the northwest, the undulating central undulating lands, including the Curragh, and several important waterways, such as the Liffey and Barrow River Corridors and the Royal Canal. These landscapes intrinsically constitute an invaluable element of Kildare's natural resource base. The sensitive development and conservation of this resource is essential to the underpinning of a strengthened rural economy and quality of life.

Planning legislation and national guidelines, such as the Draft Guidelines on Landscape and Landscape Assessment (DoEHLG) indicate that conservation of the landscape in all its contexts must now be integrated into all aspects of planning policy.

The Kildare Landscape Character Assessment, which constitutes part of the Kildare County Development Plan (CDP) 2011-2017 (i.e., Appendix 3), identifies and describes the landscape character of the entire county. It also evaluates the capacity of different areas to accept change, without disproportionate effects and proposes a series of policies and recommendations to guide developments in each type of landscape.

It is the aim of the Kildare County Development Plan "To provide for the protection, management and enhancement of the landscape of the county and to ensure that

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development does not disproportionately impact on the landscape character areas, scenic routes, or protected views through the implementation of appropriate policies and objectives to ensure the proper planning and sustainable development of the area" (Refer to CDP Chapter 14).

The following development plan policies and objectives are considered relevant with respect to the landscape, and views and prospects:

In respect of General Landscape Policies, it is the policy of Kildare County Council:

LA 1	To ensure that consideration of landscape sensitivity is an important factor in determining development uses. In areas of high landscape sensitivity, the design, type and the choice of location of proposed development in the landscape will also be critical considerations.
LA 2	To protect and enhance the county's landscape, by ensuring that development retains, protects and, where necessary, enhances the appearance and character of the existing local landscape.
LA 3	To require a Landscape/Visual Impact Assessment to accompany significant proposals, located within or adjacent to sensitive landscape. This assessment will provide details of proposed mitigation measures to address negative impacts.
LA 4	To seek to ensure that local landscape features, including historic features and buildings, hedgerows, shelter belts and stone walls are retained, protected and enhanced where appropriate, so as to preserve the local landscape and character of an area, whilst providing for future development.

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In respect of Transitional Character Areas, it is the policy of Kildare County Council:

TA 1	To maintain the visual integrity of areas, which have retained an upland character.
TA 2	To recognise that the lowlands in the transitional area are made up of a variety of working landscapes that are critical resources for sustaining the economic and social well-being of the county.
TA 3	To continue to permit development that can utilise existing infrastructure, whilst taking account of local absorption opportunities provided by the landscape, landform and prevailing vegetation.
TA 4	To continue to facilitate appropriate development, in an incremental and clustered manner, where feasible, that respects the scale, character and sensitivities of the local landscape, recognising the need for sustainable settlement patterns and economic activity within the county.

In respect of Scenic Routes and Protected Views, it is the policy of Kildare County Council:

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SR 1	To protect views from designated scenic routes by avoiding any development that could disrupt the vistas or disproportionately impact on the landscape character of the area thereby affecting the scenic and amenity value of the views.

In respect of Hill Views, it is the policy of Kildare County Council:

HV 1	To protect the upland Landscape Character Areas as identified in the Landscape Character Assessment and to ensure that development on or in the vicinity of the upland areas does not disproportionately affect views to and from the hills, or impact on the landscape character of the area as a whole.

In respect of Landscape, it is an objective of Kildare County Council:

LO 1	To have regard to the Landscape Sensitivity Classification of sites in the consideration of any significant development proposals.
LO 2	To ensure landscape assessment will be an important factor in all land-use proposals.
LO 4	To protect the visual and scenic amenities of County Kildare's built and natural environment.
LO 5	To preserve the character of all important views and prospects, particularly upland, river, canal views, views across the Curragh, views of historical or cultural significance (including buildings and townscapes) and views of natural beauty.
LO 6	To preserve and protect the character of those views and prospects obtainable from scenic routes identified in this Plan, listed in Table 14.2 and identified on Map 14.3.
LO 7	To encourage appropriate landscaping and screen planting of developments along scenic routes. Where scenic routes run through settlements, street trees and ornamental landscaping may also be required.

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Chapter 10 of the Kildare CDP sets out the rural settlement strategy that will be applied by Kildare County Council to ensure the continued vitality and viability of the rural area. The Council's aim in terms of Rural Development is "To support the provision of a high quality rural environment; encourage diversification and improved competitiveness of the rural economy; sustain the livelihood of rural communities and promote the development of the wider rural economy, all within the context of the sustainable management of land and resources".

Insofar as the current regime of landscaping, screening and phased restoration at the quarry site, which encloses the WRF site, is being operated and restored using imported inert soils, Chapter 10 of the CPD dealing with rural development and extractive industries are relevant. In section 10.7, the Council acknowledges that gravel resources are important to the general economy and provide a valuable source of employment in some areas of the county. The Council's aim in terms of Sand and Gravel Extraction is "To ensure that adequate supplies of

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aggregates are available to meet the future needs of the county and region in line with the principles of sustainable development and environmental management".

The nature of the extractive industry is such that the development is required where the resource occurs, and may give rise to land use and environmental issues. It is essential that aggregates are sourced without significantly damaging the landscape, environment, groundwater and aquifer sources, road network, heritage and/or residential amenities of the area. In this regard, it is important to note that the Council states that "Sand and gravel workings on the other hand can easily be restored to agricultural use".

In respect of the Extractive Industry, and in particular site rehabilitation, it is the policy of Kildare County Council:

EI 1	To have regard to the Quarries and Ancillary Activities Guidelines for Planning Authorities (2004) published by the DoEHLG or as may be amended from time to time.
EI 4	To ensure that extraction activities address key environmental, amenity, traffic and social impacts and details of rehabilitation.
EI 5	To ensure that development for aggregate extraction, processing and associated concrete production does not significantly impact the following: • Special Areas of Conservation (SACs). • Special Protection Areas (SPAs). • Natural Heritage Areas (NHAs). • Other areas of importance for the conservation of flora and fauna. • Areas of significant archaeological potential. • The vicinity of a recorded monument. • Sensitive landscape areas as identified at Chapter 14 of the Development Plan. • Scenic views and prospects. • Protected Structures. • Established rights of way and walking routes
EI 10	To require detailed landscaping and quarry restoration plans to be submitted with each application. Habitats and species surveying shall be carried out and shall influence the restoration plan for the site.
EI 12	To ensure that all existing workings are rehabilitated to suitable land uses and that extraction activities allow for future rehabilitation and proper land use management.

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In respect of the Extractive Industry, it is an objective of Kildare County Council:

EO 2	To ensure that the extractive industry minimises and/or mitigates any adverse visual and/or environmental impacts on the built or natural environment through adherence to the EPA publication Environment Management in the Extractive Industry (Non-scheduled minerals) 2006 and any subsequent revisions and the requirements of the Programme of Measures from the River Basin Management Plans.

3.8.4 RECEIVING ENVIRONMENT DESKTOP STUDY

As part of the assessment an examination of the Kildare County Development Plan (CDP) 2011-2017 was undertaken. Ordnance Survey Ireland (OSi) Discovery Series 1:50,000 and OSi 1:5,000 raster mapping and aerial photography were examined (Refer to A1.0 and B 2.2 – Rev. A, EIS Section 2 Figures).

A topographical survey of the existing site was carried out and modeled using digital terrain modeling software (Refer to Figure B 2.1 – Rev A, EIS Section 2 Figures), from which cross sections were produced (Refer to Figure B 2.5 Rev. A, EIS Section 2 Figures). The desktop study was used to determine the nature of the visual amenity of the area, along with the approximate visibility of the development, which is determined through topographic analysis of map data. Potential receptors of visual effects, including residents and visitors through the area were also identified.

Visual impacts are best assessed from specific viewpoints. Principal viewpoints were mapped within the study area and these views illustrated by photographs with annotations to describe any important characteristics, and the changes that have arisen as a result of the development (Refer to Figure 3.8.1 and Plates 3.8.1 to 3.8.6).

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3.8.4.1 FIELD SURVEY

A Site visit were undertaken on 20/06/2014. The purpose of the site visit was to become familiar with the site, establish the general landscape character of the area and identify principle representative viewpoints including residences, prospects, public pathways and roads with views of the site. The actual extent of visibility was also checked in the field due to the localised screening effects of buildings, walls, fences, trees, hedgerows and banks. Potential seasonal screening effects were also identified where necessary and recorded.

The visual survey also includes and is supported by a comprehensive photographic record from the principal and other relevant viewpoints. The photographs were taken at eye level (i.e., 1.6 metres above ground level) at the point of interest towards the development area using a digital camera. A panoramic image was produced by the careful ‘stitching’ together of single-frame images for each identified view.

The analysis of the visual baseline information identifies the extent and nature of the existing views of the site from the principal representative viewpoints, and the nature and characteristics of the visual amenity of the potentially sensitive visual receptors.

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Principal viewpoints were mapped and these views illustrated by photographs with annotations to describe any important characteristics, and the changes that have arisen as a result of the development (Refer to Plates 3.8.1 to 3.8.6).

3.8.4.2 LANDSCAPE BASELINE CONDITIONS

3.8.4.2.1 Site Area Description

The site of Thornberry WRF is located in a rural area in the townland of Thornberry, c. 2km southeast of Kill, whilst the next nearest town is the County Town, Naas at c. 6.5km to the west. The WRF site is co-located within the Thornberry quarry site, and occupies c. 10ha within a leaseholding of c. 11.4ha. The site is L-shaped, being c. 700m in length, c. 100m wide, and c. 300m wide at the base of the L, and is located on lands immediately north of Arthurstown Landfill, with direct access to local road L2019, which fringes the western boundary of the landholding, and the western limit of the leaseholding and application site.

Other nearby towns include Sallins c. 7km to the west, Blessington c. 7.5km to the southeast, Rathcoole c. 8km to the northeast, Clane c. 10.5km to the west northwest, Cellbridge c. 12km to the north, Tallaght c. 15km to the northeast, Leixlip c. 15.5km to the east northeast, Maynooth c. 16.5km to the north, Kilcullen c. 17.5km to the southwest, Newbridge c. 17.5km to the west southwest, and Dublin City c. 25km to the northeast. The site lies c. 2km south of Junction 7 on the N7 dual carriageway (north of Kill), and c. 6km northwest of the N81 (north of Blessington). Thus, the Thornberry site is strategically located within a catchment area with numerous large settlements, such as Kill, Naas, Sallins, Blessington, Clane, Kilcullen, Newbridge and the southern sector of the Dublin Metropolitan area, rendering the WRF well positioned to recover large volumes of inert soil and stone. The site location is highlighted on Figure 3.8.1 at a scale of 1:50,000.

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Topography

The Thornberry area is located in the plain of the Kill River within the larger Liffey River Catchment. The site sits near the headwaters, and on the south side, of the Kill River catchment basin, in which the river flows off the uplands in a roughly west northwest direction, c. 500m north of the site. A tributary stream of the Kill River flows immediately east of, and delineates the boundary of, the landholding, whilst the quarry and WRF site is setback by a buffer zone of 30m. The Kill River merges with the Painestown River north of Kill, and in turns flows into the Morell River c. 3km south of Straffan. The Morell River is a tributary of the Liffey River, and drains into the Liffey, downstream of Straffan Demesne and the K club, c. 1km south of Straffan village.

The L2019 runs from Rathcoole c. 12.5km in a southwesterly direction to Beggars End crossroads, and follows the southwesterly oriented topographic contours, which parallel the orientation of the leading edge of the Eastern Uplands and the Wicklow Mountains. The site is situated at approximately 135-150m AOD in an area characterised as rural in nature, but which is peripheral to the urban area of Kill and Naas. The area is identified as the Eastern Transition by Kildare County Council (2011), and is dominated by calcareous greywacke siltstones and shales of the Carrighill Formation. The landscape constitutes a transition from

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lowlands developed on limestones to the west, to the foothills of the Wicklow Mountains developed on more indurated Lower Palaeozoic siliceous metasediments to the east.

The wider landscape around Thornberry is generally of undulating topography and rolling low hills (elev. c. 100-200m AOD), with views of the lowlands (c. 70-80m AOD) to the west, and the uplands and Wicklow Mountains to the east. The landscape is characterised by mature hedgerows with many hedgerow trees, whilst the land is predominantly in pasture, used mostly for stock rearing, and some mixed tillage. Areas of coniferous forestry, some new deciduous forestry and some successional woodland also occur in this landscape area. Mature hedgerows with many trees tend to create enclosed rural road corridors with restricted views. The workings are effectively screened from views on local road L2019 by intervening mature and heavily wooded hedgerows, but are open to distant views from elevated ground to the east.

The sand and gravel quarry at Thornberry, and at the adjoining Arthurstown Landfill site, were developed on a meandering, glacial ridge known as a moraine, in order to extract the constituent sand and gravel. The topography of the site and immediate surroundings to the south and east, incorporating Arthurstown, is disturbed or modified due to quarrying, landfill, waste recovery and land restoration operations. This differs from the topography of the wider area within c. 1km, particularly to the north, where the landform is relatively flat to undulating, and seems to reflect the nature of the Eastern Transition area as a 'bench' within a regional scale "ridge and bench" landform.

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The unrestored sections of the quarry have a typically irregular, but concave topographic profile reflecting the quarry void (min. elev. ≥ 135m AOD). These are dominated by bare, exposed ground with hedgerows and fragments of scrub at the edges of the site, and with stockpiles of aggregate products and intact materials. The partly restored section of the quarry is being restored back to a convex or domed profile (max. elev. ≤ 150m AOD). Overburden stripped to access sand and gravel resource has been used for restoration of completed sections of the excavation. The existing topographical contours are shown in EIS Figure B 2.1 Rev A - Site Plan.

In addition to providing valuable refuge for biodiversity in a landscape dominated by intensive agriculture, hedgerows also tend to create enclosed landscapes, where views are restricted. The quarry site boundaries are largely maintained with well-treed, mature hedgerows and stock fencing, and the WRF is well screened from public view along local road L2019. The potential viewshed of the WRF site is restricted to partially open views at the entrance due to existing mature hedgerow on the L2019 roadside, and to distant views from the Kilteel road to the east. The partially open views of the quarry at the site entrance on local road L2019 is largely a passing view. There are no residences occur across from the entrance, and thus residences potentially exposed to long term extended views of the quarry and WRF. The views of the site are shown in Figure 3.8.1 and Plates 3.8.1 to 3.8.3.

Land Use

The land-use in the Thornberry area is characterised by a patchwork of medium to large agricultural fields that are designated as pasture and subordinate non-irrigated arable land (See Figure 3.8.4), reflecting medium-high intensity agricultural. There are relatively low levels of forest cover in the area, restricted largely to the hedgerows, river corridors, some

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afforestation, and extensive parkland in the Forenaughts and Rathmore areas. Although rural in character, the area contains areas of industrial and commercial use at Arthurstown, Thornberry, as well as nearby at Hartwell Lower and Oldmilltown, whilst areas of discontinuous urban fabric occur at Kill and Naas.

The area has an established history of sand and gravel working, and these activities have co-existed with other predominantly agricultural land uses in the area, principally medium-high intensity farming. The predominant land use within the WRF site, which is to be co-located within the quarry site, is by definition that of quarrying activities related to the extraction of sand and gravel, and associated operations such as placement of soil and stone in quarry restoration.

The eastern section of the quarry site (i.e., Phase 1) site has largely been completed with final grading and capping with topsoil now taking place. The western and central sections, designated as Phase 2, which houses all of the site infrastructure, are constitute the current active backfilling operations and remain in a disturbed and degraded state, typical of active quarry workings.

The development will also continue to use the established quarry infrastructure including internal roads, crushing and screening plant, and other ancillaries (Refer to EIS Figure B 2.1 – Rev A, EIS Section 2 Figures).

On completion of site activities, the site of the quarry and WRF will be decommissioned and reinstated in accordance with the approved quarry restoration scheme, and thus integrated back into the surrounding landscape. Thus, the land use will revert to agricultural use, primarily as arable and grassland.

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Drainage & Geology

Drainage within the area is discussed in more detail in Section 3.4 - Water. The Thornberry area is located in the sub-basin of the Kill River within the larger Liffey River Catchment. The site sits near the headwaters, and on the south side, of the Kill River basin, in which the river flows off the uplands near Kilteel in a roughly west northwest direction, c. 500m north of the site. A tributary stream of the Kill River flows immediately east of, and defines the boundary of the landholding. The site of the quarry and WRF is setback with a buffer zone of 30m. The Kill River merges with the Painestown River north of Kill, and in turns flows into the Morell River c. 3km south of Straffan. The Morell River is a tributary of the Liffey River, and drains into the Liffey, c. 1km south of Straffan village.

Details with respect to the local bedrock geology and soils are provided within Section 3.3 – Soils and Geology. Reference to the 1:100,000 scale map of the Geology of Kildare and Wicklow (Sheet 16) (GSI 1994) indicates that the WRF site and the surrounding area (i.e., within c. 500m) overly greywackes, siltstones and shales of the Carrighill Fm. No faults are recognized within the site, although a WNW oriented fault, of probable Variscan origin, passes c. 500m north of the site, and is the locus of the Kill River. The bedrock of the area including the site, is shown in Figure 3.3.6: Geological Bedrock Map of the Thornberry Area.

The only subsoil recognized in the quarry and WRF site is identified as glaciofluvial sands and gravels derived from Carboniferous limestone, which comprised the morainic deposits that extended across the Thornberry, Arthurstown, Upper Hartwell and Lower Hartwell Townlands. The subsoil thickness on site prior to quarrying was of the order of 25m, and visual

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examination of the subsoil confirmed the classification of a stratified deposit of fine sand and gravel, principally composed of limestone parent material, overlying a thick deposit of boulder clay.

Tourism

Kildare has developed a brand as the home of high tech industry, of a global thoroughbred industry, boutique hotels and shopping, and a wealth of natural and architectural heritage. Kildare envisions extending the marketing brand of "The Thoroughbred County" to wide range of tourism products in order to establish a clear identity, one of quality and excellence, particularly in heritage, golf, equine and horse racing.

Thornberry is located in northeast County Kildare, c. 25km from Dublin Airport and c. 30km from Dublin Port, whilst the nearest settlements are Kilteel (c. 2km), Kill (c. 2.5km), and the County Town, Naas (c. 6.5km). Thornberry benefits from the myriad amenities and attractions located within the county, as well as being within easy reach of the vibrant Capital City of Dublin. The wider are around Thornberry contains numerous historical and archaeological sites, with clusters of Protected Structures at Kilteel, including Kilteel Castle, Rathmore, Paynestown and Killhill.

Further afield, Ireland's greatest stately home, Castletown House, built in 1972 by William Conolly, Speaker of the Irish House of Commons, is located in Cellbridge. Carton House, once the ancestral seat of the Earls of Kildare and Dukes of Leinster is located in Maynooth, and reincarnated as a luxury Spa and Golf Hotel. Other heritage attractions in Kildare include: Barberstown Castle, Leixlip Castle, Maynooth Castle, the Wonderful Barn, the Moone High Cross, Castledermot Round Tower, Harristown House, Ballitore Quaker Museum, and Kildare Town Heritage Centre. Kildare Town offers a cluster of tourist attractions, including; St Brigid's Cathedral and Round Tower, the Irish National Stud, Japanese Gardens, St. Fiachra's Garden, Kildare Town Heritage Centre and Kildare Outlet Village.

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Sport tourism, particularly equine and golfing, are major attractions in Kildare. Kildare has racecourses located at Punchestown, Naas and The Curragh. The Curragh and Punchestown racecourses hold festivals that attract global audiences and international tourists. Kildare is home to the State owned National Stud Farm in Kildare town, a National Equestrian Centre and Goff's Equine Auction Centre, both in Kill. There are equestrian activities at numerous nearby equestrian centres, such as the Kill International Equestrian Centre, the Old Mill Riding Centre, Kill, Abbeyfield Farm Country Pursuits, Richardstown, Clane, Coilog Eventing, Kilmeague, Naas, and Pitfield Equestrian, Castledermot.

Golf enthusiasts visiting the area can enjoy a wide choice of excellent golf courses within short driving distance. Across north Kildare there are numerous courses, including golf courses such as, Castlewarden Golf Club, Killeen Golf Course, Palmerstown House Golf Club, Naas Golf Club, Craddockstown Golf Club, Newbridge Glof Club, Millicent Golf and Country Club, and Woodlands Golf Club. There is also the Kildare Hotel and Golf Club (K Club) is a golf and leisure complex at nearby Straffan, which hosted the 2006 Ryder Cup and incorporates two golf course designed by Arnold Palmer. It is one of only 5 Red Star hotels in Ireland. Carton House, outside Maynooth, is a 4 Star Spa and Golf Hotel with two golf courses on a magnificent 1,100 acre Parkland Demesne.

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The natural environment and landscape of Kildare contains many natural attractions, such as the Curragh plains, the bogs to the west, the rolling hills of the eastern uplands, the waterways of the River Liffey, the River Barrow and the Royal and Grand Canals, which include 75 miles of navigable waterways for the more leisurely pursuit of cruising.

Located at Farmersvale c 3.5km northeast of the site, Buggy World offers motorsports, karting, archery and adventure activities. Mondello Park Racing Track & Racing School is located c. 7.5km northwest of Naas, and the Off-Road Driving Centre at Killashee, Naas, both offer a fast-paced experience for motoring enthusiasts.

Kildare also offers many other tourist attractions, including: numerous heritage, walking and hiking trails; angling on the Barrow River; historic gardens; the Kildare Maze, Prosperous; Clonfert Pet Farm, Maynooth; Lullymore Heritage & Discovery Park, Rathangan; Solas Bhride Centre and Hermitages, Kildare; and many more (County Kildare Fáilte 2014).

There are no protected views and prospects near the site, or oriented toward the area of the site (Kildare County Council 2011).

Residential

The settlement pattern in the Thornberry area can be described as low-intensity rural settlement, albeit peripheral to the towns of Kill and Naas. The nearest large residential settlements close to the site is the village of Kilteel, located c. 2km to the east, and the settlement of Rathmore c. 2km south of the site. Further afield, are the towns of Sallins c. 7km to the west, Blessington c. 7.5km to the southeast, Clane c. 10.5km to the west northwest, Kilcullen c. 17.5km to the southwest, Newbridge c. 17.5km to the west southwest, and the southern sector of the Dublin Metropolitan area (including Maynooth, Cellbridge, Leixlip, Rathcoole and Tallaght).

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The immediate area around Thornberry is rural and sparsely populated. Residential property in the area typically comprises one-off single residences and farmsteads along public roads or at the end of lanes off the latter (Refer to Figure B 2.2 – Rev A, EIS Section 2 Figures for locations of residences). Although there are no residences within the leasehold, there is a single farmstead within the landholding (i.e., landowners residence), whilst there are six residences within 500m of the site (i.e., one on the landholding, two adjacent to the site entrance, and three on the L2019 north of the site (Refer to Figures A1.0, B 2.2, EIS Section 2 Figures for site location details). The road network in the area is of a local character, although the roads have surfaces, widths and alignments that are superior to that of a typical rural location.

3.8.4.2.2 Areas of Significance or Special Importance

The quarry site at Thornberry, which includes the site of the WRF, is not included in any area with an ecological designation (pNHA, cSAC or SPA).

There are two Natura 2000 sites located within 15km of the site, Poulaphuca Reservoir SPA (Site Code 004063) and the Red Bog cSAC (Site Code 000397). Both are many metres higher in altitude and there is no pathway by which impacts from Thornberry could be felt by their habitats or species. In addition there are four downstream sites in Dublin Bay; North Dublin

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Bay (0206) and South Dublin Bay (0210) are cSAC's while North Bull Island (4006) and South Dublin Bay (4024) are SPA's.

The nearest designated site to the Thornberry WRF is the pNHA (Site Code 001394) at Kilteel Wood c. 2km to the east, Other pNHA's within 15km of the site are: Ballynafagh Bog pNHA (Site Code 000391); Ballynafagh Lake pNHA (Site Code 001387); Grand Canal pNHA (Site Code 002104); Mouds Bog pNHA (Site Code 000395); Liffey Valley Meander Belt pNHA (Site Code 000393); Poulaphouca Reservoir pNHA (Site Code 000731); Red Bog pNHA (Site Code 000397). The quarry site at Thornberry, which includes the application site, is not included in any area with an ecological designation (NHA, cSAC or SPA).

The site does not have a direct ecological connection with any of the Natura 2000 areas except for the Dublin Bay sites. Since no outflows are expected from the operation of the project and, if this was to occur, the dilution factor in river water and in Dublin Bay is so vast, no impacts on ecology or on Natura 2000 sites can be reasonably expected.

Appropriate assessment was introduced by the EU Habitats Directive as a way of determining if a planned project is likely to have a significant effect on one of the Natura 2000 sites so far designated (i.e. the candidate SAC's and SPA's), or their conservation objectives.

Screening for Appropriate Assessment was carried out with respect to the licence application and a copy of this report was previously submitted to the EPA. The findings of the screening for Appropriate Assessment were that the activity, individually or in combination with other plans or projects is not likely to have a significant effect on the Natura 2000 network, or the conservation objectives of the sites. A Stage 2 Appropriate Assessment is therefore not required.

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As noted the nearest designated site to the Thornberry WRF is the pNHA (Site Code 001394) at Kilteel Wood c. 2km to the east. There will no direct or indirect impact on it or any pNHA as a result of the continued operation of the WRF at Thornberry.

The impact of inert waste recovery on this site will be considerable in local terms but will not result in any loss of heritage values in the locality

The proposed continuation of the WRF was the subject of an assessment that involved the investigation of the cultural heritage including the archaeological, structural and historical background of both the application area and the surrounding area (i.e., 1km radius) using a wide range of existing information as well as a field assessment (Refer to EIS Section 3.9).

There are no recorded archaeological, architectural or cultural heritage features within the area of land take, but there are 2 structures (i.e., a burial and architectural fragment) in the surrounding environment within c. 500m standoff. Despite the proximity of these protected structures and monuments, the WRF will have imperceptible impacts on recorded archaeological, architectural or cultural heritage features, such that mitigation measures are considered unnecessary. The proposed continued operation of the WRF will lead to the restoration of the lands and an improvement in the amenity of the area, and therefore to the context of these monuments.

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3.8.4.2.3 Landscape & Landscape Character Assessment

This section is based mainly on the Chapter 14, Sections 1-10 of the Kildare County Development Plan (CPD) 2011-2017 (Kildare County Council 2011), without explicit referencing within the text.

Ireland ratified the European Landscape Convention in 2002 and agreed to implement national measures to promote landscape planning, protection and management. The Planning and Development Act 2000 requires every planning authority to include objectives in their Development Plan for the preservation of the character of the landscape insofar as proper planning and sustainable development of the area requires it, including the preservation of views and prospects and the amenities of places and features of natural beauty or interest. It also provides for the designation of Landscape Conservation Areas (LCA), Areas of Special Amenity (ASA) and the assessment of landscape character.

A detailed Landscape Character Assessment of County Kildare was carried out in 2004, and is contained in Appendix 3 of the CPD 2011-2017. The purpose of the study was to objectively describe, map and classify the landscape character of each part of the County. The study focused on characterisation of the landscape based on its land cover and landform but also on its values such as historical, cultural, religious and other understandings of the landscape. It concentrates on the distinctiveness of different landscapes and on the sensitivity of that landscape to development.

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Importantly, defining landscape character enables an understanding of the inherent value and importance of individual landscape elements and processes that may alter landscape character in the future. The capacity of each area to accept change, without disproportionate effects, was evaluated and a series of policies and objectives to guide development was proposed. An important benefit of the study is the promotion of a unified approach to landscape planning and management, and as a consequence also sustainable development.

Kildare presents a wide range of landscapes. These range from: extensive lowlands in the north and south, uplands at the foothills of the Wicklow Mountains in the east, tracts of boglands in the northwest, the undulating central undulating lands, including the Curragh, and several important waterways, such as the Liffey and Barrow River Corridors and the Royal Canal. The site at Thornberry lies within Eastern Transition LCA and is the only Landscape Character Type (LCT) belonging to Transition Lands (See EIS Figure 3.8.2).

A landscape sensitivity rating was developed for each of the Landscape Character Areas, and is determined using the following factors: slope, ridgeline, water bodies, land use and prior development. Landscape sensitivity is a measure of the ability of the landscape to accommodate change or intervention without suffering unacceptable effects to its character and values. Thus, the sensitivity of a LCA could be defined as its overall resilience to sustain its character despite change and its ability to recuperate from loss or damage. A highly sensitive landscape is likely to be vulnerable, fragile and susceptible to change, whereas a low sensitivity landscape is likely to be more resilient of change (See EIS Figure 3.8.3). Landscape sensitivity mapping as applied to development control, aids awareness and identification of the potential for disproportionate visual prominence. The existence and significance of a landscape sensitivity and its relevance to the specifics of the proposed

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development must be assessed. Sensitivity is thus a critically important parameter in assessing the impact of any proposed development.

In order to determine the likely impact of a development on the landscape, the potential impact of that development must be evaluated in respect of the sensitivity of the area. However, all developments are unique, and landscapes vary in terms of their ability to absorb development at the local level, such that each site needs to be assessed on its own merits.

In addition to LCAs, and their sensitivity to development, there are certain special landscape areas within the county, some of which overlap with sensitive landscapes. These Areas of High Amenity are classified because of their outstanding natural beauty and/or unique interest value and are generally sensitive to the impacts of development. However, none occur within the Eastern Transition LCA.

Furthermore, Scenic Routes and Protected Views consist of important and valued views and prospects within the county. Scenic Routes provide views of the landscape of the county and of built and archaeological features. In addition to Scenic Routes, there are a number of Protected Views throughout the county, which are located particularly along water corridors and to and from the hills in the countryside (See EIS Figure 3.8.5). The Council recognises the need to protect the views and scenic routes, but also acknowledges that in circumstances where development is necessary, appropriate location, siting and design criteria should strictly apply.

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Eastern Transition LCA is located between the uplands and lowlands in the east of the County, and is characterised by undulating topography. The River Liffey transects the LCA north and south. The lands are generally of medium size and regular pattern, with commonly well-maintained hedgerows. The land undulates through a series of hilltops, including Carrighill (166m AOD), and elevated vantage points along the local roads provide long-distance views across the Kildare lowlands. The skyline to the east is defined by the Eastern Uplands, with distant views including the nearby Wicklow Mountains, defining the extent of visibility.

The landscape constitutes a transition from lowlands developed on limestones to the west, to the foothills of the Wicklow Mountains developed on more indurated Lower Palaeozoic siliceous metasediments to the east.

The key characteristic for this LCA that have a bearing on the relative sensitivities or resilience to development are as follows:

Geology & Soils

• A transition from lowlands developed on limestones to the west, to the foothills of the Wicklow Mountains developed on more indurated Lower Palaeozoic siliceous metasediments to the east.

• Calcareous greywackes, siltstones and shales of the Carrighill Formation underlie most of the LCA.

• Soils in the area are composed of grey brown podzolics and complexes (mainly mineral soils).

• Generally poorer drainage with a higher water table.

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Land Use

• Most extensive land-use is pasture used in stock rearing.

• Vigorous hedges and many hedgerow trees.

• Patches of non-irrigated agricultural lands (mainly tillage) and small clusters of naturally occurring vegetation, some blocks of coniferous and deciduous forests, and some successional woodlands.

• Includes the large town of Kilcullen, and smaller settlements such as Kill, Ballitore, etc., combined with a high density of dispersed rural houses and farms, is indicative of a high rural population density.

Critical Landscape Factors

• Undulating topography – provides shielding within lee of hills, and thus can conceal new features on lower-lying lands. Dynamic nature of undulating land encloses local vistas, thus rendering development unobtrusive within overall landscape.

• Slopes – intensifies visual prominence of any feature over greater distances. Gentle slopes of the hills can define the visual boundary of the adjacent lowlands and provides an increased potential for development to penetrate ridgelines when viewed from local roads and villages.

• Low Vegetation - grassland, tillage fields and generally low hedgerows are usually uniform in appearance, and fail to break up vistas, allowing long distance views. Well maintained hedgerows partially screen lowest land parcels, but commonly low vegetation is unable to visually absorb new development.

• Shelter Vegetation - Shelter vegetation is represented by coniferous plantations and scattered trees in field hedgerows. Shelter vegetation has a shielding and absorbing quality in the landscape, and can provide a natural visual barrier. It also adds to the complexity of a vista, breaking it up to provide scale and containment for built forms.

• Localised River Valley Views - This character unit is bisected by the River Liffey valley. River valleys are visually enclosed and highly localised areas of distinctive character with a high degree of visual consistency. Due to the undulating nature of this area, many views of the river valley are available from vantage points along the local roads.

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Corine Land Cover (CLC) is a map of the European environmental landscape based on interpretation of satellite images. Land cover is the observed physical cover, as seen from the ground or through remote sensing, including natural or planted vegetation and human constructions (buildings, roads, etc.) which cover the earth's surface. Water, ice, bare rock or sand surfaces count as land cover.

A map showing the 2006 CLC in the vicinity of the site has been produced (Refer to EIS Figure 3.8.4). The map shows that the land cover in the Thornberry area is characterised by a relatively simple land use pattern, dominated by pasture and subordinate non-irrigated arable land, reflecting medium-high intensity agricultural. The towns of Kill, Johnstown and Naas are designated as urban fabric, whilst Arthurstown, Thornberry and Hartwell quarries, as well as the adjacent commercial properties of Balcas, Allcrete east of the L2019, and of BAM contractors and the adjacent, vacant car sales yard west of the L2019, are all designated as

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industrial and commercial, whilst the N7/M7 is designated road and rail network. The substantial industrial yards at Oldmilltown are designated as mineral extraction site, rather than industrial and commercial. Thus, although Thornberry is nominally a rural area, pasture, industrial and commercial, and arable are the principal indicative land uses within a 1km radius.

Although Kildare has 5-10% forest cover, the 2006 CLC Map indicates no forest cover within c. 4-5km of the Thornberry site (EPA 2014). However, aerial photography shows considerable broadleaf, coniferous and mixed forest cover, as woodland in the Kill and Hartwell River Corridors, as afforestation in Kilteel Lower and Burntfurze Townlands, and as screening around parkland in the Forenaughts area, and around commercial properties in Hartwell Lower (Google Maps 2014). Forests represent an important renewable resource and contribute to sustainable rural economic development. However, woodland and forests are only a minor land use in the wider local area, but together with high, mature banked hedgerows, deep drainage ditches and rolling terrain, contribute to a partially enclosed pastoral landscape.

Kildare has very substantial sand and gravel deposits, which includes the extensive Mid-Kildare (Curragh) gravels, and in the far northeast of the county, the Blessington & Ballymore Eustace Gravels, and the Kill Gravels, where the Thornberry quarry was developed on the latter (Kildare County Council 2002). The area from Thornberry/Arthurstown to Hempstown Commons (north of Blessington) to Ballymore Eustace and to Punchestown shows evidence of historical and current sand and gravel extraction. Thus, the site of the quarry and WRF is surrounded by land that is principally occupied by agriculture, but with a significant footprint from mineral extraction sites in the wider area.

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The application pertains to an existing and active WRF within a quarry, and thus actually pertains to a non-extractive industrial facility that has slight to moderate potential to create significant impacts on the existing landscape character. As the WRF is co-located within the existing quarry, it is considered that the WRF will not result in any adverse change in land cover, but rather reinstate disturbed and degraded quarry workings to agricultural land.

Scenic Routes and Protected Views consist of important and valued views and prospects of great natural beauty. Kildare has many vantage points that offer such views and prospects. The landscape and scenery are of amenity and economic value to residents and tourists, and contribute to the quality of life, such that views and prospects adjoining public roads and from publicly accessible places must be protected.

As the landform of most of the county is generally flat with predominantly low vegetation, hilltops offer extensive views, allowing long distance vistas. Similarly from the lowland areas, one's gaze is drawn to the primary and secondary ridgelines that define the skyline. Because ridgelines are conspicuous features in the landscape, and act as dominant focal points, it is important that development does not interrupt the integrity of ridgelines. As stated earlier, the Council acknowledges that in circumstances where development is necessary, appropriate location, siting and design criteria should strictly apply. In assessing the potential impacts of development proposals on these views and prospects, there is a need that developments do not obstruct, disrupt or otherwise harm the views and prospects, and should be designed and located to avoid visual intrusion in the landscape when viewed from these vantage points.

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There are three designated Scenic Routes within the general area (i.e., <5km radius) of the Thornberry site (See EIS Figure 3.8.5). These are:

No. 11.

Description: Views of the Upland Areas on the Oughterard Road (L6018). Scenic vistas of the undulating lands at the County Boundary, as well as views of the Wicklow Mountains in the distance. The elevated nature of the road and the low vegetation of the agricultural lands allow long-distance visibility. The generally smooth terrain is interrupted by hedgerows and conifer forests. Although scattered housing occurs throughout the area, these are partially screened by vegetation. Thus, the vistas from the road remain generally unaffected. Viewshed probably includes Thornberry, with Arthurstown Landfill forming the middle distance backdrop or secondary ridgeline.

Location: Pluckerstown, Oughterard, Castlewarden North.

Nearest point c. 3km north of site.

No. 12.

Description: Views West of Kildare Plains from Redbog Area and Views towards Caureen; from Rathmore Cross Roads to Pipershall. Scenic vistas of the Kildare Plains to the southwest and the undulating lands at the County Boundary to the southeast. The elevated nature of the road and the generally low hedgerows and vegetation of the agricultural lands allow long-distance visibility. Although scattered rural housing is located in the area, these are partially screened by vegetation. The views at hedge openings along the road remain unaffected. Viewshed possibly includes Thornberry.

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Location: Greenmount, Redbog, Pipershall, Rathmore West.

Nearest point c. 1.5km south of site.

No. 22.

Description: Views to the North-West of the Open Countryside; from Kilteel Village to Rathmore Village. Open and extensive views of the surrounding lowlands are available to the west, whilst views onto the hilltops are provided to the east. The undulating nature of the lowlands in this part of the County and the hedgerows with mature trees add complexity to the vistas, as well as partially screening views along the roads. Although scattered housing is located in the area, the landscape character remains unaffected and, similarly, the views along the road onto the lowlands maintain their scenic value. Although the hilltops to the west limit the extent of the vistas, these remain highly scenic. Viewshed does include Thornberry, typically at gates and other breaks in the hedgerows, as assessed during site visit.

Location: Furryhill, Kilteel Lower, Rathmore East.

Nearest point c. 750m southeast of site.

There are two protected views and prospects within the general area (i.e., <5km radius) of the Thornberry site (Refer to EIS Figure 3.8.5). These are:

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No. 1. Cupidstownhill (elev. 379m AOD), c. 4.5km east of site. View of Thornberry area possibly partially obstructed by Kilteel-Furryhill ridge, but with panoramic vistas of the Kildare Plains beyond.

No. 2. Caureen (elev. c. 349m AOD), c. 3.5km southeast of site. Unobstructed view of Thornberry area, with panoramic vistas of the Kildare Plains beyond.

3.8.4.2.4 Characteristics of the Development

The proposed continuation of operations of the WRF co-located within the existing quarry at Thornberry will share much of the existing quarry infrastructure and plant. No additional plant, infrastructure or areas of hardstanding will be required. Operations at the WRF involve: importation by truck of soil and stone; examination of the material for contaminants; deposition of material; placement and levelling of material in the quarry void; capping with subsoil and topsoil; and finally reseeding.

The potential viewshed of the WRF site principally arises from: (1) restricted and passing views from the L2019 road through a break in the mature hedgerows at the main entrance to the site; and (2) distant views from the road running on elevated ground between Kilteel to Rathmore (Refer to Figure 3.8.1 and Plates 3.8.1 to 3.8.6). Although when restored the site will attain a slightly domed topographic profile, existing peripheral screening of intervening banks with tall, mature hedgerows is expected to remain effective at screening views along the L2019. The mature hedgerows screen the quarry and WRF site from the three contiguous residences, including the landowner's residence, but not the adjoining farmyard.

The domed profile of the Arthurstown Landfill screens potential views from the west and southwest, and forms a middle distance backdrop or secondary ridgeline to any potential view from the north to northeast including along the L2019. Thus, the Thornberry WRF would not break the ridgeline in the latter views, such as from Scenic Route 11 on the Oughterard Road.

The unrestored quarry void is largely dominated by bare, exposed ground with a profusion of recolonising pioneer species, with overgrown residual boundaries at the edges, and other fragments of scrub, as well as infrastructure, plant, and stockpiles of materials. The unrestored quarry void is not visible from outside vantages, as the principal viewshed, of distant views from the east, is screened by the domed profile of the eastern section of the site, which is currently being restored.

Unrestored ground, where backfilling has yet to commence, is screened within the quarry void (i.e., Phases 1 and 2). However, as the quarry void is progressively backfilled and the topographic profile is raised and emerges out of the pit, the backfilling and capping work of the restoration within the WRF site will become progressively exposed to outside views. Thus, backfilling work to reinstate the topographic profile may temporarily increase the visibility of the WRF operation, until such time as the land is restored and returned to agricultural use.

The area has an established history of quarry working, and these activities have co-existed with other predominantly agricultural based land uses. Co-location of the WRF within the quarry is a synergistic integration of two complementary and mutually beneficial processes, and a requirement to complete restoration of the quarry and full reinstatement of the land.

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3.8.4.3 VISUAL BASELINE CONDITIONS

As detailed above the desktop study was used to determine the nature of the visual amenity of the area along with the approximate visibility of the development, which is determined through topographic analysis of map data. Potential receptors of visual effects, including residents and visitors through the area were also identified. The desk study provided the basis for subsequent field surveys and was used to delineate the likely zone of visual influence, identify the principal viewpoints and highlight sensitive visual receptors.

For the purpose of this assessment refer to Figure 3.8.1, which highlights the study area delineated as the likely zone of visual influence, principal viewpoints and sensitive visual receptors identified.

A Site visits were undertaken on 20/06/2014. Principal viewpoints were mapped and these views illustrated by photographs with annotations to describe any important characteristics, and the changes that have arisen as a result of the development (Refer to Figure 3.8.1 and Plates 3.8.1 to 3.8.6).

3.8.5 POTENTIAL IMPACTS OF THE DEVELOPMENT

The landscape of the Thornberry area has medium sensitivity, and thus a limited capacity to absorb development, which can have a disproportionate visual impact (See EIS Figure 3.8.3). This arises from the limited capacity of this landscape of rolling or undulating land of pastoral or rural character to physically or visually absorb development. Sensitive development and conservation of the landscape resource is essential to the underpinning of the rural economy and quality of life of the area. However, it is recognised that areas where there is existing development probably have a high potential to absorb new development. Thus, the WRF is more readily absorbed by the pre-existence of, and co-location within the quarry. The eastern section of the quarry is currently being reinstated with a domed topographic profile as part of the quarry restoration scheme. These restoration works may suffer from slightly higher visibility, but existing perimeter screening, principally hedgerows and trees is considered very effective at screening views from the L2019. No additional infrastructure, including buildings or hardstanding areas, have or will be constructed as part of the WRF.

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Summary of Potential Landscape Impacts

The principal attributes (and impacts) to be assessed include *inter alia* the following:

- Change of landform from a ‘degraded’, disused section of quarry to restored agricultural land
- Change of land use from quarrying/extraction to restored agricultural land
- The loss of ecological habitat as a result of the quarry activity
- The loss if any of cultural heritage features to the quarry activity
- Views of temporary stockpiles up to 5m high of intake material, subsoil and topsoil from distant viewpoints

The results of the impact assessment are presented in Table 3.8.1 below

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Table 3.8.1 Landscape Impact Assessment Matrix

Topic area	Description of impact	Magnitude[1]	Sensitivity[1]	Level of importance[1]					Quality[2]			Duration[2]					Significance[2]	Mitigation
				I	N	R	C	L	Positive	Neutral	Negative	ST	MT	LT	P	T		
Landform	Change of landform from a 'degraded', disused quarry to restored agricultural/forestry land.	MH	MH														Moderate	Area will be reinstated to a domed topographic profile as improved land on completion of operations.
Land use	Change of land use from quarrying/extraction to restored agricultural land.	MH	MH														Slight	The final restoration of the entire quarry site will return the WRF site to agricultural use.
Loss of ecological habitat	WRF is sited within previously quarried area and as such there will be no direct impact on the ecological habitat.	N	N														Imperceptible	Area will be reinstated to a domed topographic profile as improved agricultural land on completion of operations. Landscaping and reinstatement of hedgerows.
Loss of cultural heritage	No direct impacts on known archaeological or architectural heritage.	N	N														Imperceptible	As the WRF will have no direct or indirect impact on the archaeological, architectural or cultural heritage resource, it is considered mitigation measures are not required.
Views of stockpiles	Views of temporary stockpiles up to 5m high of intake material, subsoil and topsoil from distant viewpoints	ML	M														Slight to Moderate	Final placement of capping is now been undertaken which will result in the removal of temporary stockpiles in the near future.

Key

Level of importance I = International; N = National; R = Regional; C = County; L = Local

Magnitude and sensitivity N = Negligible; VL = Very Low; L = Low; ML = Medium–Low; M = Medium; MH = Medium–High; H = High; VH = Very High

Notes

1 Criteria used based on The Landscape Institute with the Institute of Environmental Management & Assessment (2005) Guidelines for Landscape and Visual Impact Assessment - 2nd Ed.

2 The terminology used based on Chapter 5 –'Glossary of Impacts', Guidelines on the information to be contained in Environmental Impact Statements: Environmental Protection Agency (2002)

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Table 3.8.2 PREDICTED VISUAL IMPACTS WITH MITIGATION

NATURE OF IMPACT			Level of importance[1]					Quality[2]			Duration[2]					Magnitude[1]	Receptor Sensitivity[1]	Significance[2]	Mitigation
Viewpoint Plate	Location	Description	I	N	R	C	L	Positive	Neutral	Negative	ST	MT	LT	P	T				
3.8.1	View from Local L2019 road	View looking southeast opposite site entrance. Lands not open to view being screened by intervening topography and vegetation.														VL	VL	Slight to Imperceptible	No mitigation measures required with respect to this vantage.
3.8.2	View from L2019 road opposite slip road to site.	View looking southeast from site access towards site. Lands not open to view being screened by intervening topography and vegetation.														VL	VL	Slight to Imperceptible	No mitigation measures required with respect to this vantage.
3.8.3	View from gap along local L2019 road.	View looking southeast towards Landowners residence and site. Lands not open to view being screened by intervening topography and vegetation.														L	L	Slight	No mitigation measures required with respect to this vantage.
3.8.4	View looking west north west to site (c.1.8km)	Arthurstown landfill under final restoration. WRF facility on lower ground not open to significant views and partially screened by intervening hedgerows.														ML	ML	Slight to Moderate	Phase 1 nearing completion, to be graded top soiled/seeded during next available planting season Phase 2 will not be open to significant views being effectively screened by perimeter between site and adjoining Arthurstown landfill.
3.8.5	View looking west north west to site (c.1.8km)	Arthurstown landfill under final restoration. WRF facility on lower ground not open to significant views and partially screened by intervening hedgerows.														ML	ML	Slight to Moderate	Phase 1 nearing completion, to be graded top soiled/seeded during next available planting season Phase 2 will not be open to significant views being effectively screened by perimeter between site and adjoining Arthurstown landfill.
3.8.6	View looking west north west to site (c.1.4km)	Arthurstown landfill under final restoration. WRF facility on lower ground not open to significant views and partially screened by intervening hedgerows.														ML	ML	Slight to Moderate	Phase 1 nearing completion, to be graded top soiled/seeded during next available planting season Phase 2 will not be open to significant views being effectively screened by perimeter between site and adjoining Arthurstown landfill.

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Magnitude and sensitivity N = Negligible; VL = Very Low; L = Low; ML = Medium–Low; M = Medium; MH = Medium–High; H = High; VH = Very High

Notes

1 Criteria used based on The Landscape Institute with the Institute of Environmental Management & Assessment, (2005) Guidelines for Landscape and Visual Impact Assessment - 2nd Ed.

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3.8.5.1 POTENTIAL VISUAL IMPACTS

The results of the visual field survey have shown that due to intervening topography, screening, and vegetation, views towards the WRF site are generally very limited views of the entrance from the L2019 road, and distant views from elevated ground to the east (Refer to Figure 3.8.1 and Table 3.8.2 and Plates 3.8.1 to 3.8.6). With the exception of the entrance, the quarry and WRF are well screened from views from the L2019. Thus, the only significant views from outside the lands are distant views from elevated ground to the east.

In general, the view afforded by the entrance of the quarry and WRF is a partially open view, which is passing or transient. However, there are distant views from elevated ground to the east along the Kilteel-Rathmore road which is a designated Scenic Route (Refer to Figure 3.8.1 and in Table 3.8.2 and Plates 3.8.4 to 3.8.6).

3.8.5.2 INDIRECT IMPACTS

There are no indirect impacts associated with the proposed continuation of operations at the WRF and the surrounding areas.

3.8.6 MITIGATION MEASURES

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Mitigation measures include avoidance, reduction, compensation and remedy of potential impacts. The primary means of mitigation involves an efficient design and layout for the WRF that optimises use of existing infrastructure and plant, discrete placement of imported materials, screening using hedgerows and trees, and the full restoration of the WRF and quarry site, once operations at the site cease.

No mitigations measures are considered necessary with respect to the Local L2019 road to the east of the lands under restoration with the existing roadside and intervening hedgerows effectively screening the development from transient passing views along the L2019.

Expedited restoration with capping and seeding of the easternmost section of the site in the near future will significantly enhance views of the quarry void from the Scenic Route to the east.

It is considered that it will take approximately 4-6 months to complete the backfilling operations. An additional 6 months to a year should be allowed to complete final restoration to agricultural land. The existing site layout is shown by to Figure B.2.1 - Rev A.

The lands are to be restored to agricultural use by importation and recovery of inert materials in accordance with a phased restoration scheme. It is the intention to develop them for agricultural use.

Once the topsoil is re-instated it will be seeded with a suitable mix of grasses suitable for pasture in order to quickly stabilise the topsoil. Once the grass sward has become established the restored farmland can be kept either as pasture, hay meadow or arable land. Part of the area has already been restored to grassland.

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3.8.8 FIGURES

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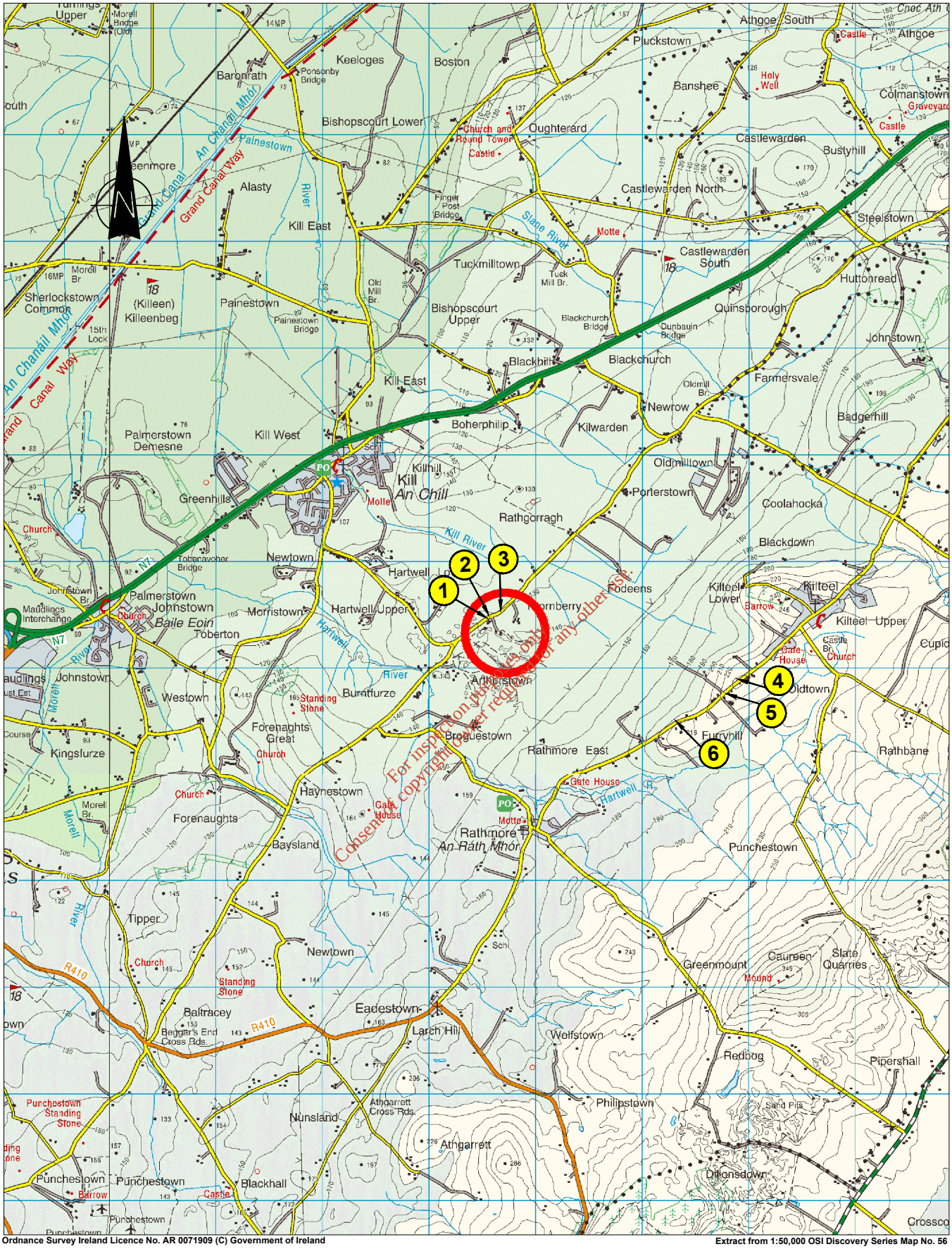

Scale: 1:50,000

0m 500m 1km 2km

Legend

Site Location

1 View Points

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Visual Impact Assessment
Sand & Gravel Merchants Ltd
Thornberry Townland
Kill
Co. Kildare

Author: John Sheils	Job No. JSPE 175
Date: 21/09/14	Ref No. 3.8.1

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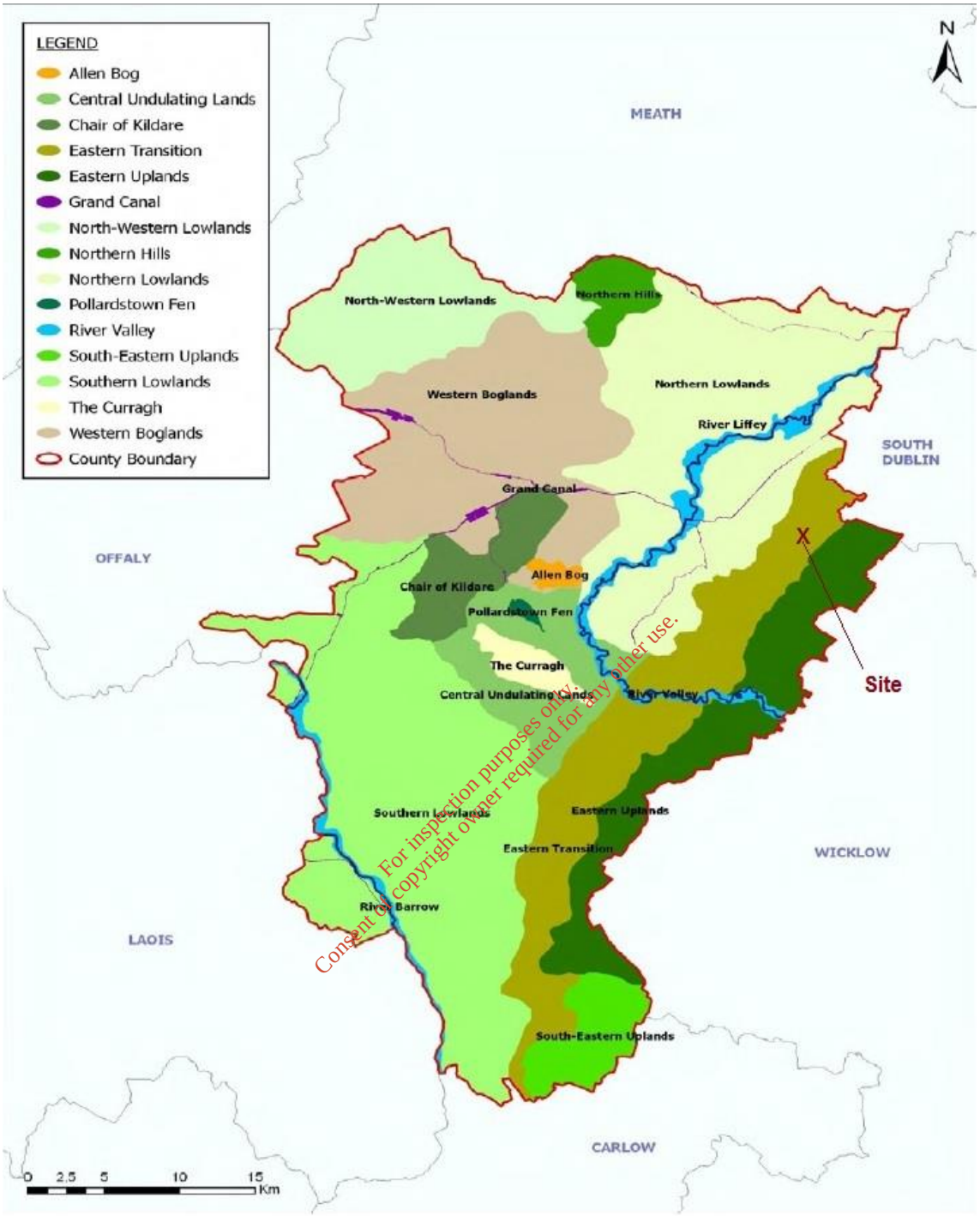

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Figure 3.8.2. Landscape Character Areas (LCAs) of County Kildare. Note that Thornberry occurs in the Eastern Transition LCA. Approximate locations of site is marked by X. Redrawn from the Kildare County Council (2011).

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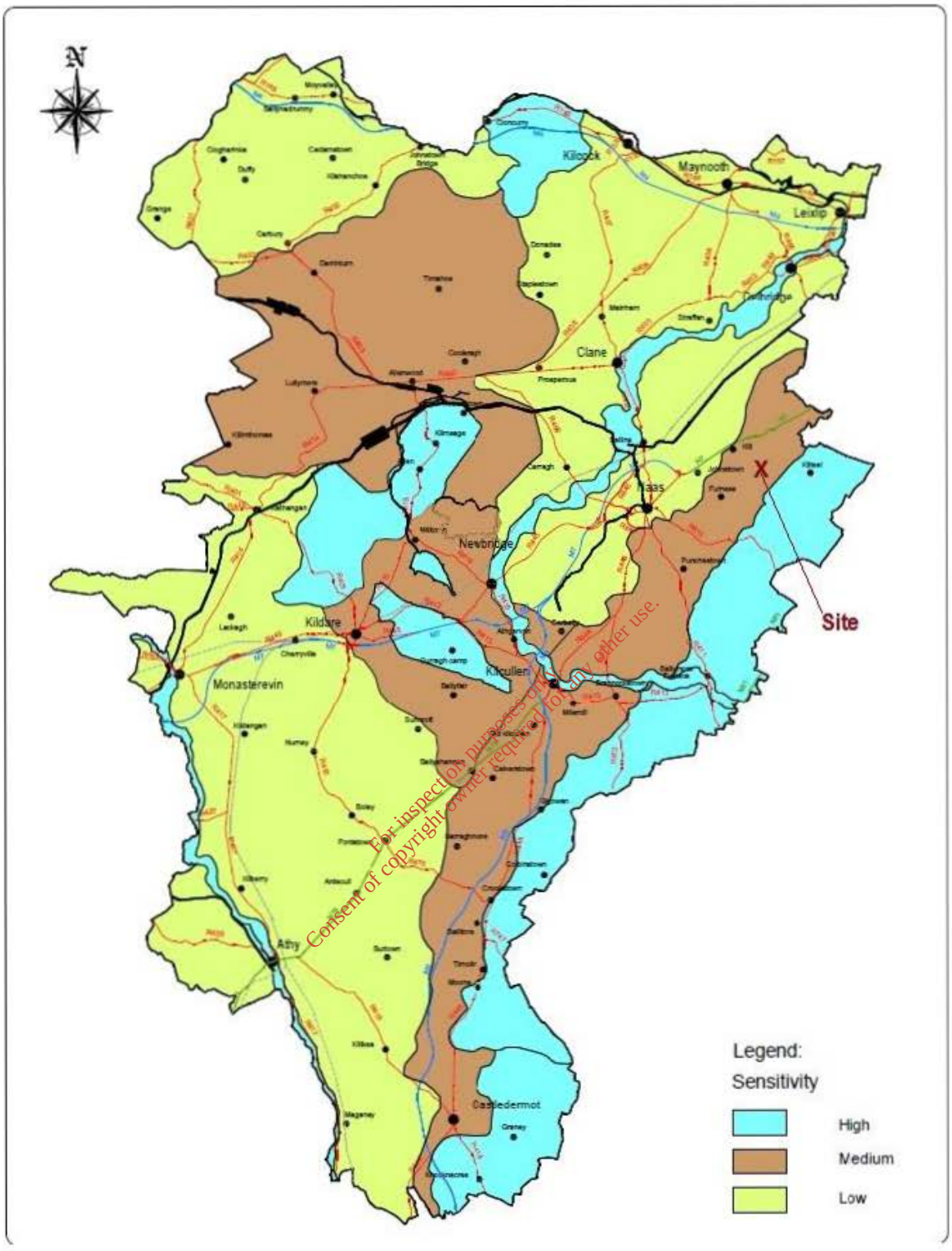

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Figure 3.8.3. Landscape Sensitivity Map of County Kildare. Note that Thornberry occurs in the Eastern Transition LCA. Approximate locations of site is marked by X. Redrawn from the Kildare County Council (2011).

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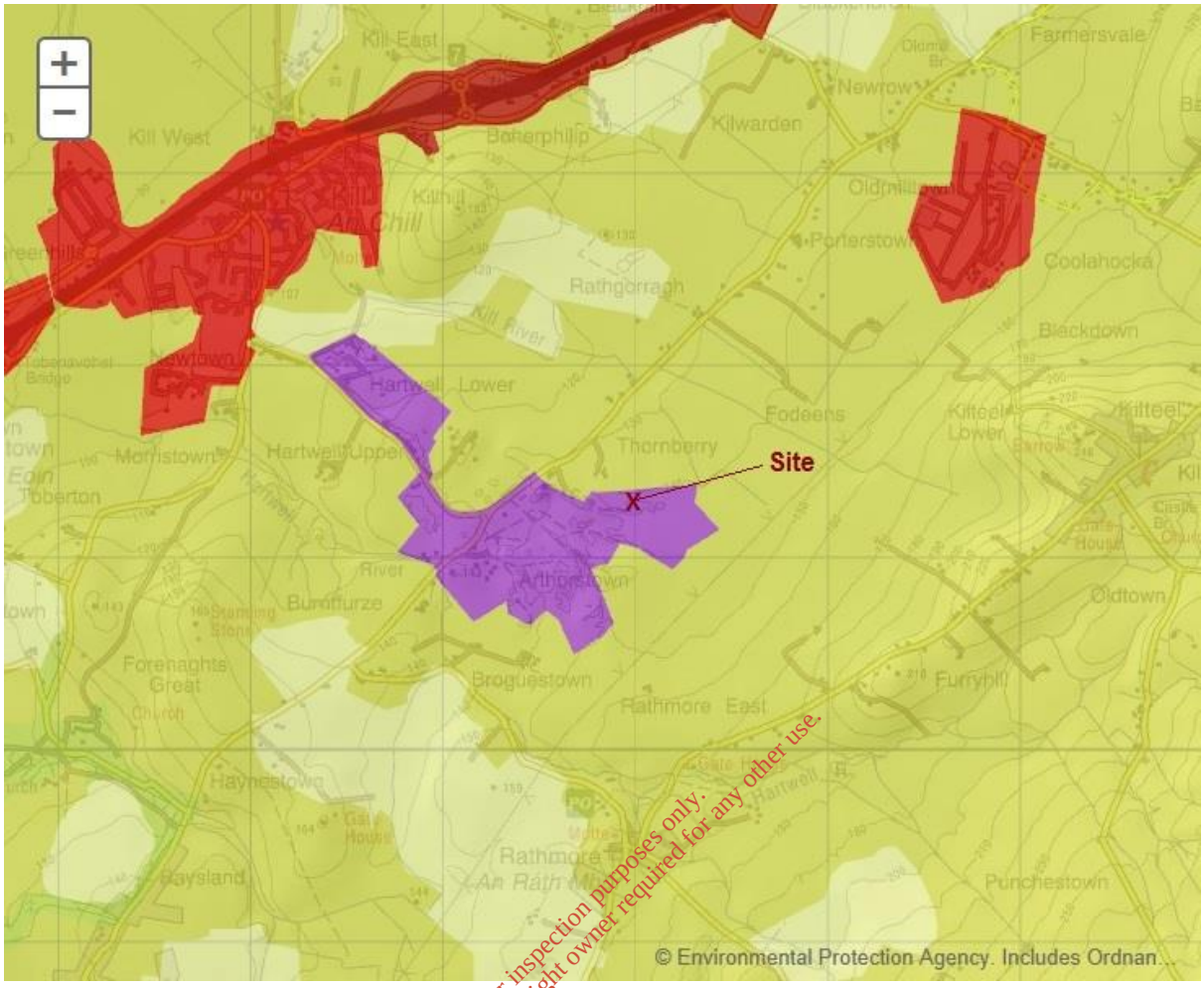

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Figure 3.8.4 Corine Landcover (2006) Mapping. Medium Green: pasture; Light Green: non-irrigated land (i.e., arable); Light Red: discontinuous urban fabric of Kill, but includes Oldmilltown Industrial Area; Dark Red: road and rail network (N7/M7); Purple: industrial or commercial units, including Arthurstown and bulk of application site at Thornberry. Site marked by X. Scale: Grid Square = 1km.

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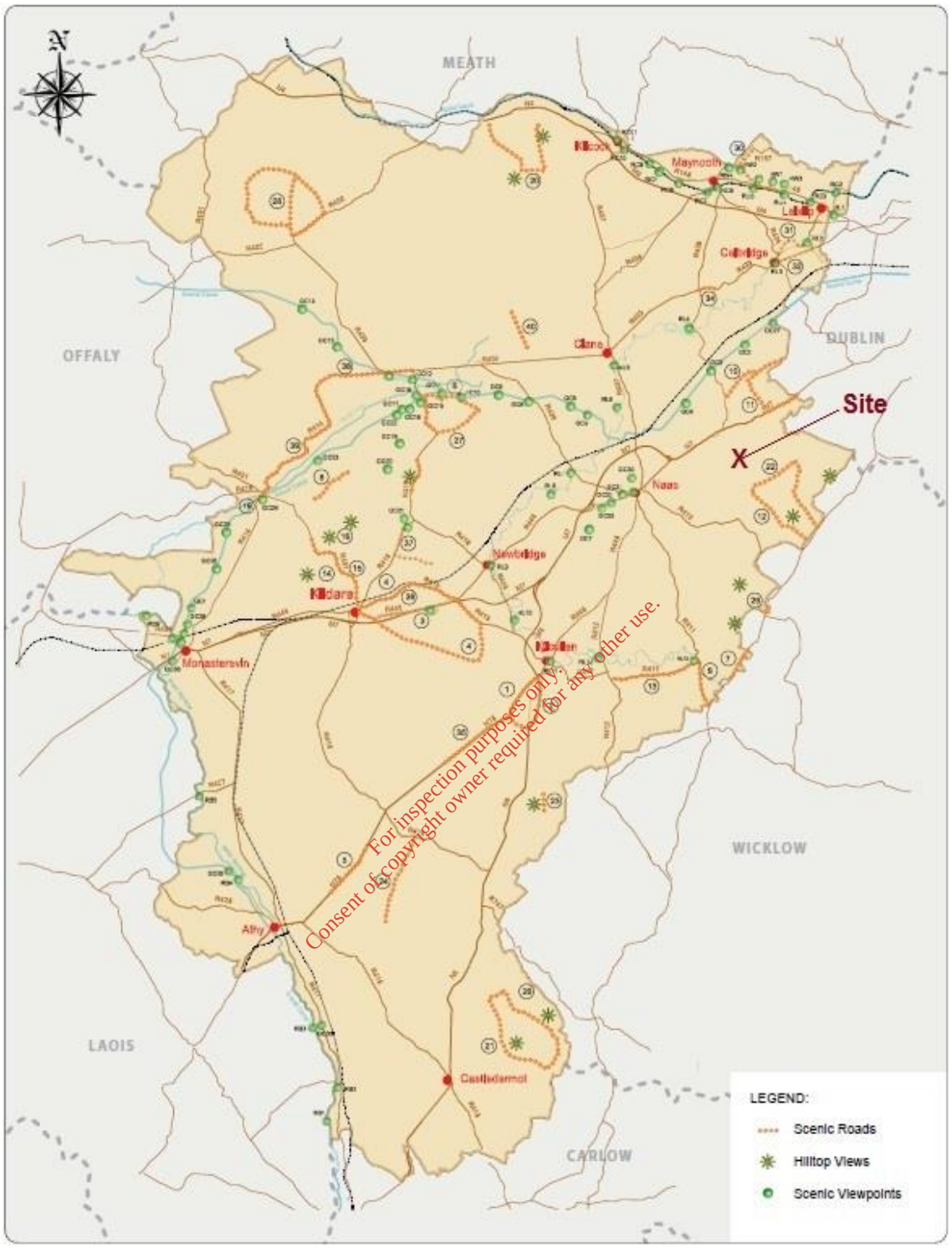

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Figure 3.8.5. Views and Prospects and Scenic Routes in County Kildare. Note the Scenic Route near Kilteel in the vicinity of, and overlooking, the Thornberry site. Approximate location of site marked by X. Redrawn from Kildare County Council (2011).

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3.8.9 PLATES

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Plate 3.8.1 - Viewpoint 1

Location: View from Local L2019 road.

Description: View looking southeast opposite site entrance. Lands not open to view being screened by intervening topography and vegetation.

Mitigation: None considered necessary from this vantage.

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Plate 3.8.2 - Viewpoint 2

Location: View from L2019 road opposite slip road to site.

Description: View looking southeast from site access towards site. Lands not open to view being screened by intervening topography and vegetation.

Mitigation: None considered necessary from this vantage.

Date of Visual Survey: 20/06/2014

Weather: Dry and overcast.

Notes: Refer to Figure 3.8.1 for locations of Principle Viewpoints.

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Plate 3.8.3 - Viewpoint 3

Location: View from gap along local L2019 road.

Description: View looking southeast towards Landowners residence and site. Lands not open to view being screened by intervening topography and vegetation.

Mitigation: None considered necessary from this vantage.

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Date of Visual Survey: 20/06/2014

Weather: Dry and overcast.

Notes: Refer to Figure 3.8.1 for locations of Principle Viewpoints.

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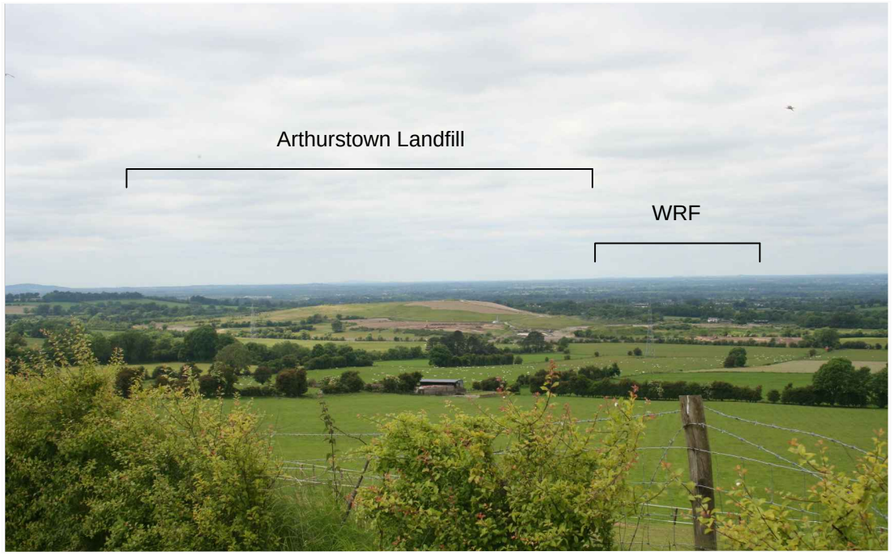

Plate 3.8.4 - Viewpoint 4

Location: View looking west north west to site (c.1.8km)

Description: Arthurstown landfill under final restoration. WRF facility on lower ground not open to significant views and partially screened by intervening hedgerows.

Mitigation: Phase 1 nearing completion, to be graded topsoiled/seeded during next available planting season. Phase 2 will not be open to significant views being effectively screened by perimeter between site and adjoining Arthurstown landfill.

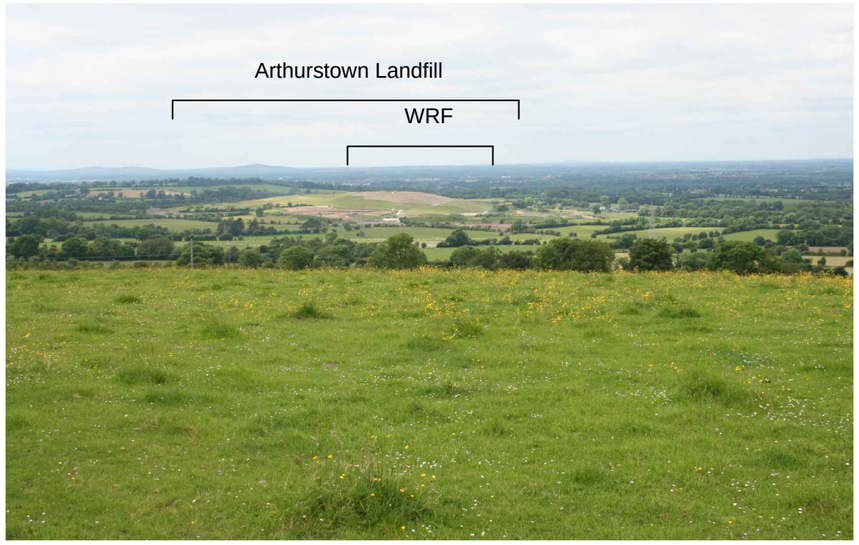

Plate 3.8.5 - Viewpoint 5

Location: View looking west north west to site (c.1.8km)

Description: Arthurstown landfill under final restoration. WRF facility on lower ground not open to significant views and partially screened by intervening hedgerows.

Mitigation: Phase 1 nearing completion, to be graded topsoiled/seeded during next available planting season. Phase 2 will not be open to significant views being effectively screened by perimeter between site and adjoining Arthurstown landfill.

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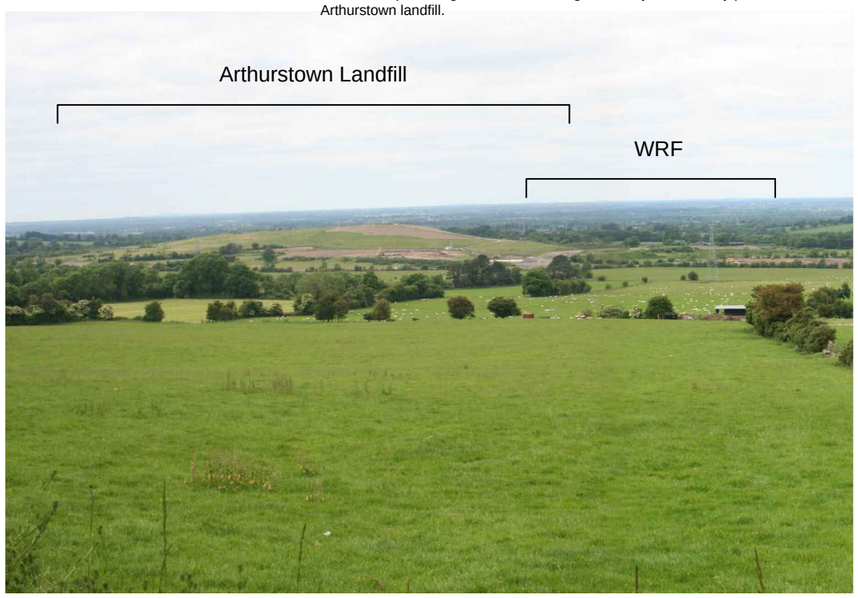

Plate 3.8.6 - Viewpoint 6

Location: View looking west north west to site (c.1.4km)

Description: Arthurstown landfill under final restoration. WRF facility on lower ground not open to significant views and partially screened by intervening hedgerows.

Mitigation: Phase 1 nearing completion, to be graded topsoiled/seeded during next available planting season. Phase 2 will not be open to significant views being effectively screened by perimeter between site and adjoining Arthurstown landfill.

Date of Visual Survey: 20/06/2014

Weather: Dry and overcast.

Notes: Refer to Figure 3.8.1 for locations of Principle Viewpoints.

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3.9 CULTURAL HERITAGE

3.9.1 INTRODUCTION

3.9.1.1 OUTLINE of Scope of Works

3.9.1.1.1 General

This report has been prepared on behalf of Sand and Gravel Merchants Ltd. in order to assess and define the impact, if any, on the archaeological, architectural and cultural heritage resource of the continued operation of a Waste Recovery Facility (WRF) at Thornberry townland, Kill, County Kildare (OS Sheet 020, figure 3.9.1). The report has been prepared by Dermot Nelis.

This desk-based study will determine, as far as is reasonably possible from existing records, the nature of the cultural heritage resource within the proposed development area using appropriate methods of study.

The study involved interrogation of the archaeological and historical background of the proposed development area. This included information from the Record of Monuments and Places (RMP) of County Kildare, Topographical Files of the National Museum of Ireland, Kildare County Development Plan 2011-2017, cartographic sources, documentary records and aerial photographs. A field inspection was carried out on 19th July 2014 in an attempt to identify any previously unrecorded features and/or portable finds within the proposed development area. A study area of 1km has been imposed around the area of land take.

An impact assessment and mitigation strategy has been prepared. The impact assessment is undertaken to outline potential adverse impacts the proposed development may have on the archaeological, architectural or cultural heritage resource, while the mitigation strategy is designed to avoid, reduce or offset such adverse impacts.

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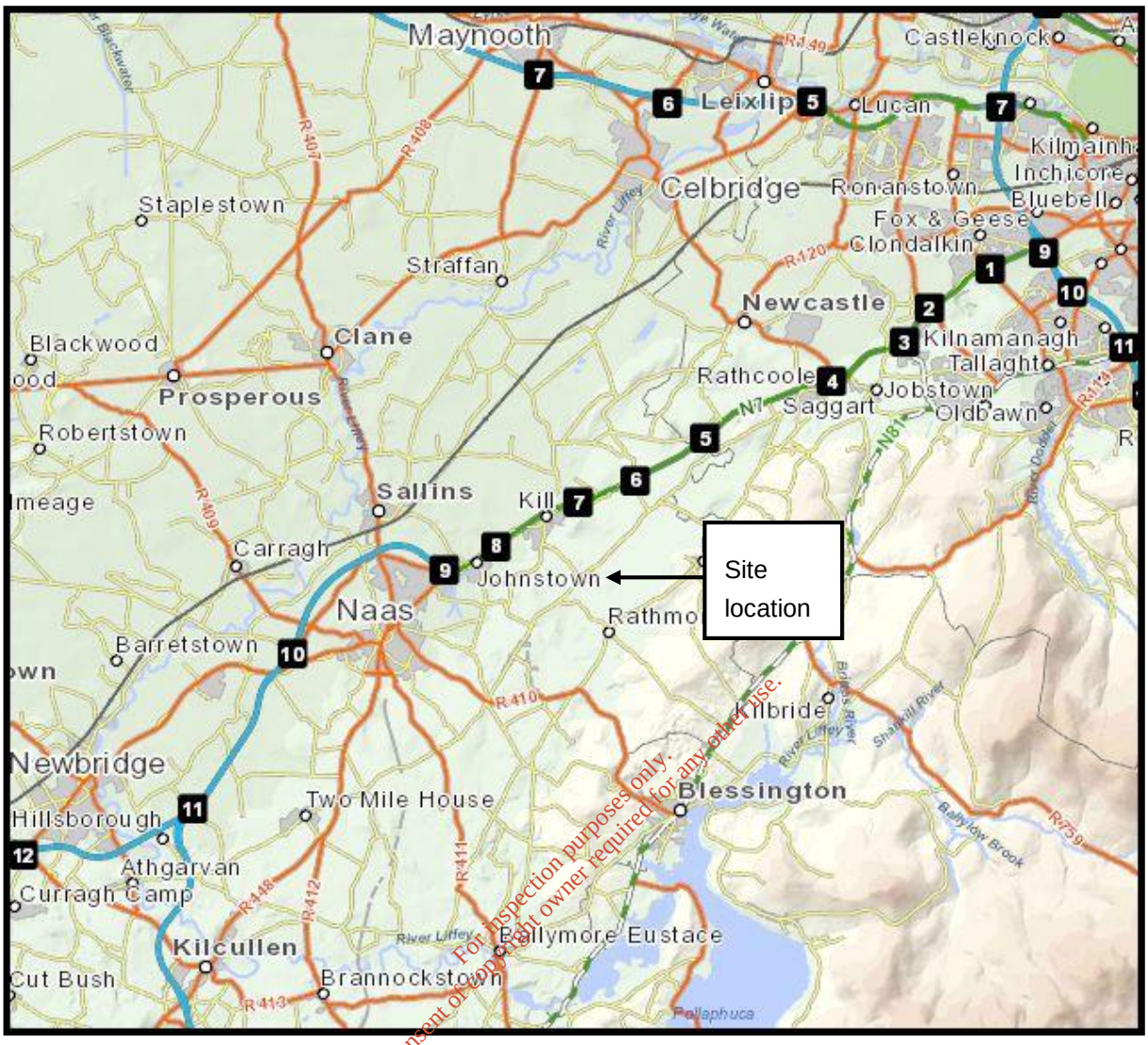

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Figure 3.9.1: Site location

3.9.1.1.2 The Development

The proposed development is located 2km south east of Kill village. It is proposed to continue the phased restoration of a sand and gravel pit using imported inert soils, stone and the recovery of inert construction and demolition waste (figure 3.9.2). Up to 70,000 cubic metres per annum of inert materials is being accepted to the site.

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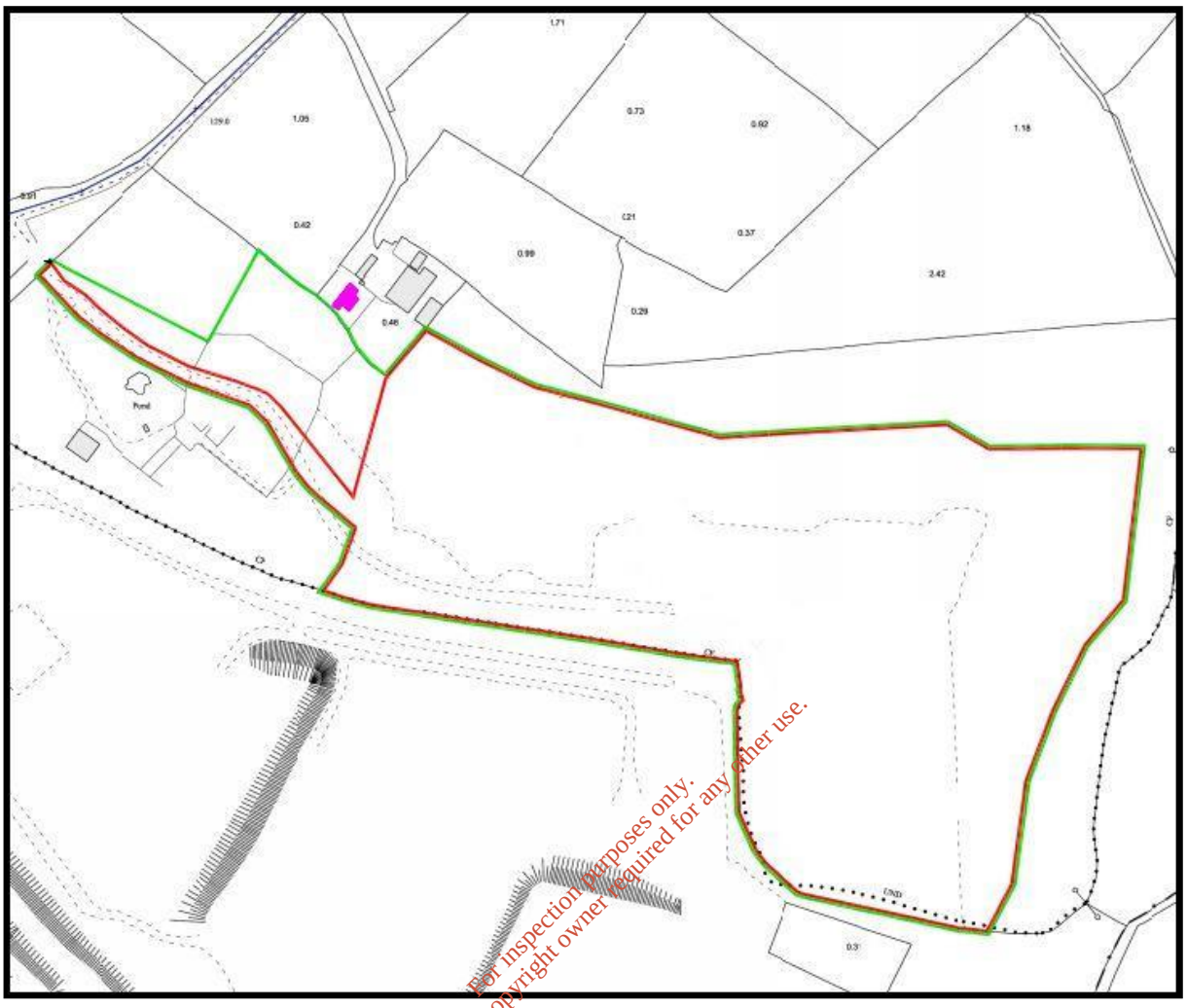

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Figure 3.9.2: Site layout

3.9.1.2 PROJECT TEAM

Dermot Nelis BA ArchOxon AIFA MIAI

Dermot Nelis graduated from Queen's University Belfast, and after gaining extensive fieldwork experience undertook postgraduate studies at the University of Oxford in archaeological consultancy and project management.

Dermot has acted as Senior Archaeologist on several road schemes for various County Councils/National Roads Authority, and Directed large-scale multi-period excavations associated with those developments. He has completed over 100 Licensed fieldwork programmes and over 250 archaeological, architectural and cultural heritage desk-based reports and Environmental Impact Assessments.

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3.9.2 BASELINE ENVIRONMENTAL STUDY

3.9.2.1 METHODOLOGY

Research has been undertaken in two phases. The first phase comprised a desktop survey of archaeological, historical and cartographic sources. The second phase involved a field inspection of the proposed development area.

3.9.2.2 PAPER SURVEY

The following sources were examined, and a list of sites and areas of archaeological, architectural or cultural heritage potential was compiled:

- Record of Monuments and Places of County Kildare;
- Topographical Files of the National Museum of Ireland;
- Cartographic and documentary sources relating to the study area;
- Aerial photographs of Ordnance Survey Ireland and Bing aerial photography;
- Kildare County Development Plan 2011 – 2017;
- National Inventory of Architectural Heritage.

Record of Monuments and Places is a list of archaeological sites known to the National Monuments Service. Back-up files of the Sites and Monuments Record (SMR) provide details of documentary sources and field inspections where these have taken place.

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Topographical Files of the National Museum of Ireland is the national archive of all known finds recorded by the National Museum. This archive relates primarily to artefacts, but also includes references to monuments and unique records of previous excavations. The find spots of artefacts are important sources of information in the discovery of sites of archaeological significance.

Cartographic sources are important in tracing land use development within the area of proposed land take, as well as providing important topographical information on sites and areas of archaeological potential. Cartographic analysis of relevant maps has been made to identify any topographical anomalies that may no longer remain within the landscape.

Documentary sources were consulted to gain background information on the historical and archaeological landscape of the proposed development area.

Aerial photographic coverage is an important source of information regarding the precise location of sites and their extent. It also provides initial information on the terrain and its potential to contain previously unidentified archaeological remains.

Kildare County Development Plan 2011-2017 contains Objectives and Policies on the preservation and management of archaeological, architectural and cultural heritage features. It was consulted to obtain information on sites within the proposed development area and the 1km study area.

National Inventory of Architectural Heritage (NIAH) is a section within the Department of Arts, Heritage and the Gaeltacht (DoAHG). The work of NIAH involves identifying and recording on a non-statutory basis the architectural heritage of Ireland from 1700 to the present day. The NIAH website also contains a non-statutory register of historic gardens and

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designed landscapes in Kildare, and this was assessed to look for the presence of any such features within the proposed development area and the 1km study area.

3.9.2.3 FIELD INSPECTION

Field inspection is necessary to determine the extent, character and condition of archaeological, architectural and cultural heritage remains, and can also lead to the identification of previously unrecorded or suspected sites and portable finds through topographical observation and local information.

3.9.3 ARCHAEOLOGICAL AND HISTORICAL BACKGROUND

3.9.3.1 GENERAL

During the Mesolithic period (*c*. 7,000-4,000 BC) people existed as hunters/gatherers, living on the coastline, along rivers and lakesides. They used flint and other stones to manufacture sharp tools, and locating scatters of discarded stone tools and debris from their manufacture can sometimes identify settlements. Their impact on the landscape was minimal, and the limited amount of evidence includes the remains of timber houses and primitive stone tools. The earliest evidence of settlement in County Kildare dates to this period and is represented by a Bann flake, a late Mesolithic tool, which was found during gas pipe-line excavations in Clane in 1998-99 (O'Farrell 2003, 3).

The population became more settled during the Neolithic period (*c*. 4,000-2,400 BC) with a subsistence economy based on crop growing and stock-raising. This period also saw changes in burial practices, and a tradition of burying the dead collectively and carrying out of cremations emerged. This period of prehistory in Kildare is represented by occasional megalithic tombs and a number of possible megalithic structures. Neolithic settlement has been identified at Dún Ailinne near Kilcullen and at Ardscull near Athy (*ibid*., 4).

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The Bronze Age (*c*. 2,400-600 BC) is characterised by the introduction of metalworking technology to Ireland and coincides with many changes in the archaeological record, both in terms of material culture as well as the nature of the sites and monuments themselves. Though this activity has markedly different characteristics to that of the preceding Neolithic period, including new structural forms and new artefacts, it also reflects a degree of continuity. During this period knowledge of metalworking was acquired resulting in changes in material culture such as the introduction of metal tools and artefacts as well as the introduction of a highly decorated pottery called Beaker pottery. In addition to changes in material culture, there were changes in burial rite from communal megalithic tombs to single burial in cists.

Bronze Age monuments from County Kildare include standing stones, cist and pit burials, barrows and *fulachta fiadh* which are one of the most numerous monument types in Ireland with over 4,500 examples recorded (Waddell 2005, 174).

An urn burial (RMP KD020-011), which dates to the Early Bronze Age (2,400-1,550 BC), is recorded approximately 600m south west of the proposed development area in Hartwell Upper townland. Digging operations in a sand ridge in 1936 uncovered evidence of burials, but the discovery was only reported and investigated by the National Museum of Ireland in 1939. Material subsequently collected by the National Museum comprised evidence of two burials from two different locations: unburnt human remains of Early Medieval date (RMP KD020-

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010, see below) and the remains of a prehistoric burial (RMP KD020-011). This comprised fragments (subsequently restored) of a small bowl food vessel (0.1m in height with a base diameter of 0.06m and a rim diameter 0.15m) decorated with a panel of conjoined lozenges, a panel of shapes like stretched hides, panels of both horizontal and vertical impressed lines, and four impressed grooves of circular form.

During the Iron Age (*c*. 600 BC-400 AD) new influences came into Ireland which gradually introduced the knowledge and use of iron, although for several centuries bronze continued to be widely used. The Iron Age in Ireland however is problematic for archaeologists as few artefacts dating exclusively to this period have been found, and without extensive excavation it cannot be determined whether several monument types, such as ring-barrows or standing stones, date to the Bronze Age or Iron Age. Most knowledge for this period stems from Irish folklore, the epic poems and legends of warrior kings and queens that are traditionally believed to be Celtic in origin.

The Early Medieval period (*c*. 400-1169 AD) is depicted in the surviving sources as entirely rural, characterised by the basic territorial unit known as *túath.* Walsh (2000, 30) estimates that there were at least 100, and perhaps as many as 150, kings in Ireland at any given time during this period, each ruling over his own *túath.*

The new religious culture brought changes in settlement and agricultural patterns. The ringforts and associated field patterns of the Early Medieval period indicate a life largely based on grazing. During this turbulent period roughly circular defensive enclosures known as ringforts were constructed to protect farmsteads. They were enclosed by an earthen bank and exterior ditch, and ranged from approximately 25m to 50m in diameter. The smaller sized and single banked type (univallate) was more than likely home to the lower ranks of society, while larger examples with more than one bank (bivallate/trivallate) housed the more powerful kings and lords. They are regarded as defended family homesteads and the extant dating evidence suggests they were primarily built between the 7th and 9th centuries AD (Stout 1997, 22-31). The ringfort is considered to be the most common indicator of settlement during the Early Medieval period. The most recent detailed study (*ibid*., 53) has suggested that there is an approximate total of 45,119 potential ringforts or enclosure sites throughout Ireland.

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Enclosure sites belong to a classification of monument whose precise nature is unclear. Often they may represent ringforts, which have either been damaged to a point where they cannot be positively recognised, or are smaller or more irregular in plan than the accepted range for a ringfort. An Early Medieval date is in general likely for this site type, though not a certainty.

The Early Medieval period is also characterised by the foundation of a large number of ecclesiastical sites throughout Ireland in the centuries following the introduction of Christianity in the 5th century. The early churches tended to be constructed of wood or post-and-wattle. Between the late 8th and 10th centuries mortared stone churches gradually replaced the earlier structures. Many of the sites, some of which were monastic foundations, were probably originally defined by an enclosing wall or bank similar to that found at coeval secular sites. This enclosing feature was probably built more to define the sacred character of the area of the church than as a defence against aggression. An inner and outer enclosure can be seen at some of the more important sites; the inner enclosure surrounding the sacred area of church and burial ground and the outer enclosure providing a boundary around living quarters and craft areas. Where remains of an enclosure survive it is often the only evidence that the site was an early Christian foundation.

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A burial (RMP KD020-010) is recorded approximately 370m west of the proposed development area in Hartwell Lower townland, and approximately 260m north east of prehistoric burial RMP KD020-011. It is recorded (www.archaeology.ie) as unburnt human remains comprising adult skull fragments and fragments of a mandible and rib from a juvenile aged 5-7 years. An object described as a "*copper spoon*" was said to have been found with the bones. A bullaun stone (RMP KD020-028) was also noted in the vicinity, although there is no information recorded on the location of this architectural feature.

A holy well (RMP KD020-004) and a holy tree/bush (RMP KD020-004001) are located approximately 580m north west of the proposed development area in Hartwell Lower townland. RMP KD020-004 was described *c*. 1915 as:

> "*St. Bridget's Well . . . now sadly neglected; it is unenclosed, and trodden around by cattle. Though a strong flow of water boils up in it, yet from its position by the side of a gripe, it would require a native of the locality to point it out*" (www.archaeology.ie).

The well was visited for toothache and earache cures and was said to have been formerly linked via St. Brigid's path to her church at Kill (RMP KD019-008002) (www.archaeology.ie). It was not associated with a pattern and is now covered by a pump house. A holy tree/bush (RMP KD020-004001) is recorded at the same site, and it was noted *c*. 1915 that:

> "*some years ago a sally tree stood near it (the holy well), which bore the usual load of votive rags etc*" (www.archaeology.ie).

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Holy wells are often found associated with early ecclesiastical sites. Although most have no artificial features associated with them, it is clear that the veneration of wells is a very ancient tradition within Ireland and more generally Europe (Lacy 1983, 301).

The commencement of Viking raids at the end of the 8th century and their subsequent settlement during the following two centuries marked the first ever foreign invasion of Ireland. Viking settlement evidence is scarce and has been found in Dublin and Waterford, however, excavations there have revealed extensive remains of the Viking towns. Outside these towns, understanding of Viking settlement is largely drawn from documentary and place-name evidence. In addition to Dublin and Waterford, documentary sources provide evidence for the Viking foundation of the coastal towns of Limerick, Wexford and Cork (Edwards 2006, 179). Other indirect evidence which suggest Viking settlement, or at least a Norse influence in Ireland, is represented by upwards of 120 Viking-age coin hoards, possible votive offerings of Viking style objects and the assimilation of Scandinavian art styles into Irish design. Whilst the initial Viking raids would have been traumatic, the wealth and urban expansion brought into the country as a result of Viking trading would have eventually benefited the Gaelic Irish and the cultural assimilation in some parts would have been significant.

The arrival of the Anglo-Normans in Ireland towards the end of the 12th century caused great changes during the following century. Large numbers of colonists arrived from England and Wales and established towns and villages. They brought with them new methods of agriculture which facilitated an intensification of production. Surplus foods were exported to markets all along Atlantic Europe which created great wealth and economic growth. Results of this wealth can be seen in the landscape in the form of stone castles, churches and monasteries.

The political structure of the Anglo-Normans centered itself around the establishment of shires, manors, castles, villages and churches. In the initial decades after the Anglo-Norman invasion a distinctive type of earth and timber fortification was constructed- the motte and bailey. Mottes

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were raised mounds of earth topped with a wooden or stone tower while the bailey was an enclosure, surrounded by an earthen ditch with a timber palisade, used to house ancillary structures, horses and livestock. There are eight motte and baileys recorded in County Kildare (www.archaeology.ie), two of which (RMP KD019-008004 and KD020-009004) are recorded within 1.6km of the proposed development area.

Kildare was shired in 1296/97. The county's proximity to Dublin made it a strategic part of the Anglo-Norman colony (Duffy 2006, 5). To the south and north east of the county were extensive clusters of manors that largely adopted pre-existing Irish settlements.

In certain areas of Ireland Anglo-Norman settlers constructed square or rectangular enclosures, now termed moated sites. Their main defensive feature was a wide, often water-filled, fosse with an internal bank. As in the case of ringforts, these enclosures protected a house and outbuildings usually built of wood. They appear to have been constructed in the latter part of the 13th century, although little precise information is available. There are 47 moated sites recorded in County Kildare (www.archaeology.ie).

More substantial stone castles followed the motte and bailey and moated sites in the 13th and 14th centuries. Tower houses are regarded as late types of castle and were erected from the 14th to early 17th centuries. Their primary function was defensive, with narrow windows and a tower often surrounded by a high stone wall (bawn). An Act of Parliament of 1429 gave a subsidy of £10 to "*liege*" men to build castles of a minimum size of 20ft in length, 16ft in breadth and 40ft in height (6m x 5m x 12m). By 1449 so many of these £10 castles had been built that a limit had to be placed on the grants. The later tower houses were often smaller, with less bulky walls and no vaulting. There are 49 tower houses recorded in County Kildare (www.archaeology.ie), the closest of which (RMP KD020-006) is located approximately 2km east of the proposed development area.

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In County Kildare the location of tower houses was especially extensive along the flanks of hill regions bounding Wicklow to the east, overlooking the bogs, woodlands and passes to the west and also protecting the route southwards to Athy and Carlow (Duffy 2006, 5).

The 14th century throughout north west Europe is generally regarded as having been a time of crisis, and Ireland was no exception. Although the Irish economy had been growing in the late 13th century, it was not growing quickly enough to support the rapidly expanding population, especially when Edward I was using the trade of Irish goods to finance his campaigns in Scotland and Wales. When the Great European Famine of 1315-17 AD arrived in Ireland, brought about by lengthy periods of severe weather and climate change, its effects were exacerbated by the Bruce Invasion of 1315-18 AD. Manorial records which date to the early 14th century show that there was a noticeable decline in agricultural production. This economic instability and decline was further worsened with the onset of the Bubonic Plague in 1348 AD.

Before the Tudors came to the throne the kings of England were also the kings of western France and so, during the 14th and 15th centuries, the various lords who ruled in Ireland were largely left to themselves. The Tudor conquest however brought a much greater interest in the affairs of Ireland. They wanted to put a stop to the raids of the Gaelic Irish on areas under English rule. To do this, they ruthlessly put down any rebellions and even quashed inter-tribal feuds. English settlers were then brought in to settle their lands. The first of these plantations occurred in the mid-16th century in what is now Laois and Offaly. After the Desmond rising in

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Munster in 1585 AD came another plantation, and parts of south western Tipperary were planted at that time.

From 1593 AD until 1603 AD there was a countrywide war between the Gaelic Irish, who were supported by the French, and the Elizabethan English. The Irish were finally defeated and with the "*Flight of the Earls*" from Rathmullan, County Donegal in 1607, Ulster, which had previously been independent of English rule, was planted.

By the 15th century County Kildare was located on the edge of the Pale around Dublin, which was the most enduring region of English colonial power. In 1515 much of the north east of the county had become part the Pale, which extended from south of Trim in County Meath to Kilcock, Clane, Naas, Kilcullen, Rathcoole and into County Dublin to Tallaght. Beyond this north eastern part, the remainder of County Kildare was subsumed into "*The Outer Pale*" of colonial order (*ibid.*).

By the Late Medieval period much of the Pale had been largely stripped of woodlands, and this brought great changes to the landscape of County Kildare whose plains were removed to accommodate agricultural and grassland areas. Surveys of the county undertaken in the 17th century reflect this extensive deforestation, referring only to small areas of woodland (*ibid.*, 7).

The 1798 Rebellion was a major event in Ireland's history. Formed in 1791, The United Irishmen had variant views: from parliamentary reform within the existing English structure to an outright overthrow of the system and the establishment of an Irish Republic. This period has been described as the "*crucible of Modern Ireland*" (Killeen 2003, 5). O'Farrell highlights the importance of County Kildare within the context of the 1798 Rebellion, where The United Irishmen were particularly strong with members fluctuating between 11,000 and 12,000.

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Expansion in the agricultural sector following a period of economic growth in Ireland from the mid-1730s led to rising prices and growth in trade. This increase in agricultural productivity resulted in growth in related industrial development throughout the country.

Two architectural fragments are recorded within the study area. RMP KD020-025 is located approximately 500m north of the proposed development area in Rathgorragh townland. It takes the form of a rectangular sandstone block (0.93m long x 0.55m wide x 0.28m high) and carries a series of short shallow grooves (on average 0.2m long x 0.05m wide x 0.05m deep). It is noted in the National Monument's Service database (www.archaeology.ie) that it may have been used as a blade-sharpening stone.

RMP KD020-024 is located approximately 930m south west of the proposed development area in Broguestown townland. It takes the form of a well-dressed rectangular granite piece (exposed length 0.46m x 0.19m in width x 0.17m thick) and has on its south face (which is still more than half-covered with render) a finely carved figure of an angel which is depicted with a small, oval head carved in relief and flanked on each side by lightly incised, outstretched wings. The angel's nose has been damaged. It is recorded (www.archaeology.ie) as being reused on the outer edge of a small landing on top of a short flight of steps leading to a barn door in a farmyard, and was noticed when a portion of heavy concrete and dash render came loose from the side of the steps.

The proposed development is located in Thornberry townland, which is in barony of Salt South and parish of Kill. Lewis (1837, Vol. II, p. 117) records that the parish of Kill contained 2,493 inhabitants. He notes that:

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"*The parish comprises 9986 statute acres, as applotted under the tithe act, and valued at £7897 per annum: the soil is of good quality and principally under tillage*" (*ibid*.).

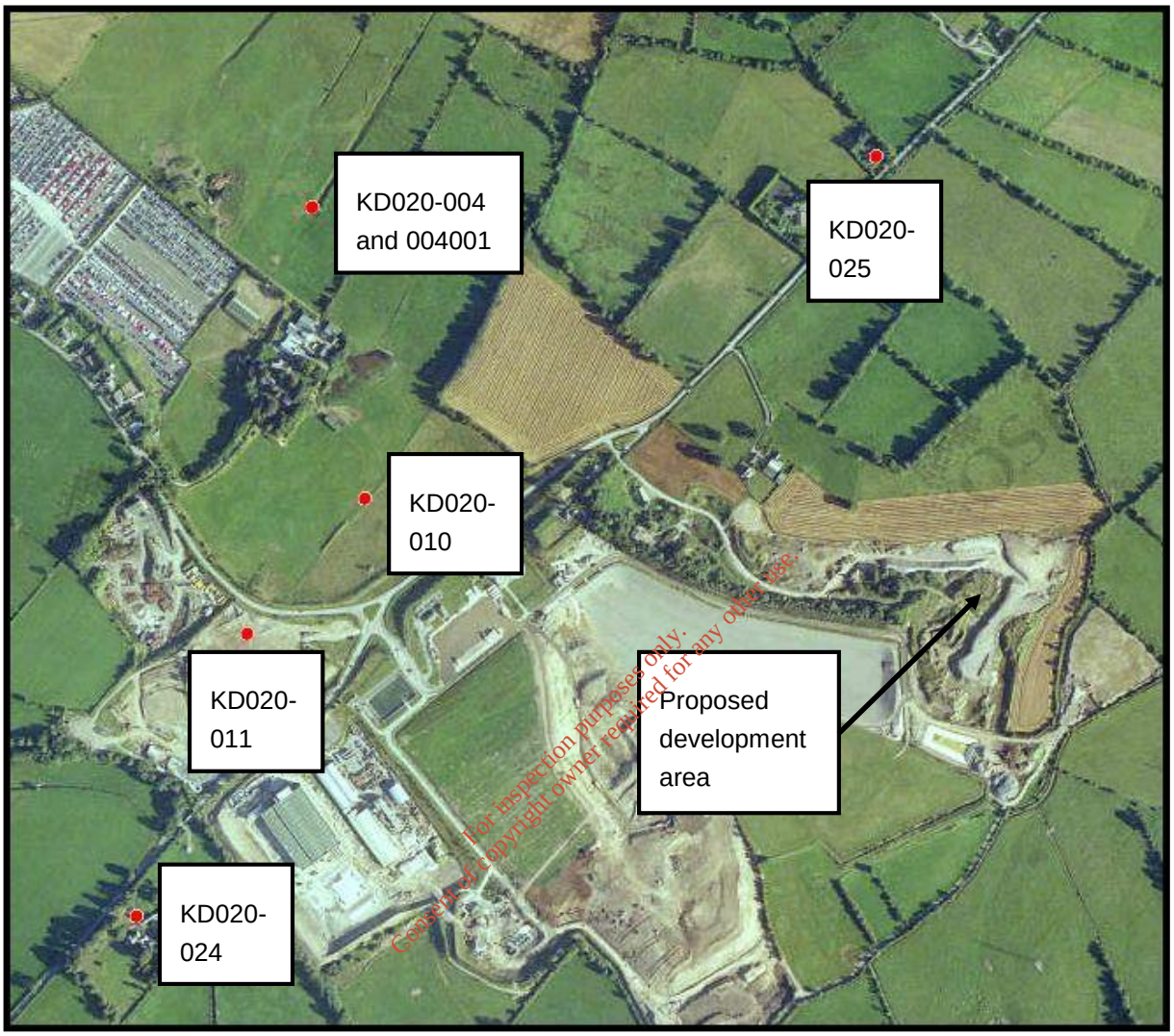

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Figure 3.9.3: RMP sites within the 1km study area

3.9.3.2 SUMMARY OF PREVIOUS FIELDWORK IN THE STUDY AREA

Reference to Summary Accounts of Archaeological Excavations in Ireland (www.excavations.ie) revealed that no fieldwork projects have been carried out in Thornberry townland, the location of the proposed development.

3.9.3.3 TOPOGRAPHICAL FILES OF THE NATIONAL MUSEUM OF IRELAND

Information on artefact finds and excavations from County Kildare is recorded by the National Museum of Ireland. Location information relating to such finds is important in establishing prehistoric and historic activity in the study area.

There are no entries recorded in the Topographical Files for Thornberry townland, the location of the proposed development.

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3.9.3.4 CARTOGRAPHIC ANALYSIS

Ordnance Survey Map First Edition 1:10,560 1839 (figure 3.9.4)

The southern side of the proposed development area is recorded as a townland boundary. Research suggests that:

"*hoards and single finds of Bronze Age weapons, shields, horns, cauldrons and gold personal objects can all be shown to occur on boundaries*" (Kelly 2006, 28).

The western end of the proposed area of land take is noted as being within the grounds of Thornberry house, and several structures are located in the vicinity of the house though outside the development area.

There are no archaeological, architectural or cultural heritage features recorded on the First Edition 1:10,560 map within the area of proposed land take.

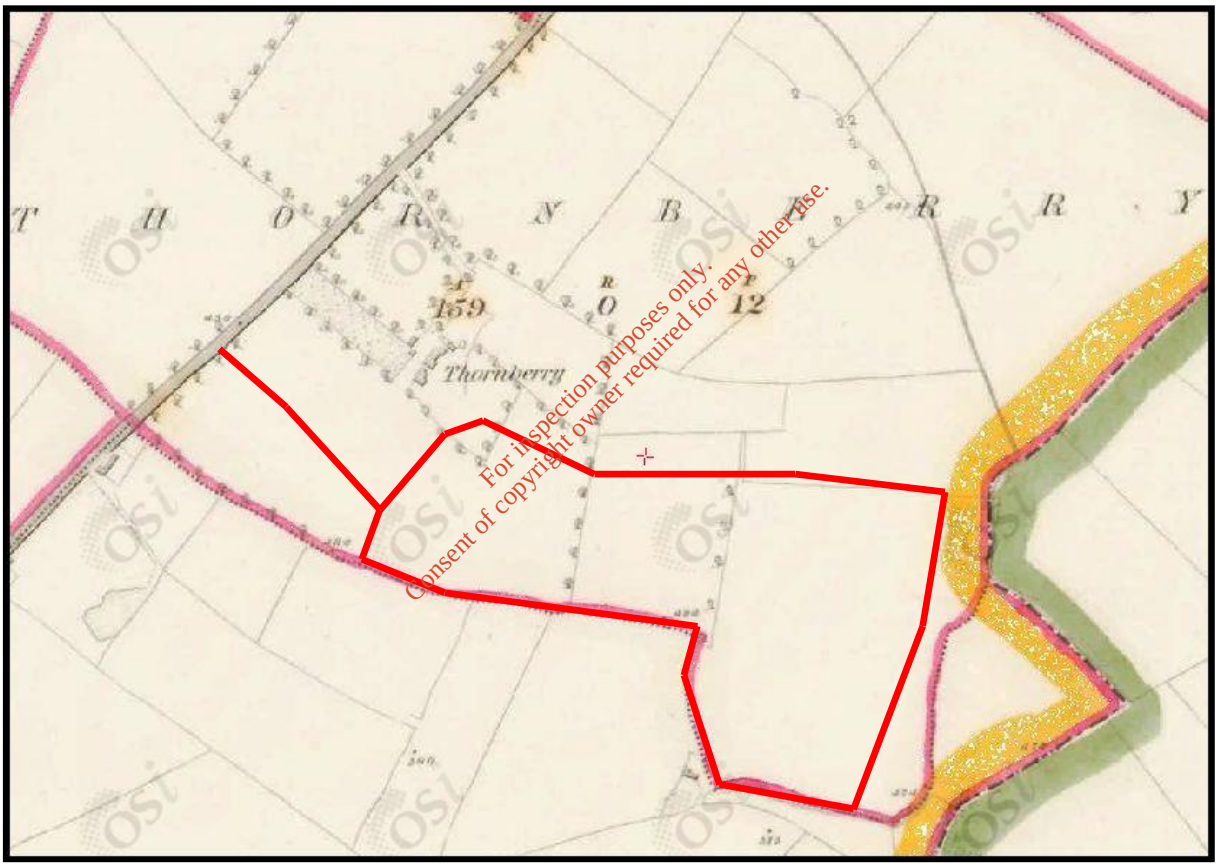

Figure 3.9.4: Extract from First Edition 1:10,560 OS map (1839) showing development area

Ordnance Survey Map Third Edition 1:10,560 1907-1909 (figure 3.9.5)

The Third Edition 1:10,560 OS map records a similar landscape within the area of proposed land take as the First Edition 1:10,560 map.

There are no archaeological, architectural or cultural heritage features recorded on the Third Edition 1:10,560 map within the area of proposed land take.

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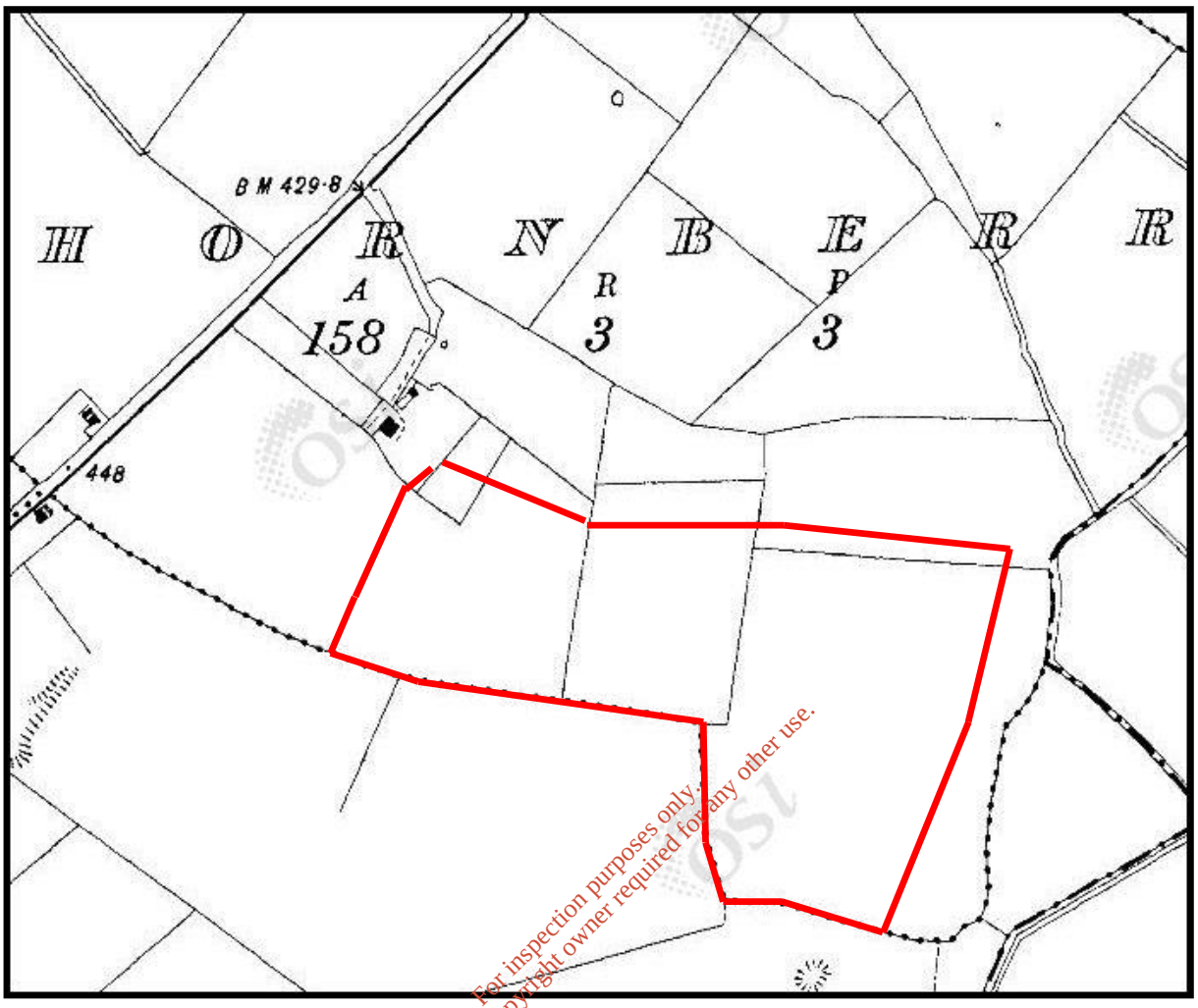

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Figure 3.9.5: Extract from Third Edition 1:10,560 OS map (1907-1909) showing development area

Ordnance Survey Map First Edition 1:2,500 1907-1909 (figure 3.9.6)

The First Edition 1:2,500 OS map records the proposed development area as being unchanged from the time of the two earlier map editions.

There are no archaeological, architectural or cultural heritage features recorded on the First Edition 1:2,500 map within the area of proposed land take.

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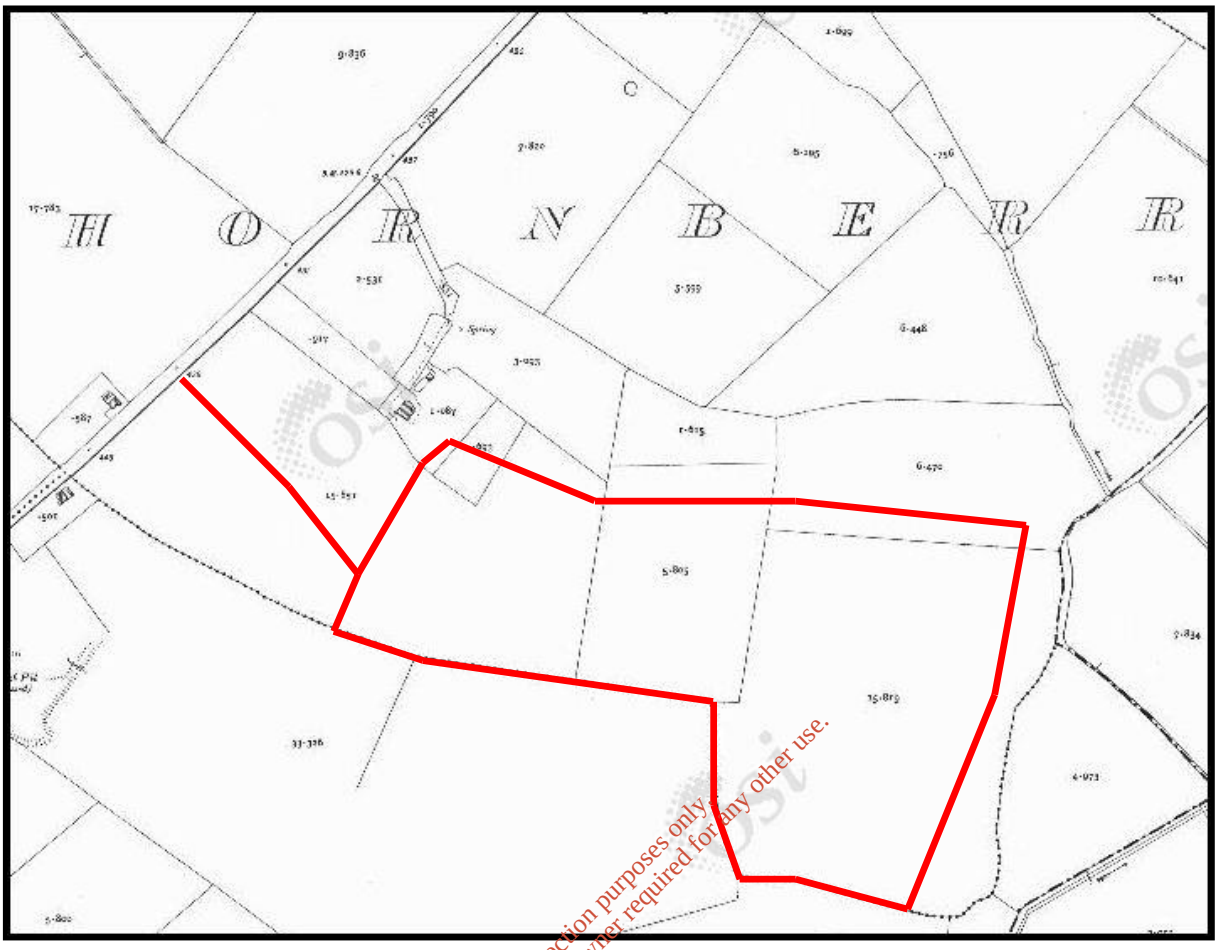

Figure 3.9.6: Extract from First Edition 1:2,500 OS map (1907-1909) showing development area

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3.9.3.5 AERIAL PHOTOGRAPHS

Aerial photographs held by Ordnance Survey Ireland (www.maps.osi.ie) were consulted to look for the presence of archaeological or architectural remains within the proposed development area.

The 2000 and 2005 photographs record a similar landscape to that which was noted during the walkover survey (see **3.9.3.9** below), with an excavated sand and gravel pit being noted.

The proposed development is recorded as an excavated pit and a partially restored area on more recent aerial photography (www.bing.com/maps).

There was no evidence of any archaeological, architectural or cultural heritage features recorded on aerial photographs within the land take of the proposed development area.

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3.9.3.6 COUNTY DEVELOPMENT PLAN

Kildare County Development Plan 2011-2017

It is the Policy (AH 1) of Kildare County Council to:

> *"have regard to the Record of Monuments and Places (RMP) and the Urban Archaeological Survey when assessing planning applications for development. No development shall be permitted in the vicinity of a recorded feature where it detracts from the setting of the feature or which is injurious to its cultural or educational value*" (Kildare County Council 2011, 209).

There are no RMP sites within the proposed development area. There are six RMP sites within the 1km study area.

Table 12.1 of the Kildare County Development Plan (*ibid*., 204) contains a list of *Zones of Archaeological Potential*. There are no Zones of Archaeological Potential within the proposed development area or the 1km study area.

Table 12.2 of the Kildare County Development Plan (*ibid*.) contains a list of *National Monuments in State Ownership*. There are no National Monuments in State Ownership within the proposed development area or the 1km study area.

Table 12.3 of the Kildare County Development Plan (*ibid*.) contains a list of *National Monuments in State Guardianship*. There are no National Monuments in State Guardianship within the proposed development area or the 1km study area.

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Table 12.4 of the Kildare County Development Plan (*ibid*., 205) contains a list of *Monuments Vested in the Care of Kildare County Council*. There are no Monuments Vested in the Care of Kildare County Council within the proposed development area or the 1km study area.

Table 12.5 of the Kildare County Development Plan (*ibid*.) contains a list of *National Monuments which are subject to Preservation Order in County Kildare*. There are no National Monuments which are subject to Preservation Order in County Kildare within the proposed development area or the 1km study area.

Table 12.6 of the Kildare County Development Plan (*ibid*., 206) contains a *Register of Historic Monuments in Kildare*. There are no sites recorded on the Register of Historic Monuments in Kildare within the proposed development area or the 1km study area.

It is the Policy (PS 1) of Kildare County Council to:

> "*conserve and protect buildings, structures and sites contained on the Record of Protected Structures of special architectural, historic, archaeological, artistic, cultural, scientific, social or technical interest*" (*ibid*., 207).

Section 12.10 of the Kildare County Development Plan (*ibid*., 215 - 250) contains the *Record of Protected Structures*. There are no Protected Structures within the proposed development area or the 1km study area.

Section 12.6 of the Kildare County Development Plan (*ibid*., 195) contains a list of *Architectural Conservation Areas*. There are no Architectural Conservation Areas or proposed Architectural Conservation Areas within the proposed development area or the 1km study area.

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3.9.3.7 NATIONAL MONUMENTS

The Department of Arts, Heritage and the Gaeltacht maintains a database on a county basis of National Monuments in State Care. The term National Monument is defined in Section 2 of the National Monuments Act (1930) as:

> "*a monument or the remains of a monument the preservation of which is a matter of national importance by reason of the historical, architectural, traditional, artistic or archaeological interest attaching thereto*".

There are no National Monuments in State Care within the proposed development area or the 1km study area.

There are no World Heritage Sites or Candidate World Heritage Sites within the proposed development area or the 1km study area.

3.9.3.8 NATIONAL INVENTORY OF ARCHITECTURAL HERITAGE

NIAH maintains a non-statutory register of buildings, structures *etc*. recorded on a county basis. There are no entries recorded on the NIAH Building Survey within the proposed development area or the 1km study area.

NIAH also maintains a non-statutory register of historic gardens and designed landscapes recorded on a county basis. There are no entries recorded on the NIAH Garden Survey within the proposed development area or the 1km study area.

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3.9.3.9 FIELD INSPECTION

The field inspection sought to assess the site, its previous and current land use, the topography and any additional environmental information relevant to the report. The inspection took place on 19th July 2014 and weather conditions were dry.

The site visit confirmed the proposed development area to consist of an excavated and partially infilled sand and gravel pit.

No archaeological, architectural or cultural heritage features were revealed within any areas of proposed land take as a result of carrying out the walkover survey.

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Plate 3.9.1: Middle of proposed development area, looking south

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Plate 3.9.2: Western end of proposed development area, looking east

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Plate 3.9.3: Southern end of proposed development area, looking south east

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Plate 3.9.4: Entrance to proposed development area, looking east

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3.9.3.10 CONCLUSIONS

There are no Recorded Monuments within the proposed development area. There are six Recorded Monuments within the 1km study area. There are no Protected Structures, Architectural Conservation Areas, proposed Architectural Conservation Areas, NIAH structures or NIAH historic gardens or designed landscapes within the proposed development area or the 1km study area. There are no National Monuments within the proposed development area or the 1km study area. There are no sites with Preservation Orders within the proposed development area or the 1km study area. There are no Zones of Archaeological Potential within the proposed development area or the 1km study area. There are no Monuments Vested in the Care of Kildare County Council within the proposed development area or the 1km study area. There are no sites recorded on the Register of Historic Monuments within the proposed development area or the 1km study area. There are no World Heritage Sites or Candidate World Heritage Sites within the proposed development area or the 1km study area. Reference to Summary Accounts of Archaeological Excavations in Ireland revealed that no fieldwork projects have been carried out in Thornberry townland, the location of the proposed development. There are no entries recorded in the Topographical Files of the National Museum of Ireland for Thornberry townland. There are no archaeological, architectural or cultural heritage features recorded on Ordnance Survey maps within the proposed development area. There was no evidence of any archaeological, architectural or cultural heritage features recorded on aerial photographs within the proposed development area. No archaeological, architectural or cultural heritage features were revealed within the area of proposed land take as a result of carrying out the walkover survey.

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3.9.4 ASSESSMENT OF IMPACTS

3.9.4.1 IMPACTS

The proposed development will involve the importation of inert waste material into part of an existing quarry from which the soils and underlying sand and gravel deposits have been excavated. As a result of carrying out this Environmental Impact Assessment, the following potential archaeological, architectural and cultural heritage impacts have been identified:

There are no Recorded Monuments, Protected Structures, Architectural Conservation Areas, proposed Architectural Conservation Areas, NIAH structures or NIAH historic gardens or designed landscapes within the proposed development area. As a result there will be no direct or indirect construction impact on the recorded or unrecorded archaeological, architectural or cultural heritage resource.

There will be no construction or operational visual or noise impact on the archaeological, architectural or cultural heritage resource.

3.9.4.2 RESIDUAL IMPACTS

There will be no residual impacts on the archaeological, architectural or cultural heritage resource.

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3.9.4.3 CUMULATIVE IMPACTS

There will be no cumulative impacts on the archaeological, architectural or cultural heritage resource.

3.9.5 MITIGATION MEASURES

There will be no direct or indirect construction impact on the recorded or unrecorded archaeological, architectural or cultural heritage resource. As such, no mitigation measures are required.

There will be no construction or operational visual or noise impact on the archaeological, architectural or cultural heritage resource. As such, no mitigation measures are required.

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www.bing.com/maps	Bing aerial photography
www.buildingsofireland.ie	National Inventory of Architectural Heritage
www.excavations.ie	Database of Irish Excavation Reports
www.kildare.ie	Kildare County Council
www.logainm.ie	Placenames Database of Ireland
www.maps.osi.ie	Ordnance Survey Ireland aerial photographs

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3.9.7 APPENDICES

APPENDIX 3.9.1 RMP SITES WITHIN THE STUDY AREA

APPENDIX 3.9.2 LEGISLATIVE FRAMEWORK PROTECTING THE CULTURAL HERITAGE RESOURCE

APPENDIX 3.9.3 IMPACT ASSESSMENT AND THE ARCHAEOLOGICAL RESOURCE

APPENDIX 3.9.4 MITIGATION MEASURES AND THE ARCHAEOLOGICAL RESOURCE

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APPENDIX 3.9.1 RMP SITES WITHIN THE STUDY AREA

RMP No.:	KD020-004 and 004001
Townland:	Hartwell Lower
Classification:	Holy well and holy tree/bush
Description:	Fitzgerald (1915-17, 494) described "*St. Bridget's Well on Mr. Lyon's farm (as) . . . now sadly neglected; it is unenclosed, and trodden around by cattle. Though a strong flow of water boils up in it, yet from its position by the side of a gripe, it would require a native of the locality to point it out*". Jackson (1979-80, 161) says the well was visited for toothache and earache cures and tokens were left at it. It was said to have been formerly linked via St. Brigid's path to her church at Kill (KD019-008002). However, the well was not associated with a pattern and is now covered by a pump house. Visible on a 2005 aerial photo with a very large drainage channel leading north north east from the well-house. Fitzgerald (1915-17, 494) records that "*some years ago a sally tree stood near it (the holy well), which bore the usual load of votive rags etc*".
RMP No.:	KD020-010
Townland:	Hartwell Lower
Classification:	Burial
Description:	In 1936, digging operations in a sand ridge uncovered evidence of burials, but the discovery was only reported and investigated by the National Museum of Ireland in 1939. Material subsequently collected by NMI actually comprised evidence of two burials from two different locations: a prehistoric burial (KD020-011) and unburnt human remains comprising adult skull fragments and fragments of a mandible and rib from a juvenile aged 5-7 years. A bone sample was dated 935 ± 35 BP. An object described as a "*copper spoon*" was said to have been found with the bones. A now unlocated bullaun stone (KD020-028) was also recorded in the vicinity.
RMP No.:	KD020-011
Townland:	Hartwell Upper

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Classification:	Urn burial
Description:	In 1936, digging operations in a sand ridge uncovered evidence of burials, but the discovery was only reported and investigated by the National Museum of Ireland in 1939. Material subsequently collected by NMI actually comprised evidence of two burials from two different locations: unburnt human remains of Early Medieval date (KD020-010) and the remains of a prehistoric burial. This comprised fragments (subsequently restored) of a small bowl food vessel 0.1m high with a base diameter of 0.06m and a rim diameter of 0.15m, decorated with a panel of conjoined lozenges, a panel of shapes like stretched hides, panels of both horizontal and vertical impressed lines and four impressed grooves of circular form.
RMP No.:	KD020-024
Townland:	Broguestown
Classification:	Architectural fragment
Description:	A well-dressed rectangular granite piece (exposed length 0.46m x 0.19m wide x 0.17m thick) with on its south face (which is still more than half-covered with render) a finely carved figure of an angel which is depicted with a small, oval head carved in relief which is flanked on each side by lightly incised, outstretched wings. The angel's nose is damaged. Reused on the outer edge of a small landing on top of a short flight of steps leading to a barn door in a farmyard, and noticed when portion of a heavy concrete and dash render came loose from the side of the steps.
RMP No.:	KD020-025
Townland:	Rathgorragh
Classification:	Architectural fragment
Description:	A rectangular sandstone block (0.93m long x 0.55m wide x 0.28m high) with a series of short shallow grooves (average length 0.2m x average width 0.05m x average depth of 0.05m). It may have been used as a blade-sharpening stone.

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APPENDIX 3.9.2 LEGISLATIVE FRAMEWORK PROTECTING THE CULTURAL HERITAGE RESOURCE

The Archaeological Resource

The **National Monuments Act**, **1930 to 2004** and relevant provisions of the **National Cultural Institutions Act**, **1997** are the primary means of ensuring the satisfactory protection of archaeological remains, which includes all man-made structures of whatever form or date except buildings habitually used for ecclesiastical purposes.

A number of mechanisms under the National Monuments Act are applied to secure the protection of archaeological monuments. These include the Record of Monuments and Places, the Register of Historic Monuments, the placing of Preservation Orders and Temporary Preservation Orders on endangered sites and National Monuments in the Ownership or Guardianship of the Minister for Arts, Heritage and the Gaeltacht or a Local Authority.

The Minister may acquire National Monuments by agreement or by compulsory order. The State or the Local Authority may assume Guardianship of any National Monument (other than dwellings). The owners of National Monuments (other than dwellings) may also appoint the Minister or the Local Authority as Guardian of that monument if the State or Local Authority agrees. Once the site is in ownership or Guardianship of the State, it may not be interfered with without the written consent of the Minister.

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Section 5 of the 1987 Act requires the Minister to establish and maintain a Register of Historic Monuments. Historic monuments and archaeological areas present on the Register are afforded statutory protection under the 1987 Act. Any interference with sites recorded on the Register is illegal without the permission of the Minister. Two months notice in writing is required prior to any work being undertaken on or in the vicinity of a Registered Monument. The Register also includes sites under Preservation Orders and Temporary Preservation Orders. All Registered Monuments are included in the Record of Monuments and Places.

Sites deemed to be in danger of injury or destruction can be allocated Preservation Orders under the 1930 Act. Preservation Orders make any interference with the site illegal. Temporary Preservation Orders can be attached under the 1954 Act. These perform the same function as a Preservation Order but have a time limit of six months, after which the situation must be reviewed. Work may only be undertaken on or in the vicinity of sites under Preservation Orders with the written consent, and at the discretion, of the Minister.

Section 12(1) of the 1994 Act requires the Minister for Arts, Heritage and the Gaeltacht to establish and maintain a Record of Monuments and Places where the Minister believes that such monuments exist. The Record comprises a list of monuments and relevant places and a map/s showing each monument and relevant place in respect of each county in the State. All sites recorded on the Record of Monuments and Places receive statutory protection under the National Monuments Act 1994.

Section 12(3) of the 1994 Act provides that:

> *"where the owner or occupier (other than the Minister for Arts, Heritage and the Gaeltacht) of a monument or place included in the Record, or any other person, proposes to carry out, or to cause or permit the carrying out of, any work at or in relation*

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to such a monument or place, he or she shall give notice in writing to the Minister of Arts, Heritage and the Gaeltacht to carry out work and shall not, except in the case of urgent necessity and with the consent of the Minister, commence the work until two months after the giving of notice".

Architectural and Built Heritage Resource

The main laws protecting the built heritage are the **Architectural Heritage (National Inventory) and Historic Properties (Miscellaneous Provisions) Act, 1999** and the **Planning and Development Act, 2000 (Amended 2010)**. The Architectural Heritage Act requires the Minister to establish a survey to identify, record and assess the architectural heritage of the country. The National Inventory of Architectural Heritage (NIAH) records all built heritage structures within specific counties in Ireland. As inclusion in the Inventory does not provide statutory protection, the document is used to advise Local Authorities on compilation of a Record of Protected Structures (RPS) as required by the Planning and Development Act, 2000.

The Planning and Development Act, 2000 requires Local Authorities to establish a Record of Protected Structures to be included in the County Development Plan (CDP). This Plan includes objectives designed to protect the archaeological, architectural and cultural heritage resource during the planning process. Buildings recorded in the RPS can include Recorded Monuments, structures listed in the NIAH, or buildings deemed to be of architectural, archaeological or artistic importance by the Minister. Sites, areas or structures of archaeological, architectural or artistic interest listed in the RPS receive statutory protection from injury or demolition under the 2000 Act. Damage to or demolition of a site registered on the RPS is an offence. The RPS list is not always comprehensive in every county.

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The Local Authority has the power to order conservation and restoration works to be undertaken by the owner of a Protected Structure if it considers the building in need of repair. An owner or developer must make a written request to the Local Authority to carry out any works on a Protected Structure and its environs, which will be reviewed within 12 weeks of application. Failure to do so may result in prosecution.

Kildare County Development Plan 2011 - 2017

Kildare County Council has written Policies and Objectives on the preservation of archaeological, architectural and cultural heritage remains in advance of permitted development. These relate to archaeological monuments and objects, vernacular structures and industrial heritage features amongst others.

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APPENDIX 3.9.3 IMPACT ASSESSMENT AND THE ARCHAEOLOGICAL RESOURCE

Potential Impacts on Archaeological Remains

Impacts can be identified from detailed information about a project, the nature of the area affected and the range of archaeological resources potentially affected. Development sites can affect the archaeological resource of a given landscape in a number of ways.

- Permanent and temporary land-take, associated structures, landscape mounding, and their construction may result in damage to or loss of archaeological remains and deposits, or physical loss to the setting of historic monuments and to the physical coherence of the landscape;
- Archaeological sites can be affected adversely in a number of ways: disturbance by excavation, topsoil stripping and the passage of heavy machinery; disturbance by vehicles working in unsuitable conditions; or burial of sites, limiting accessibility for future archaeological investigation;
- Hydrological changes in groundwater or surface water levels can result from construction activities such as de-watering and spoil disposal, or longer-term changes in drainage patterns. These may desiccate archaeological remains and associated deposits;
- Visual impacts on the historic landscape sometimes arise from construction traffic and facilities, built earthworks and structures, landscape mounding and planting, noise, fences and associated works. These features can impinge directly on historic monuments and historic landscape elements as well as their visual amenity value;
- Landscape measures such as tree planting can damage sub-surface archaeological features, due to topsoil stripping and through the root action of trees and shrubs as they grow;
- Ground consolidation by construction activities or the weight of permanent embankments can cause damage to buried archaeological remains, especially in colluvium or peat deposits;
- Disruption due to construction also offers in general the potential for adversely affecting archaeological remains. This can include machinery, site offices, service trenches etc;
- Although not widely appreciated, positive impacts can accrue from permitted developments. These can include positive resource management policies, improved maintenance and access to archaeological monuments and the increased level of knowledge of a site or historic landscape as a result of archaeological assessment and fieldwork.

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Predicted Impacts

There is no standard scale against which the severity of impacts on the archaeological and historic landscape may be judged. The severity of a given level of land-take or visual intrusion varies with the type of monument, site or landscape feature and its existing environment. Severity of impact can be judged taking the following into account:

- The proportion of the feature affected and how far physical characteristics fundamental to the understanding of the feature would be lost;
- Consideration of the type, date, survival/condition, fragility/vulnerability, rarity, potential and amenity value of the feature affected;

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- Assessment of the levels of noise, visual and hydrological impacts, either in general or site specific terms, as may be provided by other specialists.

Impacts are defined as:

> *"the degree of change in an environment resulting from a development"* (Environmental Protection Agency 2002, 30).

Impacts are described as indeterminable, negligible, minor, moderate or major on archaeological, architectural and cultural heritage remains. Moderate or major impacts are considered to be significant in Environmental Impact Assessment terms.

Significance Criteria:

Level of Impact	Significance Criteria
Major	An impact which obliterates sensitive characteristics
Moderate	An impact which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment
Minor	An impact which causes noticeable changes in the character of the environment without affecting its sensitivities
Negligible	An impact capable of measurement but without noticeable consequences
Indeterminable	An impact on a feature of unknown archaeological significance

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APPENDIX 3.9.4 MITIGATION MEASURES AND THE ARCHAEOLOGICAL RESOURCE

Mitigation is defined as features of the design or other measures of the proposed development that can be adopted to avoid, prevent, reduce or offset negative impacts.

The best opportunities for avoiding damage to archaeological remains or intrusion on their setting and amenity arise when the site options for the development are being considered. Damage to the archaeological resource immediately adjacent to developments may be prevented by the selection of appropriate construction methods. Reducing adverse impacts can be achieved by good design, for example by screening historic buildings or upstanding archaeological monuments or by burying archaeological sites undisturbed rather than destroying them. Offsetting adverse impacts is probably best illustrated by the full investigation and recording of archaeological sites that cannot be preserved *in situ*.

Definition of Mitigation Strategies

The ideal mitigation for all archaeological sites is preservation *in situ*. This however is not always a practical solution, and a series of recommendations are therefore offered to provide ameliorative measures where avoidance and preservation *in situ* are not possible.

Archaeological excavation involves the scientific removal and recording of all archaeological features, deposits and objects to the level of geological strata or the base level of a given development. Full archaeological excavation is recommended where initial investigation has uncovered evidence of archaeologically significant material and where avoidance of the site is not possible.

Archaeological test trenching is defined as:

> *"that form of excavation where the purpose is to establish the nature and extent of archaeological deposits and features present in a location which it is proposed to develop (though not normally to fully investigate those deposits or features) and allow an assessment to be made of the archaeological impact of the proposed development"* (DAHGI 1999a, 27).

Archaeological monitoring:

> *"involves an archaeologist being present in the course of the carrying out of development works (which may include conservation works), so as to identify and protect archaeological deposits, features or objects which may be uncovered or otherwise affected by the works"* (DAHGI 1999a, 28).

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3.10 MATERIAL ASSETS

3.10.1 INTRODUCTION

All projects and developments that require an EIS *by virtue of their nature, size and location*, have the potential to have an impact on the environment. This section of the EIS is essentially an overview of the material and amenity resources within the vicinity of the proposed development, coupled with an assessment of the potential impact, if any, of the development on the existing environment in respect of these assets. The section addresses the impacts on the material assets of the site and wider area with respect to the proposed continued operation of a Waste Recovery Facility (WRF) at the Thornberry quarry site.

The assessment of economic assets tend to be concerned with ensuring their equitable and sustainable use, whereas the assessment of cultural assets tend to be concerned with securing their integrity and continuity, and their necessary context. Key issues of residential development, amenity, land use, roads and utility services are addressed. Natural resources of economic value (Refer to table 3.10.1) which are also considered as material assets, are dealt with where necessary in their respective EIS sections (EPA 2003).

Material Assets is considered to include architectural and archaeological heritage and cultural heritage. For the purpose of this EIS an assessment of the potential impact, if any of the development on the existing environment with respect to these assets is considered in EIS Section 3.9 Section - Cultural Heritage.

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EPA (2003) defines material assets as "resources that are valued and that are intrinsic to specific places ….. and may be either human or natural origin, and the value may arise from either economic or cultural reasons". The Waste Recovery Facility (WRF) developments use of, or proximity to, the area's material assets, can directly and indirectly result in potential environmental impacts. Therefore the objective of this assessment is to identify the material assets of the area, determine the potential impacts of the proposed continued use of the WRF on these assets, and propose mitigation measures where necessary to ensure that they are addressed in an appropriate manner. This section also indicates the associated sections within the EIS that consider these impacts and any proposed mitigation measures.

3.10.2 STUDY METHOD

The assessment of material assets has been prepared in accordance with the Advice Notes on Current Practice (in the preparation of Environmental Impact Statements), published by the EPA (2003). Table 3.10.1 outlines the categories of assets, which the EPA suggests may need to be examined as part of the material assets study.

On the basis of categories in Table 3.10.1 and the nature of the proposed development, the material assets which potentially could be impacted by the WRF, and which have been identified for assessment are: (1) non-renewable resources (minerals, soils); (2) settlement - residential development; (3) land use; (4) transport infrastructure (roads); (5) major utilities; (6) cultural assets - archaeological, historic and architectural heritage; and (7) landscape and natural heritage. Most of these assets have been considered elsewhere within other sections of the EIS, as indicated below:

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- Non-renewable resources (minerals, soils) are discussed in Section 3.3 - Soils and Geology
- Settlement and land use are discussed in Section 3.1 – Human Beings
- Transport infrastructure (Roads) is discussed in Section 3.11 - Traffic
- Cultural assets are discussed in Section 3.9 - Cultural Heritage
- Landscape is discussed in Section 3.8 - Landscape

Table 3.10.1 EPA's Classification of Types of Material Assets

Asset Type	
Economic Assets - Natural Origin	- Assimilative capacity (air, water) - Non-renewable resources (minerals, soils) - Renewable resources
Economic Assets - Human Origin	- Settlements - Transport infrastructure (roads) - Major utilities (water, sewage, power, telecommunications) - Ownership and access
Cultural Assets – Physical Type	- Archaeology - Architecture - Settlements - Monuments, features and landmarks - Historic sites and structures - Landscape - Geological heritage
Cultural Assets – Social Type	- Language and dialects - Folklore and tradition - Religion and belief - Literary and artistic association

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3.10.3 EXISTING ENVIRONMENT

3.10.3.1 NON-RENEWABLE RESOURCES

The Kildare County Development Plan 2011-2017 recognises that gravel resources are important to the general economy. The potential of the resources to underpin construction output and provide employment and economic growth in the local and regional economy is

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also recognised, as is the need to exploit such resources in an environmentally sound and sustainable manner.

Kildare has significant resources in terms of aggregates, a resource that had come under pressure due to increased demand prior to the collapse of the construction industry in 2008. Since aggregates can only be worked where they occur, it is important to identify the location of these resources with a view to safeguarding them, coupled with the protection of amenities, prevention of pollution and the safeguarding of aquifers and ground water.

The area around Thornberry has a history of sand and gravel working, with extraction from the glacial deposits, such as moraines and other glaciofluvial outwash deposits. Furthermore, the adjoining disused sand and gravel quarry at Arthurstown has been developed as a landfill for the deposition of municipal waste. These activities, including the existing quarry have co-existed with other land uses in the area, which are mainly agricultural.

Sand & Gravel Merchants Ltd has an established small family run business based in Thornberry, Kill, Co Kildare. The company employs up to 3 people directly on site (currently 2 due to recent economic recession). The quarry has contributed indirectly to sustaining and developing the local and regional economy through the supply of building products, and has provided employment for local people, both directly and indirectly

The WRF requires one person operating a bull-dozer/back-hoe excavator, one general foreman to monitor and inspect the quality and suitability of imported materials being brought to the site for recovery and one other general site operative. It is expected that the existing staff will continue in these roles, if and when the WRF is licensed.

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3.10.3.2 SETTLEMENT - RESIDENTIAL DEVELOPMENT

There are few residences in the immediate area, with only 6 within 500m. Residential development predominantly consists of isolated farm dwellings and of owner occupied bungalow/houses along public roads (Refer to EIS Figures Figure B 2.2 – Rev A, *EIS Section 2 Figures*). The nearest large residential settlement close to the site is Kilteel (pop. c. 225), located c. 2km to the east. Further afield, Kill (pop. 3,095) is c. 2.5km to the northwest, Naas (pop. 20,713) c. 6.5 km to the west, Sallins (pop. 5,283) c. 7km to the west, Blessington (pop. 5,010) c. 7.5km to the southeast in Wicklow, Clane (pop. 6.702) c. 10.5km to the west northwest, and many more including the Dublin Metropolitan Area within 25km.

With exception of the M7 and the N81, the roads in the immediate area are of a local character and typical of a rural location. The M7 motorway (at Junction 7) lies c. 2km to the north, whilst the N81 National Secondary Road is c. 6km to the southwest, just north of Blessington. The Dublin-Limerick and Cork mainline railway runs north of Kill, with the nearest station at Naas c. 6.5km to the west.

Adequate fencing, signage and other barriers have been erected around the site for the safety of the general public and to prevent livestock straying into the development area, albeit livestock is availing of some of the restored lands. Large lockable gates are in place to guard against unauthorised and unsupervised entry to the site outside of working hours.

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3.10.3.3 LAND USE

Thornberry is located rural northeast County Kildare c. 2.5km southeast of Kill (Refer to Figure A1.0, EIS Section 2 Figures). The western boundary of the quarry site is terminates at local road L2019, whilst the northern and eastern other boundaries abut agricultural land, and the southern boundary abuts the Arthurstown landfill. There are essentially three residential properties contiguous with the WRF site, one of which occurs on the landholding, and is the landowners residence. There are only six residential properties within 500m of the site, and the settlement pattern in the locality can be described as medium- to low-intensity rural settlement.

The surrounding landscape of the area consists of rolling hills, and is a reflection of the underlying geology. The site is at an elevation of c. 135-150m AOD in an area identified as the Eastern Transition by Kildare County Council (2011), and is dominated by calcareous greywacke siltstones and shales of the Carrighill Formation. The landscape constitutes a transition from lowlands developed on limestones to the west, to the foothills of the Wicklow Mountains developed on more indurated Lower Palaeozoic siliceous metasediments to the east. Thornberry sits near the headwaters of the Kill River, which flows off the uplands to the lowlands in a roughly west northwest direction. The waters of the Kill River ultimately drain into the Liffey, c. 1km south of Straffan village.

The Thornberry quarry was developed on a meandering glacial ridge known as a moraine, in order to extract the constituent sand and gravel. The moraine forms an irregular ribbon of sand and gravel that was deposited at the terminus of the ice sheet as it stalled against the foothills of the Wicklow Mountains. The topography of the site and immediate surroundings to the south and east, incorporating Arthurstown, is disturbed or modified due to quarrying, landfill, waste recovery and land restoration operations. The unrestored sections of the quarry have a typically irregular, but concave topographic profile reflecting the quarry void (min. elev. ≥ 135m AOD), with stockpiles of aggregate products and intact materials. The restored section of the quarry (i.e., Phase 1 or P1) is being restored back to a convex or domed profile (max. elev. ≤ 150m AOD). The existing topographical contours are shown in EIS Figure 2.1 - Existing Site Survey.

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The wider landscape around Thornberry is generally of undulating topography and rolling low hills (elev. c. 100-200m AOD), with views of the lowlands (c. 70-80m AOD) to the west, and the uplands and Wicklow Mountains to the east. The landscape is characterised by mature hedgerows with many hedgerow trees, whilst the land is predominantly in pasture, used mostly for stock rearing, and some mixed tillage. Areas of coniferous forestry, some new deciduous forestry and some successional woodland also occur in this landscape area. Mature hedgerows with many trees tend to create enclosed rural road corridors with restricted views. The workings are effectively screened from views on local road L2019 by intervening mature and heavily wooded hedgerows, but are open to distant, but significant views from elevated ground to the east.

The site of the WRF coincides with the quarry site which comprises c. 10ha of the applicants leaseholding (i.e., c. 11.4ha), shown edged red and green, respectively on EIS Figure B 2.2 – Rev A, *EIS Section 2 Figures*. The predominant land use within the application site, which is co-located within the quarry site, is by definition that of quarrying activities related to the

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extraction of sand and gravel and associated operations such as placement of soil and stone in quarry restoration.

The 2006 Corine Map indicates the land-use in the area consists of a patchwork of agricultural fields that are designated predominantly as pasture with subordinate non-irrigated arable land (See Figure 3.8.4), reflecting medium-high intensity agricultural. The towns of Kill, Johnstown and Naas are designated as urban fabric, whilst Arthurstown, Thornberry and Hartwell quarries, as well as the adjacent commercial properties of Balcas, Allcrete east of the L2019, and of BAM contractors and the adjacent, vacant sales yard west of the L2019, are all designated as industrial and commercial. Interestingly, the substantial industrial yards at Oldmilltown are designated as mineral extraction site, rather than industrial and commercial. Thus, although Thornberry is nominally a rural area, pasture, industrial and commercial, and arable are the principal indicative land uses within a 1km radius.

Although Kildare has 5-10% forest cover, the 2006 Corine Map indicates no forest cover within c. 4-5km of the Thornberry site (EPA 2014). However, aerial photography shows considerable broadleaf, coniferous and mixed forest cover, as woodland in the Kill and Hartwell River Corridors, as afforestation in Kilteel Lower and Burntfurze Townlands, and as screening around parkland in the Forenaughts area, and around commercial properties in Hartwell Lower (Google Maps 2014). Forests represent an important renewable resource and contribute to sustainable rural economic development. However, woodland and forests are only a minor land use in the wider local area, but together with high, mature banked hedgerows, deep drainage ditches and rolling terrain, contribute to an partially enclosed pastoral landscape.

Ultimately, the Thornberry site will be reclaimed in accordance with the approved quarry restoration scheme, and thus undergo a change of land use back to agricultural land. Thus, as the WRF is co-located within the quarry, the proposed continuation of the WRF will result in a change in land use from mineral extraction to agricultural use.

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3.10.3.4 TRANSPORT INFRASTRUCTURE

The Thornberry site is located c. 2.5km southeast of Kill, on the east side of local road L2019. The L2019 runs from Rathcoole c. 12.5km in a southwesterly direction to Beggars End crossroads, following the southwesterly oriented topographic contours, which parallel the leading edge of the Eastern Uplands and the Wicklow Mountains.

The road network in the area can be summarised as four roughly parallel roads running in a southwesterly direction, and diverging radially as they egress from Dublin. The northwestern edge is marked by the N7 Primary National Road, the southeastern edge by the N81 Secondary National Road, whilst the two local roads, L2019 and L2021, run roughly equidistant and sub-parallel between these. The R410 Regional Road runs in a southeasterly direction from Naas to Blessington in a southern transverse corridor, and meets the L2019 at Beggars End crossroads, c. 1km north of Punchestown. North of Thornberry, McDonagh's Lane also runs in a southeasterly direction from the N7 to the N81 in a northern transverse corridor, with a slight offset near Oldmilltown. Several unnamed roads run in a southeasterly direction from Kill, through Hartwell Lower, with one major offset, through Rathmore and across to the N81, in a central transverse corridor informally identified here as the Rathmore Road.

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Thus, the roads of the area form a network of local and regional roads between two radiating national routes from Dublin, namely the N7 (connecting Dublin, Kill, Johnstown, Naas, Newbridge, etc), and the N81 (connecting Dublin, Blessington, Baltinglass, Tullow, etc.). Most site traffic serving the WRF is either off the N7 at Junction 7 near Kill, or off the N81 at Blessington on the R410, or the Rathmore Road north of Blessington.

The National Spatial Strategy 2002-2020 (NSS) identifies Dublin as the only Gateway within the Dublin and Mid-East Region or GDA, but lies c. 30km to the northeast. Within the south central sector, which includes all of Kildare and the wider area around Thornberry, there are four Primary Development Centres identified, namely Naas, Newbridge, Kilcullen and Wicklow(DEHLG 2002). These centres are strategically placed, strong and dynamic urban centres, located on major transport corridors, where development in the hinterland of Dublin should be concentrated. With a proximity of c. 6.5km, Thornberry clearly falls within the natural catchment of Naas, but not Dublin (i.e., >30km by road).

The significant roads in the region are summarised below:

- N7/M7 is the National Primary Route connecting the capital city, Dublin to Kill, Johnstown, Naas, Newbridge, Kildare, and ultimately Limerick City, and Cork City via the M8, and Kilcullen, Castledermot and ultimately Waterford City via the M9. The road is the dual carriageway between the M50 in Dublin and Naas, where it becomes motorway. It is one of the strategic radial corridors as identified in the National Spatial Strategy (DEHLG 2002).
- N81 is the National Secondary Road College, connecting Dublin to Blessington, Baltinglass and Tullow. The road is a dual carriageway between Templeogue and west of Tallaght, known as the Tallaght Bypass, where it reverts to single carriageway. It is not a strategic radial corridor as identified in the National Spatial Strategy (DEHLG 2002).
- R410 Regional Road is oriented WNW-ESE, and is the Kill to Blessington road, and forms the southern transverse corridor in the wider Thornberry area, and forms the southern transverse corridor in the wider Thornberry area.
- Rathmore Road is a local road oriented NNW-SSE, and connects Kill to the N81 north of Blessington, and forms the central transverse corridor in the wider Thornberry area.
- McDonagh's Lane is a local road oriented WNW-ESE, and connects the N7 to the N81 via Oldmilltown, and forms the northern transverse corridor in the wider Thornberry area.

The local roads in the Thornberry area are typical of a rural location, and consist of single surface dressed carriageways, generally connecting to other local roads or forming Cul De Sac's that penetrate as far as to service several houses or farmsteads.

The Dublin-Limerick and Cork mainline railway runs north of Kill, with the nearest station at Naas c. 6.5km west of the site. The rail line parallels the grand canal to Sallins, just north of Naas, after which the grand canal swings west, whilst the rail line meanders with the M7 as far south as Mountrath, Co. Laois. Dublin is identified as the nearest designated Gateway

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(DEHLG 2002), and Dublin Airport is the nearest airport at c. 25km due northeast of the site, whilst Dublin is also the nearest port at c. 30km.

The local road L2019 is a partially realigned two lane 7.3m macadam carriageway with 2 No.1m Grass verges in the vicinity of the facility entrance. The L2019 is high quality local road with a speed limit of 80 km/hr. The standard for the desirable stopping sight distance is 150m as set out in the NRA DMRB TD9 & TD41-42 and Kildare County Council Development Plan 2008 - 2014. i.e. an unobstructed visibility triangle of 150m at 4.5m back from the road edge left and right of the entrance onto the L2109. The junction of Road A and L2019 has Stopping Sight Distance of 84m and 150 m to the SW and NE respectively. The junction of with the L2019 and Road B has Stopping Sight Distance of 160m and 200 m to the SW and NE respectively.

The only deficient Stopping Sight Distance is to the SW from Road A. The practice of all traffic leaving the facility turning right onto Road B to access the L2109 overcomes this deficiency. The facility access road approaches the L2019 at an acute angle, this needs a Stop sign for junction form recognition.

The traffic impact of the quarry is at present considerably less than it was at full production in the period prior to 2008. During that period the traffic generated by the quarry had no adverse effect on traffic movement on the surrounding road networks. The traffic arising from the proposal to continue operating the WRF and importing soil and stone into the quarry will not increase traffic above the 2008 levels. The traffic impact of the WRF and quarry on the surrounding road network is considered minimal.

Further details with respect to the road networks and the impact and mitigation of traffic are contained within this report (Refer to Section 3.11).

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3.10.3.5 MAJOR UTILITIES

The water supply for the quarry and WRF is provided by the existing well on site, although potable water is brought on site. It is proposed that a chemical toilet (portaloo) will also be provided, and a maintenance contract will be entered into with the supplier.

Most residential properties in the area are serviced by a mains supply, which is operated by the local group water scheme. The landowner's property and farm is serviced by a well (PW2) which is included in the groundwater monitoring programme for the adjoining Arthurstown landfill site. The houses in the area are serviced by septic tank systems and proprietary effluent treatment systems.

Power to local residences is provided by overhead lines, which form part of ESB's country-wide, typically low voltage, electricity distribution network. The electrical power to the area is provide from a single 100kV transmission line operated by ESB Networks, running from Maynooth, via Steelstown (near Rathcoole) to Kilteel, Monread, Newbridge, and ultimately Portlaoise. This line passes within c. 200m of the eastern boundary of the Thornberry site.

The transmission grid in the area of northeastern Kildare is controlled by the Dunston 400kV Station, c. 2km south of Two Mile House, at which one of the twin 400 kV lines from Moneypoint terminates. The 400kV is stepped down to 220kV and transmitted onward via a network of 220 kV lines operated by Eirgrid. Three 220kV lines traverse the northeast Kildare area: one runs c. 250m east of the site, continues east of Kilteel, before splitting and

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terminating in Maynooth and Carrickmines, whilst one from Dunston and another from Turlough Hill run west of Naas to Maynooth (See Figure 3.10.1).

EirGrid, the national electrical transmission operator (TSO) has recently rolled out a grid development strategy called GRID25, which sets out the development of the transmission infrastructure to ensure that grid reinforcements enable connection of significant amounts of renewable energy generation. In particular, Eirgrid have planned the Grid Link Project, which will involve construction of a new 400 kV power line linking Cork and Kildare via Wexford, with one terminus at Dunston. Both overhead and underground alternatives are being examined, but new EHV power lines typically take in excess of a decade to complete, largely because of community opposition in the design and planning stages.

Bord Gais have two subsea gas pipeline interconnectors with Scotland that come ashore near Gormanstown, Co. Meath and Loughshinny, County Dublin. These pipelines connect into the network, which in the east of Ireland consists of a main line running from Cork to Dublin and up the east coast to N. Ireland, with multiple spurs to supply towns on route. One spur supplies Naas from which a distribution line supplies Johnstown and Kill. The latter main E-W pipeline passes therefore passes c. 2.5 km northwest of Thornberry (See Figure 3.10.2). Thus, there are no gas pipelines in the near vicinity of Thornberry (i.e., within c. 2km).

There are numerous mobile masts or base stations for the transmission and reception of mobile telecommunication in the region around Thornberry. These masts house both point to point microwave links and cellular technologies used in the provision of telecommunication services. The nearest cell masts to the Thornberry site are located at Oldmilltown, adjacent to an ESB substation. The next nearest cell masts are at Blackhall, east of Kill, at Goffs Bloodstock Sales at Kill, c. 3km northwest of the site, and near Junction 8 on the N7 at Johnstown c. 3.5 km from the site.

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3.10.3.6 CULTURAL ASSETS

The proposed continuation of operations of the WRF was the subject of an assessment that involved the investigation of cultural heritage including the archaeological, structural and historical background of the application area and the surrounding area using a wide range of existing information, as well as a field assessment (Refer to EIS Section 3.9).

There are no recorded archaeological, architectural or cultural heritage features within the area of land take, but there are 2 structures (i.e., a burial and architectural fragment) in the surrounding environment within c. 500m standoff. Despite the proximity of these protected structures and monuments, the WRF will have imperceptible impacts on recorded archaeological, architectural or cultural heritage features, such that mitigation measures are considered unnecessary. The proposed continued operation of the WRF will lead to the restoration of the lands and an improvement in the amenity of the area, and therefore to the context of these monuments.

3.10.3.7 LANDSCAPES & NATURAL HERITAGE

The landscape of the Thornberry site is defined by a mix of disturbed and restored lands resulting from the operation of quarrying and land restoration in the area of the pre-existing topographic ridge or moraine. Similarly, the lands of the former sand and gravel quarries to

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the immediate west at Hartwell and to the immediate south at Arthurstown have been or are currently being restored.

The wider landscape around Thornberry is generally of undulating topography and rolling low hills (elev. c. 100-200m AOD), with views of the lowlands (c. 70-80m AOD) to the west, and the uplands and Wicklow Mountains to the east. The landscape is characterised by mature hedgerows with many hedgerow trees, whilst the land is predominantly in pasture, used mostly for stock rearing, and some mixed tillage. Areas of coniferous forestry, some new deciduous forestry and some successional woodland also occur in this landscape area. Mature hedgerows with many trees have tended to create enclosed rural road corridors with restricted views. The workings are effectively screened from views on local road L2019 by intervening mature and heavily wooded hedgerows, but are open to distant, but significant views from elevated ground to the east.

The partially enclosed landscape has a medium capacity to absorb most development, as the enclosed landscape can physically or visually absorb development, mitigating the visual impact on the landscape. Nonetheless, sensitive development and conservation of the landscape resource is essential to the underpinning of the rural economy and quality of life of the area.

There are two Natura 2000 sites located within 15km of the site, Poulaphuca Reservoir SPA (Site Code 004063) and the Red Bog cSAC (Site Code 000397). Both are many metres higher in altitude and there is no pathway by which impacts from Thornberry could be felt by their habitats or species. In addition there are four downstream sites in Dublin Bay; North Dublin Bay (0206) and South Dublin Bay (0210) are cSAC's, while North Bull Island (4006) and South Dublin Bay (4024) are SPA's.

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The nearest designated site to the Thornberry WRF is the pNHA (Site Code 001394) at Kilteel Wood c. 2km to the east, Other pNHA's within 15km of the site are: Ballynafagh Bog pNHA (Site Code 000391); Ballynafagh Lake pNHA (Site Code 001387); Grand Canal pNHA (Site Code 002104); Mouds Bog pNHA (Site Code 000395); Liffey Valley Meander Belt pNHA (Site Code 000393); Poulaphouca Reservoir pNHA (Site Code 000731); Red Bog pNHA (Site Code 000397).

The quarry site at Thornberry, which includes the application site, is not included in any area with an ecological designation (NHA, cSAC or SPA).

The site does not have a direct ecological connection with any of the Natura 2000 areas except for the Dublin Bay sites. Since no outflows are expected from the operation of the project and, if this was to occur, the dilution factor in river water and in Dublin Bay is so vast, no impacts on ecology or on Natura 2000 sites can be reasonably expected.

Appropriate assessment was introduced by the EU Habitats Directive as a way of determining if a planned project is likely to have a significant effect on one of the Natura 2000 sites so far designated (i.e. the candidate SAC's and SPA's), or their conservation objectives.

Screening for Appropriate Assessment was carried out with respect to the licence application and a copy of this report was previously submitted to the EPA. The findings of the screening for Appropriate Assessment were that the activity, individually or in combination with other plans or projects is not likely to have a significant effect on the Natura 2000 network, or the

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conservation objectives of the sites. A Stage 2 Appropriate Assessment is therefore not required.

As noted the nearest designated site to the Thornberry WRF is the pNHA (Site Code 001394) at Kilteel Wood c. 2km to the east. There will no direct or indirect impact on it or any pNHA as a result of the continued operation of the WRF at Thornberry.

The impact of inert waste recovery on this site will be considerable in local terms but will not result in any loss of heritage values in the locality

The geological feature upon which the quarry was developed, and from which sand and gravel is extracted, is not designated as a County Geological Site nor as a NHA Site (Parkes & Sheehan-Clarke 2005). The nearest County Geological Site is Slate Quarries (Site Code KE004) c. 4.5km to the southeast.

Although of a rural, pastoral character, the locality is not noted particularly for amenities/activities such as fishing, walking, cycling and other outdoor pursuits. There are no Protected Views and Prospects oriented toward the area (Kildare County Council 2011), which might be affected by the continued operation of the WRF. The visual impact of the WRF is discussed in more detail in Section 3.8 - Landscape.

On completion of waste recovery activities at the WRF, the entire site will be reinstated in accordance with the approved quarry restoration scheme. Therefore in the long term, the site will be assimilated back into the landscape in a planned manner, with the attendant improvement to the visual amenity of the area.

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3.10.4 POTENTIAL IMPACTS AND PROPOSED MITIGATION MEASURES

The proposed continued operation of the WRF at Thornberry arises from: (1) from the continued generation of large volumes of inert C&D waste, including soil and stone; and (2) the requirement to restore land previously disturbed and degraded by sand and gravel extraction at the Thornberry quarry, through backfilling with recovered inert soil and stone. The recycling and recovery of C&D waste, mainly soil and stone, is essential to reduce resource utilization and divert reusable inert waste from disposal in landfill, as required under the Waste Framework Directive 2008 (2008/98/EC), and the European Communities (Waste Directive) Regulations, 2011 (S.I. 126 of 2011).

The Thornberry site is located on local road L2019, c. 2.5km southeast of Kill, and c. 6.5km east of Naas. Most site traffic serving the WRF is either off the N7 dual carriageway at Junction 7 (north of Kill) c. 2km north of the site, or off the N81 (north of Blessington) c. 6km southeast of the site. The nearest large residential settlement close to the site is Kilteel (pop. c. 225), c. 2km to the east, Kill (pop. 3,095) c. 2.5km to the northwest, and the county capital of Naas (pop. 20,713) c. 6.5 km to the west. Further afield, Sallins (pop. 5,283) is c. 7km to the west, Blessington (pop. 5,010) c. 7.5km to the southeast in Wicklow, Clane (pop. 6.702) c. 10.5km to the west northwest, Newbridge (pop. 17,127) c. 17.5km to the west southwest, Kilcullen (pop. 3,473) c. 17.5km to the southwest, and many more including the Dublin Metropolitan Area within 25km. The location thus renders the WRF centrally positioned to deliver recovery of inert soil and stone from a catchment area within the GDA with many burgeoning population centres and under strong development pressures.

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There is a preference for the deposition of soil and stone to be underpinned by a beneficial use in order to be considered waste recovery. Consequently, co-location of a waste recovery facility at Thornberry quarry, has significant positive impacts, and is thus environmentally preferred.

The impact on material assets resulting from the proposed continuation of the WRF is assessed here, and possible mitigation measures proposed to reduce any significant impacts. It is expected that the potential negative impacts on material assets of the area arising from the WRF will relate primarily to nuisance from noise, dust and traffic. Indirect or cumulative impacts associated with other similar developments within the area are dealt with where necessary under the respective topic in the EIS.

The potential impacts associated with the WRF and any proposed mitigation measures in relation to the material assets described above are covered under relevant sections of the EIS as follows:

Ref.	Material Asset	Relevant EIS Section
3.10.3.1	Non-Renewable Resources	2.4.3.1, 3.3
3.10.3.2	Settlement - Residential Development	2, 3.1, 3.6, 3.7, 3.8, 3.11
3.10.3.3	Land Use	2, 3.1, 3.2, 3.3, 3.8
3.10.3.4	Transport Infrastructure	2.4.2.11 3.1, 3.11
3.10.3.5	Major Utilities	2.4, 3.1
3.10.3.6	Cultural Assets	3.9
3.10.3.7	Landscape & Natural Heritage	2, 3.1, 3.2, 3.6, 3.7, 3.8

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Sand & Gravel Merchants Ltd. has established an on-going environmental monitoring programme on site. This programme will allow on-going monitoring of environmental emissions (noise, dust, water) from the site, thereby assisting in ensuring compliance with any future requirements or regulations. The results of this monitoring will be made available to the EPA and the Local Authority on a regular basis, where members of the public may examine it. The monitoring programme will be revised in order to ensure compliance with conditions attached to any decision to grant a Waste Management License.

The development can be controlled and regularised in accordance with the scheme as outlined in this document, through continued environmental monitoring and by planning conditions imposed by the relevant regulatory authority. The development does not have a significant impact on lands, property or amenity within the area and hence there will be no significant effect on material assets.

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3.10.5 REFERENCES

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3.10.6 FIGURES

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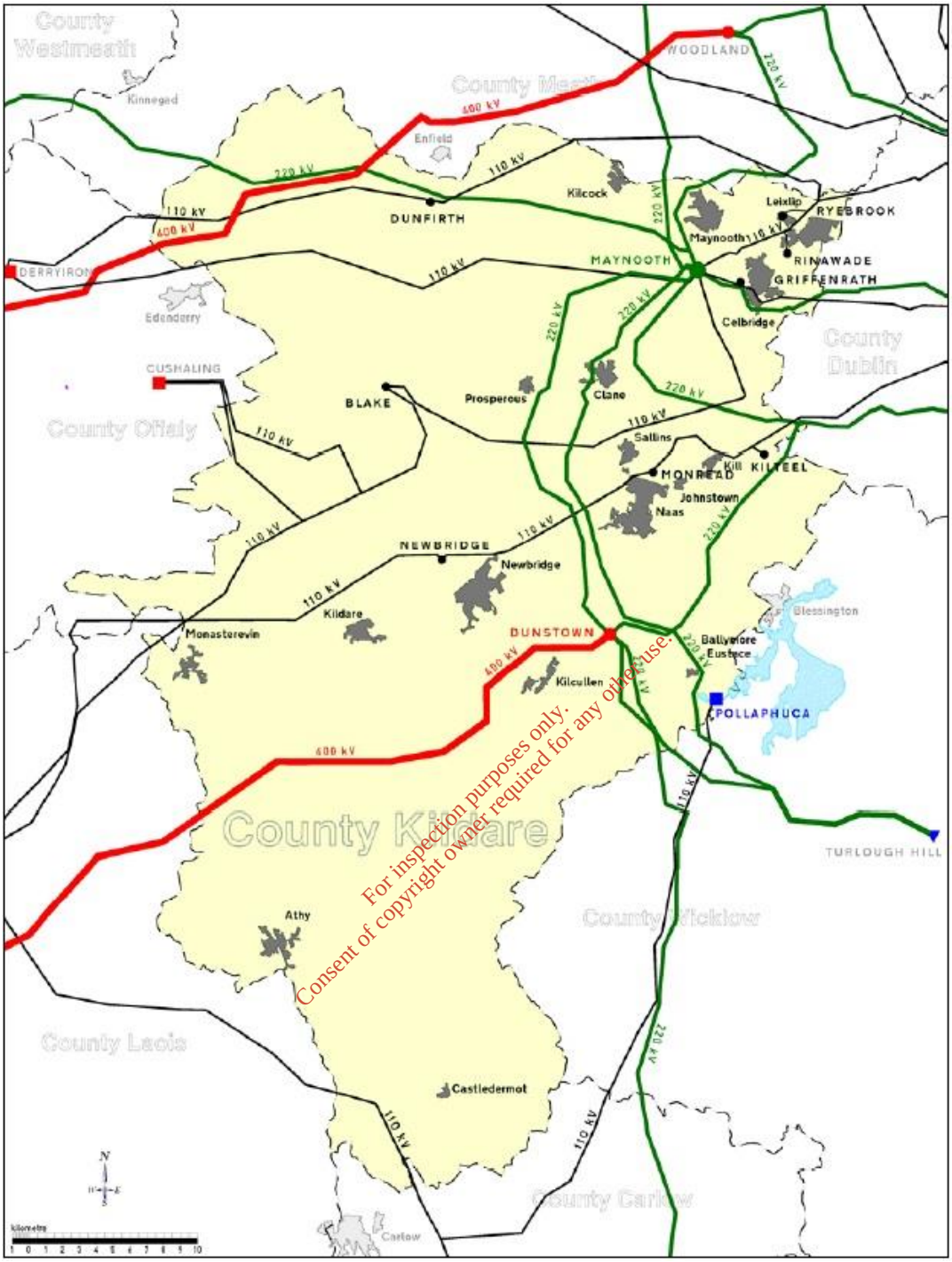

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Figure 3.10-1 Electricity Transmission Grid in County Kildare. Redrawn from Kildare County Council (2010).

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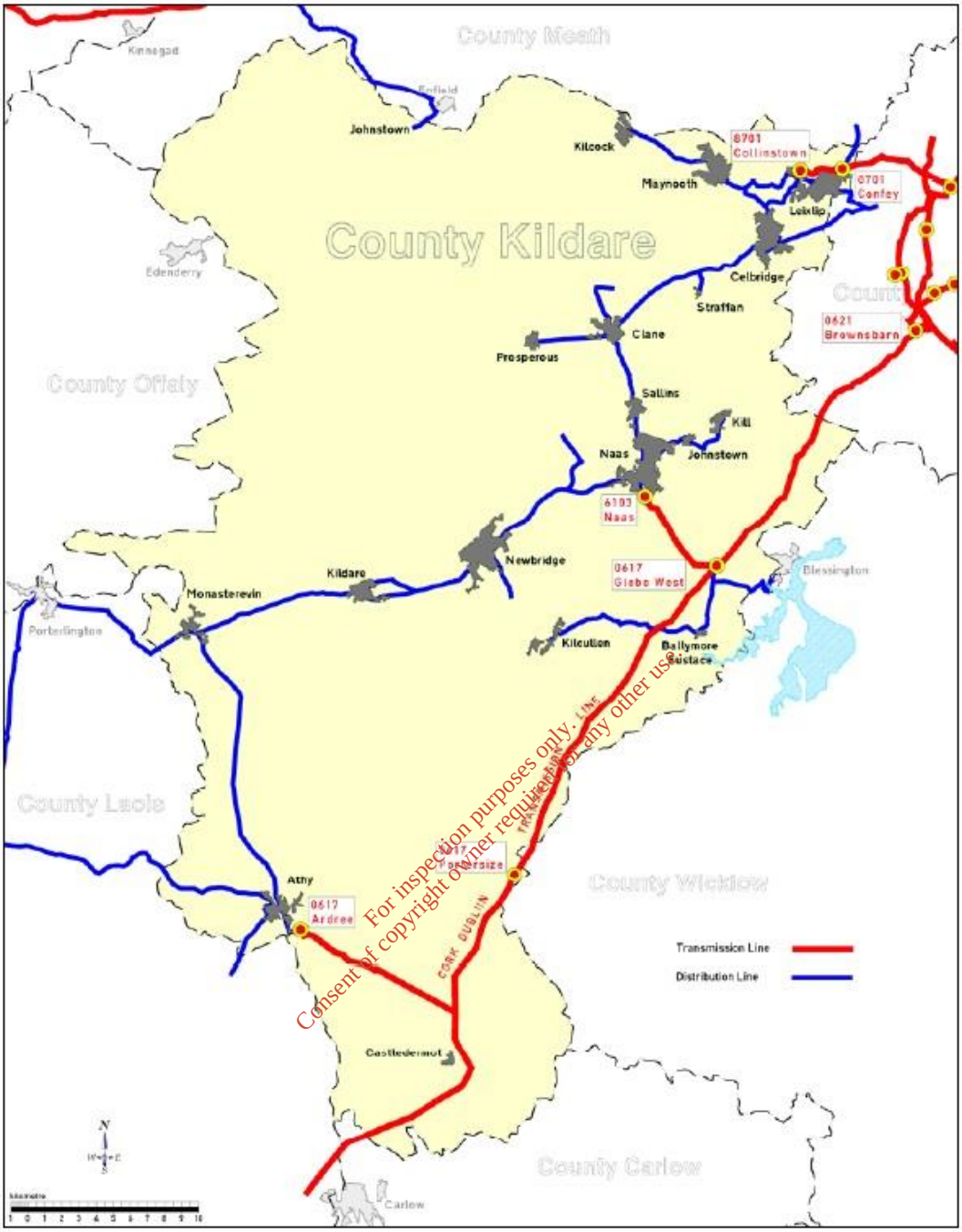

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Figure 3.10-2. Bord Gais Pipeline Network in County Kildare. Redrawn from Kildare County Council (2010).

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3.11 TRAFFIC

3.11.1INTRODUCTION

The proposed development is the continued phased restoration of a sand and gravel pit (hereinafter called the Facility) using imported inert soils, stone and recovery of inert construction and demolition waste.

Up to 70,000 cubic metres per annum is being accepted to the site and circa 25,000 cubic metres is required to complete the restoration of the site.

This section assesses the traffic impacts of the proposed development on the road network adjacent to the existing Material Recovery Facility. The traffic assessed is the traffic generated by the Material Recovery Facility, the traffic independent of the facility and the interaction of both. The assessment comprises the following main elements:-

- The Receiving Environment.
- The Current Development
- Road and Junction Capacities
- The Parking Requirements
- The impact of the Development
- Remedial and Mitigation measures.

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3.11.2 SCOPE

The traffic section has been prepared taking into account the following documents: -

- National Roads Authority (NRA) 'Traffic and Transport Assessment Guidelines', June 2005.
- NRA National Roads and Traffic Flow 2004 (2005).
- NRA Traffic Count Data 2014
- Kildare County Council Development Plan 2008 – 2014.

3.11.3. STUDY METHOD

The approach undertaken for the assessment is described in this section. Included are the details of all surveys undertaken, technical references used and assumptions made in the study. Traffic flows on the N7, the adjacent local road L2019 and the facility access road and junction were obtained by surveys carried out on 14th July 2014 at the L2019/facility access road junction and the NRA Traffic Count Data for Station 20071 on the N7 situated between Junction 7 Kill and Junction 8 Johnstown. The traffic volumes using the facility at peak production pre 2008 have been obtained from the facility owner. These results are shown in Tables 3.11.1 & 3.11.2.

3.11.4 THE RECEIVING ENVIRONMENT

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This section describes the site location and the existing road network in the immediate vicinity of the facility development.

3.11.4.1 SITE LOCATION

The facility site is situated in County Kildare to the South East of the village of Kill in the townland of Thornberry and on the south side of the N7 Dublin to Naas National Primary Route N7, approximately 6 kms from Junction 6 and 3 kms southeast of the village of Kill on the local road L2019. It is immediately adjacent to the Arthurstown Land Fill site.

Site layout plan is shown in Fig. B2.1 – Rev.

The access to the facility for all Heavy Goods Vehicles is from the National Primary Route N7 via Junction 6 Kilwarden and thence along the local road L2019 to the facility. Trucks arriving laden to the facility and leaving empty all use this route. The entrance to the facility is off a 4 leg junction situated 25m southeast of the L2019. The leg to the southeast is the facility access. The leg to the northwest (Road A) leads to the L2019. The leg to the southwest is to two residences. The leg to the northeast is a 58m paved road (Road B) to the L2019 with gates on the eastern end under the control of the facility owner. These roads have bituminous bound pavements.

All Heavy Goods Vehicles entering and leaving the facility must use the facility access road and Road B. The facility access road has an Asphalt surface for 150m.

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3.11.4.2 EXISTING ROAD NETWORK

3.11.4.2.1 Network Description

The facility entrance is located off the south side of the N7 National Primary Route in the townland of Thornberry, Kill. The facility is accessed off Junction 6 and thence south and west along the local road L2019.

The facility access road forms a 90º at grade junction with the 4 leg junction situated 25m from the local road L2019. The facility access road has a gradient of 3% towards this junction. The Road A has a gradient of 1% towards the local road L2019. Road B is flat between the L2019 and the 4 leg junction.

The local road L2019 is a partially realigned two lane 7.3m macadam carriageway with 2 No.1m Grass verges in the vicinity of the facility entrance. Overall Right of way width is 9.5 m. The width between fences is approximately 12m.

The cross section of the local road L2019 in the vicinity of the facility is shown in Figure No. 3.11.1.

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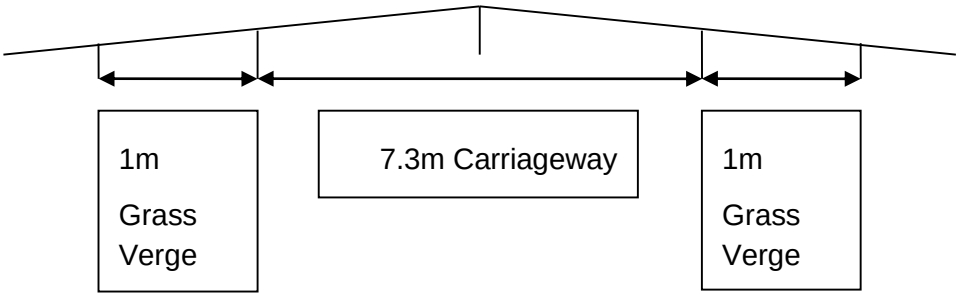

Figure 3.11.1 L2019 Cross Section

3.11.4.2.2 Access Visibility

The L2019 is high quality local road with a speed limit of 80 km/hr. The standard for the desirable stopping sight distance is 150m as set out in the NRA DMRB TD9 & TD41-42 and Kildare County Council Development Plan 2008 -2014. i.e. an unobstructed visibility triangle of 150m at 4.5m back from the road edge left and right of the entrance onto the L2109. The junction of Road A and L2019 has Stopping Sight Distance of 84m and 150 m to the SW and NE respectively. The junction of with the L2019 and Road B has Stopping Sight Distance of 160m and 200 m to the SW and NE respectively.

The only deficient Stopping Sight Distance is to the SW from Road A. The practice of all traffic leaving the facility turning right onto Road B to access the L2109 overcomes this deficiency. The facility access road approaches the L2019 at an acute angle, this needs a Stop sign for junction form recognition.

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3.11.4.3 EXISTING TRAFFIC FLOW CONDITIONS

The existing traffic volumes on the road network in the vicinity of the facility are lower than the peak flow volumes in 2007/2008. In discussions with the client there has been an estimated drop of 50% using their facility since then.

A traffic count was carried out on the junction of the local road L2019 and the facility access on 14th July 2014. The flows on the L2019 are shown in Table 3.11.1. The traffic using the facility for the same period was in low single figures. A traffic count for the same day was obtained from the NRA Traffic Data Counter 20071 located on the N7 between Junction 7 Kill and Junction 8 Johnstown. This gave a two way 2014 AADT of 73339 with a 7% HGV content.

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Table 3.11.1 Traffic Volume Survey on L2019/Facility Access (Vehicles)

TRAFFIC COUNT SUMMARY on L2019/FACILITY ACCESS								
Hour Ending	**9.00**		**10.00**		**17.30**		**18.00**	
Movement No.	**HGV**	**Total**	**HGV**	**Total**	**HGV**	**Total**	**HGV**	**Total**
1	0	0	0	0	0	3	0	4
2	20	91	13	49	9	13	1	5
3	0	1	2	1	3	4	0	3
4	2	2	0	0	1	2	0	1
5	2	2	6	6	1	1	0	0
6	21	45	13	30	11	75	3	82
Two Way flow L2019 (Vehicles)		141		86		98		95

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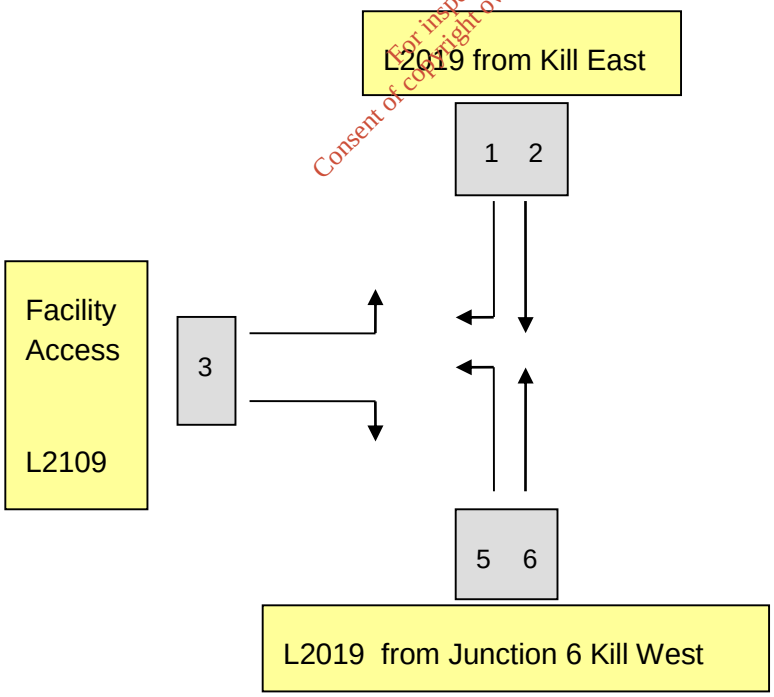

Figure 3.11.2 Junction Movements Diagram

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There was no pedestrian and little pedal cycle traffic observed in the immediate area.

The morning and evening peak flows on the N7 are 8.00-9.00 hrs and 17.00-18.00 hrs respectively. The morning and evening peak flows on the L2019 also are 8.00-9.00 hrs and 17.00-18.00 hrs respectively. The morning peak traffic generates the greatest flows on the junction.

N7 traffic data was obtained for the 14th July 2014 from the live NRA Traffic Data Counter 20071. This automatic counter is located on the N7 between Junction 7 Kill and Junction 8 Johnstown. This gave a two way 2014 AADT of 73339 with a 7% HGV content.

Table 3. 11.2. Peak Hour Flows in 2014 (Vehicles)

Link	AADT	PEAK HOUR FLOW
N7 20071	73339	
L2019	1750	138
Facility Access	110	8

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3.11.5 TRAFFIC GENERATED BY DEVELOPMENT

3.11.5.1 TRAFFIC GENERATION

The volume of peak hour traffic generated by the facility is the determining factor of the impact of the facility. The projected import of recovery material into the facility is estimated to be up to 70,000 Cubic meters per annum of inert waste. This represents an average weekly import of 1400 Cubic meters, or 2800 tonnes, or 25 inward truck movements per day. It is proposed that 100% of this material will be used as backfill within the facility. The traffic generated by the proposed facility development therefore falls into a number of categories:-

- Recovery material import haulage traffic entering laden and leaving empty the facility onto the public road network. This will be typically by means of 8 x 4 Rigid trucks with a maximum payload weight of 20 tonnes.
- Employee cars. (2 employees)
- Delivery Vehicles

The maximum production period for the facility was in 2007/2008. According to the facility operators the site accepted 40 laden trucks per day. This represented a weekly payload of 2200 Cubic meters at this time, however this has dropped to 1100 Cubic meters at present. This resulted in the following daily generated traffic based on the facility operator's information.

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Table 3.11.3 Peak Daily Facility Traffic 2008

Vehicle Type	Number	Average	Peak Hour
HGV	35 - 45	40	5
Cars & Light Goods	3	3	1

As construction activity has reduced since 2008 the present traffic generated by the facility is approximately 50% of peak. It is projected that the import of recovery material will generate less traffic than at peak as shown in Table 3.11.4.

Table 3.11.4 Peak Daily Proposed Import Traffic post 2014

Vehicle Type	Number	Average	Peak Hour
HGV	20-30	25	6
Cars & Light Goods	3	3	1

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In the traffic assessment it is therefore proposed that the peak activity figures of post 2014 will be applied (which will more than cater for any upturn in facility activity).

Table 3.11.5 Peak Daily Facility Traffic for Analysis

Vehicle Type	Average	Peak Hour
HGV	25	6
Cars & Light Goods	3	1

The peak hour for the facility traffic does not necessarily coincide with the AM and PM peak on the L2019 or the N7. However the AM and PM peak hour on the L2019 and the N7 are coincidental. By applying the peak hour figures for the L2019 to the predicted traffic generated by the import proposals to the facility will result in the most robust analysis of the traffic assessment.

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3.11.5.2 TRAFFIC DISTRIBUTION

The generated volume split of existing facility related traffic at the L2019/Facility junction was estimated as 100% HGV's eastwards to the N7 National Primary for peak facility traffic. Other vehicles 50% westwards and 50% eastwards along the L2019. The addition of the proposed import traffic will not materially change these percentages as all HGV's must travel eastwards to Junction 6 of the N7 and the import of material will also be from this direction. The calculated estimated percentages of facility related traffic are as 9.2% westwards and 90.8% eastwards along the L2019 Local Road. These percentages may change in the future but will not adversely affect the traffic operation.

The capping of the adjacent Arthurstown Land Fill site will be complete in August 2014 and this will substantially reduce the HGV volume on the L2019. However it is proposed to use the existing traffic volumes on the L2019 in order to give the most robust analysis of the traffic distribution.

3.11.5.3 TRAFFIC ASSIGNMENT

The resulting assignment of the generated traffic by the facility activity is shown in Table 3.11.6:

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Table 3.11.6 Assignment of Average Daily Facility Traffic (Vehicles/Day)

Direction	Vehicle Type		
	Car/LGV	HGV	Total
L2019 Westwards towards Kill 9.2%	2	0	2
L2019 Eastwards towards Junction 6	1	25	26
Total	3	25	28

3.11.5.4 PEAK HOUR FACILITY TRAFFIC

The facility opening hours are 08.00 hrs to 1800 hrs. Monday to Friday and 0800 hrs to 1300 hrs on Saturday.

The traffic generated during the morning and evening peak is calculated. The morning peak would greatest due to the facility employees to arriving to work. When this is added to the other vehicle daily average it yields a morning peak flow of 7 vehicles inward and 6 outwards. The evening peak flow will be of the order of 4 vehicles inward and 5 outwards.

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Table 3.11.7. Assignment of Morning Hour Facility Traffic (Vehicles/hr & PCU's)

Direction	Vehicle Type					
	LGV/Car		HGV		Total	
	V/H	PCU	V/H	PCU	V/H	PCU
Facility to Junction 6	0	0	2	6	2	6
Facility to Kill	1	1	0	0	0	1
Junction 6 to Facility	1	1	6	18	8	19
Kill to Facility	0	0	0	0	0	0
Total	2	2	8	24	10	26

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Table 3.11.8 Assignment of Evening Hour Facility Traffic (Vehicles/hr & PCU's)

Direction	Vehicle Type					
	LGV/Car		HGV		Total	
	V/H	PCU	V/H	PCU	V/H	PCU
Facility to Junction 6	1	1	1	3	2	4
Facility to Kill	3	3	1	3	4	6
Junction 6 to Facility	0	0	1	3	1	3
Kill to Facility	4	4	0	0	4	4
Total	8	8	3	9	11	17

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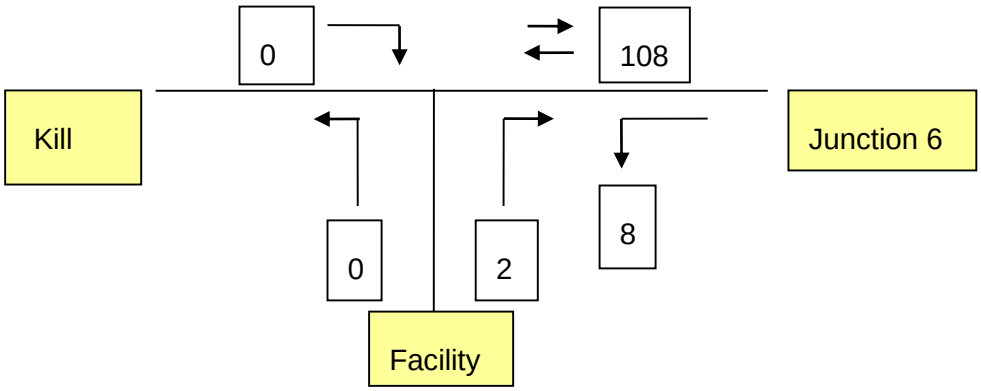

Figure 3.11.3 Facility Assignment AM Peak Hour (Vehicles)

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Facility Traffic 8.4 % of Total Traffic.

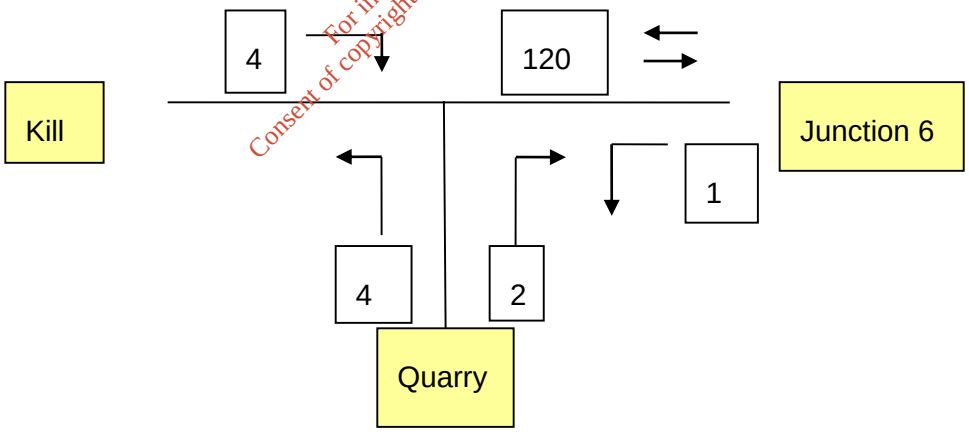

Figure 3.11.4 Facility Assignment PM Peak (Vehicles)

Facility Traffic 8.4 % of Total Traffic.

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The evening peak flow of facility traffic being the greater it will be used for the assignment. If these figures are combined with the evening peak flow traffic on the L2019 it will yield the worst scenario for assessment of the traffic day (See Section 3.11.4.3).

3.11.6 TRAFFIC FLOW ASSESSMENT

3.11.6.1 GENERAL

The existing traffic volumes on the road network in the vicinity of the facility are lower than the peak flow volumes in 2007/2008. The current volumes are obtained from the traffic count carried at the L2019/ Facility access on 14th July 2014 and the N7 traffic data was obtained for 14th July 2014 from the live NRA Traffic Data Counter 20071. These flows on the L2019 are shown in Table 3.11.1. These present volumes show a reduction since 2008. The actual facility traffic flows were obtained from the owner and these peaked in 2008.

This information defined the morning and evening peak hour flows as 8.00-9.00hrs & 17.00-18.00 hrs. As the evening peak was the greater this was the figure used for assessment.

The impact of the facility on the road network was assessed by examining the performance of the facility access with the L2019 as outlined in 3.11.5 above.

The peak HGV movements on the L2019 / Facility junction were calculated and assigned using the historical traffic from the facility. The peak hourly movements of HGV's at the L2019 junction are the combination of the facility movements and the L2019 movements. The results are shown in Tables 3.11.7 & 3.11.8 and Figures 3.11.3 & 3.11.4 above.

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3.11.7 JUNCTION OPERATION

An assessment of the L2019/Facility junction was carried out to determine the impact of the maximum operational phase of the facility. The greatest effect on the junction was Movement 1 of Figure 3.11.2 on the L2019 from the west when traffic is turning into the facility. This could potentially cause queuing of traffic on the L2019. However the total of 4 movements in the peak hour or 3% is so small so as to not constitute any effect on the total traffic. If this is true for the L2019 junction then there is an infinitesimal effect on Junction 6 on N7 National Primary.

The above results show the maximum traffic generated by the facility development has a negligible effect on the operation of both the L2019 junction and the N7 junction 6. It is to be further noted that there will be a significant reduction of HGV movements on the completion of the Arthurstown Land Fill site.

3.11.8 IMPACTS OF THE DEVELOPMENT

The impact of the Facility on the local road network has been assessed for the Operation and Restoration phases of the Facility.

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3.11.8.1 OPERATIONS OF THE DEVELOPMENT

This has been outlined in Section 3.11.5.1 above. In brief the facility generates traffic which has an impact on the adjacent road network. The Facility will not increase the traffic movements in future years on the junction as the Facility will be closed based on available void space and the current rate of filling in the near future. It is to be noted that there will also be a significant reduction of HGV movements on the completion of the Arthurstown Land Fill site. While the present traffic specifically associated with the facility business has reduced significantly since 2008 it is anticipated it will continue at this level post 2014. In this regard the traffic volumes used in the analysis will be the volumes as at the present.

3.11.8.2 FINAL RESTORATION

The final restoration phase of the development will require the use of earth moving machinery. This machinery is already on the site and it will remain there until restoration of the site is complete. The proposal for the import of the material into the facility will result in the availability of 100% of inert soil and stone which will be used as backfill and cover to meet the requirement for the restoration of the facility site. This will be self-contained within the site and will not result in any other traffic movements on the junction other than employee's cars.

3.11.9 PARKING

The parking requirements for the facility operation mainly relate to the facility employees and visitors. While the Kildare County Council Development Plan 2008 – 2014 does not specifically detail the requirements for quarries it would be reasonable to provide sufficient for employees and visitors. The maximum number of employees is 2. Therefore a car park provision of 2 + 25% for visitors (say 3 spaces) would be required.

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3.11.10 MITIGATION

The Quarry and Waste Recovery Facility will continue to import material for infill until the infill area is exhausted and the lands restored to beneficial after-use. On the basis of the available void space and current rate of backfill the importation of inert materials to this site will cease in the near future and the site shall be restored in accordance with the proposed final restoration scheme.

The site access road has been provided with an asphalt surface for a distance of c. 180 metres. There is ample provision within the pit area to facilitate queuing of traffic. Imported clean construction and demolition waste (concrete and brick) is used to construct internal haul roads as required on site. As such there is no evidence of mud and debris being carried out on to the public road.

In the event of material being spilled on the public road the quarry operator will ensure that spilled material is removed from the road surface in a safe and timely manner, as soon as they notice or are notified that a spillage has arisen. Regular sweeping of the access road and site entrance will also be carried out.

Traffic direction signs, warning signs, speed limit signs are established throughout the site

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It is considered that given the scale of the proposed development and the nature and condition of the road serving the site, and the proposed mitigation measures that the development will not lead to a greater risk to public safety by reason of traffic hazard.

3.11.11 CONCLUSIONS

The following are the conclusions of the analysis of the traffic impact of facility:

1. The capacity of the L2019 at the facility site is between 600 and 1035 pcu's/hr.
2. The traffic impact of the facility on the surrounding road network is considered minimal, (on average the projected facility traffic is 8.4% of the total traffic at the peak hour) given the present and medium forecasted level of activity at the facility.
3. The traffic impact of the facility is at present considerably less than it was at full production prior to 2008. During this peak period the traffic generated by facility had no adverse effect on traffic movement on the surrounding road networks.
4. The level of turning movements at the L2019/Facility Access junction are of a low volume within the total capacity of the road network and the proposed facility traffic represents 8.4 % average of these movements.
5. The L2019 is fully realigned as a standard single carriageway road with verges stretching to the west and east of the Facility Access junction.
6. The quality of the L2019 pavement in the vicinity of the facility entrance is at present in good condition.
7. The L2019, N7 and the adjacent receiving network is of a high quality and will be able to cater for the facility generated traffic.

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3.12 INTERACTION OF THE FOREGOING

3.12.1 INTRODUCTION

Schedule 6 of the Planning and Development Regulations 2001 (S.I. 600/2001) sets out the requirement to consider the interrelationships of certain aspects of the environment as part of the EIA process. The requirement arises from the recognition that all environmental factors are inter-related to some extent.

Interactions are usually highly complex, and a change in any one factor, such as land-use or water quality, could affect all of the other interrelated factors. Although almost all environmental aspects are inter-related to some degree only the significant interactions are usually considered in an assessment.

The interactions of the impacts and mitigation measures between one topic and another, where applicable, are discussed under the respective sub-sections within Section 3, rather than in a specific "Interactions" section. Because an EIS is typically prepared by a number of specialist consultants it is important that the interactions between the various disciplines are also considered. This section draws attention to significant interaction and interdependencies in the existing environment.

3.12.2 POTENTIAL IMPACTS AND MITIGATION MEASURES

In terms of protecting the environment, the impacts of the proposed development of a Waste Recovery Facility (WRF) at Thornberry have been assessed and where required, appropriate mitigation measures provided to remedy any significant adverse effects on the environment.

The following matrix has been generated to show where possible interactions may result between the various environmental impacts. For details of any interactions refer to the relevant sections of the EIS.

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Table 3.12.1 Interaction Matrix

Section	3.1 Human Beings	3.2 Flora & Fauna	3.3 Soils & Geology	3.4 Water	3.5 Climate	3.6 Air Quality	3.7 Noise	3.8 Landscape	3.9 Cultural Heritage	3.10 Material Assets	3.11 Traffic
3.1 Human Beings											
3.2 Flora & Fauna											
3.3 Soils & Geology											
3.4 Water	•	•	•								
3.5 Climate											
3.6 Air Quality	•	•			•						
3.7 Noise	•	•									
3.8 Landscape	•	•				•					
3.9 Cultural Heritage								•			
3.10 Material Assets	•			•		•	•	•	•		
3.11 Traffic	•	•				•	•			•	

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