Greater Dublin Drainage

Alternative Sites Assessment - Phase Two
Sites Assessment and Route Selection Report

Hydrology and Hydrogeology

May 2012

BARRY

Executive Summary

Hydrology and Hydrogeology

This study identifies the environmental constraints and predicts and evaluates the impacts of the nine alternative wastewater treatment plant sites (land parcels), seven potential transfer pipeline corridors and two marine outfalls on the existing hydrology and hydrogeology of the area. These alternate land parcels, transfer pipeline corridors and outfall locations are identified in 'Preliminary Screening Outcomes Report' published in October 2011 for the proposed Regional Wastewater Treatment Plant, Marine Outfall and Orbital Drainage System in the northern part of the Greater Dublin Area.

According to the EPA water quality database, the water quality of the Ballough River is moderate (Q3-4) whereas all other rivers in the catchment (i.e. the Rivers Tolka, Santry, Mayne, Ward, Broadmeadow and Ballyboghill) have poor (Q3) water quality.

The nine WWTP sites (land parcels) are located in the following river catchments:

- Clonshagh - the Mayne River catchment,
- Cloghran - the Sluice River catchment,
- Saucerstown - the Broadmeadow River catchment,
- Cookstown - the Belinstown/Broadmeadow River catchments,
- Baldurgan - the Belinstown/Ballyboghill River catchments,
- Annsbrook - the Ballyboghill/Belinstown River catchments,
- Newtowncorduff - the Ballough River catchment,
- Tyrrelstown - the Collinstown/Balcunnin/Rush Town stream catchments and
- Rathartan - the Collinstown/Rush Town catchments.

Almost all of the nine land parcels have a risk of some degree of flooding either on or adjacent to the site or further downstream. Similarly, almost all transfer pipeline corridors pass through some flood prone areas. In particular, the Broadmeadow, Ballyboghill and Belinstown River catchments have extensive overland flooding downstream of Baldurgan and Cookstown sites and Route E and Route F transfer pipeline corridors. Part of the Saucerstown site is located within the 0.1% AEP (Annual Exceedence Probability) flood extent of the Broadmeadow River.

Initially, relatively large land parcels were identified and through the screening process, and associated workshops, nine potential WWTP sites and associated access routes were identified within the land parcels and further assessed. The required WWTP site area is in the region of 20 ha. A 50m exclusion buffer was applied along watercourses and sites were also chosen that were outside the 0.1% AEP flood extent.

The transfer pipeline corridor Route F requires 20 watercourse crossings, Route D requires 12 crossings, Route E requires 9 crossings, Route C requires 5 crossings and Routes A, B and G require 2 crossings each.

According to the EPA 'Quality of Estuarine and Coastal Waters (2007-2010)', the Northern Outfall coastal waters are classified as 'unpolluted'. There is no similar sampling data for the Southern Outfall; however, the coastal waters to the north and

south of this location are classified as 'unpolluted'. Both outfall locations have recreational bathing areas which have achieved 'Good' water quality status in 2010 and both outfall locations have Blue Flag beaches (Northern outfall - Portrane Beach, Southern Outfall - Velvet Strand - Portmarnock Beach).

The southern outfall area is comparatively exposed to higher flood risk than the northern outfall particularly along the coastline of Baldoyle Estuary.

In general the land parcels, transfer pipeline corridors and outfall study areas are underlain by locally important bedrock aquifers and by poor bedrock aquifer in some cases. Throughout all the areas studied the groundwater vulnerability classification varies greatly from 'low' to 'rock near the surface' in some cases but is predominantly low vulnerability.

One or more than one groundwater supply wells were identified within 500m of four of the land parcels, five of the transfer pipeline corridors and in one of the outfall study areas. Similarly one or more than one karst features were identified within 2km in five of the land parcels, two of the transfer pipeline corridors and in one of the outfall study areas. No Source Protection Area's or Zones of Contribution (as defined by the Geological Survey of Ireland and the Environmental Protection Agency respectively) were found to be within close proximity of any of the land parcels, transfer pipeline corridors and outfall study areas.

The study has identified the potential impacts of each of the land parcels, WWTP sites, transfer pipeline corridor routes and outfall locations on the existing hydrological and hydrogeological environments and has discussed some mitigation measures.

Further surveys and investigations may be required once the preferred site has been determined including additional water quality testing and the identification of any abstraction points (groundwater wells) that are not listed in the GSI, EPA or FCC databases.

9 Hydrology and Hydrogeology

9.1 Introduction

This chapter outlines the existing hydrological and hydrogeological environment at each of the nine alternative waste water treatment plant (WWTP) land parcels and the corresponding transfer pipeline corridors and marine outfall locations identified in the *'Preliminary Screening Outcomes Report, October 2011'*, for the proposed Regional WWTP and associated infrastructure for the northern part of the Greater Dublin Area. It identifies the environmental constraints, predicts and evaluates the impacts of the scheme on the existing hydrology and hydrogeology and outlines measures to mitigate these impacts.

Initially, nine relatively large land parcels, seven transfer pipeline corridor routes (A-G) and two outfall locations were identified and the phase 2, stage 1 assessment was carried out to identify any impacts. During the phase 2 assessment process, and associated workshops, nine potential WWTP sites and associated access routes were identified within the land parcels and further assessed.

The phase 2, stage 1 matrices include the assessment of the WWTP land parcels (transfer pipeline corridor routes and outfalls) whilst the phase 2, stage 2 matrix refers to the potential WWTP site and associated access route.

The detailed assessment of the impacts on the ecological environment and soil and geology of the study area has been reported on in separate chapters of this report but, where necessary, also referenced in this chapter.

9.2 Methodology

Hydrology

In considering the implications of the overall scheme on the hydrological environment, the WWTP land parcels, WWTP sites, the transfer pipeline corridor routes, the outfall locations and their environs should be considered in terms of sensitive surface water receptors and potential to impact upon them. This element is concerned with potential effects on the surface water regime (flooding, water quality and flow).

The assessment was based on the following:

Proximity to water bodies in terms of flooding and as an indicator of sensitive water receptors - The proximity to water bodies and their water quality (based on the EPA quality results) provides an indication of the sensitive surface water receptors potentially associated with each option, assuming pathways exist.

Culverting requirement – The requirement for culverting over a stream or bridging a river is used as an indication of the potential to reduce the conveyance capacity of the watercourse and the associated increase to flood extent and frequency.

Area prone to flooding – The review of existing datasets to determine if the site is prone to flooding. The OPW records of historic floods and the flood extent maps produced under FEM FRAMS* were used to assess whether the proposed sites and

route options are at risk of flooding and whether extensive flooding (historic and/or predicted) occurs immediately upstream or downstream.

Potential impact on ecologically important and designated sites – The proximity to any Natura 2000 environmental designated sites such as Special Protection Areas (SPA), Natural Heritage areas (NHA), Proposed Natural Heritage Areas (pNHA) and Special Areas of Conservation (SAC). As noted earlier, these are discussed in more detail in the ecology chapter. In addition, the proximity of the two marine outfall locations to amenity areas such as designated or undesignated bathing water locations or designated shellfish waters is also discussed.

The overall environmental impacts are a combination of the above. The risk is a combination of the assessment of the presence of a sensitive receptor (streams and sensitive water bodies) and the pathway (drainage channels) by which the receptor can be affected.

** The FEM FRAMS project included the hydraulic modelling and mapping of flood risk of various rivers in the Fingal and East Meath catchment. Further details, reports and maps are provided on the project website (www.fingaleastmeathframs.ie).*

Hydrogeology

In considering the implications of the overall scheme on the hydrogeological environment, the WWTP land parcels, WWTP sites, the transfer pipeline corridor routes, the outfall locations and their environs should be considered in terms sensitive groundwater receptors and potential to impact. This element is concerned with potential effects on the groundwater regime (flow and quality).

The assessment was based on the following:

Aquifer classification – Aquifer Classification is based on the hydrogeological characteristics and the value/ importance of the groundwater resource in a given area.The GSI have classified all the aquifers in Ireland into three main categories namely regionally important, locally important, or poor aquifers. This information including the extent of the aquifer is provided on the GSI aquifer classification maps.

Groundwater vulnerability – Groundwater Vulnerability determines the ease with which groundwater in a given area may be contaminated. The GSI has classified GW vulnerability into low, moderate, high, extreme and rock near the surface categories. This information is provided on the GSI groundwater vulnerability maps.

GSI Groundwater Protection Response matrix for landfills result – Following consultation between the GSI and Jacobs/Tobin, the GSI recommended the use of the GSI Groundwater Protection Responses for Landfills Matrix. Further details on this methodology are included in Appendix D.

Groundwater supplies – the identification of water supply springs and bored wells in the vicinity of the proposed sites. These include supplies for public, domestic, agricultural or industrial use. This information is taken from the GSI database and, where available, the Local Authority records.

Source Protection Areas and Zones of Contribution – The objective of source protection areas (GSI mapping) and zones of contribution (EPA mapping) is to provide protection to groundwater sources by placing tighter controls on activities within all or

part of the area that contributes to the groundwater source. These therefore provide information on the location and importance of groundwater sources.

Identification of hydrogeological features from the karst database – Karst features are natural hydrogeological features. These are formed in areas of limestone or other highly soluble rock, in which the landforms are of dominantly solutional origin, and in which the drainage is usually underground in solutionally enlarged fissures and conduits. Karst features include caves, swallow holes, turloughs and springs. Information on the location of all known karst features in Ireland is provided on the GSI karst data maps.

The overall environmental impact implications are a combination of the above. The risk is a combination of the assessment of the presence of a sensitive receptor (aquifer abstraction) and the pathway (proximity, vulnerability etc.) by which the receptor can be effected. In the context of groundwater quality we also need the presence of a hazard. In sewerage scheme projects the hazard is often the result of leakage or an accidental spillage.

9.2.1 Desktop Study

Extensive information on this scheme, in the form of maps, databases and reports, was provided by the Client at the start of the project. This data was supplemented by the following online data from various websites and other sources:

Hydrometric data from the Office of Public Works website (www.opw.ie/hydro).

Historic flood data from the National Flood Hazard Mapping website (www.floodmaps.ie).

Water quality data from the Environmental Protection Agency website (http://maps.epa.ie/internetmapviewer/mapviewer.aspx).

Data on fisheries from the Inland Fisheries Ireland website (www.fisheriesireland.ie).

Flood extent maps (0.1% AEP fluvial and tidal flood extent) from the Fingal East Meath Flood Risk Assessment and Management Study (FEM FRAMS) website (www.fingaleastmeathframs.ie).

OPW Preliminary Flood Risk Assessment (PRFA) Maps. These PFRA maps show the indicative extents and outcomes of analysis. They are currently in draft format for consultation and available from the cfram website. These maps were only consulted where data was not available from the FEM FRAMS project. (www.cfram.ie).

Groundwater vulnerability map, Aquifer vulnerability map, Karst feature map, Groundwater well map and source protection area (SPA) map from the Geological Survey of Ireland website (www.gsi.ie).

Zones of Contribution and Groundwater Source Wells from the Environmental Protection Agency website (www.epa.ie).

Google earth website (www.googleearth.com).

Ordinance survey Ireland website (www.osi.ie).

Fingal County Council's data on groundwater wells and abstraction points

In addition, during the public consultation process in November 2011, a comment regarding flooding was received in relation to the Saucertown land parcel, which has also been taken into consideration during this study.

9.2.2 River Names

During the course of this study it has become apparent that there are a variety of names for the different rivers and tributaries between the EPA website, FEM FRAMS project and Eastern River Basin District (ERBD) database. The EPA river names have been used and a table in Appendix E provides details of the different names.

9.2.3 Site Visits

All pipeline route corridors and outfall pipe locations have been visited by the consultant on several occasions between 2008 and 2010 (e.g., on 28th January 2009, 8th July 2009, 18th July 2009, 15th March 2010, 12th October 2010) as part of a previous study (FEM FRAMS). Most of the nine WWTP land parcels have also been visited by the consultant. However, the access to some land parcels (e.g. Newtowncorduff, which lies between the M1 and R132) is difficult and hence no additional information on hydrology and hydrogeology can be collected from a windshield survey. Therefore, it was decided not to undertake any further windshield survey at this stage, but to focus on the available areal mapping and photographs, online maps and to utilise the knowledge of the sites gathered during the previous study.

9.3 Existing Environment

All nine alternative WWTP sites, seven transfer pipeline corridor routes and two outflow locations are situated in the Eastern River Basin District (ERBD), in the administrative area of Fingal County Council. Most of the watercourses are located in Hydrometric Area (HA) No. 8 but some are also located in HA No. 9. The characteristics of the study area, mainly of HA No. 8 is that, it has many small watercourses, running from west to east and discharging individually into various estuaries (Baldoyle, Malahide and Rogerstown) or directly to the Irish Sea.

The soils and geology characteristics of the catchment indicate locally important and poor aquifers generally overlain by low permeability overburden material (as detailed in the soils and geology chapter) with generally low to moderate vulnerability. This explains why the stream density is relatively high despite rainfall being relatively low (in contrast with parts of West of Ireland). The low permeability overburden material will also lead to increased surface water runoff which can also increase the flood risk.

Almost all of the transfer pipeline corridor routes running from south to north will cross many different watercourses. Most of the watercourses are ungauged and water quality data is not available from the EPA website. Similarly, some of the watercourses have a history of flooding, as shown by the flood extent maps produced under the Fingal East Meath Flood Risk Assessment and Management Study (FEM FRAMS).

There is one public groundwater supply scheme within the study area (red box on the figures). This is the Bog of the Ring which is operated and maintained by Fingal County Council. The wellfield is located approximately 3.5km SW of Balbriggan and 1km west of the M1. The map of the ZOC from the Groundwater Source Protection Report is provided in Appendix F. This source is located at least 6km from the nearest

site under assessment or pipeline corridor route. It will therefore not be affected by the proposed scheme and is not considered further.

There is another public groundwater supply scheme just outside the study area called the Curragha Water Supply Scheme. This groundwater source is the main public water supply wells for Ashbourne and the surrounding hinterland. The groundwater wells are located 4.5km north west of Ashbourne. The map of the Source Protection Zones from the Groundwater Source Protection Zones Report is provided in Appendix F. This source is located at least 13km from the nearest site under assessment or pipeline corridor route. It will therefore not be affected by the proposed scheme and is not considered further.

The existing hydrological and hydrogeological environment for each of the WWTP land parcels, WWTP sites, the transfer pipeline corridor routes, the outfall locations are outlined below:

Annsbrook Land Parcel

This land parcel is located approximately 2.5km east north east of Ballyboghill and has an area of approximately 62ha. It lies in open agricultural land (tillage and grassland).

Hydrology
The surface water from the northern half of the land parcel drains to the Ballough River and the surface water from the southern half of the land parcel drains to the Richardstown River (a tributary of the Ballyboghill River). Both the Ballough and Ballyboghill Rivers discharge into Rogerstown Estuary (approximately 4km downstream), which is an ecologically important site, e.g., SAC, SPA, pNHA, Ramsar and SNR site (refer to Figure 9.1).

The EPA WQ monitoring station on the Ballough River at Corduff Bridge located approximately 3km downstream of the Annsbrook land parcel shows the river water quality in 2010 as Q3-Q4 (moderate status). Similarly, the river WQ of the Ballyboghill River at Station 08012 (Ballyboghill village) located approximately 3km upstream of the Annsbrook site in 2010 is Q3 (poor status). According to the EPA website, the water quality of Rogerstown Estuary, in 2010, is intermediate (i.e., between unpolluted and potentially eutrophic). The Ballyboghill and Ballough Rivers are not designated salmonid rivers. The nearest recreational water bodies (e.g., bathing site) are Portrane (the Brook Beach), Donabate (Balcarrik Beach), Rush (South Beach), which are all approximately 8km distant.

The National flood hazard mapping website www.floodmaps.ie does not show any record of historic flooding in the vicinity of the Annsbrook land parcel. The nearest historic flooding location was at Baldrumman, near the M1 crossing of the Ballough River (eastern tributary of the Ballough River). The flood extent maps produced under FEM FRAMS indicates that the Annsbrook site is not flooded by either the Ballough or Ballyboghill Rivers. However, it is noted that the Ballyboghill River has extensive overland flooding approximately 3km further downstream (refer to Figure 9.2).

Hydrogeology
The Geological Survey of Ireland (GSI) 100k Bedrock mapping indicates that the land parcel is underlain entirely by the Lucan Formation (LU) which consists of dark grey, well bedded, cherty, graded limestones and calcareaous shales.

According to the GSI bedrock aquifer mapping, the land parcel is underlain by a locally important bedrock aquifer (Lm) to the north of the land parcel which is generally moderately productive and by a locally important bedrock aquifer (Ll) to the south of the land parcel which is moderately productive in local zones only. The GSI sand and gravel aquifer mapping was also consulted but no sand or gravel aquifers were present in the vicinity of the land parcel (refer to Figure 9.3).

The GSI groundwater vulnerability mapping shows the area in the vicinity of the land parcel to have a groundwater vulnerability rating of low (refer to Figure 9.4). After consulting the GSI groundwater mapping, no groundwater source wells were found to be within 500m of the land parcel (refer to Figure 9.5).

A review of the GSI Karst and Hydrogeological features mapping did not identify any features within 2km of the land parcel (refer to Figure 9.6). The Source Protected Areas and the Zones of Contribution mapping were also consulted however neither were found to be within close proximity of the land parcel (refer to Figure 9.7).

Hard copy information received from Fingal County Council (Appendix A) suggests the presence of additional ground water abstraction points and groundwater wells within or in close proximity of the proposed land parcel.

Annsbrook WWTP Site and Access Route

The 20 ha Annsbrook site has been set back 50m from the Ballough and the Richardstown River (a tributary of the Ballyboghill River). The access to the site is parallel to the Richardstown River and thus does not require any new culvert. Restricted surface water from the proposed WWTP development may be discharged either into Ballough River (water quality Q3-4) or into Ballyboghill Tributary (water quality Q3), both of which outfall to Rogerstown Estuary (a SAC, SPA, pNHA, Ramsar and SNR site). Although there are no known records of historic flooding in the vicinity of the site, the Ballyboghill River has extensive overland flooding approximately 3km downstream.

According to the GSI bedrock aquifer mapping, the site is underlain by a locally important bedrock aquifer (Lm) to the north which is generally moderately productive and by a locally important bedrock aquifer (Ll) to the south of the land parcel which is moderately productive in local zones only. The site has a groundwater vulnerability rating of low. Although the GSI/EPA website does not show any groundwater source wells or karst features within 500m or 2km respectively of the proposed site, information received from Fingal County Council (Appendix A) suggests the possibility of additional ground water abstraction points and groundwater wells within or in close proximity of the proposed site.

Baldurgan Land Parcel

This land parcel is located approximately 1.6km southeast of Ballyboghill and has an area of approximately 57ha. The land parcel is located in open agricultural land.

Hydrology
The surface water from the northern part of the land parcel drains directly to the Ballyboghill River; from western part of the land parcel to a small tributary of the Ballyboghill River and from the southern part of the land parcel to the Belinstown River tributary. The Ballyboghill river discharges into Rogerstown Estuary (approximately

5km downstream), which is an SAC, SPA, pNHA, Ramsar and SNR site. The Belinstown River discharges to Malahide Bay (approximately 7km downstream), which is a SAC and pNHA site (refer to Figure 9.1).

The EPA water quality monitoring data for 2010 shows that the water quality of Malahide Bay is potentially eutrophic. The river WQ of the Ballyboghill River at Station 08012 in 2010 is Q3 (poor status). The nearest recreational water bodies (e.g. bathing sites) in the vicinity of the proposed site are Portrane (the Brook Beach) and Donabate (Balcarrik Beach), which are approximately 9km distant.

The National flood hazard mapping website www.floodmaps.ie does not show any record of historic flooding in the vicinity of the Baldurgan site. The nearest historic flooding location is Ballyboghill village, which was flooded in November 2002. The flood extent maps produced under FEM FRAMS show some overland flooding along the Ballyboghill River adjacent to the Baldurgan site. Both the Ballyboghill and Belinstown Rivers have extensive overland flooding (both tidal and fluvial) in the vicinity of the M1 and R132 (approximately 2km downstream of the site (refer to Figure 9.2)).

Hydrogeology
The GSI 100k Bedrock mapping indicates that the land parcel is underlain entirely by the Lucan Formation (LU) which consists of dark grey, well bedded, cherty, graded limestones and calcareaous shales.

According to the GSI bedrock aquifer mapping, the land parcel is entirely underlain by a locally important bedrock aquifer (Ll) which is moderately productive in local zones only. The GSI sand and gravel aquifer mapping was also consulted but no sand or gravel aquifers were present in the vicinity of the land parcel (refer to Figure 9.3).

The GSI groundwater vulnerability mapping shows the area in the vicinity of the land parcel to have a groundwater vulnerability rating of low (refer to Figure 9.4). After consulting the GSI groundwater mapping, one groundwater source well was found to be within 500m of the land parcel (refer to Figure 9.5).

A review of the GSI Karst and Hydrogeological features mapping did not identify any features within 2km of the land parcel (refer to Figure 9.6). The Source Protected Areas and the Zones of Contribution mapping were also consulted however neither were found to be within close proximity of the land parcel (refer to Figure 9.7).

Hard copy information received from Fingal County Council (Appendix A) suggests the presence of additional ground water abstraction points and groundwater wells within or in close proximity of the proposed land parcel.

Baldurgan WWTP Site and Access Route

The 21.6 ha Baldurgan site has been located away from the floodplain of the Ballyboghill River and set back 50m from the Belinstown River tributary. The access to the site will require a new culvert/bridge across the Ballyboghill River, which has propensity to flooding near the proposed crossing. The Ballyboghill River (water quality Q3) outfalls to Rogerstown Estuary (a SAC, SPA, pNHA, Ramsar and SNR site); the Belinstown River discharges into the Malahide Bay (a SAC and pNHA site). No water quality monitoring stations are available on the Belinstown River. If the Baldurgan land parcel is selected for the proposed WWTP, then a water quality monitoring survey may be required to establish the baseline water quality of the Belinstown River. There are no known historic flood records in the vicinity of the site. Flood maps produced by FEM

FRAMS show overland flooding in the Ballyboghill River close to the northern boundary of the proposed site and extensive tidal and fluvial flooding in both the Ballyboghill and Belinstown Rivers approximately 2km downstream.

The proposed site is entirely underlain by a locally important bedrock aquifer (Ll) which is moderately productive in local zones only. The groundwater vulnerability mapping shows the area in the vicinity of the proposed site to have a groundwater vulnerability rating of 'low'. One groundwater source well (St. Bridget's Well) was found to be 400m south of the proposed site. No karst features were found to be within 2km of the proposed site. Information received from Fingal County Council (Appendix A) suggests the possibility of additional ground water abstraction points and groundwater wells within or in close proximity of the proposed site.

Clonshagh Land Parcel

This land parcel is located approximately 2.5km to the east south east of Dublin Airport and 1.5km to the east of the M1/M50 junction. It has a total area of approximately 40ha. The land parcel is located in open agricultural land.

Hydrology
Surface water from the northern part of the land parcel drains to the Cuckoo Stream (a tributary of the Mayne River). Surface water from southern part drains to the Mayne River, which is located approximately 200m to the south of the land parcel. A small area on the eastern part drains into a minor tributary of the Mayne River. The Mayne River discharges into Baldoyle Estuary (approximately 4km downstream), which is an SPA, SAC and pNHA site (refer to Figure 9.1).

The EPA water quality monitoring station on the Mayne River located at hydrometric station 08006 (Hole-in-the-wall), approximately 2km downstream of the land parcel shows the water quality of the Mayne River in the year 2010 as Q3 (poor status). The nearest recreational water bodies (e.g. bathing site) in the vicinity of the proposed site are Portmarnock Beach (approximately 5km), Malahide Beach (approximately 5km) and Sutton Burrow Beach (approximately 8km).

The National flood hazard mapping website www.floodmaps.ie does not show any record of historic flooding in the vicinity of the Clonshagh land parcel (refer to Figure 9.2). The nearest two historic flooding locations are the recurring flooding at Stockhole Lane (approximately 1 km northwest) and the November 1993 flooding at Balgriffin (approximately 1.5m to the east). According to the above website, a number of defence assets were put in place since the flood event of November 1993. The Stockhole flooding location lies outside of the River Mayne catchment (in the Sluice River catchment). The flood extent maps produced under FEM FRAMS show no flooding in the vicinity of the Clonshagh land parcel for both the 1% and 0.1% AEPs. However, the Mayne River has extensive overland flooding approximately 2km downstream of the land parcel.

Hydrogeology
The GSI 100k Bedrock mapping indicates that the land parcel is jointly underlain by the Lucan Formation (LU) to the west and the Tober Coleen Formation (TC) to the east. The Lucan Formation (LU) consists of dark grey, well bedded, cherty, graded limestones and calcareaous shales while the Tober Coleen Formation (TC) consists of dark grey, calcareaous, commonly bioturbated mudstones and subordinate thin micrite limestones.

According to the GSI bedrock aquifer mapping, the land parcel is underlain by a poor bedrock aquifer (Pl) to the east of the site which is generally unproductive except locally and by a locally important bedrock aquifer (Ll) to the west of the site which is moderately productive in local zones only. The GSI sand and gravel aquifer mapping was also consulted but no sand or gravel aquifers were present in the vicinity of the land parcel (refer to Figure 9.3).

The GSI groundwater vulnerability mapping shows the area in the vicinity of the land parcel to have a groundwater vulnerability rating that ranges from low to moderate but is predominantly low (refer to Figure 9.4). After consulting the GSI groundwater mapping, no groundwater source wells were found to be within 500m of the land parcel (refer to Figure 9.5).

A review of the GSI Karst and Hydrogeological features mapping identified one feature within 2km of the land parcel (refer to Figure 9.6) The Source Protected Areas and the Zones of Contribution mapping were also consulted however neither were found to be within close proximity of the land parcel (refer to Figure 9.7).

Fingal County Council has no groundwater borehole records for this land parcel.

Clonshagh WWTP Site and Access Route

The 23.1 ha Clonshagh site has been set back 50m from the Cuckoo Stream (a tributary of the Mayne River). The access to the site is from the west and does not require culverting or any river or stream. The Mayne River (water quality Q3) outfalls to Baldoyle Estuary (a SPA, SAC and pNHA site). There are no known records of historic flooding in the vicinity of the site. Flood maps produced by FEM FRAMS do not show any overland flooding in the vicinity of the site, but do show extensive overland flooding approximately 2km downstream.

The proposed site is partially underlain by a locally important bedrock aquifer (Ll) to the west (which is moderately productive in local zones only) and predominantly underlain by a poor bedrock aquifer (Pl) to the east. The groundwater vulnerability mapping shows the area in the vicinity of the proposed site to have a groundwater vulnerability rating of 'low'. No groundwater source wells were found to be within 500m of the proposed site however one karst feature (St. Doolagh's Well) was found to be 1.3km to the east of the proposed site. Fingal County Council has no groundwater borehole records for this land parcel.

Cloghran Land Parcel

This land parcel is located approximately 2km to east of Dublin Airport and 3km to southeast of Swords. It has a total area of approximately 32ha. The land parcel is located in open agricultural land currently used for grazing cattle and horses.

Hydrology
Surface water from most of the land parcel drains to the Sluice River, which runs close to the northern boundary of the site. Surface water from a small southeastern area drains to a minor tributary of the Sluice River. The Sluice River discharges into Baldoyle Estuary (approximately 5km downstream), which is a SPA, SAC and pNHA site (refer to Figure 9.1).

The EPA website does not show any water quality monitoring data for the Sluice River. The nearest recreational water bodies (e.g., bathing sites) in the vicinity of the proposed site are Portmarnock Beach (approximately 5km), Malahide Beach (approximately 5.5km) and Sutton Burrow Beach (approximately 6.5km).

The National flood hazard mapping website www.floodmaps.ie does not show any record of historic flooding in the vicinity of the Cloghran land parcel (refer to Figure 9.2). The nearest historic flooding locations are:
recurring flooding at Stockhole Lane (Sluice tributary)
flooding at Streamstown to Malahide Road (Sluice Tributary)
recurring flood at Kinsaley Lane (Sluice River)
the August 1986 flood (Hurricane Charlie) at Kinsaley Hall (Sluice River)

Of the above four historic flooding locations, Kinsaley Lane and Kinsaley Hall flooding locations are approximately 2km downstream from the land parcel on the Sluice River.

The flood extent maps produced under FEM FRAMS show no flood of the Sluice River in the vicinity of the Cloghran site for both the 1% and 0.1% AEPs. However, the Sluice River has some localised overland flooding near Marshallstown (Kettle's Lane) and near Nevinstown East, approximately 0.5 km upstream, to the west of the M1 motorway. Similarly, the FEM FRAMS flood extent map also shows extensive overland flooding approximately 2km downstream (Kinsaley Lane area) and further downstream (to the east of Dublin – Belfast railway line). According to anecdotal evidence, Kettle's Lane was also flooded during the October 2011 flood event.

Hydrogeology
The GSI 100k Bedrock mapping indicates that the land parcel is underlain entirely by the Tober Coleen Formation (TC) which consists of dark grey, calcareaous, commonly bioturbated mudstones and subordinate thin micrite limestones.

According to the GSI bedrock aquifer mapping, the land parcel is entirely underlain by a poor bedrock aquifer (Pl) which is generally unproductive except locally. The bedrock aquifer mapping consulted was provided by the GSI as well as the sand and gravel aquifer mapping which was also consulted but no sand or gravel aquifers were present in the vicinity of the land parcel. The GSI sand and gravel aquifer mapping was also consulted but no sand or gravel aquifers were present in the vicinity of the land parcel (refer to Figure 9.3).

The GSI groundwater vulnerability mapping shows the area in the vicinity of the land parcel to have a groundwater vulnerability rating that ranges from low to high but is predominantly low (refer to Figure 9.4). After consulting the GSI groundwater mapping, no groundwater source wells were found to be within 500m of the land parcel (refer to Figure 9.5)

A review of the GSI Karst and Hydrogeological features mapping identified one feature within 2km of the land parcel (refer to Figure 9.6). The Source Protected Areas and the Zones of Contribution mapping were also consulted however neither were found to be within close proximity of the land parcel (refer to Figure 9.7)

Fingal County Council has no groundwater borehole records for this land parcel.

Cloghran WWTP Site and Access Route

The 25.9 ha Cloghran site has been set back 50m from the Sluice River to the north. The access to the site is from the south and does not require culverting of a river or stream. The Sluice River flows adjacent to the northern boundary of the site and outfalls to Baldoyle Estuary (a SPA, SAC and pNHA site). As the WQ data of the Sluice is not available in the EPA website, a water quality monitoring survey of the Sluice River should be undertaken if this site is selected for the proposed WWTP. The Sluice River has history of flooding at the upstream and downstream locations but not close to the site. Flood maps produced by FEM FRAMS show some overland flooding extent approximately 500m upstream and extensive flooding approximately 2km downstream.

The proposed site is entirely underlain by a poor bedrock aquifer (Pl) which is generally unproductive except locally. The groundwater vulnerability mapping shows the area in the vicinity of the proposed site to have a groundwater vulnerability rating that ranges from 'low' to 'high' but is predominantly 'low'. No groundwater source wells were found to be within 500m of the proposed site however one karst feature (St. Doolaghs Well) was found to be 2km to the south east of the proposed site. Fingal County Council has no groundwater borehole records for this land parcel but if this site were to be selected then a well survey may be required to establish the existence, location and type of any abstraction points.

Cookstown Land Parcel

This land parcel is located approximately 2km to southeast of Ballyboghill village and has a total area of approximately 80 ha. The land parcel is located in open agricultural land (tillage).

Hydrology
The prominent hydrological features in the vicinity of the Cookstown land parcel are the Belinstown River to the north and a minor tributary of the Broadmeadow River to the south. Most of the site (90%) lies in the Belinstown River catchment but a small area (10%), on the southern side, lies in the Broadmeadow River catchment.

The Belinstown River discharges to Malahide Bay (approximately 8km downstream), which is a SAC and pNHA site. The Broadmeadow River discharges into Broadmeadow Estuary (approximately 5km downstream), which is a SPA, SAC and pNHA site (refer to Figure 9.1).

According to the EPA water quality monitoring data for 2010, the water quality of Malahide Bay is potentially eutrophic, whereas that of Broadmeadow Estuary is eutrophic. The water quality of the Broadmeadow River near Waterworks (approximately 3km downstream) is Q3 (poor status). No water quality monitoring stations and hence no water quality data is available for the Belinstown River. The nearest recreational water bodies (e.g., bathing sites) in the vicinity of the proposed site are Portrane (the Brook Beach) and Donabate (Balcarrik Beach), both approximately 9km distant.

The National flood hazard mapping website www.floodmaps.ie does not show any record of historic flooding in the vicinity of the Cookstown site. However, both the Belinstown and Broadmeadow have historic flooding approximately 3km downstream of the site. The noted downstream historic flooding areas are (refer to Figure 9.2):

recurring flooding at Turvey Avenue (R132) from Belinstown River

recurring flooding at Cobb's Lane, Donabate from Belinstown River
August 1986 flooding at Swords from the Broadmeadow River
Recurring flooding at Balheary Road at Swords from the Broadmeadow River

The flood extent maps produced under FEM FRAMS show no flood of the Belinstown and Broadmeadow Rivers in the vicinity of the Cookstown site for both the 1% and 0.1% AEPs. However, the Belinstown River has extensive fluvial and tidal flooding extents approximately 3km downstream, in the vicinity of the M1 and between the M1 and the Dublin to Belfast railway line. Similarly, the Broadmeadow River also has overland flooding approximately 1km downstream of the site.

Hydrogeology
The GSI 100k Bedrock mapping indicates that the land parcel is underlain entirely by the Lucan Formation (LU) which consists of dark grey, well bedded, cherty, graded limestones and calcareaous shales.

According to the GSI bedrock aquifer mapping, the land parcel is entirely underlain by a locally important bedrock aquifer (Ll) which is moderately productive in local zones only. The GSI sand and gravel aquifer mapping was also consulted but no sand or gravel aquifers were present in the vicinity of the land parcel (refer to Figure 9.3).

The GSI groundwater vulnerability mapping shows the area in the vicinity of the land parcel to have a groundwater vulnerability rating of low (refer to Figure 9.4). After consulting the GSI groundwater mapping, one groundwater source well was found to be within 500m of the land parcel (refer to Figure 9.5).

A review of the GSI Karst and Hydrogeological features mapping did not identify any features within 2km of the land parcel (refer to Figure 9.6). The Source Protected Areas and the Zones of Contribution mapping were also consulted however neither were found to be within close proximity of the land parcel (refer to Figure 9.7).

Hard copy information received from Fingal County Council (Appendix A) suggests the presence of additional ground water abstraction points and groundwater wells within or in close proximity of the proposed land parcel.

Cookstown WWTP Site and Access Route

The 25.7 ha Cookstown site is located in the Belinstown River catchment and has been set back 50m from the Belinstown River. The access to the site is from the south-west and would require a new culvert on the tributary of the Broadmeadow River. The Belinstown River flows adjacent to the northern boundary of the site and outfalls to Malahide Bay (a SAC and PNHA site). As the WQ data of the Belinstown River is not available in the EPA website, a water quality monitoring survey of this river should be undertaken if this site is selected. The Belinstown River does not have known records of historic flooding in the vicinity of the site. Flood maps produced by FEM FRAMS do not show any overland flooding in the vicinity of the site, and extensive overland flooding are shown approximately 3km downstream.

The proposed site is entirely underlain by a locally important bedrock aquifer (Ll) which is moderately productive in local zones only. The groundwater vulnerability mapping shows the area in the vicinity of the proposed site to have a groundwater vulnerability rating of low. One groundwater source well (St. Bridgets Well) was found to be 210m south east of the proposed site however no karst features were found to be within 2km of the proposed site. Information received from Fingal County Council (Appendix A)

suggests the possibility of additional ground water abstraction points and groundwater wells within or in close proximity of the proposed site.

Newtowncorduff Land Parcel

This land parcel is located approximately 2.2km to the west of Lusk and has an area of approximately 43ha. The land parcel is located in open agricultural land, primarily tillage. An overhead transmission line runs parallel to the M1 on the western boundary of the site.

Hydrology
The Ballough River and a tributary of the Ballough River are located to the south and east of this site. Surface water from the site will discharge to the Ballough River which in turn discharges into Rogerstown Estuary (approximately 3km downstream). Rogerstown Estuary is an ecologically very important site, e.g., a SAC, SPA, pNHA, Ramsar and SNR site (refer to Figure 9.1).

The EPA website shows that the water quality of the Ballough River for the year 2010 at the monitoring site approximately 3km downstream was Q3-4 (moderate status). Similarly, the water quality of Rogerstown Estuary, in 2010, was intermediate (i.e., between unpolluted and potentially eutrophic). The Ballough River is not a designated salmonid river. The nearest recreational water bodies (e.g., bathing sites) in the vicinity of the proposed site are Portrane (the Brook Beach), Donabate (Balcarrik Beach), Rush (South Beach), which are all approximately 7km distant.

The National flood hazard mapping website www.floodmaps.ie does not show any record of historic flooding in the vicinity of the Newtowncorduff site. The nearest historic flooding locations are at Baldrumman, near M1 crossing of the Ballough River (eastern tributary of the Ballough River). The flood extent maps produced by FEM FRAMS does not show any flooding at the site, but has some overland flooding approximately 1km downstream.

Hydrogeology
The GSI 100k Bedrock mapping indicates that the land parcel is underlain entirely by the Lucan Formation (LU) which consists of dark grey, well bedded, cherty, graded limestones and calcareaous shales.

According to the GSI bedrock aquifer mapping, the land parcel is underlain by a locally important bedrock aquifer (Lm) to the north of the site which is generally moderately productive and by a locally important bedrock aquifer (Ll) to the south of the site which is moderately productive in local zones only. The GSI sand and gravel aquifer mapping was also consulted but no sand or gravel aquifers were present in the vicinity of the land parcel (refer to Figure 9.3).

The GSI groundwater vulnerability mapping shows the area in the vicinity of the land parcel to have a groundwater vulnerability rating that ranges from low to high but is predominantly low (refer to Figure 9.4). After consulting the GSI's groundwater mapping one groundwater source well was found to be within 500m of the land parcel (refer to Figure 9.5).

A review of the GSI Karst and Hydrogeological features mapping identified four features within 2km of the land parcel (refer to Figure 9.6). The Source Protected Areas and the Zones of Contribution mapping were also consulted however neither were found to be within close proximity of the land parcel (refer to Figure 9.7).

Hard copy information received from Fingal County Council (Appendix A) suggests the presence of additional ground water abstraction points and groundwater wells within or in close proximity of the proposed land parcel.

Newtowncorduff WWTP Site and Access Route

The 22.8 ha Newtowncorduff site is located in the Ballough River catchment. It has been set back 50m from the Ballough River. The access to the site is from the north north-east and would require a new culvert on the Ballough tributary. The Ballough River (water quality Q3-4) outfalls to Rogerstown Estuary (a SAC, SPA, pNHA, Ramsar and SNR site). There are no known records of historic flooding in the vicinity of the site. Flood maps produced by FEM FRAMS do not show any overland flooding close to the site, with some overland flooding extents shown approximately 1km downstream.

The proposed site is jointly underlain by a locally important bedrock aquifer (Lm) to the north (which is generally moderately productive) and by a locally important bedrock aquifer (Ll) to the south (which is moderately productive in local zones only). The groundwater vulnerability mapping shows the area in the vicinity of the proposed site to have a groundwater vulnerability rating of 'low'. One bored groundwater source well with good yields is used for both agriculture and domestic needs was found to be located 510m to the north. Four karst features (Horlakes, St. Catherine's, Bridetree and Maccullins Wells) were found to be within 1.8km north east to south east of the proposed site. Further information provided by FCC suggests the possibility of additional ground water abstraction points and groundwater wells within or in close proximity of the proposed site (Appendix A).

Rathartan Land Parcel

This land parcel is located approximately 2.0km to the west of Rush and 2.5km to the east of Lusk and has a total area of approximately 41ha. The land parcel lies in an open agricultural land, mainly tillage. The Dublin to Belfast railway line runs close to the western edge of the site (approximately 80m at its closest point).

Hydrology
The surface water from the most part of the site drains to the Collinstown Stream, which runs adjacent to the western boundary of the land parcel. Surface water from a small area in the southeastern part of the land parcel drains to the Palmerstown Stream. Neither the Collinstown Stream nor the Palmerstown Stream are designated salmonid rivers. These streams discharge into Rogerstown Estuary (approximately 1 km downstream), which is an ecologically very important site, e.g., a SAC, SPA, pNHA, Ramsar and SNR site (refer to Figure 9.1).

No EPA water quality monitoring stations are available on either the Collinstown or the Palmerstown streams. The EPA website shows that in the year 2010, the water quality of Rogerstown Estuary was intermediate (i.e., between unpolluted and potentially eutrophic). The Rush South Beach is located within 2km to the southeast of the site, and has good water quality (bathing). The other two beaches, namely, Portrane (the Brook Beach) and Loughshinny Beach are approximately 3km distant.

The National flood hazard mapping website www.floodmaps.ie does not show any record of historic flooding in the vicinity of the Rathartan site. The nearest two historic flooding locations are at Spout Hill on the Lusk to Rush Road and at Whitehouse Road,

both locations are approximately 0.5km to the south of the site (see Figure 9.2). According to the information available on the above website, Whitestown Road floods following heavy rains. The website also mentions that remedial works were carried out at Spout Hill flooding location in 2003/2004. The flood extent maps produced by FEM FRAMS show that neither the Collinstown Stream or the Palmerstown Stream floods this site for either the 1% or the 0.1% AEPs.

Hydrogeology
The GSI 100k Bedrock mapping indicates that the land parcel is jointly underlain by the Lucan Formation (LU) to the north and the Rush Conglomerate Formation (RU) to the South. The Lucan Formation (LU) consists of dark grey, well bedded, cherty, graded limestones and calcareaous shales. The Rush Conglomerate Formation (RU) consists of graded quartz- and limestone-pebble conglomerates and lithic sandstones, interbedded with laminated shale and thin limestones.

According to the GSI bedrock aquifer mapping, the land parcel is predominantly underlain by a locally important bedrock aquifer (Lm) to the north of the site which is generally moderately productive and to a lesser extent by a locally important bedrock aquifer (Ll) to the south of the site which is moderately productive in local zones only. The GSI sand and gravel aquifer mapping was also consulted but no sand or gravel aquifers were present in the vicinity of the land parcel (refer to Figure 9.3).

The GSI groundwater vulnerability mapping shows the area in the vicinity of the land parcel to have a groundwater vulnerability rating of low (refer to Figure 9.4). After consulting the GSI groundwater mapping, no groundwater source wells were found to be within 500m of the land parcel (refer to Figure 9.5).

A review of the GSI Karst and Hydrogeological features mapping identified one feature within 2km of the land parcel (refer to Figure 9.6). The Source Protected Areas and the Zones of Contribution mapping were also consulted however neither were found to be within close proximity of the land parcel (refer to Figure 9.7).

Hard copy information received from Fingal County Council (Appendix A) suggests the presence of additional ground water abstraction points and groundwater wells within or in close proximity of the proposed land parcel.

Rathartan WWTP Site and Access Route

The 25.1 ha Rathartan site is located in the Collinstown Stream catchment and has been set back 50m from the river. The accessto the site is from the south west and will require a new culvert on the Collinstown Stream. The Collinstown Stream flows adjacent to the western boundary of the site and outfalls to Rogerstown Estuary (a SAC, SPA, pNHA, Ramsar and SNR site) less than 1km downstream. As the WQ data of the Collinstown Stream is not available in the EPA website, a water quality monitoring survey of this stream has to be undertaken if this site is selected. Three recreational bathing sites, namely, the Rush South Beach, the Brook Beach and the Loughshinny Beach are located within approximately 3km of the site. There are some known records of historic flooding approximately 500m downstream of the sites but none in the vicinity of the site. The flood maps produced by FEM FRAMS do not show any overland flooding in the vicinity of the site.

The proposed site is entirely underlain by a locally important bedrock aquifer (Lm) which is generally moderately productive. The groundwater vulnerability mapping shows the area in the vicinity of the proposed site to have a groundwater vulnerability rating of ‘low’. The GSI mapping does not show any groundwater source well within

500m of the proposed site however one karst feature a Bog Well was found to be 1.7km north west of the proposed site. Further information provided by FCC suggests the possibility of additional ground water abstraction points and groundwater wells within or in close proximity of the proposed site (Appendix A).

Saucerstown Land Parcel

This land parcel is located approximately 3km to northwest of Swords and has a total area of approximately 36ha. The site is located in an open agricultural land. A school complex is situated to the south of the land parcel and the Swords and Roganstown golf course to the northwest of the site.

Hydrology
The prominent hydrological features in the vicinity of the Saucerstown land parcel are the Broadmeadow River and its tributaries. Surface water from the northern part drains directly to the Broadmeadow River. Surface water from the central part drains to a tributary of the Broadmeadow River which runs along the middle of the site. If the site is selected for the proposed WWTP, the Broadmeadow Tributary running along the middle of the site would require culverting. Similarly, the southern part of the land parcel drains to another tributary of the Broadmeadow River. The OPW's hydrometric station on the Broadmeadow River (08008) is located just 1km downstream of the land parcel.

The Broadmeadow River discharges into the Broadmeadow Estuary (approximately 3km downstream), which is a SPA, SAC and pNHA site (refer to Figure 9.1). According to the EPA water quality monitoring data for 2010, the Broadmeadow Estuary is eutrophic. The water quality of the Broadmeadow River near Waterworks (approximately 2km downstream) is Q3 (poor status). There are no recreational water bodies (e.g., bathing sites) in the vicinity of the proposed site. The nearest recreational bathing sites are Donabate (Balcarrik Beach) and Malahide Beach, both located approximately 5km away and are outside of the Broadmeadow catchment.

The National flood hazard mapping website www.floodmaps.ie does not show any record of historic flooding in the vicinity of the Saucerstown site. The historic flooding locations close to the site are (refer to Figure 9.2 in Appendix G):

recurring flooding at Warblestown (located approximately 1.5km upstream)
flooding of August 1986 flooding at Swords (approximately 1km downstream)
recurring flooding at Balheary Road at Swords (approximately 1.5km downstream)

The flood maps produced under FEM FRAMS show that the northern part of the Saucerstown site lies within the 0.1% AEP flood extent of the Broadmeadow River. The Broadmeadow also has extensive overland flooding extent in the vicinity of the Saucerstown site both upstream and downstream of the site. It should also be noted that the tributary of the Broadmeadow that runs through the site was not modeled as part of FEM FRAMS so it is possible the flood extent may be more significant at this location.

Hydrogeology
The GSI 100k Bedrock mapping indicates that the land parcel is jointly underlain by the Tober Coleen Formation (TC) to the north and the Malahide Formation (ML) to the south. The Tober Coleen Formation (TC) consists of dark grey, calcareaous, commonly bioturbated mudstones and subordinate thin micrite limestones while the Malahide

Formation (ML) consists of calcareous shales, siltstones and sandstones, and thin limestones.

According to the GSI bedrock aquifer mapping, the land parcel is predominantly underlain by a poor bedrock aquifer (Pl) to the north of the land parcel which is generally unproductive except and to a lesser extent by a locally important bedrock aquifer (Ll) to the south of the land parcel which is moderately productive in local zones only. The GSI sand and gravel aquifer mapping was also consulted but no sand or gravel aquifers were present in the vicinity of the land parcel (refer to Figure 9.3).

The GSI groundwater vulnerability mapping shows the area in the vicinity of the land parcel to have a groundwater vulnerability rating that ranges from low to high but is predominantly moderate (refer to Figure 9.4). After consulting the GSI groundwater mapping, no groundwater source wells were found to be within 500m of the land parcel (refer to Figure 9.5).

A review of the GSI Karst and Hydrogeological features mapping did not identify any features within 2km of the land parcel (refer to Figure 9.6). The Source Protected Areas and the Zones of Contribution mapping were also consulted however neither were found to be within close proximity of the land parcel (refer to Figure 9.7).

Fingal County Council has no groundwater borehole records for this land parcel.

Saucerstown WWTP Site and Access Route

The 23.4 ha Saucerstown site is located in the Broadmeadow River catchment. Two tributaries of the Broadmeadow River flow adjacent to the northern, southern and eastern boundaries of the site. The access to the site is from the south and would require a new culvert on one of the Broadmeadow tributaries. The Broadmeadow River (water quality Q3) discharges into the Broadmeadow Estuary (a SPA, SAC and pNHA site) the water quality of which is eutrophic. The national flood hazard mapping website www.floodmaps.ie shows records of a major flooding approximately 1km downstream and recurrence flooding approximately 1.5km downstream of the site. Flood maps produced by FEM FRAMS show extensive overland flooding extent (0.1% AEP) adjacent to the northern boundary of the site and also in the vicinity of the site at both upstream and downstream locations.

The proposed site is partially underlain by a locally important bedrock aquifer (Ll) to the south which is moderately productive in local zones only and by a poor bedrock aquifer (Pl) to the north. The groundwater vulnerability mapping shows the area in the vicinity of the proposed site to have a groundwater vulnerability rating of low to high but predominately moderate. No groundwater source wells or karst features were found to be within 500m or 2km respectively of the proposed site. Fingal County Council has no groundwater borehole records for this land parcel.

Tyrrelstown Little Land Parcel

This land parcel is located approximately 2.5km to the northeast of Lusk and 3.5km to the northwest of Rush, and has a total area of approximately 104ha. The site is located in open agricultural land. The Dublin to Belfast railway line runs close to the eastern edge of the site (the nearest point is approximately 300m).

Hydrology

The prominent hydrological features in the vicinity of the Tyrrelstown Little land parcel are the Collinstown Stream, Rush Town Stream and the Balcunnin Stream. The Irish sea is approximately 2km east of the site. Almost 75% of the land parcel area drains to the Collinstown Stream, which is located near the southwestern boundary of the site. Approximately 5% of the land parcel area drains to the Rush Town Stream, which is located near southeastern boundary of the site. The remaining 20% of the land parcel area drains to the Irish Sea. The Rush Town Stream outfalls to the Irish Sea (approximately 3.5km downstream) whereas the Collinstown Stream discharges into Rogerstown Estuary (approximately 2.5km downstream) which is an ecologically very important water body and an SAC, SPA, pNHA, Ramsar and SNR site. The nearest recreational bathing sites are Loughshinny Beach and Rush South Beach which are both within 3km of the site (refer to Figure 9.1).

According to the EPA water quality monitoring data for 2010, the water quality of Rogerstown Estuary was intermediate (i.e., between unpolluted and potentially eutrophic). The water quality of the coastal area (Irish Sea) near the site is also unpolluted. The EPA's website does not show any water quality monitoring stations on the Rush Town or the Collinstown Stream.

The National flood hazard mapping website www.floodmaps.ie does not show any record of historic flooding in the vicinity of the Tyrrelstown Little site. The nearest two historic flooding locations are at Spout Hill on Lusk to Rush Road (Collinstown Stream) approximately 2km downstream and at Skerries Road from the Rush Town Stream approximately 3km downstream of the site (see Figure 9.2). According to the information available on the above website, remedial works were carried out at the Spout Hill flooding location in 2003/2004. The flood extent maps produced under FEM FRAMS show that neither the Collinstown Stream nor the Rush Town Stream floods this site for either the 1% or the 0.1% AEPs.

Hydrogeology

The GSI 100k Bedrock mapping indicates that the Tyrrelstown Little land parcel is underlain by the Loughshinny Formation (LO) to the north, the Naul Fomation (NA) to the south and the Lucan Formation (LU) further south again. The Loughshinny Formation (LO) consists of laminated to thinly bedded, argillacaceous, pyritic, locally cherty micrites and graded calcerites, interbedded with dark grey to black shale. The Naul Formation (NA) consists of calcerenite and calcisiltite with minor chert and occasional thin shales. The Lucan Formation (LU) consists of dark grey, well bedded, cherty, graded limestones and calcareaous shales.

According to the GSI bedrock aquifer mapping, the land parcel is entirely underlain by a locally important bedrock aquifer (Lm) which is generally moderately productive. The GSI sand and gravel aquifer mapping was also consulted but no sand or gravel aquifers were present in the vicinity of the land parcel (refer to Figure 9.3).

The GSI groundwater vulnerability mapping shows the area in the vicinity of the land parcel to have a groundwater vulnerability rating of low (refer to Figure 9.4). After consulting the GSI groundwater mapping, three groundwater source wells were found to be within 500m of the land parcel (refer to Figure 9.5).

A review of the GSI Karst and Hydrogeological features mapping identified one feature within 2km of the land parcel (refer to Figure 9.6). The Source Protected Areas and the Zones of Contribution mapping were also consulted however neither were found to be within close proximity of the land parcel (refer to Figure 9.7).

Hard copy information received from Fingal County Council (Appendix A) suggests the presence of additional ground water abstraction points and groundwater wells within or in close proximity of the proposed land parcel.

Tyrrelstown Little WWTP Site and Access Route

The 24.1 ha Tyrrelstown Little site is located in the Collinstown Stream catchment. The access to the site is from the north and west and does not require any culverting of a river or stream. The Collinstown Stream is located near the south-western boundary of the site and outfalls to Rogerstown Estuary (a SAC, SPA, pNHA, Ramsar and SNR site). As the WQ data of the Collinstown Stream is not available in the EPA website, a water quality monitoring survey of this stream should be undertaken if this site is selected. Two recreational bathing sites, namely, the Loughshinny Beach and Rush South Beach are located within 3km of the site. Some known records of historic flooding are located approximately 2-3 km downstream of the site. The flood maps produced by FEM FRAMS do not show any overland flooding in the vicinity of the site.

The proposed site is entirely underlain by a locally important bedrock aquifer (Lm) which is which is generally moderately productive. The groundwater vulnerability mapping shows the area in the vicinity of the proposed site to have a groundwater vulnerability rating of low. No groundwater source wells were found to be within 500m of the proposed site however one karst feature a Bog Well was found to be 0.7km west of the proposed site. Further information available from FCC suggests the possibility of additional groundwater abstraction points and groundwater wells within or in close proximity of the proposed site (Appendix A).

Transfer Pipeline Corridor - Route A

The Route A transfer pipeline corridor is approximately 6km long. It starts at the M50/N3 Junction near Blanchardstown, runs along the outer boundary of M50 for 4km and at the M50/N2 Junction; it takes a left turn and runs alongside N2 up to Killshane Bridge.

Hydrology
The first 4.5km of Route A passes through the Tolka River catchment, and the last 1.5km passes through the Ward River catchment. The route crosses the Tolka River near its starting point, a minor tributary of the Tolka River just before the M50/N2 junction and a tributary of the Ward River at Killshane Bridge. Route A would require a major pipe crossing structure on the Tolka River, which is a flood prone river.

The OPW flood hazard mapping website www.floodmaps.ie shows historic floods in both the Tolka and the Ward catchment along the Route A corridor. The PFRA maps show localised flooding in the vicinity of Abbotstown from the Tolka River and its tributary. Severe flooding of the road along Blanchardstown Bypass occurred in November 2002 due to high river levels and surface water drainage backup. The road was impassable and cars were submerged under Snugborough Road flyover. A historic flood occurred at Kilshane Cross (tributary of the Ward River) in 2002, following which drainage works were carried out as part of the road development in 2005.

The water quality in 2010 for the Tolka River was Q2-3 (poor status) and that of the Ward River was Q3 (poor status).

Hydrogeology
According to the GSI bedrock aquifer mapping, the transfer pipeline corridor is underlain by a poor bedrock aquifer which is generally unproductive except locally and by a locally important bedrock aquifer which is moderately productive in local zones only. The GSI sand and gravel aquifer mapping was also consulted but no sand or gravel aquifers were present in the vicinity of the transfer pipeline corridor (refer to Figure 9.3).

The GSI groundwater vulnerability mapping shows the area in the vicinity of the transfer pipeline corridor has a groundwater vulnerability rating that ranges from moderate to rock near surface or karst but is predominantly high (refer to Figure 9.4). The GSI groundwater mapping website identifies three groundwater source wells within the transfer pipeline corridor (refer to Figure 9.5).

A review of the GSI Karst and Hydrogeological features mapping identified no karst or hydrogeological features within 200m of the transfer pipeline corridor (refer to Figure 9.6). The Source Protected Areas and the Zones of Contribution mapping were also consulted however neither were found to be within close proximity of the transfer pipeline corridor (refer to Figure 9.7).

Fingal County Council has no groundwater borehole records for this transfer pipeline corridor. A well survey of the proposed transfer pipeline route may be required at a later stage to confirm the existence, location and type of any abstraction points.

Transfer Pipeline Corridor - Route B

The Route B transfer pipeline corridor is approximately 9km long. It passes through the Clonshagh land parcel and links Route A to Route G. It starts near Baleskin (just to the east of the M50/N2 Junction), runs along the outer boundary of M50 up to M50/M1 junction, after which it runs along the northern boundary of the N32, passes the Clonshagh land parcel, after which it takes a left turn, crosses the Cuckoo Stream and then takes a right turn to join Route G at the R107 near Kinsaley.

Hydrology
The first 2.5km of the Route B passes through the Santry River catchment, the next 5 km passes through the Mayne River catchment and the last 1.5km passes through the Sluice River catchment. The route crosses three watercourses, namely, the Santry River, the Mayne River and the Cuckoo Stream.

The OPW flood mapping website www.floodmaps.ie shows records of two historic floods along the Route B corridor near Dubber Cross area and near Ballymun in November 2002 in the Santry catchment and further two locations on the N1 north to M50 flyover in the Mayne catchment. The PFRA maps show some localised flooding from the Santry River where the pipeline route and river converge. The FEM FRAMS maps show localised flooding from the Mayne River in the vicinity of Dardistown and from the Cuckoo stream at the R132 near Dublin Airport.

According to the EPA website in 2010, the water quality of both the Santry River and the Mayne River is Q3 (poor status).

Hydrogeology
According to the GSI bedrock aquifer mapping, the transfer pipeline corridor is underlain by a poor bedrock aquifer which is generally unproductive except locally and by a locally important bedrock aquifer which is moderately productive in local zones

only. The GSI sand and gravel aquifer mapping was also consulted but no sand or gravel aquifers were present in the vicinity of the transfer pipeline corridor (refer to Figure 9.3).

The GSI groundwater vulnerability mapping shows the area in the vicinity of the transfer pipeline corridor has a groundwater vulnerability rating that ranges from low to extreme but is predominantly low (refer to Figure 9.4). The GSI groundwater mapping website identifies four groundwater source wells within the transfer pipeline corridor (refer to Figure 9.5).

A review of the GSI Karst and Hydrogeological features mapping identified no features within 200m of the transfer pipeline corridor (refer to Figure 9.6). The Source Protected Areas and the Zones of Contribution mapping were also consulted however neither were found to be within close proximity of the transfer pipeline corridor (refer to Figure 9.7).

Fingal County Council has no groundwater borehole records for this transfer pipeline corridor.

Transfer Pipeline Corridor - Route C

The Route C transfer pipeline corridor is approximately 9km long. It passes through Cloghran WWTP and links Route F to Route G. It starts near Mountambroso Great (Route F) and runs due southwest, and after crossing the Ward River it takes left turn and goes along the Sluice River, crosses the M1, the R132 and passes through Cloghran land parcel and then joins the Route G near Kinsaley.

Hydrology
The northern 3km of Route C passes through the Ward River catchment and the southern 6km through the Sluice catchment. This route requires crossing of the Ward River, the Sluice River and three tributaries of the Sluice River.

The flood mapping website www.floodmaps.ie does not show records of historic floods along the Route C corridor. The flood maps prepared under FEM FRAMS shows some overland flooding along the Sluice River, along the route C corridor.

According to the EPA website, the water quality of the Mayne River is Q3 (poor status) in 2010. Water quality of the Sluice River is not available from the EPA website. Therefore, a water quality survey of the Sluice River would require if this route were to be selected.

Hydrogeology
According to the GSI bedrock aquifer mapping, the transfer pipeline corridor is underlain by a poor bedrock aquifer which is generally unproductive except locally and by a locally important bedrock aquifer which is moderately productive in local zones only. The GSI sand and gravel aquifer mapping was also consulted but no sand or gravel aquifers were present in the vicinity of the transfer pipeline corridor (refer to Figure 9.3).

The GSI groundwater vulnerability mapping shows the area in the vicinity of the transfer pipeline corridor has a groundwater vulnerability rating that ranges from low to rock near surface or karst but is predominantly high (refer to Figure 9.4). The GSI groundwater mapping website identifies no groundwater source wells within the transfer pipeline corridor (refer to Figure 9.5).

A review of the GSI Karst and Hydrogeological features mapping identified no features within 200m of the transfer pipeline corridor (refer to Figure 9.6). The Source Protected Areas and the Zones of Contribution mapping were also consulted however neither were found to be within close proximity of the transfer pipeline corridor (refer to Figure 9.7).

Fingal County Council has no groundwater borehole records for this transfer pipeline corridor. A well survey of the proposed transfer pipeline route may be required at a later stage to confirm the existence, location and type of any abstraction points.

Transfer Pipeline Corridor - Route D

The Route D transfer pipeline corridor is approximately 11.4km long. It passes through the Saucerstown land parcel and links Route F to Route G. It starts near Lispopple Cross Roads (Route F) and runs due east up to Saucerstown WWTP site, after which it runs along the Broadmeadow River corridor up to the R132. It crosses both the Broadmeadow and the Ward Rivers before crossing the R132 and the M1, after which it runs due southwest to join Route G near Kinsaley.

Hydrology
Route D passes through the Broadmeadow, Ward, Gaybrook and Sluice River catchments and some coastal area. This route requires crossing of the Broadmeadow River (twice), the Ward River, the Gaybrook Stream, the Sluice River as well as one tributary of the Sluice River and six tributaries of the Broadmeadow River.

The flood mapping website www.floodmaps.ie show records of various historic floods along the Route D corridor, e.g., Swords (Broadmeadow), Balheary Road (Broadmeadow), Estuary Road (coastal), Garton Court (coastal), Kinsaley Lane (Sluice) and Kinsaley Hall (Sluice). The flood maps prepared under FEM FRAMS shows extensive overland flooding on the Broadmeadow River between Saucerstown and the M1 and in the Sluice River near the Kinsaley Hall and Kinsaley Lane area.

According to the EPA website, the water quality of the Broadmeadow and Ward River is Q3 (poor status) in 2010. Water quality of the Gaybrook and Sluice River is not available in the EPA website. Therefore, a water quality survey of the Sluice and Gaybrook would be required if this route is selected.

Hydrogeology
According to the GSI bedrock aquifer mapping, the transfer pipeline corridor is underlain by a poor bedrock aquifer which is generally unproductive except locally and by a locally important bedrock aquifer which is moderately productive in local zones only. The GSI sand and gravel aquifer mapping was also consulted but no sand or gravel aquifers were present in the vicinity of the transfer pipeline corridor (refer to Figure 9.3).

The GSI groundwater vulnerability mapping shows the area in the vicinity of the transfer pipeline corridor has a groundwater vulnerability rating that ranges from low to rock near surface or karst but is predominantly high (refer to Figure 9.4). The GSI groundwater mapping website identifies three groundwater source wells within the transfer pipeline corridor (refer to Figure 9.5).

A review of the GSI Karst and Hydrogeological features mapping identified no features within 200m of the transfer pipeline corridor (refer to Figure 9.6). The Source Protected

Areas and the Zones of Contribution mapping were also consulted however neither were found to be within close proximity of the transfer pipeline corridor (refer to Figure 9.7).

Fingal County Council has no groundwater borehole records for this transfer pipeline corridor. A well survey of the proposed transfer pipeline route may be required at a later stage to confirm the existence, location and type of any abstraction points.

Transfer Pipeline Corridor - Route E

The Route E transfer pipeline corridor is approximately 11.3km long. It passes through the Rathartan WWTP site and links Route D and Route F to the northern outfall location. Route E starts near Bealheary (Route D), and travels due north and then due northeast, passing through Rathartan before joining the northern outfall location.

Hydrology
Route E passes through the Broadmeadow, Lissenhall, Belinstown, Ballyboghill, Ballough, Baleally, Rathmooney, Collinstown, Palmerstown and Rush Town stream catchments and some coastal areas. This route requires crossing of the Belinstown River, the Ballyboghill River, the Ballough River, the Baleally Stream, the Rathmooney Stream, the Collinstown Stream, the Palmerstown Stream, the Rush Town Stream and a tributary of the Broadmeadow River.

The flood mapping website www.floodmaps.ie does not show any record of historic flooding along the Route E corridor. The flood maps prepared under FEM FRAMS shows extensive overland flooding on the Broadmeadow, Belinstown and Ballyboghill Rivers near the proposed Route E crossing of these rivers.

According to the EPA website, the water quality of the Broadmeadow, Ward and Ballyboghill River is Q3 (poor status) and that of the Ballough River is Q3-4 (moderate status) in 2010. Water quality of the other rivers and streams crossed by this route is not available from the EPA site.

Hydrogeology
According to the GSI bedrock aquifer mapping, the transfer pipeline corridor is underlain by a poor bedrock aquifer which is generally unproductive except locally and by a locally important bedrock aquifer which is moderately productive in local zones only. The GSI sand and gravel aquifer mapping was also consulted but no sand or gravel aquifers were present in the vicinity of the transfer pipeline corridor (refer to Figure 9.3).

The GSI groundwater vulnerability mapping shows the area in the vicinity of the transfer pipeline corridor has a groundwater vulnerability rating that ranges from low to rock near surface or karst but is predominantly low (refer to Figure 9.4). The GSI groundwater mapping website identifies six groundwater source wells within the transfer pipeline corridor (refer to Figure 9.5).

A review of the GSI Karst and Hydrogeological features mapping identified two features within 200m of the transfer pipeline route (refer to Figure 9.6). The Source Protected Areas and the Zones of Contribution mapping were also consulted however neither were found to be within close proximity of the transfer pipeline corridor (refer to Figure 9.7).

It should be noted that information provided by Fingal County Council suggests the possibility of additional ground water abstraction points and groundwater wells within or in close proximity of the transfer pipeline corridor however no digital mapping of these abstraction points is available. The information provided by Fingal County Council can be found in Appendix A. A well survey of the proposed transfer pipeline route may be required at a later stage to confirm the existence, location and type of these abstraction points.

Transfer Pipeline Corridor - Route F

The Route F transfer pipeline corridor is approximately 21.5km long. It passes through five land parcels, namely, Cookstown, Baldurgan, Annsbrook, Newtowncorduff and Tyrrelstown Little, and links routes A, B, C, D and E to the northern outfall location.

Hydrology
Route F starts near Killsane Bridge on the N2 and travels in an northeast direction passing through the Ward, Broadmeadow, Belinstown, Ballyboghill, Ballough Rivers and the Baleally, Rathmooney, Collinstown, Rush Town and Balcunnin Stream catchments. This route crosses all the major river channel of the above watercourses and their tributaries.

The flood mapping website www.floodmaps.ie shows only one location of historic flooding along this route, namely, at Warblestown (Broadmeadow River). The flood maps prepared under FEM FRAMS show some overland flooding on the Broadmeadow and Ballyboghill Rivers near the proposed Route F crossing of these rivers.

According to the EPA website, the water quality of the Broadmeadow, Ward and Ballyboghill Rivers is Q3 (poor status) and that of Ballough River is Q3-4 (moderate status) in 2010. Water quality of the other rivers and streams crossed by this route is not available from the EPA site.

Hydrogeology
According to the GSI bedrock aquifer mapping, the transfer pipeline corridor is underlain by a poor bedrock aquifer which is generally unproductive except locally and by a locally important bedrock aquifer which is moderately productive in local zones only. The GSI sand and gravel aquifer mapping was also consulted but no sand or gravel aquifers were present in the vicinity of the transfer pipeline corridor (refer to Figure 9.3).

The GSI groundwater vulnerability mapping shows the area in the vicinity of the transfer pipeline corridor has a groundwater vulnerability rating that ranges from low to rock near surface or karst but is predominantly low (refer to Figure 9.4). The GSI groundwater mapping website identifies five groundwater source wells within the transfer pipeline corridor (refer to Figure 9.5).

A review of the GSI Karst and Hydrogeological features mapping identified two features within 200m of the transfer pipeline corridor (refer to Figure 9.6). The Source Protected Areas and the Zones of Contribution mapping were also consulted however neither were found to be within close proximity of the transfer pipeline corridor (refer to Figure 9.7).

It should be noted that information provided by Fingal County Council suggests the possibility of additional ground water abstraction points and groundwater wells within or

in close proximity of the transfer pipeline corridor however no digital mapping of these abstraction points is available. The information provided by Fingal County Council can be found in Appendix A. A well survey of the proposed transfer pipeline route may be required at a later stage to confirm the existence, location and type of these abstraction points.

Transfer Pipeline Corridor - Route G

The Route G transfer pipeline corridor is approximately 5km long and links Routes B, C and D to the southern outfall location. Route G starts near the Agriculture Institute near Kinsaley, travels due east, then takes a right turn and travels due south, and then takes a left turn to travel due east.

Hydrology
The first 1 km of the route passes through the Sluice River catchment and remaining 4km through the Mayne River catchment. This route requires crossing of the Mayne River and its tributary.

The flood mapping website www.floodmaps.ie shows a record of historic flooding at the Mayne River Bridge in Baldoyle. The flood maps prepared under FEM FRAMS also shows extensive fluvial and tidal flooding near Mayne Bridge.

According to the EPA website, the water quality of the Mayne River is Q3 (poor status) in 2010. Water quality of the Sluice River is not available from the EPA website.

Hydrogeology
According to the GSI bedrock aquifer mapping, the transfer pipeline corridor is underlain by a poor bedrock aquifer which is generally unproductive except locally and by a locally important bedrock aquifer which is moderately productive in local zones only. The GSI sand and gravel aquifer mapping was also consulted but no sand or gravel aquifers were present in the vicinity of the transfer pipeline corridor (refer to Figure 9.3).

The GSI groundwater vulnerability mapping shows the area in the vicinity of the transfer pipeline corridor has a groundwater vulnerability rating that ranges from low to extreme but is predominantly low (refer to Figure 9.4). The GSI groundwater mapping website identifies no groundwater source wells within the transfer pipeline corridor (refer to Figure 9.5).

A review of the GSI Karst and Hydrogeological features mapping identified no features within 200m of the transfer pipeline corridor (refer to Figure 9.6). The Source Protected Areas and the Zones of Contribution mapping were also consulted however neither were found to be within close proximity of the transfer pipeline corridor (refer to Figure 9.7).

Fingal County Council has no groundwater borehole records for this transfer pipeline corridor. A well survey of the proposed transfer pipeline route may be required at a later stage to confirm the existence, location and type of any abstraction points.

The existing hydrological and hydrogeological environment for the location of the Marine Outfalls is outlined below.

Northern Outfall Study Area

Hydrology

The Northern Outfall is located in the coastal area adjacent to Rush and Rush Demesne, to the northeast of Rogerstown Estuary. According to the EPA 'Quality of Estuarine and Coastal Waters (2007-2010)', the coastal waters are classified as 'unpolluted'. Three recreational bathing sites, namely Loughshinny Beach, Rush South Beach and Portrane Beach are located within the northern outfall study area. All three beaches had 'Good' water quality status in 2010. In addition, Portrane Beach is a Blue Flag Beach.

The National Flood Hazard Mapping website www.floodmaps.ie shows two historic flooding locations, namely, at Loughshinny (November 2002) and at Skerries Road. The coastal flood maps prepared under FEM FRAMS shows some localised coastal flooding between Drumanagh and Breakwater where both the Rush Town Stream and St. Catherine Stream outfall to the Irish Sea.

Hydrogeology

According to the GSI bedrock aquifer mapping, the outfall study area is underlain by a poor bedrock aquifer which is generally unproductive except locally and by a locally important bedrock aquifer which is moderately productive in local zones only. The GSI sand and gravel aquifer mapping was also consulted but no sand or gravel aquifers were present in the vicinity of the outfall study area (refer to Figure 9.3).

The GSI groundwater vulnerability mapping shows the area in the vicinity of the outfall study area has a groundwater vulnerability rating that ranges from low to rock near surface or karst but is predominantly low (refer to Figure 9.4). The GSI groundwater mapping website identifies four groundwater source wells within the outfall study area (refer to Figure 9.5).

A review of the GSI Karst and Hydrogeological features mapping identified no features within 200m of the outfall study area (refer to Figure 9.6). The Source Protected Areas and the Zones of Contribution mapping were also consulted however neither were found to be within close proximity of the outfall study area (refer to Figure 9.7).

It must be noted that information provided by Fingal County Council suggests the possibility of additional ground water abstraction points and groundwater wells within or in close proximity of the outfall study area however no digital mapping of these abstraction points is available. The information provided by Fingal County Council can be found in Appendix A, a well survey of the proposed outfall study area (land part) may be required at a later stage to confirm the existence, location and type of these abstraction points.

Southern Outfall Location

Hydrology
The Southern Outfall is located near the Baldoyle Estuary. Both the Mayne River and the Sluice River discharge into this estuary. The National Flood Hazard Mapping website www.floodmaps.ie shows records of two historic flooding areas, one at Mayne Bridge and the other is recurring coastal flooding at Baldoyle. The coastal flood maps prepared under FEM FRAMS shows extensive flooding near the north-western and south-western part of the study area.

The Southern Outfall, which crosses Baldoyle Estuary, is located in the coastal area adjacent to Portmarnock strand. There is no sampling data for this location in the EPA 'Quality of Estuarine and Coastal Waters (2007-2010)', however, the coastal waters to the north are classified as 'unpolluted' and Dublin Bay, located to the south, is also classified as 'unpolluted'. One recreational bathing site, namely Velvet Strand - Portmarnock Beach, is located within the southern outfall study area. Velvet Strand - Portmarnock Beach is a Blue Flag beach and had a 'Good' water quality status in 2010.

Hydrogeology
According to the GSI bedrock aquifer mapping, the outfall study area is entirely underlain by a poor bedrock aquifer which is generally unproductive except locally. The bedrock aquifer mapping consulted was provided by the GSI as well as the sand and gravel aquifer mapping which was also consulted but no sand or gravel aquifers were present in the vicinity of the land parcel. The GSI sand and gravel aquifer mapping was also consulted but no sand or gravel aquifers were present in the vicinity of the outfall study area (refer to Figure 9.3).

The GSI groundwater vulnerability mapping shows the area in the vicinity of the outfall study area has a groundwater vulnerability rating that ranges from low to high but is predominantly high (refer to Figure 9.4). The GSI groundwater mapping website identifies no groundwater source wells within the outfall study area (refer to Figure 9.5).

A review of the GSI Karst and Hydrogeological features mapping identified no features within 200m of the outfall study area (refer to Figure 9.6). The Source Protected Areas and the Zones of Contribution mapping were also consulted however neither were found to be within close proximity of the outfall study area (refer to Figure 9.7).

Fingal County Council has no groundwater borehole records for this outfall route. A well survey of the proposed outfall route (land part) may be required at a later stage to confirm the existence, location and type of any abstraction points.

9.4 Predicted Impacts

The potential impacts of any development on the existing surface water hydrology and hydrogeology of the project area can be divided into two categories, namely, the impacts during construction and the impacts during operation. An assessment of the predicted impacts of the scheme during construction and operation phase is presented in the following paragraphs:

9.4.1 Construction Phase

The main impacts of the scheme in relation to the existing hydrology and hydrogeology of the area during construction are the flooding of the WWTP site from the adjacent watercourses, increased flood risks due to increased surface water runoff, and the risk of pollution of surface water and groundwater.

There could be an impact on the existing flood regime during construction at certain sites if appropriate mitigation measures are not put in place. As described in Section 9.3 above, the Rivers Broadmeadow, Ballyboghill and Belinstown have extensive overland flooding near the pipeline corridor and downstream of the Baldurgan and Cookstown land parcels. Part of the Saucerstown land parcel is located within the 0.1% AEP flood extent of the Broadmeadow River.

The assessment of the WWTP sites and access roads has taken into account the existing flood risk in the catchment and the sites have been chosen to avoid floodplain areas up to the 0.1% AEP. A 50m buffer zone has been allowed between the WWTP sites and the river or stream to make space for water. It is recommended that the Contractors site compound, working and storage areas is located outside the 0.1% AEP.

The access routes to the WWTP sites may require the culverting of some rivers and streams. These culverts should be sized in accordance with the Section 50 consents so as not to cause an afflux (i.e. backing up of the river increasing the water level). Similarly for the smaller drains and ditches that may be intercepted.

Trenchless construction techniques will be used for the installation of the pipeline at any significant watercourse crossing. In such scenarios, the construction fronts should be located beyond the floodplain of the summer peak flood of an appropriate return period (say 1 in 20 years). *(For 10% risk over 2 year construction period, the required return interval for construction period flood is approximately 20 years. (Ref: Thomas Telford: Flood and Reservoir Safety, Institute of Civil Engineers, UK)).* The surface water runoff at the construction fronts will need to be managed properly to prevent flow of silt laden surface water flowing into the river.

Conventional open trench method will also be adopted for the installation of the pipeline at other watercourse crossings. Any direct discharge of water from excavation trenches and groundwater dewatering to the nearby watercourse could increase the flood risk of a stream with limited discharge capacity. If adequate mitigation measures are not applied, such an open trench method of river crossing could lead to silt laden surface water flow to the river, which poses a risk to the river water quality.

As some of the watercourses crossed by the pipeline have a history of recurring flooding within the pipeline corridor, any excavation works or stockpiling of excavated material along the overland flow path could trigger flooding during moderate to severe rainfall periods. Such a flooding phenomenon could be expected in small streams with high gradients.

Large pipeline schemes laid in sloping areas with underlying clay can give rise to considerable problems with silty runoff, particularly following topsoil stripping. During high intensity rainfall, the problems of silty runoff are exacerbated. If allowed to enter surface watercourses this runoff can give rise to high suspended solids which can have a detrimental impact to the aquatic life, and in particular, to fisheries.

An appropriate attenuation system from the WWTP construction area is required to prevent surface water runoff increasing the risk of flooding in the nearby watercourse (particularly those with a history of flooding). In addition, any spillage of fuel, oil and hazardous chemicals to the watercourse could severely impact the water quality of the watercourse and could have a detrimental impact on fisheries.

The potential pollution of groundwater with chemicals used during the construction of WWTP, pipeline and the outfall could severely impact the water quality of the groundwater and could have a detrimental impact on any spring and groundwater wells nearby. Areas of most concern are those with a groundwater vulnerability of High to Extreme and especially in areas with rock near the surface or karst.

9.4.2 Operational Phase

The assessment of the WWTP sites and access roads has taken into account the existing flood risk in the catchment and the sites have been chosen to avoid floodplain areas up to the 0.1% AEP. A 50m buffer zone has been allowed between the WWTP sites and the river or stream to make space for water.

It is assumed that the surface water drainage of the WWTP site and access road will be designed to incorporate SuDS principles with an attenuation system in place to limit discharges from the site to the greenfield site flow rate. This would also mitigate impacts of the scheme on the existing surface water and ground water regime during the operation phase.

As the pipeline will be buried underground, it is considered that there will be negligible impacts from the pipeline on the existing surface water and groundwater regime during the operational phase. There is the potential to provide new groundwater flow paths along the pipeline if no remedial measures are applied. Remedial measures would include the installation of puddle clay or other impermeable barrier at intervals along the pipeline.

The main impact on surface water and ground water quality during operation phase is the accidental spillage of sewage, accidental spillage of oil and hazardous chemicals used for the treatment of sewage, improper handling of sludge and leakages or pipe bursts. This can be mitigated by the development and implementation of a robust operation and maintenance regime.

9.5 Evaluation

9.5.1 Evaluation of Land Parcels and WWTP sites

The evaluation of the nine land parcels for the four hydrology and six hydrogeology criteria is presented in Table 9.1, Appendix B. The evaluation of the nine WWTP sites for the hydrology and hydrogeology criteria is presented in Table 9.2, Appendix B with a summary provided in Table 9.3, Appendix B. The estimation of the importance of hydrological attributes and rating of significant environmental impacts for the nine sites were generally undertaken in accordance with the criteria developed by the National Roads Authority in the *'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes'* (Box 4.2, Box 4.3 and Box 4.4). Some amendments were made to the criteria to cater for the type of development. Further details are provided in Table A, Appendix C. For each of the nine sites, the attribute of importance ('extremely high', 'very high', 'high', 'medium' and

'low') were used to establish the five impact levels, namely, 'profound', 'significant', 'moderate', 'slight' and 'imperceptible'. Further details are provided in Table B, Appendix C.

Following consultation between the GSI and Jacobs/Tobin, the GSI recommended the use of the GSI Groundwater Protection Responses for Landfills Matrix. Further details on this methodology are included in Appendix D. The response category (R1-R4) is based on an assessment of the aquifer category and associated vulnerability rating. A 'Poor Aquifer' with a 'Low' vulnerability rating would have an R1 response category and would be considered a suitable location for a landfill site whilst A 'Regionally Important Aquifer' with a 'High' vulnerability rating would have an R4 response category and would be considered not a suitable location for a landfill site. Whilst it is acknowledged that the |Greater Dublin Drainage Scheme is a waste water scheme, the methodology does provide a method to rank or differentiate between sites. The results of this assessment have been included in Tables 9.1, 9.2 and 9.3 mentioned above.

9.5.2 Evaluation of Route Options

Four environmental criteria were used to evaluate the hydrological impact on the transfer pipeline corridor routes. Similarly, five environmental criteria were used evaluate the hydrogeological impact.

The evaluation of the alternative transfer pipeline corridor routes is presented in Table 9.4, Appendix B.

9.5.3 Evaluation of Marine Outfall Location

Four environmental criteria were used to evaluate the hydrological impact on the marine outfall. Similarly, five environmental criteria were used evaluate the hydrogeological impact.

The evaluation of the two marine outfall locations is presented in Table 9.5, Appendix B.

9.6 Mitigation Measures

The project should be designed in accordance with the report entitled 'The Planning System and Flood Risk Management, Guidelines for Planning Authorities'.

The River Basin Management Plan 2009 - 2015 for the ERBD has been adopted by the Fingal County Council, the objectives which are to

- prevent deterioration;
- restore good status;
- reduce chemical pollution;
- achieve water-related protected areas objectives.

These include the objective to maintain water status for high and good status waters and to restore to at least good status all waters by 2015.

For the construction on any watercourse crossings, a detailed Pollution Control Plan, Emergency Response Plan and Method Statements will be drafted in agreement with

Fisheries and other relevant authorities and having regard to relevant pollution prevention guidelines. All works in or adjacent to watercourses will comply with the EPA/Fisheries/OPW requirements.

Flood maps of all watercourses except the Tolka and Santry Rivers have been prepared under FEM FRMAS. The study has identified the flood risk areas along the rivers, which are shown in Figure 9.2. In those areas which are liable to flooding, the following measures are to be taken to reduce the potential impact of the works in the event of a flood:

- Location of site compounds, storage areas outside the 0.1% AEP,
- Immediate removal/disposal of surplus material off site,
- Provision of drainage within soil bunds to reduce the influence upon the surface runoff pathways of flood water,
- Avoidance of direct discharge of surface water from any temporary impervious area to the nearby watercourse without proper attenuation,
- Provision of temporary attenuation ponds if the stream to which surface water from the construction area is discharged has limited capacity.

Although WWTP sites (land parcels) are not located along the Tolka and Santry Rivers, the Transfer Pipeline Corridor Route A and Route B pass through these catchments. Therefore, further flood impact assessment of these two rivers would be required for these routes. The Office of Public Works (OPW) should be contacted for all issues related to watercourse flooding.

Direct disposal of water from excavations and from groundwater dewatering to the nearby watercourse will not be allowed as these could impact both on water quality of the watercourse and increased flood risk. Any discharge of such water, after proper treating/desilting will be discussed and agreed with the landowner and if necessary, discharge consent will be acquired from the concerned authority (EPA, Fisheries etc.) prior to the commencement of work.

A proper SuDS principle for the management surface water runoff at the WWTP would mitigate the impact of flooding during operation phase. Similarly, following best practice for the handling of all chemicals etc., used in the treatment plant could mitigate risk of surface water and groundwater pollution during operation phase. If the pipeline is installed in a trench which is buried and the surface restored to the original ground condition as far as practicable, there would be negligible impact during the pipeline construction and operation phase and hence mitigation measures are generally not required.

The access routes to the WWTP sites may require the culverting of some rivers and streams. These culverts should be sized in accordance with the Section 50 consents so as not to cause an afflux (i.e. backing up of the river increasing the water level). Similarly for the smaller drains and ditches that may be intercepted by the works.

It is recommended that once the WwTW site is identified that an abstraction point (GW well) survey is undertaken within 0.5km of the site boundary. The purpose is to identify the location, yield and type of GW wells in the vicinity of the proposed site.

APPENDICES

Appendix A – Fingal County Council's data on groundwater wells and abstraction points

Appendix B – Evaluation Matrices

Appendix C – Ranking Criteria

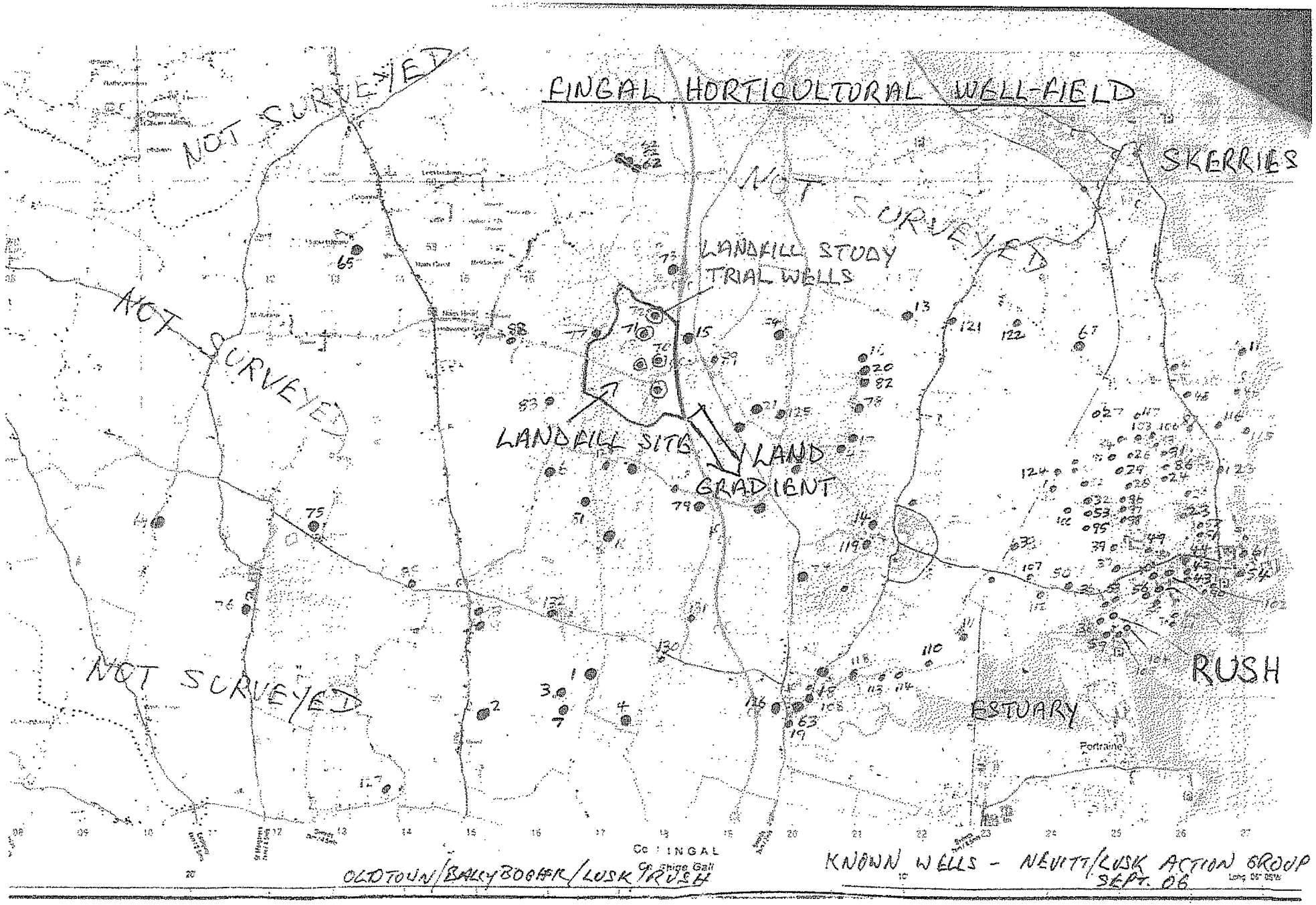
Appendix D – GSI Groundwater Protection Responses for Landfills

Appendix E – River Names

Appendix F – Groundwater Source Protection Zones Reports - Bog of the Ring and Curragha WSS

Appendix G – Figures

Appendix A – Fingal County Council's data on groundwater wells and abstraction points


FINGAL HORTICULTURAL WELL-FIELD
NOT SURVEYED
NOT SURVEYED
NOT SURVEYED
NOT SURVEYED
SKERRIES
LANDFILL STUDY
TRIAL WELLS
LANDFILL SITE
LAND
GRADIENT
RUSH
ESTUARY
Portrane
Co FINGAL
Co Fingal Gall
OLDTOWN/BALLYBOGHER/LUSK/RUSH
KNOWN WELLS - NEVITT/LUSK ACTION GROUP
SEPT. 06

Dunnes Drilling Services Ltd.

01/08/2006 14:38:01

Wells in Townland BALLYBOUGHAL With Depths (Mts) Between 0 And 9999999 And Yields (GPH) between 0 And 9999999

	Log No	Date	Customer	County	Townland	Yield GPH	Depth M	Steel Casing	PVC Casing	Diameter	Depth to rock
1	1962	25/05/2000	Bergin Tim	DUBLIN	BALLYBOUGHAL	25000 ✓	115.82	12.19	0	200	7.62
			Ballyboughal Swords Co. Dublin								
2	2371	24/11/2000	Farmvale	DUBLIN	BALLYBOUGHAL	500	121.92	92.97	0	150	21.37
			Skidoo Farm Yard Ballyboughal Co. Dublin Aidan Ryan (builder)								
			50-80gph at 304ft. Perforate 6" steel lining - 500gph								
3	2718	23/05/2002	Garrigan David	DUBLIN	BALLYBOUGHAL	2500	137.16	24.38	137.16	150	21.34
			Baldurgan house Ballyboughal Co Dublin								
			Water at - 270, 410 - 450ft in broken parts. Chlorine								
4	3584	12/05/2006	Weldon Brian	DUBLIN	BALLYBOUGHAL	1200	121.92	37.49	0	200	30.48
			Ballyboughall Co Dublin								
			Water at 150 & 200ft								
5	4558	25/06/2003	Donovan Gerry	DUBLIN	BALLYBOUGHAL	1460	85.34	6.1	85.34	150	3.66
			Ballyboughal Co Dublin								
			Install rubber seal on PVC at 25ft. 1 Bag bentonite grout + 1 gallon chlorine								
6	4613	11/09/2003	Hoey Gabriel	DUBLIN	BALLYBOUGHAL	1500	54.86	53.03	54.86	150	0
			Ballyboughal Co. Dublin								
			174ft of 8" & 14ft of 12". Chlorine								
7	4810	02/06/2004	Garrigan David	DUBLIN	BALLYBOUGHAL	1500	146.3	24.38	0	150	12.19
			Baldugan House Ballyboughal Co Dublin								
			No PVC Installed. 1 Bag Bentonite installed								
8	4991	13/12/2004	Kerrigan Thomas	DUBLIN	BALLYBOUGHAL	10000 ✓	109.73	67.06	76.2	200	0
			Johnstown Ballyboughal Co Dublin								
			1 gallon of chlorine								
9	5359	16/08/2005	Donovan Gerry	DUBLIN	BALLYBOUGHAL	400	76.2	30.48	76.2	150	22.86
			Ballyboughal Co Dublin								
			Water at 200 & 225ft. Bentonite pellets & chlorine installed								
10	2E+06	08/12/1994	Cooney Liam	DUBLIN	BALLYBOUGHAL	1000	45.72	29.26	35.05	150	0
			Annesbrook Ballyboughal Co. Dublin								
			Hit rock at 95ft. Lining very tight. Soft rock with good water.								

45,060

Dunnes Drilling Services Ltd.

01/08/2006 14:38:17

Wells in Townland LUSK With Depths (Mts) Between 0 And 9999999 And Yields (GPH) between 0 And 9999999

	Log No	Date	Customer	County	Townland	Yield GPH		Depth M	Steel Casing	PVC Casing	Diameter	Depth to rock
11	3120	26/06/2001	McGuinness Johnny	DUBLIN	LUSK	2500		121.92	15.85	121.92	200	14.02
			Loughshinney Lusk Co. Dublin									
			Water entry at 120 & 240ft. Rock broken 275ft no change in water rate									
12	3258	09/05/2002	Llywellyn David	DUBLIN	LUSK	1080		60.96	36.58	60.96	150	21.34
			Lusk									
13	3486	03/07/2003	Thorne Vincent	DUBLIN	LUSK	2000		109.73	6.1	109.73	150	3.05
			Man O War Lusk Co Dublin									
14			Water at 40 + 160ft - Bentonite + Chlorine installed									
	3563	14/02/2006	Carroll Produce	DUBLIN	LUSK	7000	✓	91.44	13.72	91.44	200	7.62
			The Green Lusk Co Dublin									
15			Water at 80, 220 and 265ft. Grout in casing with bentonite pellets									
	3601	23/03/2006	Thorne John	DUBLIN	LUSK	6000	✓	91.44	16.46	89.92	150	0
			Five Roads Lusk Co Dublin									
16			PVC stopped at 295 ft. Bentonite & chlorine installed									
	4742	30/08/2004	Country Crest	DUBLIN	LUSK	10000	✓	91.44	44.5	0	150	42.67
			Man of War Lusk Co Dublin									
17			Water at 180ft - 3000gph. Water at 200ft - 5000 gph. Water at 270 - 290ft -									
	5366	08/09/2005	Hartford Colin	DUBLIN	LUSK	2000		68.58	56.39	68.58	150	30.48
			Rathmooney Lusk Co Dublin									
18			Well No 2 - Rock very soft and broken. Water at 200 & 210ft. Chlorine									
	87300	01/01/1989	Marion Nurseries	DUBLIN	LUSK	7000	✓	48.76	10.36	48.76	0	0
			Laddy Dejong Newhaggard Lusk Co. Dublin									
19	125400	18/07/1995	Butterley Niall	DUBLIN	LUSK	6500	✓	103.5	12	103.5	200	0
			Lusk Co. Dublin									
20	128100	31/08/1995	Hoey Michael Coun	DUBLIN	LUSK	20000	✓	91.5	44.2	91.5	200	0
			Man of War Lusk Co. Dublin									
			Rock very broken									

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Wells in Townland LUSK With Depths (Mts) Between 0 And 9999999 And Yields (GPH) between 0 And 9999999

	Log No	Date	Customer	County	Townland	Yield GPH	Depth M	Steel Casing	PVC Casing	Diameter	Depth to rock
21	130400	08/09/1994	Leonard Thomas The Five Roads Lusk Co. Dublin Water at 100ft	DUBLIN	LUSK	1800	36.58	6.7	36.58	125	0
22	198600	18/01/1995	McLoughlan John Lusk co. dublin Water at 130ft.	DUBLIN	LUSK	500	47.5	24.38	47.2	150	0

2300.

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Wells in Townland RUSH With Depths (Mts) Between 0 And 9999999 And Yields (GPH) between 0 And 9999999

	Log No	Date	Customer	County	Townland	Yield GPH	Depth M	Steel Casing	PVC Casing	Diameter	Depth to rock
23	1449	16/12/1998	Monks Colm Rush Co. Dublin	DUBLIN	RUSH	200	73.15	30.5	73.15	150	24.3
24	1573	22/03/1999	Water at 210 to 230ft. Archer Camelis Rush Co. Dublin	DUBLIN	RUSH	900	115.8	17	0	150	15.2
25	1922	20/10/1999	Water at 200ft 300gph. Nugent Joe The Avenue Palmer Road Rush Co. Dublin	DUBLIN	RUSH	1000	54.86	36.58	54.86	150	21.34
26	1963	29/05/2000	1 bag bentontie, 1 gallon chlorine. Install 7ft of 10" starter pipe. Pull 7ft Farrell Adrian Rush Co. Dublin	DUBLIN	RUSH	200	42.67	22.86	42.67	150	18.29
27	2077	12/07/2000	First water at 90ft. 1 bag of bentonite, chlorine Fagan Paudge Loughshinney Rush Co. Dublin	DUBLIN	RUSH	10000 ✓	106.68	18.29	106.68	200	15.24
28	2887	17/01/2003	Hit water at 80ft & 150ft. Hit main water at 230ft and 310ft. Flynn Martin Kemure Park Old Road Rush Co. Dublin	DUBLIN	RUSH	1800	137.16	362	0	150	0
29	3047	02/11/2000	29ft of 12"; 154ft of 8"; 180ft of 6" casing. Water at 260ft and 360ft and OHare Paul Kenure Park Rush Co. Dublin	DUBLIN	RUSH	2000	48.77	44.19	44.2	150	0
30	3110	01/06/2001	Install 35ft of 8" starter pipe. Pull 20ft of 8" starter pipe. Chlorine Ruirok Michael Rush Co. Dublin	DUBLIN	RUSH	2000	9144	51.82	91.44	150	48.76
31	3383	19/02/2004	Chlorine Corr Liam Corrs Lane Rush Co Dublin	DUBLIN	RUSH	2000	36.58	30.48	36.58	150	15.24
32	5223	20/05/2005	1 gal of chlorine installed Flynn Martin Hayestown Rush Co Dublin	DUBLIN	RUSH	4000 ✓	39.62	36.58	36.58	200	18.29

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Wells in Townland RUSH With Depths (Mts) Between 0 And 9999999 And Yields (GPH) between 0 And 9999999

	Log No	Date	Customer	County	Townland	Yield GPH	Depth M	Steel Casing	PVC Casing	Diameter	Depth to rock
33	5354	05/08/2005	Gilmartin Mark Kemure Park Rush Co Dublin Bentonite & chlorine installed	DUBLIN	RUSH	1000	76.2	24.38	76.2	150	6.1
34	42200	01/01/1986	Archer Nick Rush Co. Dublin	DUBLIN	RUSH	1200	54.86	0	0	0	0
35	76500	01/01/1988	Ryan Luke Rush Co. Dublin	DUBLIN	RUSH	3000	60.96	7.62	60.96	0	0
36	117100	19/05/1995	Weldon Jackie Lower Church Road Rush Co. Dublin	DUBLIN	RUSH	2100	91.5	16	91.5	200	9
37	166000	26/10/1995	Flynn Paul Rush Co. Dublin	DUBLIN	RUSH	2500	103.6	0	103.6	200	0
38	169400	18/06/1996	Langan David Chanel road Rush co. dublin Deepened well 80ft to 340ft	DUBLIN	RUSH	4000	97.53	11.58	97.53	200	0
39	169500	20/06/1996	Hegarty Joan Rush Co. Dublin Soft broken black rock	DUBLIN	RUSH	3000	47.24	37.18	47.24	150	0
40	183500	13/10/1993	Kelly Mickey Golf road Rush Co. Dublin 1st well Pump should not be lower than 129ft to avoid lifting sand.	DUBLIN	RUSH	300	106.68	8.53	0	200	0
41	183600	14/10/1993	Kelly Mickey Golf Road Rush Co. Dublin 2nd Well water at 200ft to 225ft	DUBLIN	RUSH	350	83.82	7.67	0	200	0
42	187500	22/03/1994	Thorne Vincent Rush Co. Dublin No. 1 not enough water in well	DUBLIN	RUSH	400	91.44	12.19	0	200	0
43	187600	23/03/1994	Thorne Vincent Rush Co. Dublin 2nd Well	DUBLIN	RUSH	200	68.58	11.58	0	200	0

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Wells in Townland RUSH With Depths (Mts) Between 0 And 9999999 And Yields (GPH) between 0 And 9999999

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Log No	Date	Customer	County	Townland	Yield GPH	Depth M	Steel Casing	PVC Casing	Diameter	Depth to rock
240000	20/10/1992	Thorne Matt Rush Co. Dublin	DUBLIN	RUSH	2000	115.82	12.19	115.82	150	0

2000.

44150
Rush.

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Wells in Townland rathmooney With Depths (Mts) Between 0 And 9999999 And Yields (GPH) between 0 And 9999999

45

Log No	Date	Customer	County	Townland	Yield GPH	Depth M	Steel Casing	PVC Casing	Diameter	Depth to rock
5365	06/09/2005	Hartford Colin	DUBLIN	RATHMOONEY	200	76.2	42.67	76.2	150	30.48

Balough Lusk Co Dublin

Well No 1 - Water at 205 & 225ft - Chlorine installed

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01/08/2006 16:43:27

Wells in Townland LOUGHSHINNEY With Depths (Mts) Between 0 And 9999999 And Yields (GPH) between 0 And 9999999

	Log No	Date	Customer	County	Townland	Yield GPH	Depth M	Steel Casing	PVC Casing	Diameter	Depth to rock
46	1303	19/02/1998	Butterley Patrick	DUBLIN	LOUGHSHINNEY	800	122	15.84	0		7.62
			Loughshinney Lusk Co. Dublin.								
			8" well. Water at 140 - 150ft 200gph 260 - 280ft 500 - 1,000gph								
47	3273	08/07/2002	Farmvale / Bobby Jo	DUBLIN	LOUGHSHINNEY	500	83.82	10.97	83.82	150	5.48
			Skerries Farm Loughshinney Co. Dublin								
			14ft of 8" and 22ft of 6".								

1300.

Dunnes Drilling Services Ltd.

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Wells in Townland LOUGHSHINNY With Depths (Mts) Between 0 And 9999999 And Yields (GPH) between 0 And 9999999

Log No	Date	Customer	County	Townland	Yield GPH	Depth M	Steel Casing	PVC Casing	Diameter	Depth to rock
182200	03/09/1993	Thorn Matt	DUBLIN	LOUGHSHINNY	10000	91.44	8.53	91.44	150	0
		Washing Plant Loughshinny Co. Dublin								

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Wells in Townland RUSH With Depths (Mts) Between 0 And 9999999 And Yields (GPH) between 0 And 9999999

	Log No	Date	Customer	County	Townland	Yield GPH	Depth M	Steel Casing	PVC Casing	Diameter	Depth to rock
49	244	01/01/1984	Flynn Jim Rush Co. Dublin	DUBLIN	RUSH	1200	42.67	19.5	24.38	0	0
50	314	23/07/1996	Jones Christopher Rush Co. Dublin	DUBLIN	RUSH	3600 ✓	42.67	27.43	42.67	150	0
51	315	25/07/1996	Archibold james 56 Main Street Rush Co. Dublin	DUBLIN	RUSH	540	109.7	10.66	109.7	150	0
52	594	20/01/1997	Butterley William Haystown Rush Co. dublin	DUBLIN	RUSH	2000	61	10.97	61		0
53	595	21/01/1997	Water at 100/180ft. Butterley william Channel Road Rush Co. Dublin	DUBLIN	RUSH	1000	73.15	15.24	0		0
54	642	06/03/1997	water at 160 180ft. Water Salty Harford Noel Old Barrack Rd. Rush co. dublin	DUBLIN	RUSH	4000 ✓	61	54.25	0	150	0
55	643	12/03/1997	8" cassing 40ft 6" casing 60ft Slotted 6" casing Archer Camillus Old Barrack Rd. Rush Co. Dublin	DUBLIN	RUSH	6000 ✓	91.5	85.03	0	150	0
56	645	20/03/1997	56ft 200mm Casing. 279 ft 150mm casing. Morris Leonard Willobank South Shore Rd. Rush Co. Dublin	DUBLIN	RUSH	900	91.5	11.25	91.5	150	0
57	964	23/04/1996	200mm Casing 37ft. 6" casing 60ft. Farrell Dessie Rush Co. Dublin	DUBLIN	RUSH	1500	66.35	42.67	66.35	200	0
58	1409	17/07/1998	Weldon Jackie Lower Channell Road Rush Co.Dublin	DUBLIN	RUSH	2000	109.72	11.5	109.72	200	10
59	1448	11/12/1998	Water at 220/295 and 318ft. Butterley Liam Rush Co. Dublin	DUBLIN	RUSH	2000	42.67	12.8	42.67	150	11

24740

Well	Name	Townland	Capacity	Notes
60	WAVIN	BALBRIGGAN	N/K	INDUSTRIAL
61	P J JONES	RUSH	6000 GPH	
62	BOG OF RING	RING COMMONS	33000	PUBLIC
63	N BUTTERLY	LUSK	6500	
64	S DENNIGAN	OLDTOWN	10000	PROCESSOR
65	M FLYNN	NAUL	5000	
66	T MOORE	BALLOUGH	10000	PROCESSOR
67	J ROONEY	LOUGHSHINNY	N/K	ARTESIAN
68	EIS	NEVITT	4000	TEST WELL
69	EIS	NEVITT	6000	"
70	EIS	NEVITT	3100	"
71	EIS	NEVITT	N/K	ARTESIAN
72	EIS	NEVITT	N/K	"
73	EIS	NEVITT	N/K	"
74	J LANDY	CORDUFF	2000	
75	P KEOGH	OLDTOWN	10000	
76	S MC'CUSKER	OLDTOWN	6000	ARTESIAN
77	T BRODERICK	TOOMAN	1000	ARTESIAN
78	J MURRAY	BALLYMAGUIRE	6000	TWO WELLS
79	J ARCHBOLD	BALLOUGH	N/K	
80	P WHITE	BALLOUGH	N/K	
81	T DOCKRELL	WIMBLETOWN	N/K	
82	M HOEY	BALLYMAGUIRE	4500	3RD WELL
83	N/K	PARNELSTOWN	N/K	
84	PRISON	OBERSTOWN	N/K	
85	ROGERS	BALLYBOUGHILL	N/K	POTATOES
86	D MCNALLY	KENURE	3000	
87	C CARRICK	KENURE	5000	
88	O'CONNOR	FIVE ROADS	N/K	
89	F FARREN	RUSH	2000	
90	B HAYES	KENURE	4500	
92	M MCCANN	KENURE	4000	
93	J MCGUINNESS	SUNDRIVE	6000	
94	P MCGUINNESS	HEYESTOWN	1500	
95	P CARRICK	"	6000	
96	MCNAMARA	"	6000	
97	M MCGUINNESS	"	5000	
98	M MCGUINNESS	"	6000	
99	T BUTTERLEY	CHANNEL	1800	
100	N LEONARD	HEYESTOWN	6000	
101	P FARREN	SUNDRIVE	3500	
102	K CARRICK	SHORE	2000	
103	M FOLEY	KENURE	8000	
104	L ARCHER	RUSH	2500	

105	P KERRIGAN	RUSH	500	
106	J FARRELL	HEYESTOWN	3000	
107	J FARRELL	WHITESTOWN	6000	
108	J BUTTERLEY	LUSK	4000	
109	J BUTTERLEY	LUSK	6000	
110	B LEONARD	LUSK	I500	
111	P BUTTERLEY	LUSK	2800	
112	C JONES	LUSK	8000	
113	F RUIGROK	LUSK	2000	
114	P RUIGROK	LUSK	2000	
115	J FARRELL	DRUMANAGH	2000	
116	B JONES	CAIRN HILL	1500	
117	N ARCHER	HEYESTOWN	2000	
118	M BUTTERLEY	WBD LUSK	1500	
119	D MCNALLY	LUSK	3000	
120	N LEONARD	LUSK	3500	
121	B LEONARD	SKERRIES	2000	
122	D BOYLAN	SKERRIES	2000	
123	J FYNNES	RUSH	3000	
124	N LEONARD	HEYESTOWN	3000	
125	ROONEYS	OBERSTOWN	1000	
126	ESSO	LUSK	1800	
127	R ROONEY	ROLESTOWN	1000	
128	N REILLY	BALDRUMMAN	N/K	FARMER
129	P JENKINSON	JOHNSTOWN	N/K	GREENHOUSES
130	J BYRNE	GRACEDIEU	N/K	FARMER
131	M TULLY	RICHARDSTOWN	N/K	HORTICULTURE
132	D ROGERS	CHAIRMAN IFA	N/K	POTATOES

Register of Abstractions from Waters

Local Authority: Fingal County Council

	Name	Address	Source of abstracted water	Point(s) of abstraction	Proposed use for abstracted water	Average daily abstraction rate	Max quantity abstracted over 24hrs	Max rate abstracted per hr	The period(s) during which abstraction is made	Seasonal or other changes in rate of abstraction, if any	Point(s) of return of abstracted water, after use
1	kepak, Clonee	Clonee, Co. Meath	Groundwater	2 borewells onsite	Used in Killing & Production in beef abbatoir & boning halls	595m3	1200m3	50m3	Continuous	N/A	Fingal County Council Sewer
2	Roadstone Dublin Ltd. Huntstown Quarry.	Huntstown Quarry, Finglas, D11.	Groundwater			Water Abstraction is not metered	Site visit needed to request installation of water meter to determine if Abstraction is in excess of 25m3 / Day				
3	Liam & Mary Cooney	Annesbrook, Ballyboughal, Swords, Co. Dublin.	Groundwater	Well onsite via electric pump	Livestock Drinking	438,000 Litres	1,200 Litres	Dependent on amount consumed by animals - Submersible pump	All year round	None	N/A
4	John McLoughlin	Quickpenny Road, Rathmooney, Lusk, Co. Dublin.	Private Well	Single well - Head in garden	Domestic use	Normal Household quantities	Normal Household quantities	?	Normal Household usage	None	Septic Tank
5	David Llewelly	Quickpenny Road, Lusk, Co. Dublin.	Well onsite - ca 40m deep (aquifer)	Well ca 40m deep	Irrigation, washing of containers & equipment for fruit juice production & fermentation & domestic use	1000L - 2000L Estimate	ca 20,000 L (seldom)	5000 L/Hr	Daylight Hours, all year round	Irrigation only - May - Sept	Soil percolation (majority) Run-off to open ditch
6	Joan Hegarty	37 Kenure Park, Rush, Co. Dublin.	Bore Hole	Single Bore Hole	Watering Crops - Seasonally	20 Gallons	40 Gallons	10 Gallons	Evening period during summer time	Summer period mainly	Soil percolation
7	Liam Butterley	Ave Maria, Rogerstown, Rush, Co. Dublin	Well	Well in yard at Nursery	Irrigation of glasshouse crops	24,000 Litres	40,000 Litres	4,000 Litres	March - November	Highest abstraction rate in June / July. Lowest in March, Oct - Nov	None
8	John Thorne	Hedgestown, Lusk, Co. Dublin	Bore Hole	Single Bore Hole	Spraying Crops	250 Gallons	1500 Gallons	8000 Gallons	Spring / Summer		N/A
9	Noel Harford	Old Barrack Road, Rush, Co. Dublin.	Well	Well on premises	Watering Veg	500 Gallons	1000 Gallons		Summer time		N/A
10	Vincent Thorne	Sandy Lane, Rush	Well	Well on premises	Watering & preparation of vegetables	9840 Gallons	1500 Gallons	118 Gallons	7 to 8 hours a day during daytime	In summer 1500 Gallons per day	95% of water abstracted is recycled
11	Bobby Jones	Skerries Farm, Loughshinney, Co. Dublin	Private Well	Borehole Offcie	Domestic use & for cattle	200 Gallons	200 Gallons	9 Gallons	All year round		Percolation to ground
12											
13	James Archibold	56 Main St, Rush, Co. Dublin	wells	Field off Farrens Lane, Rush 360 ft deep & Field at Ballough, Lusk 120 ft deep		During irrigation 450 Gallons per Hour	5000 Gallons	450 Gallons per Hour	dry / drought conditions & during crop spraying	No winter or early spring use	Seepage to ground on irrigation area of 74 ha

Appendix B – Evaluation Matrices

Phase 2 Alternative Sites Assessment - Environmental Criteria Evaluation Matrix
Stage 1 of Criteria Evaluation (Land Parcels)

Ref	Environmental Criteria	Table 9.1 - Waste Water Treatment Plant Sites (Land Parcels)								
1.0	**Hydrology**	**Annsbrook**	**Baldurgan**	**Clonshagh**	**Cookstown**	**Cloghran**	**Newtowncorduff**	**Rathartan**	**Saucerstown**	**Tyrrelstown Little**
1.1	Proximity to water bodies in terms of flooding and as an indicator of sensitive surface water receptors	***Moderate:*** The Ballough River (water quality Q3/Q4) and Ballyboghill tributary (Q3) are within 10m of the site, High importance. Will have permanent impact on small proportion of attribute.	***Moderate:*** Ballyboghill River (north), Ballyboghill tributary (west) (water quality Q3) and Belinstown tributary (south) within 10m of the site, High importance. Will have permanent impact on small proportion of attribute.	***Moderate***: Cuckoo River (north) within 10m and Mayne River (south) (water quality Q3) and Mayne tributary (south) within 200m of the site, High importance. Will have permanent impact on small proportion of attribute.	***Moderate:*** Belinstown River (north) and Broadmeadow tributary (south) (water quality Q3) within 10m of the site, High importance. Will have permanent impact on small proportion of attribute.	***Moderate***: Sluice River (north) and Sluice tributary (south) within 10m of the site High importance. Will have permanent impact on small proportion of attribute.	***Moderate:*** Ballough tributary (east) and Ballough River (west) (water quality Q3/Q4) within 10m of the site, High importance. Will have permanent impact on small proportion of attribute.	***Moderate:*** Collinstown Stream (west) and Palmerstown Stream (southeast) within 10m of the site, High importance. Will have permanent impact on small proportion of attribute.	***Profound:*** Broadmeadow River and its tributaries (water quality Q3) are within 10m of the site; one tributary runs at the middle of the site, Extremely High Importance. Will have permanent impact on a significant proportion of attribute.	***Imperceptible:*** Collinstown Stream (southwest), Rush Town Stream (southeast) and St. Catherine Stream (north) within 100m of the site, Low importance. Will have permanent impact on small proportion of attribute.
1.2	Area prone to flooding (based on historical data and predicted flood extents adjacent to the site as well as up and downstream locations)	***Imperceptible:*** No flooding to the site from the Ballough and Ballyboghill rivers. The Ballyboghill has extensive overland flooding approx. 3km downstream, Low importance. Will have permanent impact on small proportion of attribute.	***Slight:*** The Ballyboghill floods adjacent to the northern boundary of the site. Both Ballyboghill and Belinstown have extensive overland flooding approx. 2km downstream, medium Importance. Will have permanent impact on small proportion of attribute.	***Imperceptible:*** No flooding from the Mayne / Cuckoo to the site. The Mayne has history of flooding upstream and downstream; and predicted overland flooding approx. 2km downstream, Low importance. Will have permanent impact on small proportion of attribute.	***Imperceptible:*** The Belinstown has extensive predicted overland flooding (both tidal & fluvial) and recurrence historic flooding approx. 3km downstream, Low importance. Will have permanent impact on small proportion of attribute.	***Slight:*** No flooding from the Sluice River at the site. The Sluice has history of flooding and predicted overland flooding approx. 0.5km upstream and 2km downstream Medium importance. Will have permanent impact on small proportion of attribute.	***Imperceptible:*** No flooding from Ballough River. The eastern tributary was not modelled in FEM FRAMS, but has a history of flooding upstream, Low importance. Will have permanent impact on small proportion of attribute.	***Imperceptible:*** No flooding from the Collinstown Stream and Palmerstown Stream close to the site. History of flooding at downstream locations, Low importance. Will have permanent impact on small proportion of attribute.	***Moderate:*** Part of the site is located within 0.1% AEP flooding extent of the Broadmeadow River. History of flooding downstream, High importance. Will have permanent impact on small proportion of attribute.	***Imperceptible:*** No flooding from the Collinstown Stream and Rush Town Stream to the site. History of flooding at downstream locations, Low importance. Will have permanent impact on small proportion of attribute.
1.3	Potential Impact on ecologically important and designated sites.	***Slight:*** Discharging into Rogerstown Estuary (a SAC, SPA, pNHA, Ramsar and SNR site) approx., Medium importance. 4km downstream. Will have permanent impact on small proportion of attribute.	***Slight:*** The Ballyboghill and Belinstown discharge into Rogerstown Estuary (a SAC, SPA, pNHA, Ramsar and SNR site) and Malahide Bay (a SAC, SPA and pNHA site) approx. 5 and 7km downstream respectively, Medium importance. Will have permanent impact on small proportion of attribute.	***Imperceptible:*** The Mayne discharges into Baldoyle Estuary (a SPA, SAC and pNHA site) approx. 4km downstream. Will have permanent impact on small proportion of attribute, Low importance. Will have permanent impact on small proportion of attribute.	***Imperceptible:*** Belinstown discharging into Malahide Bay and Broadmeadow tributary discharging into Broadmeadow Estuary (a SAC, SPA, pNHA site) approx. 8 and 5km downstream respectively, Low importance. Will have permanent impact on small proportion of attribute.	***Imperceptible:*** Sluice discharging into Baldoyle Estuary (a SAC, SPA and pNHA site) approx. 5km downstream, Low importance. Will have permanent impact on small proportion of attribute.	***Slight:*** Ballough discharging into Rogerstown Estuary (a SAC, SPA, pNHA, Ramsar and SNR site) approx. 3km downstream, Medium importance. Will have permanent impact on small proportion of attribute.	***Moderate:*** Collinstown stream discharging into Rogerstown Estuary (a SAC, SPA, pNHA, Ramsar and SNR site) approx. 1km downstream, High importance. Will have permanent impact on small proportion of attribute.	***Imperceptible:*** Broadmeadow discharging into Broadmeadow Estuary (a SAC, SPA, pNHA site) approx. 3km downstream, Low importance. Will have permanent impact on small proportion of attribute.	***Slight:*** Jone' Stream discharges into Rogerstown Estuary; and Rush Town Stream and St Catherine Stream discharge into the Irish sea (unpolluted water quality) approx. 3km downstream, Medium importance. Will have permanent impact on small proportion of attribute.
2.0	**Hydrogeology**	**Annsbrook**	**Baldurgan**	**Clonshagh**	**Cookstown**	**Cloghran**	**Newtowncorduff**	**Rathartan**	**Saucerstown**	**Tyrrelstown Little**
2.1	Aquifer Classification - importance of the groundwater resource to a given area	***Moderate:*** Locally Important Bedrock Aquifer (LI, Lm) underlies land parcel, Medium importance. Will have permanent impact on a significant proportion of attribute.	***Moderate:*** Locally Important Bedrock Aquifer (LI) underlies land parcel, Medium importance. Will have permanent impact on a significant proportion of attribute.	***Moderate:*** Poor Bedrock Aquifer (PI) and Locally Important Bedrock Aquifer (LI) underlies land parcel, Medium importance. Will have permanent impact on a significant proportion of attribute.	***Moderate:*** Locally Important Bedrock Aquifer (LI) underlies land parcel, Medium importance. Will have permanent impact on a significant proportion of attribute.	***Slight:*** Poor Bedrock Aquifer (PI) underlies land parcel, Low importance . Will have permanent impact on a significant proportion of attribute.	***Moderate:*** Locally Important Bedrock Aquifer (Lm & LI) underlies land parcel, Medium importance. Will have permanent impact on a significant proportion of attribute.	***Moderate:*** Locally Important Bedrock Aquifer (Lm & LI) underlies land parcel, Medium importance. Will have permanent impact on a significant proportion of attribute.	***Moderate:*** Poor Bedrock Aquifer (PI) and Locally Important Bedrock Aquifer (LI) underlies land parcel, Medium importance. Will have permanent impact on a significant proportion of attribute.	***Moderate:*** Locally Important Bedrock Aquifer (Lm) underlies land parcel, Medium importance. Will have permanent impact on a significant proportion of attribute.
2.2	Vulnerability Classification - potential for groundwater contamination	***Slight:*** Low Vulnerability, Low importance. Will have permanent impact on a significant proportion of attribute.	***Slight:*** Low Vulnerability, Low importance. Will have permanent impact on a significant proportion of attribute.	***Slight:*** Low to Moderate Vulnerability, Predominantly Low, Low importance. Will have permanent impact on a significant proportion of attribute.	***Slight:*** Low Vulnerability, Low importance. Will have permanent impact on a significant proportion of attribute.	***Moderate:*** Low to High Vulnerability, Predominantly Low, Medium importance. Will have permanent impact on a significant proportion of attribute.	***Moderate:*** Low to High Vulnerability, Predominantly Low, Medium importance. Will have permanent impact on a significant proportion of attribute.	***Slight:*** Low Vulnerability, Low importance. Will have permanent impact on a significant proportion of attribute.	***Moderate:*** Low to High Vulnerability, Predominantly Moderate, Medium importance. Will have permanent impact on a significant proportion of attribute.	***Slight:*** Low Vulnerability, Low importance. Will have permanent impact on a significant proportion of attribute.
2.3	GSI Groundwater Protection Response matrix for landfills result	***R1***	***R1***	***R2***	***R1***	***R2***	***R2***	***R1***	***R2***	***R1***
2.4	Groundwater Supplies - identification of water supply springs and bored wells based on GSI, EPA and FCC records.	***None:*** No Groundwater Supplies within 500m however unconfirmed information from FCC suggests the possibility of additional groundwater abstraction points and wells nearby (Appendix A). If present, well(s) would be of Low importance but will have permanent impact on a significant proportion of attribute.	***Slight:*** 1x Spring; St. Bridget's Well (2925SEW024) 380m South. Unconfirmed information from FCC suggests the possibility of additional groundwater abstraction points and wells nearby (Appendix A). Low importance but will have permanent impact on a significant proportion of attribute.	***None:*** No Groundwater Supplies within 500m	***Slight:*** 1x Spring; St. Bridget's Well (2925SEW024) 180m North East. Unconfirmed information from FCC suggests the possibility of additional groundwater abstraction points and wells nearby (Appendix A). Low importance but will have permanent impact on a significant proportion of attribute.	***None:*** No Groundwater Supplies within 500m	***Slight:*** 1x bored well; 2925SEW030 used for agriculture and domestic use with good yields 420m North. Unconfirmed information from FCC suggests the possibility of additional groundwater abstraction points and wells nearby (Appendix A). Low importance but will have permanent impact on a significant proportion of attribute.	***None*** : No Groundwater Supplies within 500m however unconfirmed information from FCC suggests the possibility of additional groundwater abstraction points and wells nearby (Appendix A). If present, well(s) would be of Low importance but will have permanent impact on a significant proportion of attribute.	***None:*** No Groundwater Supplies within 500m	***Slight:*** 3 x bored wells; 3225SWW013 bored well with moderate yield 350m east, 3225SWW009 bored well with good yield 460m south east, 3225SWW008 bored well with good yield 480m south east. Unconfirmed information from FCC suggests the possibility of additional groundwater abstraction points and wells nearby (Appendix A). Low importance but will have permanent impact on a significant proportion of attribute.
2.5	Groundwater Source Protection Area's and Zones of Contribution as per available GSI & EPA data	***None:*** No Source Protection Areas or Zones of Contribution in close proximity	***None:*** No Source Protection Areas or Zones of Contribution in close proximity	***None:*** No Source Protection Areas or Zones of Contribution in close proximity	***None:*** No Source Protection Areas or Zones of Contribution in close proximity	***None:*** No Source Protection Areas or Zones of Contribution in close proximity	***None:*** No Source Protection Areas or Zones of Contribution in close proximity	***None:*** No Source Protection Areas or Zones of Contribution in close proximity	***None:*** No Source Protection Areas or Zones of Contribution in close proximity	***None:*** No Source Protection Areas or Zones of Contribution in close proximity
2.6	Identification of hydrogeological features from the GSI karst database	***None:*** No Karst Feature within 2km	***None:*** No Karst Feature within 2km	***Slight:*** 1x spring; St. Doolaghs Well 860m east of the site, Low importance. Will have permanent impact on a significant proportion of attribute.	***None:*** No Karst Feature within 2km	***Slight:*** 1x spring; St. Doolaghs Well 2km south east of the site, Low importance. Will have permanent impact on a significant proportion of attribute.	***Slight:*** 4 x springs; Horlakes Well, St. Catherine's Well, Bridetree Well and St. Maccullins Well 1.3km and 1.8km north east to south east of the site, Low importance. Will have permanent impact on a significant proportion of attribute.	***Slight:*** 1 x spring; Bog Well 1.7km north west of the site, Low importance. Will have permanent impact on a significant proportion of attribute.	***None:*** No Karst Feature within 2km	**Slight:** 1x spring; Bog Well 680m west of the site, Low importance. Will have permanent impact on a significant proportion of attribute.

Phase 2 Alternative Sites Assessment - Environmental Criteria Evaluation Matrix
Stage 2 of Criteria Evaluation (Sites)

Ref	Environmental Criteria	Table 9.2 - Waste Water Treatment Plant Sites								
1.0	**Hydrology**	**Annsbrook**	**Baldurgan**	**Clonshagh**	**Cookstown**	**Cloghran**	**Newtowncorduff**	**Rathartan**	**Saucerstown**	**Tyrrelstown Little**
1.1	Proximity to water bodies in terms of flooding and as an indicator of sensitive surface water receptors	***Slight:*** The Ballough River (water quality Q3/Q4) and Ballyboghill tributary (water quality Q3) are within 170m and 60m of the site respectively, Medium importance. Will have permanent impact on small proportion of attribute.	***Slight:*** Ballyboghill River (200m north), Ballyboghill tributary (40m west) (water quality Q3) and Belinstown tributary (60m south) of the site (all Q3), Medium importance. Will have permanent impact on small proportion of attribute.	***Slight:*** Medium: Cuckoo River (north) within 50m and Mayne River and Mayne Tributary (south) (water quality Q3) within 370m of the site, Medium importance. Will have permanent impact on small proportion of attribute.	***Moderate:*** Belinstown River (10m north) and Broadmeadow tributary (1km south) (water quality Q3) of the site, High Importance. Will have permanent impact on small proportion of attribute.	***Moderate:*** Sluice River (10m north) and Sluice tributary (290m south) of the site, High importance. Will have permanent impact on small proportion of attribute.	***Moderate:*** Ballough tributary (180m east) and Ballough River (10m west) of the site (water quality Q3), High importance. Will have permanent impact on small proportion of attribute.	***Slight:*** Collinstown Stream (30m west) and Palmerstown Stream (120m southeast) of the site, Medium importance. Will have permanent impact on small proportion of attribute.	***Significant:*** Broadmeadow tributaries (water quality Q3) are within 10m of the site; the site is surrounded by tributaries almost throughout its perimeter, High importance. Will have permanent impact on small proportion of attribute. Will have permanent impact on a significant proportion of attribute.	***Imperceptible:*** Collinstown Stream (120 southwest), Rush Town Stream (360m southeast) and Balcunnin Stream (930m north) of the site, Low Importance. Will have permanent impact on small proportion of attribute.
1.2	Culverting requirement - used to indicate impact on flood-prone watercourses due to reduced conveyance.	***None:*** No new culvert required.	***Moderate:*** Crossing Ballyboghill River , High importance. Will have permanent impact on small proportion of attribute.	***None:*** No new culvert required	***Imperceptible:*** Culvert might be required for a local minor tributary, Low importance. Will have permanent impact on small proportion of attribute.	***None:*** No new culvert required	**Slight:** Crossing Ballough Tributary , Medium importance. Will have permanent impact on small proportion of attribute.	**Slight:** Crossing Collinstown Stream , Medium importance. Will have permanent impact on small proportion of attribute.	***Slight:*** Crossing BroadmeadowTributary, Medium importance. Will have permanent impact on small proportion of attribute.	***None:*** No new culvert required.
1.3	Area prone to flooding (based on historical data and predicted flood extents adjacent to the site as well as up and downstream locations)	***Imperceptible:*** No flooding to the site from the Ballough and Ballyboghill rivers. The Ballyboghill has extensive overland flooding approx. 3km downstream, Low importance. Will have permanent impact on small proportion of attribute.	***Slight:*** Ballyboghill have overland flooding approx. 200m to the north of the site. The Belinstown has extensive overland flooding approx. 2km downstream, medium importance. Will have permanent impact on small proportion of attribute.	***Imperceptible:*** No flooding from the Mayne / Cuckoo Rivers to the site. The Mayne has history of flooding; and predicted overland flooding approx. 2km downstream, Low importance. Will have permanent impact on small proportion of attribute.	***Imperceptible:*** The Belinstown has extensive predicted overland flooding (both tidal & fluvial) and recurrence historic flooding approx. 3.5km downstream, Low importance. Will have permanent impact on small proportion of attribute.	***Slight:*** No flooding from the Sluice River at the site. The Sluice has history of flooding and predicted overland flooding approx. 0.5km upstream and 2km downstream, Medium importance. Will have permanent impact on small proportion of attribute.	***Imperceptible:*** No flooding from Ballough River. The eastern tributary was not modelled in FEM FRAMS, but has a history of flooding upstream, Low importance. Will have permanent impact on small proportion of attribute.	***Imperceptible:*** No flooding from the Collinstown Stream and Palmerstown Stream close to the site. History of flooding at downstream locations, Low importance. Will have permanent impact on small proportion of attribute.	***Moderate:*** The Broadmeadow River flooding extent is adjacent to the site boundary, High importance. Will have permanent impact on small proportion of attribute.	***Imperceptible:*** No flooding from the Collinstown and Rush Town Stream to the site. History of flooding at downstream locations, Low importance. Will have permanent impact on small proportion of attribute.
1.4	Potential Impact on ecologically important and designated sites.	***Slight:*** The rivers discharge into the Rogerstown Estuary (SAC, SPA, pNHA, Ramsar and SNR) approx. 4.1km downstream, Medium importance. Will have permanent impact on small proportion of attribute.	***Slight:*** The rivers discharge into Rogerstown Estuary (SAC, SPA, pNHA, Ramsar and SNR) and Malahide Bay (SAC, SPA and pNHA) approx. 5.3 and 7km downstream respectively, Medium importance. Will have permanent impact on small proportion of attribute.	***Imperceptible:*** The Mayne River discharges into Baldoyle Estuary (SPA, SAC and pNHA) approx. 4.6km downstream, Low importance. Will have permanent impact on small proportion of attribute.	***Imperceptible:*** The Belinstown River discharges into Malahide Bay and the Broadmeadow tributary discharges into Broadmeadow Estuary (SAC, SPA, pNHA) approx. 7 and 5km downstream respectively, Low importance. Will have permanent impact on small proportion of attribute.	***Imperceptible:*** The river discharges into Baldoyle Estuary (SAC, SPA and pNHA) approx. 4.3km downstream, Low importance. Will have permanent impact on small proportion of attribute.	***Slight:*** The river discharges into Rogerstown Estuary (SAC, SPA, pNHA, Ramsar and SNR) approx. 2.9km downstream, Medium importance. Will have permanent impact on small proportion of attribute.	***Moderate:*** The Collinstown stream discharges into Rogerstown Estuary (SAC, SPA, pNHA, Ramsar and SNR) approx. 1km downstream, High importance. Will have permanent impact on small proportion of attribute.	***Imperceptible:*** The Broadmeadow River discharges into the Broadmeadow Estuary (SAC, SPA, pNHA) approx. 3km downstream, Low importance. Will have permanent impact on small proportion of attribute.	***Slight:*** The Collinstown Stream discharges into Rogerstown Estuary and Rush Town Stream discharges into the Irish sea (unpolluted water quality) approx. 2.2km downstream, Medium importance. Will have permanent impact on small proportion of attribute.
2.0	**Hydrogeology**	**Annsbrook**	**Baldurgan**	**Clonshagh**	**Cookstown**	**Cloghran**	**Newtowncorduff**	**Rathartan**	**Saucerstown**	**Tyrrelstown Little**
2.1	Aquifer Classification - importance of the groundwater resource to a given area	***Moderate:*** Locally Important Bedrock Aquifer (LI & Lm) underlies site, Medium importance. Will have permanent impact on a significant proportion of attribute.	***Moderate:*** Locally Important Bedrock Aquifer (LI) underlies site, Medium importance. Will have permanent impact on a significant proportion of attribute.	***Moderate:*** Poor Bedrock Aquifer (PI) and Locally Important Bedrock Aquifer (LI) underlies site, Medium importance. Will have permanent impact on a significant proportion of attribute.	***Moderate:*** Locally Important Bedrock Aquifer (LI) underlies site, Medium importance. Will have permanent impact on a significant proportion of attribute.	***Slight:*** Poor Bedrock Aquifer (PI) underlies site, Low importance. Will have permanent impact on a significant proportion of attribute.	***Moderate:*** Locally Important Bedrock Aquifer (Lm & LI) underlies site, Medium importance. Will have permanent impact on a significant proportion of attribute.	***Moderate:*** Locally Important Bedrock Aquifer (Lm) underlies site, Medium importance. Will have permanent impact on a significant proportion of attribute.	***Moderate:*** Poor Bedrock Aquifer (PI) and Locally Important Bedrock Aquifer (LI) underlies site, Medium importance. Will have permanent impact on a significant proportion of attribute.	***Moderate:*** Locally Important Bedrock Aquifer (Lm) underlies site, Medium importance. Will have permanent impact on a significant proportion of attribute.
2.2	Vulnerability Classification - potential for groundwater contamination	***Slight:*** Low Vulnerability, Low importance. Will have permanent impact on a significant proportion of attribute.	***Slight:*** Low Vulnerability, Low importance. Will have permanent impact on a significant proportion of attribute.	***Slight:*** Low Vulnerability, Low importance. Will have permanent impact on a significant proportion of attribute.	***Slight:*** Low Vulnerability, Low importance. Will have permanent impact on a significant proportion of attribute.	***Moderate:*** Low to High Vulnerability, Predominantly Low, Medium importance. Will have permanent impact on a significant proportion of attribute.	***Slight:*** Low Vulnerability, Low importance. Will have permanent impact on a significant proportion of attribute.	***Slight:*** Low Vulnerability, Low importance. Will have permanent impact on a significant proportion of attribute.	***Moderate:*** Low to High Vulnerability, Predominantly Moderate, Medium importance. Will have permanent impact on a significant proportion of attribute.	***Slight:*** Low Vulnerability, Low importance. Will have permanent impact on a significant proportion of attribute.
2.3	GSI Groundwater Protection Response matrix for landfills result	***R1***	***R1***	***R1***	***R1***	***R2***	***R1***	***R1***	***R2***	***R1***
2.4	Groundwater Supplies - identification of water supply springs and bored wells based on GSI, EPA and FCC records.	***None:*** No Groundwater Supplies within 500m however unconfirmed information from FCC suggests the possibility of additional groundwater abstraction points and wells nearby (Appendix A). If present, well would be of Low importance and would have a permanent impact on a significant proportion of attribute.	***Slight:*** 1x Spring; St. Bridget's Well 400m South. Unconfirmed information from FCC suggests the possibility of additional groundwater abstraction points and wells nearby (Appendix A). Low importance. Will have permanent impact on a significant proportion of attribute.	***None:*** No Groundwater Supplies within 500m	***Slight:*** 1x Spring; St. Bridget's Well 210m South East. Unconfirmed information from FCC suggests the possibility of additional groundwater abstraction points and wells nearby (Appendix A). Low importance. Will have permanent impact on a significant proportion of attribute.	***None:*** No Groundwater Supplies within 500m	***Slight:*** 1x bored well; for agriculture and domestic use with good yields 510m North. Unconfirmed information from FCC suggests the possibility of additional groundwater abstraction points and wells nearby (Appendix A). Low importance. Will have permanent impact on a significant proportion of attribute.	**None:** No Groundwater Supplies within 500m. Unconfirmed information from FCC suggests the possibility of additional groundwater abstraction points and wells nearby (Appendix A). If present, well(s) would be of Low importance and would have a permanent impact on a significant proportion of attribute.	**None:** No Groundwater Supplies within 500m	**None:** No Groundwater Supplies within 500m. Unconfirmed information from FCC suggests the possibility of additional groundwater abstraction points and wells nearby (Appendix A). Low importance. Will have permanent impact on a significant proportion of attribute.
2.5	Groundwater Source Protection Area's and Zones of Contribution as per available GSI & EPA data	***None:*** No SPA's or ZOC's in close proximity	***None:*** No SPA's or ZOC's in close proximity	***None:*** No SPA's or ZOC's in close proximity	***None:*** No SPA's or ZOC's in close proximity	***None:*** No SPA's or ZOC's in close proximity	***None:*** No SPA's or ZOC's in close proximity	***None:*** No SPA's or ZOC's in close proximity	***None:*** No SPA's or ZOC's in close proximity	***None:*** No SPA's or ZOC's in close proximity
2.6	Identification of hydrogeological features from the GSI karst database	***None:*** No Karst Feature within 2km	***None:*** No Karst Feature within 2km	***Slight:*** 1x spring; St. Doolaghs Well 1.2km east of the site, Low importance. Will have permanent impact on a significant proportion of attribute.	***None:*** No Karst Feature within 2km	***Slight:*** 1x spring; St. Doolaghs Well 2km south east of the site, Low importance. Will have permanent impact on a significant proportion of attribute.	***Slight:*** 4 x springs; Horlakes Well, St. Catherine's Well, Bridetree Well and St. Maccullins Well within 1.8km north east to south east of the site, Low importance. Will have permanent impact on a significant proportion of attribute.	***Slight:*** 1 x spring; Bog Well 1.7km north west of the site, Low importance. Will have permanent impact on a significant proportion of attribute.	***None:*** No Karst Feature within 2km	***Slight:*** 1x spring; Bog Well 700m west of the site, Low importance. Will have permanent impact on a significant proportion of attribute.

Phase 2 Alternative Sites Assessment - Environmental Criteria Evaluation Matrix
Stage 2 of Criteria Evaluation (Sites)

Ref	Environmental Criteria	Table 9.3 - Waste Water Treatment Plant Sites (Summary)								
1.0	**Hydrology**	**Annsbrook**	**Baldurgan**	**Clonshagh**	**Cookstown**	**Cloghran**	**Newtowncorduff**	**Rathartan**	**Saucerstown**	**Tyrrelstown Little**
1.1	Proximity to water bodies in terms of flooding and as an indicator of sensitive surface water receptors	Slight	Slight	Slight	Moderate	Moderate	Moderate	Slight	Significant	Imperceptible
1.2	Culverting requirement - used to indicate impact on flood-prone watercourses due to reduced conveyance.	None	Moderate	None	Imperceptible	None	Slight	Slight	Slight	None
1.3	Area prone to flooding (based on historical data and predicted flood extents adjacent to the site as well as up and downstream locations)	Imperceptible	Slight	Imperceptible	Imperceptible	Slight	Imperceptible	Imperceptible	Moderate	Imperceptible
1.4	Potential Impact on ecologically important and designated sites.	Slight	Slight	Imperceptible	Imperceptible	Imperceptible	Slight	Moderate	Imperceptible	Slight
2.0	**Hydrogeology**	**Annsbrook**	**Baldurgan**	**Clonshagh**	**Cookstown**	**Cloghran**	**Newtowncorduff**	**Rathartan**	**Saucerstown**	**Tyrrelstown Little**
2.1	Aquifer Classification - importance of the groundwater resource to a given area	Moderate	Moderate	Moderate	Moderate	Slight	Moderate	Moderate	Moderate	Moderate
2.2	Vulnerability Classification - potential for groundwater contamination	Slight	Slight	Slight	Slight	Moderate	Slight	Slight	Moderate	Slight
2.3	GSI Groundwater Protection Response matrix for landfills result	R1	R1	R1	R1	R2	R1	R1	R2	R1
2.4	Groundwater Supplies - identification of water supply springs and bored wells based on GSI, EPA and FCC records.	None	Slight	None	Slight	None	Slight	None	None	None
2.5	Groundwater Source Protection Area's and Zones of Contribution as per available GSI & EPA data	None	None	None	None	None	None	None	None	None
2.6	Identification of hydrogeological features from the GSI karst database	None	None	Slight	None	Slight	Slight	Slight	None	Slight

Phase 2 Alternative Sites Assessment - Environmental Criteria Evaluation Matrix
Stage 1 of Criteria Evaluation (Pipeline Routes)

Ref	Environmental Criteria	Table 9.4 - Transfer Pipeline Corridor Routes						
1.0	**Hydrology**	**Route Section A**	**Route Section B**	**Route Section C**	**Route Section D**	**Route Section E**	**Route Section F**	**Route Section G**
1.1	Proximity to water bodies in terms of flooding and as an indicator of sensitive surface water receptors	Tolka and Ward (2 river catchments).	Santry, Mayne and Sluice (3 river catchments)	Ward and Sluice (2 river catchments)	Broadmeadow, Ward, Gaybrook and Sluice (4 river catchments) and some coastal areas.	Broadmeadow, Lissenhall, Belinstown, Ballyboghill, Ballough, Baleally, Rathmooney', Jone's, Palmerstown and Rush Town (10 river catchments) and some coastal areas.	Ward, Broadmeadow, Belinstown, Ballyboghill, Ballough, Beleally, Rathmooney, Jone's, Rush Town and Balcunnin (10 river catchments) and some coastal areas.	Sluice and Mayne (2 river catchments) and some coastal areas.
1.2	Culverting requirement - used to indicate impact on flood-prone watercourses due to reduced conveyance.	Tolka River and Ward Tributary (2 crossings).	Santry tributary and Mayne River (2 crossings)	Ward River, Sluice River and three tributaries of the Sluice (5 crossings).	Sluice River and its one tributary, Gaybrook, Ward River, Broadmeadow River (twice) and approx. six tributaries of Broadmeadow (12 crossings).	A tributary of the Broadmeadow, Belinstown, Ballyboghill, Ballough, Baleally, Rathmooney', Collinstown, Palmerstown and Rush Town Stream (9 crossings).	Ward, two Ward tributaries, Broadmeadow, four Broadmeadow tributaries, Belinstown, Ballyboghill, two Ballyboghill tributaries, Ballough, two Ballough tributaries, Baleally, Bride, Collinstown, one Collinstown tributary, St. Catherine (20 crossings).	Mayne and its one tributary (2 crossings)
1.3	Area prone to flooding (based on historical data and predicted flood extents adjacent to the site as well as up and downstream locations)	Historic flooding in Tolka in the vicinity of the transfer pipeline corridor, especially at the beginning of the route corridor near Blanchardstown Bypass.	Series of historic flood locations where the route crosses the Mayne River.	No historic flooding on the corridor. Flood maps show some overland flooding along the Sluice River.	Series of historic flooding locations on the corridor. Flood extent maps show extensive overland flooding on the Sluice and Broadmeadow.	No historic flooding location on the corridor. Flood extent maps show extensive overland flooding on the Broadmeadow, Belinstown and Ballyboghill crossings.	One historic flooding location on the corridor. Flood extent maps show overland flooding on the Broadmeadow, Belinstown and Ballyboghill crossings.	Historic flooding on the Mayne River. Flood maps show extensive fluvial and tidal flooding near Mayne Bridge (towards the end of this route).
1.4	Potential Impact on ecologically important and designated sites.	Ecologically important sites more than 10km away.	Baldoyle Estuary (a SPA, SAC and pNHA site) approx. 3km downstream.	Baldoyle Estuary (a SPA, SAC and pNHA site) approx. 3km and Broadmeadow Estuary (a SAC, SPA, pNHA site) approx. 6km downstream.	The route passes close to Broadmeadow Estuary (a SAC, SPA, pNHA site).	Rogerstown Estuary (a SAC, SPA, pNHA, Ramsar and SNR site) and Broadmeadow Estuary (a SAC, SPA, pNHA site) less than 2km downstream.	Rogerstown Estuary (a SAC, SPA, pNHA, Ramsar and SNR site) approx. 3 km downstream.	Baldoyle Estuary (a SPA, SAC and pNHA site) close to the pipeline corridor.
2.0	**Hydrogeology**	**Route Section A**	**Route Section B**	**Route Section C**	**Route Section D**	**Route Section E**	**Route Section F**	**Route Section G**
2.1	Aquifer Classification - importance of the groundwater resource to a given area	Poor Bedrock Aquifer and Locally Important Bedrock Aquifer underlies Route	Poor Bedrock Aquifer and Locally Important Bedrock Aquifer underlies Route	Poor Bedrock Aquifer and Locally Important Bedrock Aquifer underlies Route	Poor Bedrock Aquifer and Locally Important Bedrock Aquifer underlies Route	Poor Bedrock Aquifer and Locally Important Bedrock Aquifer underlies Route	Poor Bedrock Aquifer and Locally Important Bedrock Aquifer underlies Route	Poor Bedrock Aquifer and Locally Important Bedrock Aquifer underlies Route
2.2	Vulnerability Classification - potential for groundwater contamination	Moderate to Rock Near Surface or Karst, Predominantly high	Low to Extreme, Predominantly Low	Low to Rock Near Surface or Karst, Predominantly High	Low to Rock Near Surface or Karst, Predominantly High	Low to Rock Near Surface or Karst, Predominantly Low	Low to Rock Near Surface or Karst, Predominantly Low	Low to Extreme, Predominantly Low
2.3	Groundwater Supplies - identification of water supply springs and bored wells based on GSI, EPA and FCC records.	1 x well with a moderate yield	1 x spring and 6 x bored wells for industrial use with moderate to good yields	No Groundwater Supplies within 500m	2 x bored wells for agriculture and domestic use with good yields	6 x bored wells for industrial, agriculture and domestic use with good yields and unconfirmed information from FCC suggests the possibility of additional groundwater abstraction points and wells nearby (Appendix A).	1 x spring and 2 x bored wells for agricultural and domestic use with good yields and unconfirmed information from FCC suggests the possibility of additional groundwater abstraction points and wells nearby (Appendix A).	No Groundwater Supplies within 500m
2.4	Groundwater Source Protection Area's and Zones of Contribution as per available GSI & EPA data	None: No Source Protection Areas or Zones of Contribution in close proximity	None: No Source Protection Areas or Zones of Contribution in close proximity	None: No Source Protection Areas or Zones of Contribution in close proximity	None: No Source Protection Areas or Zones of Contribution in close proximity	None: No Source Protection Areas or Zones of Contribution in close proximity	None: No Source Protection Areas or Zones of Contribution in close proximity	None: No Source Protection Areas or Zones of Contribution in close proximity
2.5	Identification of hydrogeological features from the GSI karst database	No Karst Feature within the transfer pipeline corridor	No Karst Feature within the transfer pipeline corridor	No Karst Feature within the transfer pipeline corridor	No Karst Feature within the transfer pipeline corridor	2 x springs; St. Catherine's Well and Bridetree Well within 50m south of the transfer pipeline corridor	2 x springs; St. Catherine's Well and Tober Caillin within the transfer pipeline corridor	No Karst Feature within the transfer pipeline corridor

Phase 2 Alternative Sites Assessment - Environmental Criteria Evaluation Matrix
Stage 1 of Criteria Evaluation (Marine Outfalls)

Ref	Environmental Criteria	Table 9.5 - Marine Outfalls	
1.0	**Hydrology**	**Northern Outfall Study Area**	**Southern Outfall Study Area**
1.1	Proximity to water bodies in terms of flooding and as an indicator of sensitive surface water receptors	Rush coastal area (unpolluted status) and Rogerstown Estuary (a SAC, SPA, pNHA, Ramsar and SNR site) located within the study area.	Baldoyle Estuary (a SPA, SAC and pNHA site) within the study area.
1.2	Potential to impact Shellfish Waters	The study area is not located in the Shellfish Waters.	The study area is not located in the Shellfish Waters.
1.3	Area prone to flooding (based on historical data and predicted flood extents adjacent to the site as well as up and downstream locations)	Two historic flooding locations in the study area. Flood extent maps showed some coastal flooding between Drumanagh and Breakwater.	Record of two historic flooding near the stud area. Extensive costal flooding near the north-western and south-western part.
1.4	Potential Impact on ecologically important and designated sites	Rogerstown Estuary is an SAC, SPA, pNHA, Ramsar and SNR site. Three recreational bathing sites (Good water quality) located within the study area, one of which is a blue flag beach. Outfall into unpolluted coastal water.	Baldoyle Estuary is an SPA, SAC and pNHA site. Unknown water quality of the Baldoyle Estuary. One recreational bathing site (Good water quality) located within the study area and is also a blue flag beach.
2.0	**Hydrogeology**	**Northern Outfall Study Area**	**Southern Outfall Study Area**
2.1	Aquifer Classification - importance of the groundwater resource to a given area	Poor Bedrock Aquifer and Locally Important Bedrock Aquifer underlies the outfall study area	Poor Bedrock Aquifer underlies the outfall study area
2.2	Vulnerability Classification - potential for groundwater contamination	Low to Rock Near Surface or Karst, Predominantly Low	Low to High, Predominantly High
2.3	Groundwater Supplies - identification of water supply springs and bored wells based on GSI, EPA and FCC records.	7 x bored wells for agriculture and domestic use with moderate to excellent yields and unconfirmed information from FCC suggests the possibility of additional groundwater abstraction points and wells nearby (Appendix A). A well survey may be required at a later date.	No Groundwater Supplies within 500m
2.4	Groundwater Source Protection Area's and Zones of Contribution as per available GSI & EPA data	None: No Source Protection Areas or Zones of Contribution in close proximity	None: No Source Protection Areas or Zones of Contribution in close proximity
2.5	Identification of hydrogeological features from the GSI karst database	2 x springs; St. Catherine's Well and Tober Caillin within the outfall study area	No Karst Feature within 500m of the outfall study area

Appendix C – Ranking Criteria

Table A - Criteria For Rating Site Attributes						
Criteria	**Extremely High**	**Very High**	**High**	**Medium**	**Low**	**None**
Proximity to water bodies in terms of flooding and as an indicator of sensitive surface water receptors	Stream (Q4, Q5) runs through site	within 10m and Q4, Q5	within 10m and Q3,Q4	within 10 to 50 m and Q2,Q3	more than 50m and Q1, Q2	-
Culverting requirement - used to indicate impact on flood-prone watercourses due to reduced conveyance.			Crossing flood prone streams	Crossing other streams	Crossing local/minor streams	-
Area prone to flooding (based on historical data and predicted flood extents adjacent to the site as well as up and downstream locations)		Flood plain protecting more than 50 residential or commercial properties from flooding	Flood plain protecting between 5 and 50 residential or commercial properties from flooding or Adjacent river flooding or extensive flooding D/S	Flood plain protecting between 1 and 5 residential or commercial properties from flooding or extensive flooding few km D/S	Flood plain protecting between 1 residential or commercial property from flooding or extensive Flooding D/S	-
Potential Impact on ecologically important and designated sites.	Discharging to unpolluted waterbody / NATURA 2000	Discharging to unpolluted waterbody/NATURA 2000 sites within 1km d/s	Discharging intermediate waterbody/NATURA 2000 sites within 1km d/s	Discharging intermediate waterbody/NATURA 2000 sites beyond 1km d/s	Discharging to eutrophic waterbody / NATURA 2000 sites downstream	-
Aquifer Classification - importance of the groundwater resource to a given area	-	Regionally Important Aquifer with multiple wellfields	Regionally Important Aquifer	Locally Important Aquifer	Poor Bedrock Aquifer	-
Vulnerability Classification - potential for groundwater contamination	Rock at or Near Surface	Extreme	High	Moderate	Low	-
GSI Groundwater Protection Response matrix for landfills result	Refer to GSI Groundwater Protection Responses for Landfills, Appendix D.					
Groundwater Supplies - identification of water supply springs and bored wells based on GSI, EPA and FCC records.	-	potable water source supplying >2500 homes	potable water source supplying >1000 homes	potable water source supplying >50 homes	potable water source supplying <50 homes	-
Groundwater Source Protection Area's and Zones of Contribution as per available GSI & EPA data	Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation e.g. SAC or SPA status	Groundwater supports river, wetland or surface water body ecosystem protected by national legislation - NHA status or Inner source protection area for regionally important water source	Outer source protection area for regionally important water source	within 500m of outer source protection area for regionally important water source	within 2km of outer source protection area for regionally important water source	-
Identification of hydrogeological features from the GSI karst database	within 10m	within 50m	within 100m	within 500m	within 2km	-

Impact Level	Table B - Attribute Importance				
	Extremely High	**Very High**	**High**	**Medium**	**Low**
Profound	Any Permanent impact on attribute	Permanent impact on significant proportion of attribute			
Significant	Temporary impact on significant proportion of attribute	Permanent impact on small proportion of attribute	Permanent impact on significant proportion of attribute		
Moderate	Temporary impact on small proportion of attribute	Temporary impact on significant proportion of attribute	Permanent impact on small proportion of attribute	Permanent impact on significant proportion of attribute	
Slight		Temporary impact on small proportion of attribute	Temporary impact on significant proportion of attribute	Permanent impact on small proportion of attribute	Permanent impact on significant proportion of attribute
Imperceptible			Temporary impact on small proportion of attribute	Temporary impact on significant proportion of attribute	Permanent impact on small proportion of attribute

***Box 4.4**: Criteria for rating impact significance at route selection stage (NRA Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Scheme).*

Appendix D – GSI Groundwater Protection Responses for Landfills

Groundwater Protection Responses for Landfills

Background

Groundwater in Ireland is protected under European Community and national legislation. Local authorities and the Environmental Protection Agency (EPA) have responsibility for enforcing this legislation. The Geological Survey of Ireland (GSI) in conjunction with the Department of Environment and Local Government (DoELG) and the EPA have developed a methodology for the preparation of groundwater protection schemes to assist the statutory authorities and others to meet their responsibility to protect groundwater (DoELG/EPA/GSI, 1999). This methodology incorporates land surface zoning and groundwater protection responses.

These groundwater protection responses are concerned with the site selection process for landfills and the associated design, operation and monitoring of landfill sites. These responses outline the likely acceptability of landfills in each groundwater protection zone (as described in *Groundwater Protection Schemes* (DoELG/EPA/GSI, 1999)) and the recommended level of response/restriction, which depends on the groundwater vulnerability, the value of the groundwater and the contaminant loading.

In general terms this guidance is for the siting of landfills for non-hazardous wastes. The principles involved may also be applied to the selection process for landfill sites for hazardous and inert waste.

A significant factor in siting all landfills is the protection of groundwater, which is an important resource and source of water supply in Ireland, particularly in rural areas.

The geology and hydrogeology of any region have a major bearing on: (i) the availability of suitable areas for landfill sites; (ii) the level of natural protection for groundwater from contamination by landfill leachate; and (iii) the design, operation and monitoring of landfills.

Groundwater protection schemes, supported by detailed investigations, provide hydrogeological information for landfill site selection. They are used to identify areas where landfills should normally be excluded and areas where they are less likely to pose a risk to groundwater. The groundwater protection responses outlined here require that new landfills should not generally be developed on regionally important aquifers.

Developers of landfills should have regard to both the resource potential and the vulnerability of the underlying and adjacent aquifers. The groundwater protection responses combine both of these factors in a matrix which facilitates rational decisions on the acceptability or otherwise of a landfill from a hydrogeological point of view.

The risk to groundwater from the landfilling of waste is mainly influenced by:

- the nature of the waste;
- the leachate composition;
- the volume of leachate generated;
- the groundwater vulnerability;
- the proximity of a groundwater source;
- the value of the groundwater resource;
- the landfill design; and
- the landfill operation and management practices.

In general the pollution risk is greatest in source protection areas and on regionally important aquifers.

The topsoil and subsoil, depending on their type, permeability and thickness, play a critical role in preventing groundwater contamination and mitigating the impact of many potential pollutants. They act as a protecting filtering layer over groundwater.

Guidance presented in these responses should be used to assist in the selection, design and management of landfill sites, and is based on the precautionary principle. The concept of risk management should be used in the decision making process for the selection of new landfill sites.

These groundwater protection responses should be read in conjunction with *Groundwater Protection Schemes* (DoELG/EPA/GSI, 1999).

Landfilling of Waste: a Hazard for Groundwater

The generation of leachate is one of the main hazards to groundwater from the disposal of waste by landfilling. Good site selection, design and operation assists in minimising the risk of pollution. Leachate from landfills for non hazardous waste is a highly polluting liquid and its composition is dependent on the nature of the waste within the landfill. The pollution potential can be evaluated by calculating the volume and predicting the composition of leachate that will be generated.

The volume of leachate depends principally on the area of the landfill, the meteorological and hydrogeological factors and the effectiveness of the capping. It is essential that the volume of leachate generated be kept to a minimum. The design and operation of the landfill should ensure that the ingress of groundwater and surface water is minimised and controlled.

Leachate composition varies due to a number of different factors such as the age and type of waste and operational practices at the site.

The conditions within a landfill vary over time from aerobic to anaerobic thus allowing different chemical reactions to take place. Most landfill leachates have high BOD, COD, ammonia, chloride, sodium, potassium, hardness and boron levels. Ammonia is a contaminant which may be used as an indicator of contamination, particularly in terms of surface water, as it can be toxic to fish at low concentrations (1 mg/l). Chloride is a mobile constituent which is often used as an indicator of contamination. The leachate from landfills for non-hazardous waste may produce reducing conditions beneath the landfill, allowing the solution of iron and manganese from the underlying deposits.

Leachates from landfill sites for non-hazardous waste often contain complex organic compounds, chlorinated hydrocarbons and metals at concentrations which pose a threat to groundwater and surface waters. Solvents and other synthetic organic chemicals are a significant hazard, being of environmental significance at very low concentrations and resistant to degradation. Moreover, they may be transformed in some cases into more hazardous compounds.

Landfills have the potential to produce leachate for several hundred years.

Groundwater Protection Response Matrix for Landfills

The reader is referred to the full text in *Groundwater Protection Schemes* (DoELG/EPA/GSI, 1999) for an explanation of the role of groundwater protection responses in a groundwater protection scheme.

The siting, design, operation and monitoring of landfills must comply with the guidelines outlined in the EPA's Landfill manuals except where such facilities hold a waste licence issued by the EPA. A Waste Licence is required for all landfills.

From the point of view of reducing the risk to groundwater, it is recommended that all landfills be located in, or as near as possible to, the zone in the bottom right hand corner of the matrix.

The appropriate response to the risk of groundwater contamination is given by the assigned response category (**R**) appropriate to each protection zone (Table 1).

Response Matrix for Landfills

VULNERABILITY RATING	SOURCE PROTECTION AREA		RESOURCE PROTECTION Aquifer Category					
			Regionally Important (R)		Locally Important (L)		Poor Aquifers (P)	
	Inner	Outer	Rk	Rf/Rg	Lm/Lg	Ll	Pl	Pu
Extreme (E)	R4	R4	R4	R4	$R3^2$	$R2^2$	$R2^2$	$R2^1$
High (H)	R4	R4	R4	R4	$R3^1$	$R2^1$	$R2^1$	R1
Moderate (M)	R4	R4	R4	$R3^1$	$R2^2$	$R2^1$	$R2^1$	R1
Low (L)	R4	$R3^1$	$R3^1$	$R3^1$	R1	R1	R1	R1

In all cases standards prescribed in the *EPA Landfill Site Design Manual (EPA, 1999)* or conditions of a waste licence will apply.

R1 Acceptable subject to guidance in the EPA Landfill Design Manual or conditions of a waste licence.

R2¹ Acceptable subject to guidance in the EPA Landfill Design Manual or conditions of a waste licence.

- Special attention should be given to checking for the presence of high permeability zones. If such zones are present then the landfill should only be allowed if it can be proven that the risk of leachate movement to these zones is insignificant. Special attention must be given to existing wells down-gradient of the site and to the projected future development of the aquifer.

R2² Acceptable subject to guidance outlined in the EPA Landfill Design Manual or conditions of a waste licence.

- Special attention should be given to checking for the presence of high permeability zones. If such zones are present then the landfill should only be allowed if it can be proven that the risk of leachate movement to these zones is insignificant. Special attention must be given to existing wells down-gradient of the site and to the projected future development of the aquifer.
- Groundwater control measures such as cut-off walls or interceptor drains may be necessary to control high water table or the head of leachate may be required to be maintained at a level lower than the water table depending on site conditions.

R3¹ Not generally acceptable, unless it can be shown that:

- the groundwater in the aquifer is confined; or
- there will be no significant impact on the groundwater; and
- it is not practicable to find a site in a lower risk area.

R3² Not generally acceptable, unless it can be shown that:

- there is a minimum consistent thickness of 3 metres of low permeability subsoil present;
- there will be no significant impact on the groundwater; and
- it is not practicable to find a site in a lower risk area.

R4 Not acceptable.

Regionally Important Aquifers

The siting of landfills on or near regionally important aquifers should only be considered:

- Where the hydraulic gradient (relative to the leachate level at the base of the landfill) is upwards for a substantial proportion of each year (confined aquifer situation).
- Where the proposed landfill is located in the discharge area of an aquifer. In this case surface water may be more at risk.
- Where a map showing a regionally important aquifer includes low permeability zones or units which cannot be delineated using existing geological and hydrogeological information but which can be found by site investigations. Location of a landfill site on such a unit may be acceptable provided leakage to the permeable zones or units is insignificant.
- Where the wastes types are restricted and the waste acceptance procedures employed are in accordance with the criteria specified by the EPA.

Investigations

Special attention should be given to checking for the presence of more permeable zones, such as faults, particularly in fractured bedrock aquifers. Geophysical surveys may be used to identify zones which should be investigated further by drilling to determine their vertical and lateral extent. Hydrogeological tests should also be carried out to define the local and regional effects of the zones. Investigations should be carried out in accordance with the EPA's Landfill Manual *Investigations for Landfills, 1995.*

References

DoELG/EPA/GSI, 1999. Groundwater Protection Schemes. Department of the Environment and Local Government, Environment Protection Agency and Geological Survey of Ireland.

EPA, 1995. Landfill Manual: Investigations for Landfills. Environmental Protection Agency.

EPA, 1995. Landfill Manual: Landfill Monitoring. Environmental Protection Agency.

EPA, 1997. Landfill Manual: Landfill Operational Practices. Environmental Protection Agency.

EPA, 1999. Landfill Manual: Landfill Site Design. Environmental Protection Agency.

Appendix E – River Names

River Name EPA	River Name FEM FRAM Study	River Name Eastern River Basin District
Mayne River	Mayne River	Mayne River IE_EA_09_1428
Sluice River	Sluice River	Sluice River IE_EA_09_1532
-	Gaybrook Stream	-
Ward River	Ward River	Ward River IE_EA_08_571 IE_EA_08_644 IE_EA_08_670
Broadmeadow River	Broadmeadow River	Broadmeadow River IE_EA_08_240 IE_EA_08_295
Staffordstown Stream	Lissenhall Stream	-
Belinstown Stream	Turvey River	Donabate River IE_EA_08_826
Ballyboghil River	Ballyboghil River	Ballyboghil River IE_EA_08_822
Ballough Stream	Corduff River	Ballough Stream IE_EA_08_221 IE_EA_08_792
Regles Stream	Baleally Stream	-
Rathmooney Stream	Bride's Stream	-
Collinstown Stream	Jone's Stream	Lusk River IE_EA_08_524 IE_EA_08_523
Palmerstown Stream	Rush West Stream	-
Rush Stream	Rush town Stream	-
Balcunnin Stream	St Catherine's Stream	-
Lane Stream	Rush Road Stream	-
Mill Stream	Mill Stream	Skerries Stream IE_EA_08_483
Glebe North Stream	Bracken River	Balbriggen IE_EA_08_794
Delvin River	Delvin River	Delvin River IE_EA_08_238 IE_EA_08_138

Appendix F – Groundwater Source Protection Zones Reports - Bog of the Ring and Curragha WSS

Bog of the Ring

Groundwater Source Protection Zones

Prepared by:

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Fingal County Council

March 2005

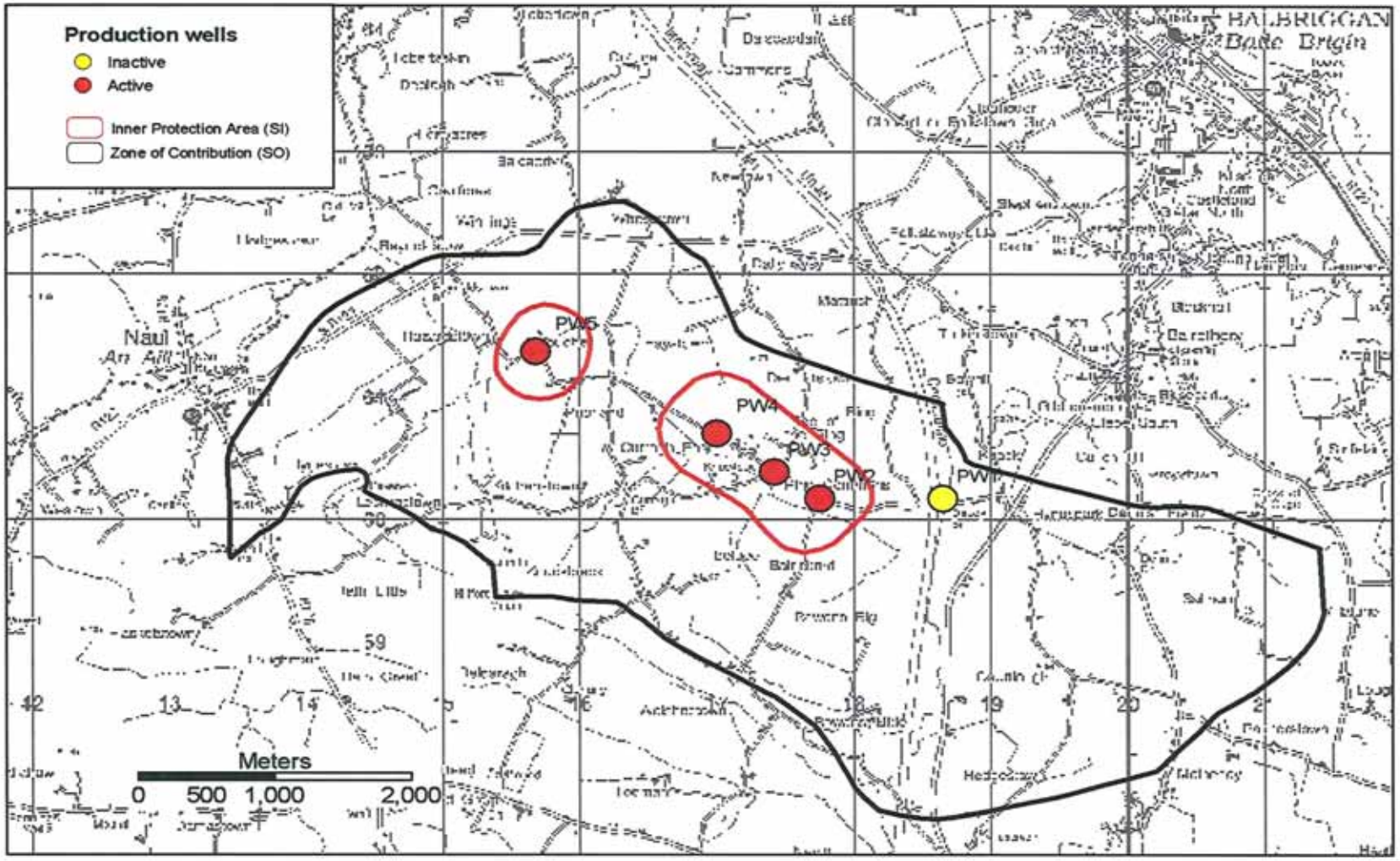

Figure 8: Zone of contribution (ZOC) to the Bog of the Ring wells, showing the Inner (SI) and Outer (SO) protection zones. See text and Table 10 for explanation

CURRAGHA WATER SUPPLY

GROUNDWATER SOURCE PROTECTION ZONES

Prepared for:

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Prepared by:
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Revised June 2004
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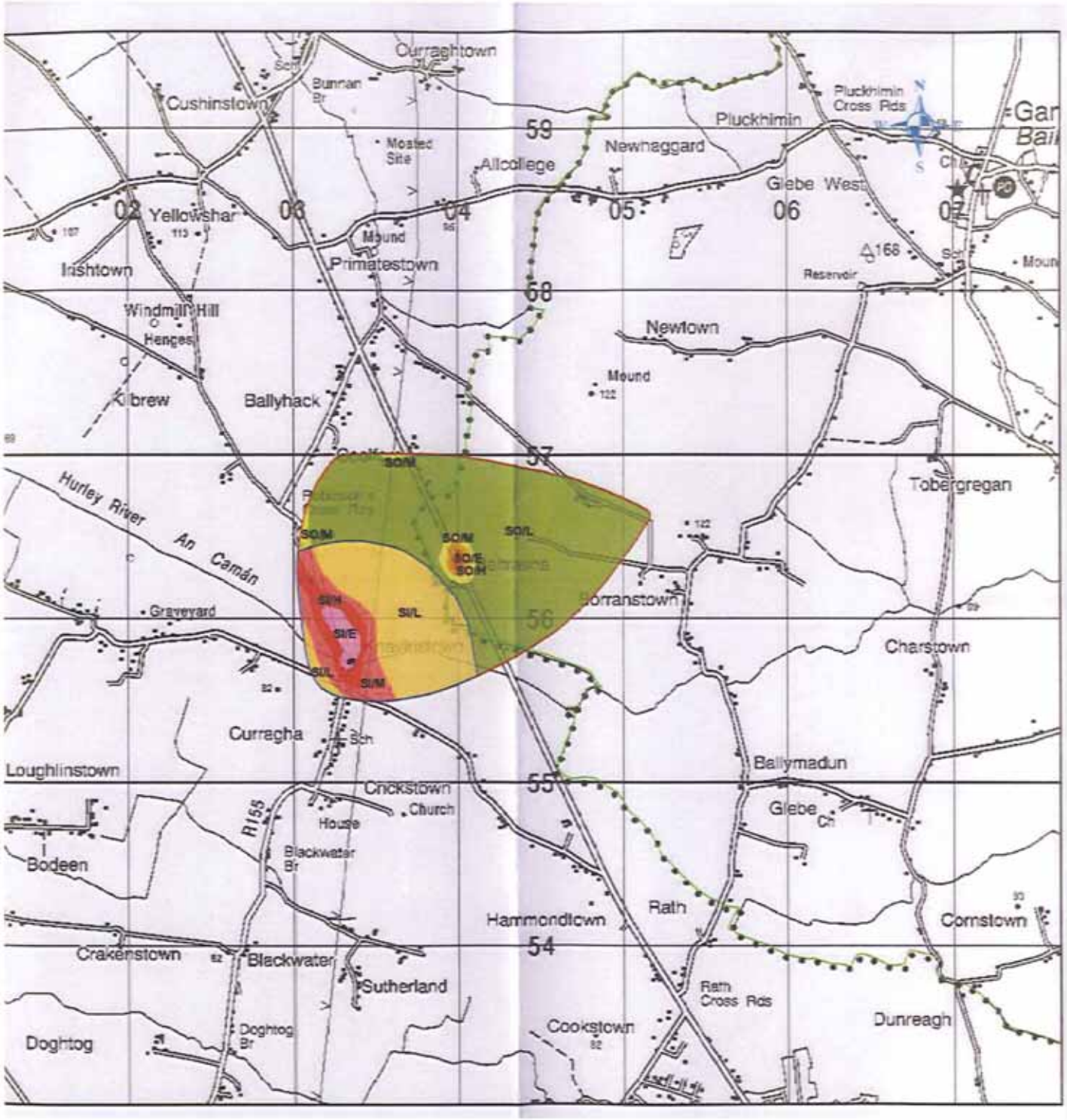

COUNTY MEATH
GROUNDWATER PROTECTION SCHEME
SOURCE PROTECTION ZONES

Vulnerability Rating	Source Protection Zones Inner (SI)	Outer (SO)
Extreme (E)	SI/E	SO/E
High (H)	SI/H	SO/H
Moderate (M)	SI/M	SO/M
Low (L)	SI/L	SO/L

Zone of Contribution of Wells (SO)
Inner protection area (SI)
County Boundary
Public Supply Well

Project Hydrogeologist: Conn Kelly
Project Manager: Geoff Wright
Digital Map Production: Silvia Canice

This Source Protection Zone map is designed for general information and strategic planning usage. The boundaries are based on the available evidence and local details have been generalised to fit the map scale. Evaluation of specific sites and circumstances will normally require further and more detailed assessments and will frequently require site investigations to determine the risk to groundwater.

The map is intended for use in conjunction with groundwater protection responses for potentially polluting activities, which rate the degree of acceptability of these activities in each zone and describes the control measures necessary to prevent pollution.

GEOLOGICAL SURVEY OF IRELAND

Curragha

1:25,000

0 0.5 1 2 Kilometres

Appendix G - Figures