HYDROLOGY AND HYDROGEOLOGY 6

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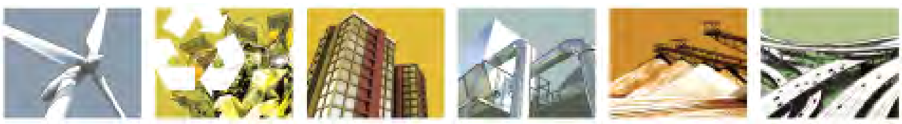

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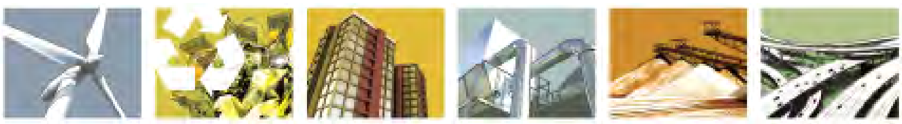


INTRODUCTION

6.1 This Environmental Impact Statement (EIS) provides supporting information to accompany a Planning Application to Fingal County Council by Roadstone Limited in respect of a proposed increase in the permitted waste intake of construction and demolition waste at the waste recovery facility at the Huntstown Quarry Complex at North Road, Finglas, Dublin 11, from a maximum of 24,950 tonnes per annum at the present time to 95,000 tonnes per annum in future years.

6.2 No further C&D waste will be imported to the existing waste recovery facility, located on a 1.9 hectare site in the Central Quarry. The planning application provides for processing and off-site dispatch of C&D waste stockpiled at the existing facility in the near-term (2-3 years), following publication of End of Waste criteria for recycled aggregate. It also provides for

(i) relocation of C&D waste recovery activities to a dedicated new long-term recovery facility on a 5.2 hectare site in the north-eastern corner of the Huntstown Quarry Complex and

(ii) construction of a hardstanding area, waste processing shed, surface water management infrastructure and upgraded internal access road at the new waste recovery facility.

6.3 This Chapter of the EIS presents baseline information on the local hydrology and hydrogeology of the application site and assesses the impact of the proposed increase in the rate of waste intake and the relocation of the recovery facility on the local hydrological and hydrogeological environment.

6.4 For the purposes of this assessment, the study area comprises the application site the surrounding area up to 5km radius around the site boundary. Unmitigated potential impacts on hydrology and hydrogeology are considered for the initial assessment, before appropriate mitigation measures for the potential impacts identified are discussed, and the identified potential impacts reassessed assuming the identified mitigation measures in place.

Background

6.5 The application site comprises two distinct areas within the Huntstown Quarry Complex; an area around the established C&D waste recovery facility at the Central Quarry (the existing facility) and another at the proposed replacement facility at the north-eastern corner of the quarry complex (the relocated facility).

6.6 Ground levels across the existing recovery facility at the Central Quarry have been significantly disturbed by previous quarrying activities. The original ground levels around the quarry typically fall from around 85mOD on the northern side to 80mOD on the southern side. Existing quarry floor levels typically vary from 58mOD to 60mOD.

6.7 Ground level at the proposed site of the relocated facility, in the north-eastern corner of the quarry complex are typically 78mOD to 79mOD and fall gently from east to west, north to south. The site currently comprises seasonal grassland which is grazed by horses. There is a thicket of semi-mature deciduous trees planted along the eastern boundary which screens much of the area from external views beyond the site. There is also an existing mound / screening berm located in the north-eastern corner which rises to a level of approximately 82mOD (ie. 3m to 4m above surrounding ground levels).

6.8 At the present time, the only sub-surface (piped) stormwater drainage infrastructure at Huntstown exists across the central infrastructure area where aggregate processing and concrete production activities are concentrated.

6.9 Rain falling across the existing C&D waste recovery facility at the Central Quarry either

- runs over unsealed ground into the existing quarry void, to a small pond in the north-eastern corner of the quarry floor or
- percolates down through the existing soil / rock at the ground surface as recharge to groundwater, at which point it joins groundwater flow through the ground.

6.10 Groundwater levels around the Central Quarry are depressed by dewatering activities at the North Quarry and South Quarry which are located on either side of it.

6.11 Surface water run-off and any dewatered groundwater at the Central Quarry collects in the pond on the quarry floor, from where it is pumped up to the ground surface to the existing water treatment infrastructure (settlement ponds) located on the eastern side of the central infrastructure area. Thereafter, the run-off is passed through an existing hydrocarbon interceptor and discharged to the Ballystrahan Stream and from there, to the Ward River which flows further to the north. The layout of the existing surface water management system is shown in Figure 2-6 of this EIS.

6.12 Rain falling over the proposed replacement facility, at the north-eastern corner of the quarry complex, generally

- percolates down through soil at the ground surface and recharges to the underlying groundwater table or
- runs south and west over the existing ground surface to a minor (seasonal) pond in the south-western corner.

6.13 It is envisaged that when the recovery facility is relocated to the north-eastern corner, rainfall will continue to percolate through a layer of permeable hardstand (crushed rock) placed over the mineral subsoil and down to the underlying groundwater table, as it does at present. Any surface water run-off which does arise over the hardstand area will fall over the built-up / regraded ground surface toward an open collector channel running in a verge along the western edge of the facility (and along the eastern side of the access road which leads to it). the facility (and along the western side of the recovery facility).

6.14 Any surface water run-off will collect in an enlarged pond in the south-western corner of the facility, from whence it will be pumped across the licenced facility to existing settlement ponds, polishing pond (reed-bed) and hydrocarbon interceptor / grit trap before being discharged to the Ballystrahan Stream.

6.15 Rain falling over the proposed recovery shed will be collected by gutters along the eaves and flow to downpipes along the side of the structure. It will then flow via a network of buried stormwater drainage pipes around the shed to an open grassed channel (swale) running north-south along the eastern boundary of the application site. Thereafter the roof run-off will discharge to the channel of a former natural stream which runs east toward the Ballystrahan Stream. As roof-run-off from the proposed shed will be uncontaminated, it is not proposed to provide any treatment prior to its discharge off-site.

Scope of Work

6.16 This Chapter describes the local hydrological and hydrogeological environment at and around the Huntstown quarry complex based on available information from the area. A qualitative assessment has been undertaken of the potential impacts on this environment arising from the proposed intensification of C&D waste recovery facility at the Central Quarry and the re-location of recovery activities to a dedicated new long-term recovery facility to the north-eastern corner of the quarry complex. The methodology of the assessment is described later in this Chapter.

Sources of Information

6.17 The following sources of information have been consulted in order to investigate the hydrogeology and hydrology of the area surrounding the application site:

- The Environmental Protection Agency for Ireland website (www.epa.ie) for maps and environmental information;
- Geological Survey of Ireland website (www.gsi.ie);
- Geology of Meath, Sheet 13 (1999), and Geology of Kildare-Wicklow (1994) 1:100,000 scale, Geological Survey of Ireland
- Groundwater Protection Schemes. Department of the Environment and Local Government, Environmental Protection Agency, and Geological Survey of Ireland, 1999; and
- Water Maps, Water Framework Directive online mapping (www.wfdireland.ie)

Contributors

6.18 This study of surface water and groundwater was undertaken and prepared by Dominica Baird, an Associate Hydrogeologist with SLR Consulting Ireland

RECEIVING ENVIRONMENT

Available Information : Soil and Geology

6.19 A detailed description of the local and regional soil, subsoil and bedrock geology is provided in Chapter 5 of this EIS. A summary is provided below:

Soils and Subsoils

6.20 The Environmental Protection Agency (EPA) website publishes soils and subsoils maps created by the Spatial Analysis Unit, Teagasc in collaboration with the Geological Survey of Ireland. These maps indicate that the area around the existing C&D waste recovery area and the location of the planned replacement facility is / was typically underlain by well-drained mineral soils derived from underlying stony glacial till subsoil which in turn was derived from limestone parent material (refer to Figures 5-1 and 5-2 of this EIS).

6.21 The soil at the existing C&D waste recovery area has been removed previously to facilitate the extraction of rock and there is currently little or no soil or subsoil remaining at that location.

Solid Geology

6.22 The soil and subsoil deposits around the existing C&D waste recovery area at the Central Quarry and the proposed future replacement facility are underlain by bedrock of several lower Carboniferous Formations (refer to Figure 5-3 and

Figure 5-4 of this EIS). The geological maps indicate that four bedrock formations occur across the Huntstown Quarry Complex. These are:

- The Waulsortian Limestone, described as mainly pale grey biomicrite.
- The Tober Colleen Formation described as very gradationally-interbedded calcareous mudstone and very argillaceous micrite. It overlies, and fills in the gaps between depressions of the Waulsortian Limestones.
- The Boston Hill Formation,: described as a rather uniform, thick successions of nodular diffusely bedded, argillaceous fossiliferous limestones (and their dolomitised equivalents) and subordinate thin shales. Improved understanding of local structural geology means that this formation is now recognised as part of the Malahide Formation.
- The Malahide Formation: at its top, is described as a fossiliferous limestone and shale with some oolites and sandstone, biomicrites and biosparites.

Local Geology

6.23 The bedrock geology of the Huntstown area is complex. It has however been extensively studied and is the subject of published research, summarised in Chapter 5 of this EIS (Geology). The predominant bedrock at Huntstown is limestone, grouped into the Waulsortian, Malahide (Boston Hill) and Tober Colleen Formations, as previously described.

6.24 Six groundwater monitoring wells (designated GW01 to GW06) were installed across the Huntstown Quarry complex in July 2010. The locations of these monitoring wells are shown on Figure 6-1 and Figure 6-5. The well construction records are presented in Appendix 6-A. Groundwater monitoring well GW2 is located beyond the south eastern boundary of the existing C&D waste recovery area. Groundwater monitoring well GW3 is located to the south-east of the proposed future replacement facility.

6.25 The monitoring wells were constructed using rotary percussion drilling techniques, and therefore only general descriptions were obtained of bedrock encountered. Where not affected by quarrying activities, the depth to bedrock across the quarry complex ranges from 1.9m to 13m. The boreholes were drilled to a final depth of between 49m and 80.5m below ground level. Groundwater monitoring piezometers were installed so that specific response zones could be isolated from other water ingress.

6.26 An deep borehole which was recently drilled at the site of the replacement facility in November 2016 was installed with a monitoring standpipe to verify findings from an earlier geophysical investigation and to gather groundwater data. The location of the borehole is shown in Figure 6-1.

Karst

6.27 A review of the GSI karst database (www.gsi.ie) suggests that there are no karst landforms or features within 5 km of the Huntstown Quarry complex.

6.28 The presence, nature and extent of any karstification at Huntstown Quarry was separately assessed by inspection of existing quarry faces and a programme of geophysical surveying and rock drilling undertaken in 2015. These investigations revealed a number of minor solutionally enlarged and clay-infilled joints, particularly within the Feltrim (Waulsortian) Limestone Formation which occurs around the Central Quarry. Where they occur, such features would generally be expected to pinch (narrow) with depth.

6.29 The previous development of the Central Quarry was terminated by a series of major clay-infilled features which occur at its eastern end. Examination of these features indicates that they are largely vertical or sub-vertical features, orientated north-south or north-northwest to south-southeast.

6.30 Details of the recent drilling programme are presented in Chapter 5. These identified a number of clay-infilled solution features, interpreted as a thin zone of vertical to sub-vertical fissures, orientated roughly north-south, over 200m beyond the existing western limit of the Central Quarry.

Available Information : Hydrogeology

Aquifer Characteristics and Groundwater Vulnerability

6.31 The overall quarry complex at Huntstown is located across the Swords Groundwater Body (GWB) and the Dublin GWB, the boundary between which is inferred to run through the middle of the site, refer to Figure 6-6. The existing C&D waste recovery area at the Central Quarry is located within the Dublin GWB while the site of the planned replacement facility in the north-eastern corner of the quarry complex is located in the Swords GWB.

6.32 There are no identified groundwater supply source protection areas within the Swords GWB (www.gsi.ie). There are no major abstractions for groundwater supply from the Dublin GWB. The source protection area for a wellfield at Dunboyne extends marginally into the Dublin GWB. The source protection zone for this wellfield however is 8.5 km west of the Huntstown Quarry complex. Huntstown Quarry itself represents probably the largest groundwater abstraction from the Swords or Dublin Groundwater Bodies.

6.33 The predominant bedrock at Huntstown is limestone. As is typical of Irish bedrock, groundwater flow through the limestone formations is controlled by secondary fissure permeability. The bulk permeability of the limestone formations is relatively high, with groundwater storage and movement mainly constrained to the upper weathered horizons of each unit and to discontinuities (such as such as joints, fractures and faults).

6.34 Bedrock aquifer maps published on the GSI website indicate that the Huntstown Quarry complex straddles bedrock formations which are generally considered to be Locally Important (LI) karstified aquifers. Of the three bedrock formations exposed at Huntstown, both the Waulsortian and Malahide (Boston Hill) Formations are considered to be Locally Important Aquifers (LI), while the Tober Colleen Formation is considered to be a Poor Aquifer (PI). An extract of the bedrock aquifer map is presented as Figure 6-2.

6.35 The subsoil deposits that overlie the bedrock at Huntstown tend to be relatively thin but play an important role in groundwater recharge. Where there are glacial till subsoils present there will be reduced groundwater recharge to the underlying bedrock due to the lower permeability of the tills. Where glacial till subsoils are absent at the site then recharge will be directly to the underlying bedrock.

6.36 Groundwater vulnerability maps published on the GSI website indicate that the Huntstown Quarry complex is located within an area with high to extreme groundwater vulnerability status. This is principally due to the fact that subsoil has been removed over most of the site and is relatively thin in areas where it remains undisturbed (as at the proposed site for the relocated facility). An extract of the groundwater vulnerability map is presented as Figure 6-3.

6.37 The quarry excavations at Huntstown have intersected the groundwater table and lowered it around the periphery with the excavation of each quarry bench. There are minor groundwater inflows to each of the quarries that drain to the quarry floor, where they are contained. Water is pumped from the quarry floor as and when required in order to maintain dry conditions on the floor.

6.38 Surface water run-off (and any dewatered groundwater) at the existing C&D waste recovery area is currently pumped from a sump at a low point in the north eastern corner of the Central Quarry and passed through the existing surface water management system, which includes settlement ponds and a hydrocarbon interceptor located to the east of the central infrastructure area at Huntstown.

6.39 The pump on the quarry floor is floating on the sump and is automated via an automatic float level switch. The pump is only turned on as needed, which is approximately 24 hours per month in winter and spring. Although there is no flow meter at the Central Quarry, when in use the pumping rate is estimated to be approximately 4,500m^3/month (which averages out at less than 2 l/sec). The surface water management system at the existing recovery facility is represented in schematic form in Figure 2-8. When pumps are active, the maximum permitted rate of discharge off-site to the Ballystrahan Stream is 1,800m^3 per day (or approximately 20l/sec).

Rainfall and Climate

6.40 The Average Annual Rainfall (AAR) in the area around Huntstown is c. 824 mm/yr. for the period 1981-2010 (Met Eireann, 2012). The monthly average rainfall values for 1981-2010 are shown in below in Table 6-1.

Table 6-1
Monthly Rainfall Averages (mm) 1981-2010 for Huntstown

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	AAR
70	53	57	58	65	72	59	80	65	86	79	80	824

6.41 Rainfall values for one-hour and two-day storm events of 5-year return period intensity are 16mm and 59.6mm respectively, see Met Eireann Depth Duration Frequency rainfall return table in Appendix 6-B.

Groundwater Recharge

6.42 The groundwater recharge potential has been modelled by the Geological Survey of Ireland (GSI) based on subsoil characteristics, aquifer type, soil drainage and bedrock geology.

6.43 The groundwater recharge beneath the existing quarries at the application site has been assessed by the GSI in accordance with the guidelines from the Irish Working Group on Groundwater (WGGW, 2005). The effective rainfall at the application site is assessed as 419 mm/yr.

6.44 The Water Framework Directive's Working Group on Groundwater (2005) however has suggested that a reasonable 'cap' on recharge to locally important aquifers would be 150mm/year to 200 mm/year and that any incident rainfall in excess of this will be rejected as run-off. Therefore, the maximum groundwater recharge capacity is considered to be 200 mm/yr. The bulk of this groundwater recharge would be likely to occur between late October and early March.

Groundwater Levels and Flow

6.45 During the groundwater well installation works in July 2010, groundwater strikes were recorded at all wells during drilling. A summary of water strikes is presented in Table 6-2 below with elevations.

Table 6-2
Groundwater Strikes Recorded during Well Drilling (July/August 2010)

Borehole Name	Well depth (m)	Water Strike (mbgl)	Water Strike (mOD)	Water Level (mbgl) 05/08/10	Water Level (mOD) 05/08/10
GW01	61	54	26.98	25.47	56.27
GW02*	55	32	49.51	11.99	70.34
GW03**	49	31	46.94	20.46	58.01
GW04	61	54	26.88	29.59	52.14
GW05	55	14.5	70.01	10.81	74.52
GW06	80.5	49	33.16	40.46	42.32

* beyond south eastern boundary of the existing C&D waste recovery area

**south east of the proposed future relocation area

6.46 Water levels presented here were recorded on the 5 August 2010, approximately three weeks after the completion of drilling and groundwater monitoring well installation. Groundwater level monitoring is ongoing at the site by Roadstone.

6.47 Recent groundwater levels at GW01 to GW05 are shown in Table 6-3 and summary groundwater levels are shown in Table 6-4 below.

Table 6-3
Groundwater Levels

Date	GW01 (mOD)	GW02 (mOD)	GW03 (mOD)	GW04 (mOD)	GW05 (mOD)
Ground Level mOD	*80.98*	*81.51*	*77.94*	*81.21*	*84.95*
21/05/2015	<51.74	75.61	59.57	60.03	83.14
24/06/2015	<51.74	59.53	60.25	55.75	78.78
20/07/2015	<51.74	62.83	59.12	53.99	77.31
26/08/2015	<51.74	58.03	57.87	52.43	78.64
29/09/2016	<51.74	65.53	57.62	53.33	78.13
18/11/2015	<50.98	68.23	58.09	60.53	82.32
13/01/2016	54.04	79.12	66.76	62.43	83.93
31/03/2016	<50.98	67.43	61.57	57.63	83.35
16/06/2016	45.28	58.65	58.53	53.73	77.09

Table 6-4
Summary Groundwater Levels (May 2015 to June 2016)

	GW01 (mOD)	GW02 (mOD)	GW03 (mOD)	GW04 (mOD)	GW05 (mOD)
Maximum	54.04	79.12	66.76	62.43	83.93
Average	-	66.11	59.93	56.65	80.30
Minimum	-	58.03	57.62	52.43	77.09

Table 6-5
Variation in Groundwater Levels (May 2015 to June 2016)

	GW01 (m)	GW02 (m)	GW03 (m)	GW04 (m)	GW05 (m)
Variation	-	21.09	9.14	10.00	6.84

6.48 Groundwater level details for the Huntstown site are shown in Table 6-3, Table 6-4 and Table 6-5 above. Note that monitoring well GW06 has dried out on account of recent deepening of the South Quarry and as a result there are no recent records of water levels at this location.

6.49 The recorded groundwater levels at GW2, adjacent to the existing C&D waste recovery area vary from 79mOD (2.4m bgl) to 58mOD (23.5m bgl), with the highest groundwater levels in the winter months. The groundwater levels at GW3, adjacent to the planned future recovery facility, have less variation and vary from 66.8mOD (11.18m bgl) to 57.6mOD (20.32m bgl).

6.50 The groundwater levels around the quarry complex are influenced by their proximity to dewatered quarry voids which lowers groundwater level in the immediate vicinity, refer to Figure 6-1. They are also likely to be influenced by variations in bedrock geology.

6.51 Groundwater contours based on winter recorded groundwater levels in the monitoring wells, measured on 13/01/2016, have been used to determine groundwater contours in the area, presented on Figure 6-1. The groundwater levels in January 2016 followed a particularly wet Autumn period and reflect *maximum* winter groundwater levels over the period May 2015 to June 2016.

6.52 These data establish the indicative groundwater flow directions across the Huntstown Quarry Complex. Although the existing C&D waste recovery area appears to straddle a groundwater divide, groundwater beneath much of this area is inferred to flow south – south east, towards the sump in the floor of the adjoining South Quarry. Groundwater beneath the planned replacement facility is inferred to flow west – south west, toward sumps in the floor of the adjoining North Quarry.

6.53 The depths to groundwater indicate that the existing dewatering operations at Huntstown have lowered groundwater levels over a significant area around the quarry complex and have locally altered the regional groundwater flow regime in the surrounding aquifer, diverting it toward sumps on quarry floor(s). Based on the distance-drawdown method, it is estimated that a reduction of 10m in groundwater levels extends from the quarry faces to 1.1 km from the quarry complex.

Groundwater Abstractions : Use and Quality

6.54 The GSI national well database records indicate that there are 12 wells or drill holes within 1 km of the Huntstown Quarry Cmplex. Of these, only 2 appear to be wells used for groundwater abstraction: one is in the Waulsortian Limestone Formation to the west of the site, and one, also in Waulsortian Formation is to the south of the site.

6.55 Much of the potable water demand in Huntstown and the surrounding area is satisfied by a Local Authority mains supply. The adjoining Huntstown Power Station sources approximately 150m^3/day of water from an on-site well for operational use.

6.56 Under Ireland's obligations for the Water Framework Directive, the status of groundwater bodies nationally has been assessed (www.wfdireland.ie), both on the basis of their quality and availability. The Swords GWB is classified as being of 'Good' overall status and is identified as being '*probably not at risk*' of losing its current 'Good' status. The Dublin GWB is also classified as being of Good overall status, however it is classified as being '*at risk*' of losing its current 'Good' status from urban development pressures.

6.57 At the quarry itself, water abstraction for the concrete production is sourced from sumps on the southern quarry floor which collect groundwater ingress and run-off water. These sumps are continually pumped to maintain dry conditions on the quarry floor.

6.58 Groundwater samples were obtained from the monitoring wells in August 2010 and more recently in 2015 and 2016. Water quality test parameters from August 2010 are presented in Table 6-6. Summary groundwater quality data for three rounds of sampling undertaken between 2015 and 2016 is presented in Table 6-7.

Table 6-6
Groundwater Quality (August 2010)

	GW01	GW02*	GW03**	GW04	GW05	GW06	IGV
pH	7.34	6.84	7.46	7.32	6.86	7.12	6.5 -9.5
Conductivity	114	229	376	512	681	354	1000
Sodium	24.52	17.89	28.62	25.42	16.89	18.45	150
Potassium	3.54	2.99	4.01	3.12	1.58	2.57	5
Calcium	80.7	75.45	92.52	85.42	68.57	78.45	200
Magnesium	17.54	15.42	20.27	19.85	14.56	20.12	50
Chloride	19.23	24.68	43.11	27.49	19.51	34.16	30
Sulphate	48.96	12.09	17.24	36.11	24.66	18.71	200
Total Alkalinity	301	292	351	332	247	313	NAC
Total Hardness	340	352	440	494	220	252	200
Nitrate	18.66	12.45	24.77	16.62	9.32	6.44	25
Nitrite	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.1
Ammoniacal Nitrogen	0.02	0.01	0.04	0.02	0.01	<0.01	0.15
Iron	0.006	<0.001	0.052	<0.001	<0.001	0.067	0.2
Manganese	0.001	<0.001	0.013	<0.001	<0.001	0.021	0.05
Orthophosphate	0.1	0.09	0.06	0.02	<0.01	0.01	0.08
Total Organic Carbon	4.1	4.4	1.5	0.5	3.2	9.9	NAC

* beyond south eastern boundary of the existing C&D waste recovery area

**south east of the proposed future relocation area

Shaded Maximum admissible concentration exceeded

IGV Interim Guideline Value for groundwater, as set out in the EPA Publication 'Towards setting Guideline values for the Protection of Groundwater in Ireland'.

6.59 The groundwater quality data from August 2010 indicate that the groundwater at Huntstown can be considered to be of good status. Virtually all parameters analysed had ion concentrations lower than the Interim Guideline Values (IGV) set out in the EPA Publication '*Towards setting Guideline values for the Protection of Groundwater in Ireland*'. The guideline value for chloride was exceeded at two locations, but this may be due to proximity to the coast (12-km), and its seawater.

6.60 All samples exceeded the guideline for hardness, but it should be noted that hardness occurs naturally at high concentrations in limestone bedrock. About 65% of all groundwater samples from the recent national database have hardness in excess of 200 mg/l. Values of orthophosphate exceeding the guideline value are probably the result of local fertiliser application on agricultural lands surrounding the quarry complex.

Table 6-7
Summary GW Quality data (2015-2016 for three samples)

Parameter	Unit	Limit	GW01			GW02			GW03			GW04			GW05		
			Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.
Ammoniacial Nitrogen	mg/l		<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.34	0	0.23	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Conductivity	uS/cm @ 20°C		1043	883	728	1316	938	651	933	844	704	844	822	778	516	498	481
Diesel Range Organics	mg/l		0.059	0.043	0.026	0.025	0.015	0.010	0.023	0.014	0.010	0.028	0.016	0.010	0.032	0.022	0.010
Nitrate	mg/l		1	0.7	0.5	1	0.8	0.5	1	0.7	0.5	4	3.3	3	<0.5	<0.5	<0.5
Nitrite	mg/l		<0.20	<0.2	<0.20	<0.20	<0.2	<0.20	<0.20	<0.2	<0.20	<0.20	<0.2	<0.20	<0.20	<0.2	<0.20
Orthophosphate as P	mg/l		<0.33	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33
pH	pH Units		7.3	7.2	7.1	7.3	7.2	7.1	7.4	7.3	7.1	7.4	7.2	7	7.6	7.6	7.6
PRO	mg/l		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TPH	mg/l		0.067	0.039	0.01	0.052	0.024	0.01	0.045	0.022	0.01	0.067	0.029	0.01	0.068	0.034	0.01
Faecal Coliforms	cfu/100ml		6	3	0	25	9	0	0	0	0	0	0	0	4	1	0
Total Coliforms	cfu/100ml		15	10	8	>100	72	16	4	3	3	8	3	0	6	3	2

6.61 The hydrochemistry of the groundwater samples from 2015-2016 (on 3 No. samples from each location, see Table 6-7) indicates generally good groundwater quality across the five wells and in the aquifer around and beyond the Huntstown quarry complex. Nitrate and nitrite is low and conductivity is below the threshold value of 1875 μs/cm. Some coliforms have been recorded in samples, although faecal coliforms are low or absent from the monitoring wells. Hydrocarbons including Diesel Range Organics (DRO) and Total Petroleum Hydrocarbons (TPH) are recorded in samples but are present at relatively low levels only. Petrol Range Organics (PRO) are below laboratory detection level.

Groundwater Protection

6.62 The term 'groundwater protection' refers to the ability of subsoils to reduce an influent contaminant load through a variety of biological, physical and chemical processes. The thickness of unsaturated subsoil above an aquifer is therefore a key parameter in determining how well-protected it is. However, the importance of the resource to be protected (i.e. the size of the aquifer) is also fundamental to the magnitude of the risk.

6.63 The DoELG / EPA / GSI have developed a scheme (Groundwater Protection Response Matrix for Landfills) to assessing potential landfill sites on the basis of groundwater vulnerability and aquifer status. However, it should be noted that this scheme has largely been developed for new non-hazardous landfills (i.e. receiving a 'traditional' waste stream of municipal solid wastes, and commercial and industrial wastes). It is therefore not a directly applicable tool for assessment of an inert C&D waste recovery facility.

6.64 Notwithstanding this, the Groundwater Vulnerability Map (Figure 6-3) and the Aquifer Map (Figure 6-2) indicate that both the existing C&D recovery facility and the proposed replacement facility are both located within an area of extreme vulnerability and over a Locally Important Karstified Bedrock Aquifer. These classifications have been compared against the matrix for non hazardous landfills; which indicates that the site setting falls within a response category of R2[2], which is described as being 'acceptable subject to guidance outlined in the EPA Landfill Design Manual or conditions of a waste licence'. The existing C&D facility at the Central Quarry has been operating since 2004 in accordance with a series of waste (facility) permits issued by Fingal County Council.

6.65 Soil stripping will be required at the planned replacement recovery facility, prior to placement of hardstanding. However, this area is already classified as an area of extreme vulnerability and so the removal of existing soil cover will not alter its existing classification.

Available Information : Hydrology

Local Hydrology : Surface Water Bodies

6.66 The Huntstown quarry complex straddles two river catchments, that of the Ward River to the north and the Tolka River to the south, with approximately equal areas of the landholding in each catchment, as shown in Figure 6-4. The existing C&D waste recovery area is located in the Tolka River catchment. The proposed site of the relocated facility in the north-eastern corner of the quarry complex is located in the Ward River catchment.

6.67 In reality, land drainage works and surface water managements systems at Huntstown will have slightly altered the boundary between the Ward and Tolka catchments across the application site and the wider area. Excess water from the existing C&D waste recovery area at the Central Quarry is pumped north to settlement ponds and a hydrocarbon interceptor to the east of the central infrastructure area at Huntstown. This has the effect of placing the existing C&D waste recovery area within the Ward River catchment.

Local Hydrology: Quality

6.68 The Ward River and its tributary the Ballystrahan stream are classified as being of 'Poor' status (www.epa.ie). The River Ward itself has a median Q-rating of 3 (unsatisfactory). Siltation by agriculture and urban wastewater discharges are believed to be the principal contributors to reduced water quality in the catchment.

Local Hydrology : Flows

6.69 The EPA hydrometric website indicates that there was previously a hydrometric station on the River Ward at Owens Bridge, approximately 4.5 km north-east of the Huntstown Quarry complex. This station is however no longer in operation. When operational, it had recorded flow from a catchment area of approximately 36 km^2, but this does not include the Ballystrahan sub-catchment (in which the application site is situated).

6.70 As part of work for the Water Framework Directive, the EPA has prepared an internet-based model for the calculation of ungauged catchments (http://watermaps.wfdireland.ie/HydroTool/), and, for a 7 km^2 area of the Ballystrahan catchment at St. Margaret's, the flows in Table 6-8 have been estimated. Note that the error associated with this model can be in the region of 50%, but it is an improvement on other desk-based methods.

Table 6-8
Flows Estimated for the Ballystrahan Sub-Catchment at St. Margarets

Flows equalled or exceeded for the given percentage of time (litres/sec)										
5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	95%
317	209	131	92	71	66	50	36	25	15	11

Discharge Consents

6.71 There are currently four monitored discharge points at and adjacent to the Huntstown Quarry complex:

- A discharge from the settlement pond / reed bed which receives influent groundwater and rainwater from the North Quarry, designated W4. Discharge point W4 is located to the south-east of the relocated C&D waste recovery facility and is of relevance for planned future discharges arising at this facility;
- A discharge from the Central Quarry, northwards to the settlement ponds located to the east of the infrastructure area, designated W2. Downstream of the monitoring point, this discharge mixes with that of from the aggregate processing area / concrete production area. This discharge is of relevance to the proposed intensification at the existing recovery facility.

- A combined discharge further downstream from W4 which receives waters from the North Quarry and wastewaters from the aggregate processing / concrete production area. This combined discharge ultimately discharges to the Ward River catchment at a discharge point designated W1;
- A discharge to the south (from the southern quarry and surrounding areas), into the River Tolka catchment (Discharge Licence WPW/F/075), designated W3. This discharge is not within the catchment for the C&D waste recovery area(s), and so will not be discussed further.
- A discharge from Huntstown Power Station, which discharges to the Ballystrahan Stream;

Locations of surface water monitoring points are identified on Figure 6-5.

6.72 Discharges from the ongoing inert soil waste recovery activities at the North Quarry are monitored and controlled by way of the EPA Waste Licence (Ref. W0277-01) at the monitoring / control point at W4. This discharge control point will also serve as the control point for discharges arising from the replacement C&D recovery facility, should approval be granted for it.

6.73 A revised effluent discharge licence in respect of combine waters from the North Quarry and concrete production facility (Ref. WPW/F008-01) was issued by Fingal County Council in November 2011, see Appendix 6-C. This discharge licence imposes water quality and volume (1,800m^3 over any 24hr. period) limits on the combined discharges of water from the North Quarry and aggregate processing / concrete production areas within the Huntstown Quarry Complex. The discharge licence also requires that the discharged water, and samples upstream and downstream of the discharge point, are tested on a monthly basis for water quality. Sample locations are indicated on Figure 6-5 (W1 and DL).

Surface Water Quality

6.74 Surface water quality has been monitored for compliance with both the existing EPA Waste Licence and Local Authority discharge licence. Water quality compliance monitoring is undertaken at four locations. Details of monitoring undertaken between October 2015 and April 2016 (after the commencement of soil recovery activities at the North Quarry) are summarised in Table 6-9.

Table 6-9
Surface Water Compliance Monitoring (October 2015 to April 2016)

Name	Location	Purpose of Monitoring	Number of Samples
N.v-notch (W1)	Weir for discharge to Ballystrahan Stream	Discharge licence	14
Upstream (DL)	Upstream of discharge point	Discharge licence	4
Downstream (DL)	Downstream of discharge point	Discharge licence	4
W4	Pumped water from N. Quarry after the settlement lagoon	Waste Licence	2

6.75 The results of this water quality compliance monitoring (for both the Waste Licence and Discharge Licence) are set out in Table 6-10, Table 6-11 and Table 6-12. More detailed water quality test results are presented in Appendix 6-D.

Table 6-10
Water Quality Results for Discharge to Ballystrahan Stream (W1)

Parameter	Unit	Discharge Licence Limit (W1)	Waste Licence Emission Limit (W4)	Number of Samples	Discharge to Ballystrahan Stream (W1)- (N. v-notch weir)		
					Min.	Avg.	Max.
Parameter	Units	MAC Value	MAC Value	No. Samples	Minimum	Average	Maximum
pH	pH Units	6.0-9.0	6.0-9.0	19	7.7	7.9	8.1
Temperature °C	°C	25	25	19	5	11	18
BOD	mg/l	5	5	19	<2	<2	<2
Suspended Solids	mg/l	20	15	19	1	15	39
Ammoniacial Nitrogen	mg/l	-	-	18	0.08	0.14	0.26
Orthophosphate as P	mg/l	-	0.5	16	<0.33	<0.33	<0.33
COD	mg/l	30	-	8	4	7	10
Detergents as MBAS	mg/l	10	-	8	<0.05	0.09	0.28
Dissolved Oxygen	mg/l		-	8	8.3	9.15	9.9
Mineral Oil	mg/l	10	-	8	0.01	0.016	0.023
Phosphate as P	mg/l	1	-	6	0.33	0.50	1
Sulphate	mg/l	300	-	8	221	241	280
Ammonia as NH4	mg/l	1	0.5	7	<0.1	<0.1	<0.1
Zinc	mg/l	-	-	3	0.01	0.01	0.01
Cadmium	mg/l	-	-	3	<0.03	<0.03	<0.03
Copper	mg/l	-	-	3	<0.05	<0.05	<0.05
Iron	mg/l	-	-	3	<0.05	<0.05	<0.05
Lead	mg/l	-	-	3	0.2	0.24	0.26
Magnesium	mg/l	-	-	3	17	19	22

Parameter	Unit	Discharge Licence Limit (W1)	Waste Licence Emission Limit (W4)	Number of Samples	Discharge to Ballystrahan Stream (W1)- (N. v-notch weir)		
					Min.	Avg.	Max.
Manganese	mg/l	-	-	3	<0.03	<0.03	<0.03
Nickel	mg/l	-	-	3	<0.01	<0.01	<0.01
Dissolved Solids	mg/l	-	-	3	415	448	468
DRO	mg/l	-	-	2	0.021	0.023	0.025
TPH	mg/l	-	-	2	0.03	0.039	0.048

Table 6-11
Water Quality Results Upstream of Discharge to Ballystrahan Stream

Parameter	Unit	Upstream of Discharge to Ballystrahan Stream			
		18/11/2015	13/01/2016	26/02/2016	31/03/2016
pH	pH Units	8.1	7.7	7.6	7.9
Temperature	^{o}C	11	9	10	12
BOD	mg/l	3	<2	<2	<2
Suspended Solids	mg/l	79	2	<1	12
Ammonia as NH4	mg/l	<0.10	<0.10	0.62	0.23
Mineral Oil	mg/l	0.03	<0.010	<0.010	<0.010

Table 6-12
Water Quality Results Downstream of Discharge to Ballystrahan Stream

Parameter	Unit	Downstream of Discharge to Ballystrahan Stream			
		18/11/2015	13/01/2016	26/02/2016	31/03/2016
pH	pH Units	8.1	7.9	7.9	7.9
Temperature oC	^{o}C	11	6	8	10
BOD	mg/l	<2	<2	<2	<2
Suspended Solids	mg/l	11	9	13	7
Ammonia as NH4	mg/l	<0.10	<0.10	<0.10	<0.10
Mineral Oil	mg/l	0.011	<0.010	<0.010	<0.010

Table 6-13
Water Quality Results for Waste Licence Emission Monitoring Point W4

Parameter	Unit	ELV	W4 - Pumped Water from North Quarry				
			05/05/2016	12/05/2016	16/05/2016	26/05/2016	09/06/2016
pH	pH Units	6.0-9.0	7.6	7.7	7.9	8	7.9
Temperature oC	^{o}C	25	13	14	12	13	17
BOD	mg/l	5	<2	<2	<2	<2	<2
Suspended Solids	mg/l	15	16	4	3	2	5
Ammoniacal Nitrogen	mg/l	0.5	<0.1	<0.08	<0.08	<0.08	<0.08
Orthophosphate as P	mg/l	0.5	<0.33	<0.33	<0.33	<0.33	<0.33

6.69 The off-site discharge at monitoring / control point W1 (v-notch weir) is generally of good quality except for suspended solids. The level of suspended solids at the weir exceeded the Discharge Licence Limit of 20mg/l on four occasions (see Appendix 6-D).

6.76 The recorded water quality upstream and downstream of the discharge point at the v-notch weir (W1) presented in Table 6-11 and Table 6-12 respectively indicates that the receiving waters are generally of reasonable quality, with low suspended solids downstream of the discharge point. The sample upstream of the discharge point taken on 18/11/2015 indicates high suspended solids which is not present in the sample downstream of the same date. There are also some hydrocarbons recorded in the sample on the same date which are present upstream and downstream of the discharge point.

6.77 Waste Licence Emission monitoring point W4 is for water discharges solely from the location of ongoing recovery activities at the North Quarry. Five sets of recent monitoring results for this monitoring point are shown in Table 6-13 above. The water quality is within the Emission Limit Values (ELVs) set by the existing EPA Waste Licence except for a minor exceedence (by 1mg/l) of the limit for suspended solids recorded for a sample taken on 05/05/2016. It should however be noted that subsequent, more recent test results were generally less than half of the permitted limit value.

Discharge Volumes

6.78 The cumulative discharge from the North Quarry and central infrastructure area is limited to a maximum of 1,800m^3 over any 24 hour period by Schedule B2 of the existing EPA Waste Licence and Condition No. 11 of the current Discharge Licence (refer to Appendix 6-C). The discharge volume is monitored on a continuous basis at the v-notch weir and the summary daily maximum and average volumes discharged are shown In Table 6-14 by month.

Table 6-14
Summary Discharge Volumes to Ballystrahan Stream (2015 - 2016)

Month	Maximum Daily (m^3/day)	Average Daily (m^3/day)
March 2015	1,751	958
April 2015	1,973	602
May 2015	1,968	813
June 2015	1,125	469
July 1st to 17th 2015	1,090	502
August 7th to 31st 2015	1,556	511
September 2015	1,953	376
October 2015	1,845	286
November 2015	1,750	871
December 2015	1,885	1,635
January 2016	1,874	1,325
February 2016	2,036	1,384
March 2016	1,630	938
April 2016	1,905	996
May 2016	1,097	538
June 2016	1,256	354

6.79 The daily discharge volumes from the 18th July to the 7th August 2015 are not available as there was a fault with the discharge flow logger and no discharge flow measurements were recorded. The logger fault was repaired in early August 2015 and recording resumed on the 7th August.

6.80 The daily discharge volumes recorded at the weir indicate that the maximum discharge is close to the discharge licence limit of 1,800 m^3/day, and was exceeded on a number of occasions, see Table 6-14. The permitted daily discharge volume was exceeded 21 times between March 2015 and June 2016.

Flooding

6.81 The Office of Public Works (OPW) website (www.floodmaps.ie) indicates that there is a record of one historic flood event in the vicinity of Huntstown, at Kilshane Cross in November 2002. This flood was attributed to ‘runoff from adjacent grasslands’, and was not related to quarrying activities at Huntstown.

6.82 Surface water run-off and discharges at the Huntstown Quarry complex are managed on a continual basis so that they do not increase the risk of flooding in the surrounding area. An assessment was previously undertaken for the channel carrying capacity of the Ballystrahan stream in connection with the discharge licence application, in order to demonstrate the existing channel capacity for the discharge.

6.83 The OPW has produced a model flood extent map for the Ward River (www.opw.ie) which extends up the lower reaches of the Ballystrahan Stream, but not to the quarry complex or application site which is located at the headwaters of the stream. The flood mapping indicates some flooding along the channel for the modelled 1% Annual Exceedance Probability event within c. 0.5km of the confluence with the Ward River.

Limitations

6.84 The assessment of the hydrological and hydrogeological environment presented above is based on visual observations from site visits, available monitoring records, published information and discussions with personnel employed on site. It should be viewed as a largely qualitative assessment.

IMPACT OF PROPOSED DEVELOPMENT

Evaluation Methodology

6.85 The impacts on the local surface water and groundwater environment of the proposed intensification of activity at the existing C&D waste recovery facility and the planned future relocation of the facility to the north-eastern corner of the quarry complex are assessed in this section.

6.86 The methodology applied here is a qualitative risk assessment methodology in which the probability of an impact occurring and the magnitude of the impact, if it were to occur, are considered. This approach provides a mechanism for identifying the areas where mitigation measures are required, and for identifying mitigation measures appropriate to the risk presented by the development. This approach allows effort to be focused on reducing risk where the greatest benefit may result.

6.87 The assessment of risk is based on the matrix outlined in Table 6-15 below.

Table 6-15
Matrix Used to Assess Potential Impacts

Probability of Occurrence	Magnitude of Potential Impacts			
	Severe	Moderate	Mild	Negligible
High	High	High	Medium	Low
Medium	High	Medium	Low	Near Zero
Low	Medium	Low	Low	Near Zero
Negligible	Low	Near Zero	Near Zero	Near Zero

6.88 The assessment of likely magnitude of potential impacts in relation to hydrogeology and hydrology is assessed in accordance with criteria detailed in Table 6-16 below.

Table 6-16
Magnitude of Potential Hydrological and Hydrogeological Impacts

Magnitude	Potential Impact
Negligible	No alteration or very minor changes with no impact to watercourses, hydrology, hydrodynamics, erosion and sedimentation patterns; No alteration to groundwater recharge or flow mechanisms; and No pollution or change in water chemistry to either groundwater or surface water.
Mild	Minor or slight changes to the watercourse, hydrology or hydrodynamics; Changes to site resulting in slight increase in runoff well within the drainage system capacity; Minor changes to erosion and sedimentation patterns; and Minor changes to the water chemistry of surface runoff and groundwater. .
Moderate	Some fundamental changes to watercourse, hydrology or hydrodynamics; Changes to site resulting in an increase in runoff within system capacity; Moderate changes to erosion and sedimentation patterns; and Moderate changes to the water chemistry of surface runoff and groundwater.
Severe	Wholesale changes to watercourse channel, route, hydrology or hydrodynamics; Changes to site resulting in an increase in runoff with flood potential Significant changes to erosion and sedimentation patterns; and Major changes to the water chemistry or hydro-ecology.

6.89 In addition to their nature and significance, the potential impacts will be assessed in terms of their duration, whether they are direct or indirect impacts. Any cumulative impact of the potential impacts will be assessed, particularly with regard to the cumulative impacts with the adjoining soil waste recovery facility, which is permitted to take in 1,500,000 tonnes of material per annum.

6.90 The following sections identify the potential impacts of the proposed developments on the hydrogeological and hydrological environments. It also assesses the likelihood of occurrence of each identified impact in accordance with Table 6-15 and Table 6-16. It should be noted that the impacts are initially assessed with no mitigation or design measures incorporated to reduce the risk.

Construction Stage

6.91 There is no construction stage associated with the intensification of activities at the existing C&D waste recovery facility at the Central Quarry. No activity will be undertaken at the site however until a waste licence review has been completed and a revised waste licence issued by the EPA.

6.92 Relocation of the C&D facility will require the construction of a hardstanding area, waste processing shed, surface water management infrastructure and upgraded internal access road. Potential short term impacts during the construction stage for the relocation of the facility are considered qualitatively below.

Potential Impacts on Groundwater

6.93 During the construction stage of the replacement C&D facility, there is a risk of groundwater pollution from the following potential sources:

- accidental spillage of fuels and lubricants by construction plant during construction works, and
- increase in suspended solids and potential for contaminated runoff entering groundwater during construction works, particularly during soil stripping.

6.94 Without mitigation, the probability of occurrence of spillage of fuels, lubricants and other potentially contaminative liquids (contaminated runoff) is **medium** during the construction stage. The magnitude of such an impact would be '**moderate**'. Therefore, the overall risk to groundwater, without mitigation, is '***medium***'.

6.95 Without mitigation, the probability of suspended solids in runoff entering groundwater is considered to be '**medium**' due to the required soil stripping at the proposed relocated facility. The magnitude of the potential impact on groundwater is considered to be '**mild**', as mobilisation and transport of suspended solids requires a flow velocity greater than that usually achievable in the groundwater environment. Therefore the overall risk is **'*medium-low*'**.

Potential Impacts on Surface Water

6.96 The Ballystrahan Stream is located to the east of the proposed relocated facility. The construction phase could result in waters with elevated suspended solids being discharged from the site and entering the Ballystrahan Stream. Given existing site drainage patterns, the probability of such an event occurring is considered to be '**low**' and the magnitude of impact is '**moderate**'. The overall impact on surface waters is therefore assessed as '***medium-low***' if mitigation measures were not in place.

Operational Stage

6.97 Potential short-long term impacts during the operational stage for both the intensification of the existing C&D facility (in the near-term) and the relocation of the facility (in the near-to-long term) are considered qualitatively below.

Potential Impacts on Groundwater

6.98 The proposal to intensify C&D waste recovery activity and to relocate the facility has the potential to impact on groundwater quality.

6.99 During the continued / future operation of the recovery facility (at either location), there is a risk of groundwater pollution from the following sources:

- accidental spillage of fuels and lubricants by construction plant during handling / transfer and processing of waste and operational procedures;
- increase in suspended solids and potential for contaminated runoff entering groundwater as a result of intensification of C&D recovery activity, and
- deposition of rogue loads of contaminated C&D waste at the facility.

6.100 There is a potential increase in risk to groundwater quality from these sources if there is increased site activity and increased level of traffic associated with the intensification of C&D recovery activities.

6.101 Without mitigation, the probability of occurrence of spillage of fuels, lubricants and other potentially contaminative liquids (contaminated runoff) is **medium** due to the extended area of the site and the increased number of vehicles and plant moving around the facility. The magnitude of such an impact would be '**moderate**'. Therefore, the overall risk to groundwater, without mitigation, is '***medium***'.

6.102 Without mitigation, the probability of suspended solids in runoff entering groundwater is considered to be '**medium-high**' due to the increase in volumes of waste materials being handled. The magnitude of the potential impact on groundwater is considered to be '**mild**', as mobilisation and transport of suspended solids requires a flow velocity greater than that usually achievable in the groundwater environment. Therefore the overall risk is '***medium***'.

6.103 Without mitigation, the probability of occurrence of a rogue load which may have the potential to contaminate groundwater at the site is '**medium**'. The magnitude of impact is '**mild**' to '**moderate**' depending on where the rogue load is stockpiled. Therefore, the overall impact is considered to be '**low**' to '**medium**'.

Potential Impacts on Surface Water

6.104 There are several permanent surface water features within the Huntstown Quarry complex including natural or modified watercourses and artificial features such as ditches, temporary channels, sumps and/or settlement ponds which are used for surface water management. The surface water runoff is directed towards the sump at the existing C&D facility and is currently being pumped and passed through the surface water treatment system prior to discharge off-site to the Ballystrahan Stream.

6.105 The intensification of activity at the existing C&D facility could result in an increase in suspended solids in the surface water runoff, where it will be passed through the existing treatment system. In view of the proposed scale of C&D waste recovery activities relative to that of other on-site activities and the existence and historical performance of the established surface water management infrastructure, the probability that the projected intensification of activity at the Central Quarry will result in an increase in suspended solids impacting on surface water is considered to be '**low**' and the magnitude of impact is '**mild**'. The overall impact on surface waters is assessed as '***low***'.

6.106 Surface water run-off from the planned future replacement facility could potentially carry suspended solids toward the Ballystrahan Stream to the east of the site. The probability of such an event occurring is considered to be '**high**' and the magnitude of impact is '**moderate**'. Therefore, the overall impact on surface water is assessed as '***high***' if mitigation measures are not put in place.

6.107 There could be a potential impact on surface water flow quantities arising from the proposed relocation of the waste recovery facility, principally on account of the increased stormwater run-off to be managed from the proposed recovery shed. The probability of this event occurring is considered to be '**high**' and in view of the area involved, the magnitude of impact is considered to be '**moderate**'. Therefore, the overall impact on surface water is assessed as '**high**' if mitigation measures are not put in place.

6.108 Excluding roof run-off however, the quantity of run-off directed to the proposed settlement pond at a low point in the south-western corner is not expected to be significant and increase in flow quantities can be readily managed within existing quarry sumps and/or surface water holding / settlement ponds within the quarry complex. These have the capacity to provide attenuation prior to discharge.

Summary of Potential Impacts

6.109 A summary of potential impacts *without mitigation* is presented in Tables 6-17 and 6-18 below.

Table 6-17
Unmitigated Risk and Magnitude of Potential Impacts (Construction)

Potential Impact	Spatial Impact, Duration, Direct/Indirect	Probability of Occurrence	Magnitude of Impact	Significance of Impact	Mitigation Required?
Groundwater Quality					
Spillages of fuel	Local, Short Term, Direct	Medium	Moderate	Medium	Yes
Release of suspended solids	Local, Short-Term, Direct	Medium	Mild	Medium - Low	Yes
Surface Water Quality					
Release of suspended solids during soil stripping	Local, Short Term, Direct	Low	Moderate	Medium - Low	Yes

Table 6-18
Unmitigated Risk and Magnitude of Potential Impacts (Operational)

Potential Impact	Spatial Impact, Duration, Direct/Indirect	Probability of Occurrence	Magnitude of Impact	Significance of Impact	Mitigation Required?
Groundwater Quality					
Spillages of fuel	Local, Short Term, Direct	Medium	Moderate	Medium	Yes
Release of suspended solids	Local, Short-Term, Direct	Medium - High	Mild	Medium	Yes
Rogue load of contaminated material	Local, Short Term, Direct	Medium	Mild to Moderate	Low to Medium	Yes
Surface Water Quality					
Release of suspended solids following intensification	Local, Short Term, Direct	Low	Mild	Low	No

Potential Impact	Spatial Impact, Duration, Direct/Indirect	Probability of Occurrence	Magnitude of Impact	Significance of Impact	Mitigation Required?
Release of suspended solids following relocation	Local, Short and Long Term, Direct	High	Moderate	High	Yes
Surface Water Quantity					
Increase in surface water discharge following relocation	Local, Short and Long Term, Direct	High	Moderate	High	Yes
Capture of surface water runoff from the Tolka River catchment during intensification	Regional, Long Term, Indirect	High	Negligible	Low	No

6.110 Tables 6-17 and 6-18 indicate that if no mitigation measures are applied to take account of the intensification of the C&D waste recovery activities, there is potential for the activity to cause a direct and detrimental impact to the aquifer by increased risk of pollution to groundwater. The impacts are local, and range from short-term to long-term.

6.111 If several of the identified potential impacts to groundwater quality were to materialise, there could be a cumulative effect, which would increase the overall significance of the impact. There is also a potential cumulative effect with other activities within the quarry complex.

6.112 Similarly, in the absence of effective surface water management systems, the relocation and establishment of the proposed C&D waste recovery facility has the potential to increase the risk of direct impact to the Ballystrahan Stream, both in terms of quality and quantity of flows discharged.

6.113 Any surface water runoff from the application site will go to the Ward River catchment. The mitigation measures outlined in following sections will be implemented and incorporated into the development proposal to reduce the potential impacts identified above.

Interactions

6.114 It is considered that the groundwater and surface water at Huntstown are not interconnected at the present time and will not be for the duration of the works. It is further considered that the headwaters of the Ballystrahan Stream are not in continuity with regional groundwater at the application site.

MITIGATION MEASURES

6.115 Proposed mitigation measures required to reduce the potential impacts associated with the proposed works to acceptable levels with a low risk to the receiving environment, are identified in this section. These measures are designed to either reduce the likelihood of an event occurring, or reduce the magnitude of the consequences if the event does occur. It should be noted that several of the mitigation measures proposed would have a positive effect on more than one potential impact.

Existing and Proposed Mitigation Measures

6.116 In order to mitigate against the risk of pollution to groundwater and surface water occurring, the following management measures will be included. Note that existing measures will be extended to and/or applied at the relocated C&D facility once it is established and operational:

Existing Measures -

- A site specific traffic management system has been put in place to reduce the potential conflicts between vehicles, at both the C&D waste recovery facilities and across the wider quarry complex site where vehicles transit to the quarries and production areas, thereby reducing the risk of an accidental vehicle collision;
- the speed limit is enforced to further reduce the likelihood and significance of collisions between vehicles;
- all plant is regularly maintained and inspected daily for leaks of fuels, lubricating oil or other contaminating liquids/liquors;
- refuelling of vehicles is undertaken at a surfaced area from a fuel tank(s) that is bunded or from a mobile double skinned fuel bowser in order to minimise the risk of uncontrolled release of polluting liquids / liquors;
- the maintenance of plant and machinery is undertaken within the existing site maintenance shed or off-site, as appropriate, to minimise the risk of uncontrolled release of polluting liquids;
- spill kits are available on-site to stop the migration of spillages, should they occur;
- all C&D waste is vetted, inspected and tested to confirm it is inert prior to importation and recovery at the facility. Waste handling procedures at the facility provide for classification, compliance and verification testing of waste intake;
- all surface water run-off collected in the sump at the existing C&D facility at the Central Quarry is pumped to a settlement pond prior to discharge off-site to surface watercourses in order to reduce the concentration of suspended solids.

Proposed Measures –

- Temporary surface water management infrastructure (settlement ponds) will be provided to manage run-off during the construction / establishment phase for the proposed replacement C&D facility;
- Materials used to construct the external hardstanding area will continue to allow rainwater to percolate to the underlying groundwater table and prevent the build-up / generation of mud / wet fines. Heavily trafficked hardstand areas will be regularly maintained regularly as required;
- Stormwater runoff from the roof of the proposed recovery shed at the relocated recovery facility will be collected by gullies and a sub-surface drainage system around the shed and discharges to an open channel grassed channel (swale) running north-south along the eastern boundary of the facility, to be discharged to the channel of a former natural stream which runs east toward the Ballystrahan Stream. As roof-run-off from

the proposed shed will be uncontaminated, there is no requirement to provide any treatment prior to its discharge off-site;

- Flood attenuation for roof run-off will be provided by fitting a flow control device / hydrobrake at the downstream end of the swale (and immediately upstream of the channel leading to the Ballystrahan Stream) in order to limit the maximum stormwater run-off to the existing greenfield rate.
- Surface water runoff from the access road and hardstanding areas will be collected by open collector channels to an enlarged pond in the south-western corner of the proposed new C&D waste recovery facility. It is envisaged that the water collecting in the pond will be pumped intermittently as required from there to the existing network of settlement / holding ponds across the quarry complex. The pump will float at the pond and its level controlled by way of an automatic float level switch.
- The surface water run-off will ultimately be pumped from the settlement / holding ponds and passed through the existing polishing pond (reed-bed) and hydrocarbon interceptor / grit trap before being discharged to the Ballystrahan Stream.
- Existing water treatment systems at the quarry complex will continue to be upgraded, as necessary (with provision of additional settlement pond capacity as required) in order to ensure that suspended solids in all off-site discharges are compliant with Emission Limit values set out in the EPA Waste Licence and / or Local Authority Discharge Licence;
- The C&D waste recovery facility will continue to be run in accordance with best waste management practice, with the required plant and staff resources put in place to facilitate this.

6.117 Taken together, these measures reduce the potential impact of

- spillage of fuels and lubricants from '*medium*' / '*medium-low*' to '*low*';
- an increase in suspended solids to groundwater from '*medium*' to '*low*';
- contamination from rogue loads from '*medium-low*' to '*low*';
- release of suspended solids to surface waters from '*medium-low*' and '*high*' to '*low'.*
- increase in quantities of stormwater flows off-site from *'high' to 'low'.*

Monitoring

6.117 Monitoring measures have been implemented at the quarry complex and existing recovery facility in accordance with planning consents and monitoring requirements under the existing EPA Waste Licence. These monitoring measures will continue during at and around the recovery facilities in order to monitor any potential impact of the inert C&D waste recovery activities on groundwater or surface water.

6.118 It is envisaged that the untreated surface water discharge from the Central Quarry will be sampled and monitored at location W2, immediately upstream of its discharge into the settlement lagoons (which also treat run-off from the central infrastructure area). In this way, the environmental performance at the C&D waste recovery facility can be monitored independently of other site based activities at the quarry complex.

6.119 Occasional sampling and testing is / will also be undertaken on samples taken from any temporary surface water features / ponds or sumps which may either be created or form naturally at low points within the Central Quarry or at the replacement recovery facility (W5 and W6 respectively). These and other established surface water monitoring locations at the Huntstown facility are shown on Figure 6-5.

6.120 An additional groundwater monitoring location, designated GW07 has recently been installed at the site of the proposed replacement facility. Groundwater at this location will be included (for a period) in future rounds of monitoring at the quarry complex. The location of this borehole / monitoring well is indicated in Figure 6-5.

Existing Groundwater Monitoring

6.121 Groundwater monitoring is being undertaken in accordance with Schedule C.5 of the Waste Licence at GW01, GW02, GW03, GW04 and GW05. Monitoring and sampling at GW06 has been suspended as no groundwater is intercepted by the well since the South Quarry was deepened.

6.122 The groundwater sampling schedule is set out in Schedule C of the existing Waste Licence, as shown in Table 6-19 below.

Table 6-19
Groundwater Monitoring Schedule from Waste Licence

Parameter	Monitoring Frequency	Analysis Method / Technique
Groundwater Level	Quarterly	Standard Method
Visual Inspection	Quarterly	Standard Method
pH	Quarterly	pH Electrode/meter
Conductivity	Quarterly	Standard Method
Ammonia as N	Biannually	Standard Method
Orthophosphate as P	Biannually	Standard Methods
Total Dissolved Solids	Biannually	Standard Method
Dissolved Metals	Annually	Standard Method
Total Petroleum Hydrocarbons	Annually	Standard Method
Diesel Range Organics	Annually	Standard Method
Petrol Range Organics	Annually	Standard Method
Total Coliforms	Annually	Standard Method
Faecal Coliforms	Annually	Standard Method

Existing Surface Water Monitoring

6.123 Surface water at the application site is currently tested for a range of physical and chemical parameters in line with the discharge licence and Waste Licence requirements.

6.124 Surface water sampling and chemical testing will be undertaken as per the requirements of the existing Waste Licence for the site. The surface water test parameters and monitoring frequency are set out in Schedule C of the Waste Licence and is shown in Table 6-20 below.

Table 6-20
Surface Water Monitoring Schedule from Waste Licence

Parameter	Monitoring Frequency	Analysis Method / Technique
Visual Inspection	Daily	Examine colour and odour
Flow	Daily	Flow meter
Temperature	Weekly	Temperature probe
pH	Weekly	pH Electrode/meter
BOD	Weekly	Standard Method
Suspended solids (mg/l)	Weekly	Standard Method
Ammonia as N	Weekly	Standard Method
Orthophosphate as P	Weekly	Standard Method
Dissolved Metals (Cd, Cu, Fe, Pb, Mg, Mn, Ni and Zn)	Quarterly	Standard Method
Total Dissolved Solids	Quarterly	Standard Method
Total Petroleum Hydrocarbons	Biannually	Standard Method
Diesel Range Organics	Biannually	Standard Method
Petrol Range Organics	Biannually	Standard Method

6.125 The emission limit values for the discharge to surface water are set out in Schedule B of the Waste Licence and are shown in Table 6-20 below. These limits will continue to apply if the rate of waste intake is increased.

Table 6-21
Surface Water Emission Limit Values

Parameter	Unit	Emission Limit Value
Temperature	^{o}C	25
pH	pH units	6 - 9
BOD	mg/l	5
Suspended Solids	mg/l	15
Ammonia as N	mg/l	0.5
Orthophosphate as P	mg/l	0.5

RESIDUAL IMPACTS

6.126 Examination of the identified potential impacts on the receiving environment, summarised in Table 6-22 overleaf confirms that, provided appropriate mitigation measures in put in place, there are no significant residual impacts with respect to groundwater and/or surface water.

6.127 It is therefore considered that with the implementation of the mitigation measures outlined in Section 6.116, the proposed intensification of the existing C&D area and the relocation of the facility will not cause any significant impact on groundwater and/or surface water.

Table 6-22
Summary of Mitigation and Residual Impacts at Huntstown

Potential Impact	Spatial Impact, Duration, Direct/Indirect	Probability of Occurrence	Magnitude of Impact	Significance of Impact	Mitigation Required?	Mitigation Measures	Mitigated Probability of Occurrence	Mitigated Magnitude of Impact	Residual Magnitude of Impact
Groundwater Quality									
Spillages of fuel	Local, Short Term, Direct	High	Moderate	High	Yes	Traffic systems, speed limits, maintenance, refuelling measures, tank bunding and spill kits	Low	Moderate	Low
Release of suspended solids	Local, Long Term, Direct	High	Mild	Medium	Yes	Silt reduction measures through good site housekeeping and surface water management	Low	Mild	Low
Rogue load of contaminated material	Local, Short Term, Direct	Medium	Mild to Moderate	Low to Medium	Yes	Inspection and testing of waste loads. Testing to include classification, compliance and verification testing of the waste intake.	Low	Mild to Moderate	Low
Surface Water Quality									
Release of suspended solids following intensification and / or relocation	Local, Short and Long Term, Direct	High	Moderate	High	Yes	Silt reduction measures through surface water management including settlement / holding ponds and hydrocarbon interceptors Up grading of existing surface water treatment as required	Low	Mild	Low

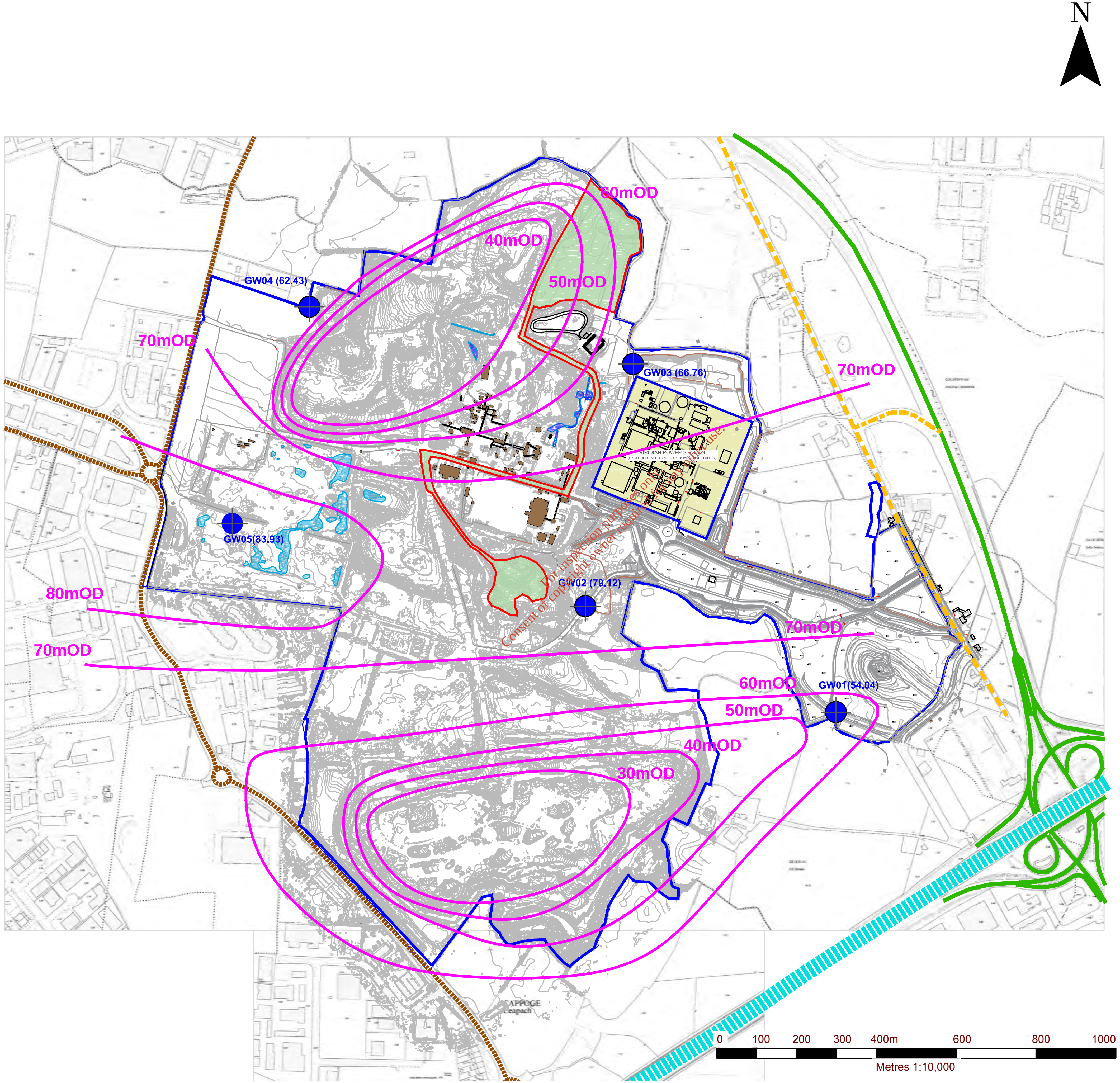
Potential Impact	Spatial Impact, Duration, Direct/Indirect	Probability of Occurrence	Magnitude of Impact	Significance of Impact	Mitigation Required?	Mitigation Measures	Mitigated Probability of Occurrence	Mitigated Magnitude of Impact	Residual Magnitude of Impact
Surface Water Quantity									
Increase in surface water discharge following relocation	Local, Short and Long Term, Direct	High	Moderate	High	Yes	Install stormwater drainage at recovery shed and a swale to attenuate off-site flows	Low	Low	Low
Capture of surface water runoff from the Tolka River catchment	Local, Long Term, indirect	High	Negligible	Low	No				

CONCLUSIONS

6.128 The groundwater and surface water regimes at both existing and planned future recovery facilities have been assessed with reference to information held by the Geological Survey of Ireland, the Environmental Protection Agency and others. This information has been supplemented with site specific investigation information including monitoring results from the wider quarry complex.

6.129 The potential impacts on the hydrogeological and hydrological environment of the proposed intensification of C&D waste recovery activities at the existing facility at the Central Quarry and the relocation of the facility to the north-eastern corner of the quarry complex have been identified and assessed, and where appropriate, mitigation measures have been proposed to be incorporated into the design of the development.

FIGURES



NOTES

1. EXTRACT FROM 1:2,500 ORDNANCE SURVEY DIGITAL SHEET **NO'S. 3062-A, 3062-B, 3062-C, 3062-D, 3063-A, 3063-C, 3130-A & 3130-B**.

2. ORDNANCE SURVEY IRELAND LICENCE NO. **SU 0000716 (C)** ORDNANCE SURVEY & GOVERNMENT OF IRELAND

LEGEND

- ROADSTONE LIMITED LAND INTEREST **(c. 200.3 ha)**
- APPLICATION AREA **(c 8.27 ha)**
- N2 DUAL CARRIAGEWAY
- NORTH ROAD (R135)
- LOCAL ROAD
- M50 MOTORWAY
- GROUNDWATER MONITORING WELLS (GROUNDWATER LEVEL 13/01/2016 mOD)
- INTERPRETED GROUNDWATER LEVEL CONTOUR (13/01/2016) - WINTER MAXIMUM LEVEL
- SEMI-PERMANENT / EPHEMERAL PONDS IN WEST QUARRY (JUNE 2016)

SLR
global environmental solutions
SLR CONSULTING IRELAND
7 DUNDRUM BUSINESS PARK
WINDY ARBOUR
DUBLIN 14
T: +353-1-2964667
F: +353-1-2964676
www.slrconsulting.com

ROADSTONE LIMITED
ENVIRONMENTAL IMPACT STATEMENT

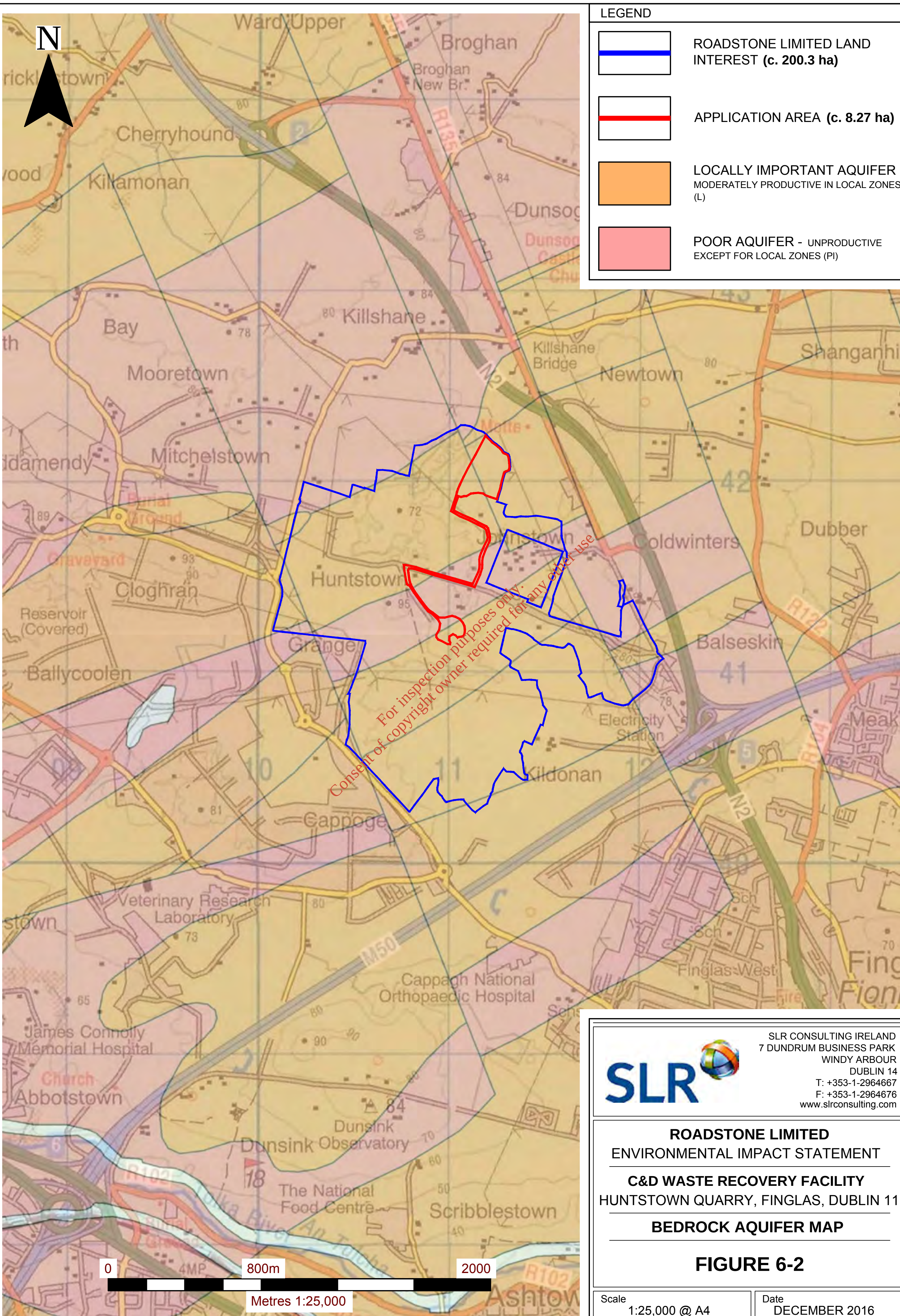
C&D WASTE RECOVERY FACILITY
HUNTSTOWN QUARRY, FINGLAS, DUBLIN 11

GROUNDWATER CONTOURS (JAN 2016)

FIGURE 6-1

Scale	Date
1:10,000 @ A3	DECEMBER 2016

0180.00166.0.FIG_6-1.Groundwater Contour Map.dwg



LEGEND

ROADSTONE LIMITED LAND INTEREST **(c. 200.3 ha)**

APPLICATION AREA **(c. 8.27 ha)**

LOCALLY IMPORTANT AQUIFER
MODERATELY PRODUCTIVE IN LOCAL ZONES (L)

POOR AQUIFER - UNPRODUCTIVE EXCEPT FOR LOCAL ZONES (PI)

SLR CONSULTING IRELAND
7 DUNDRUM BUSINESS PARK
WINDY ARBOUR
DUBLIN 14
T: +353-1-2964667
F: +353-1-2964676
www.slrconsulting.com

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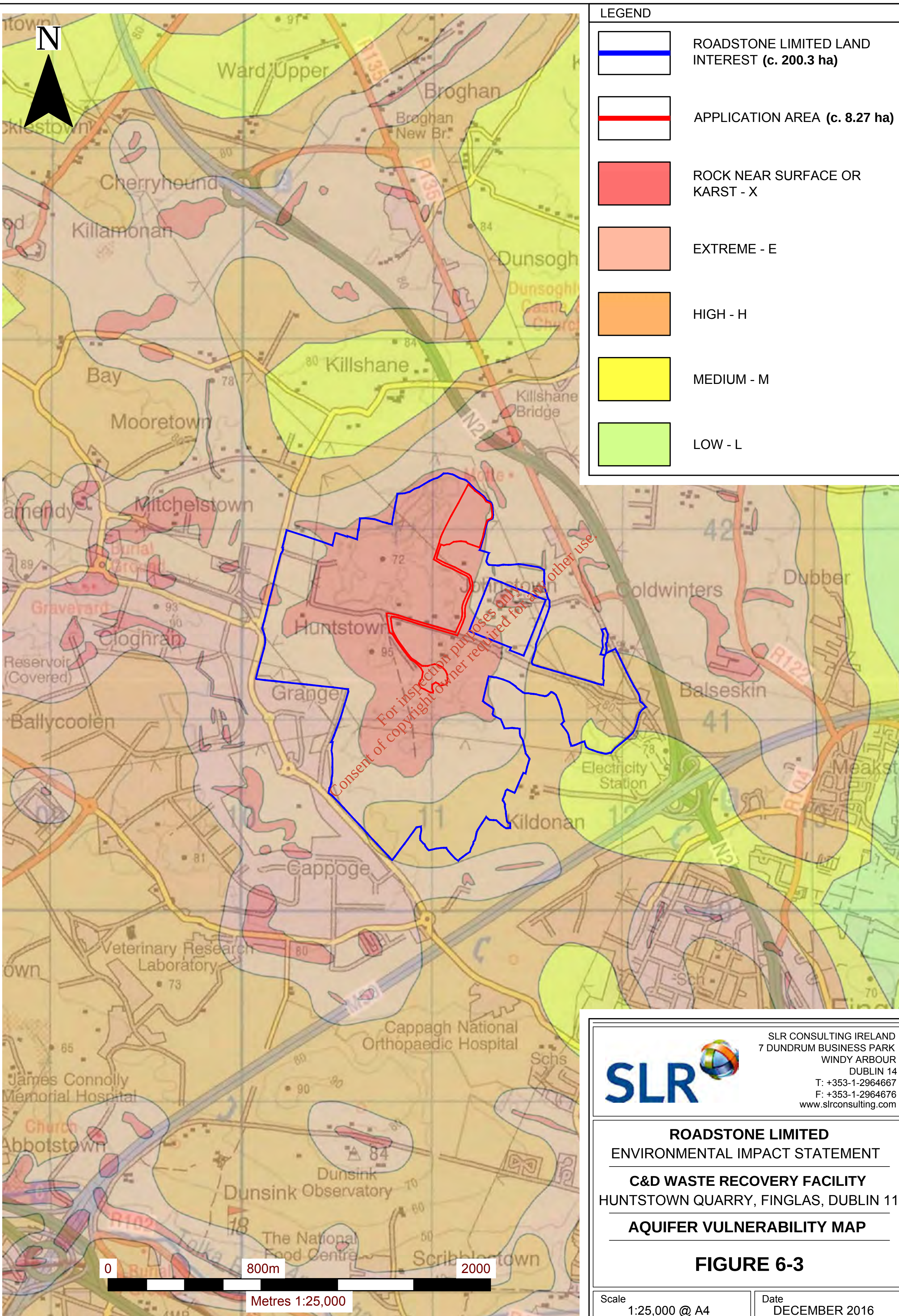
BEDROCK AQUIFER MAP

FIGURE 6-2

Scale	Date
1:25,000 @ A4	DECEMBER 2016

0180.00166.0.FIG_6-2.Bedrock Aquifer Map.dwg



LEGEND

Blue line	ROADSTONE LIMITED LAND INTEREST **(c. 200.3 ha)**
Red line	APPLICATION AREA **(c. 8.27 ha)**
Red	ROCK NEAR SURFACE OR KARST - X
Pink	EXTREME - E
Orange	HIGH - H
Yellow	MEDIUM - M
Green	LOW - L

SLR
SLR CONSULTING IRELAND
7 DUNDRUM BUSINESS PARK
WINDY ARBOUR
DUBLIN 14
T: +353-1-2964667
F: +353-1-2964676
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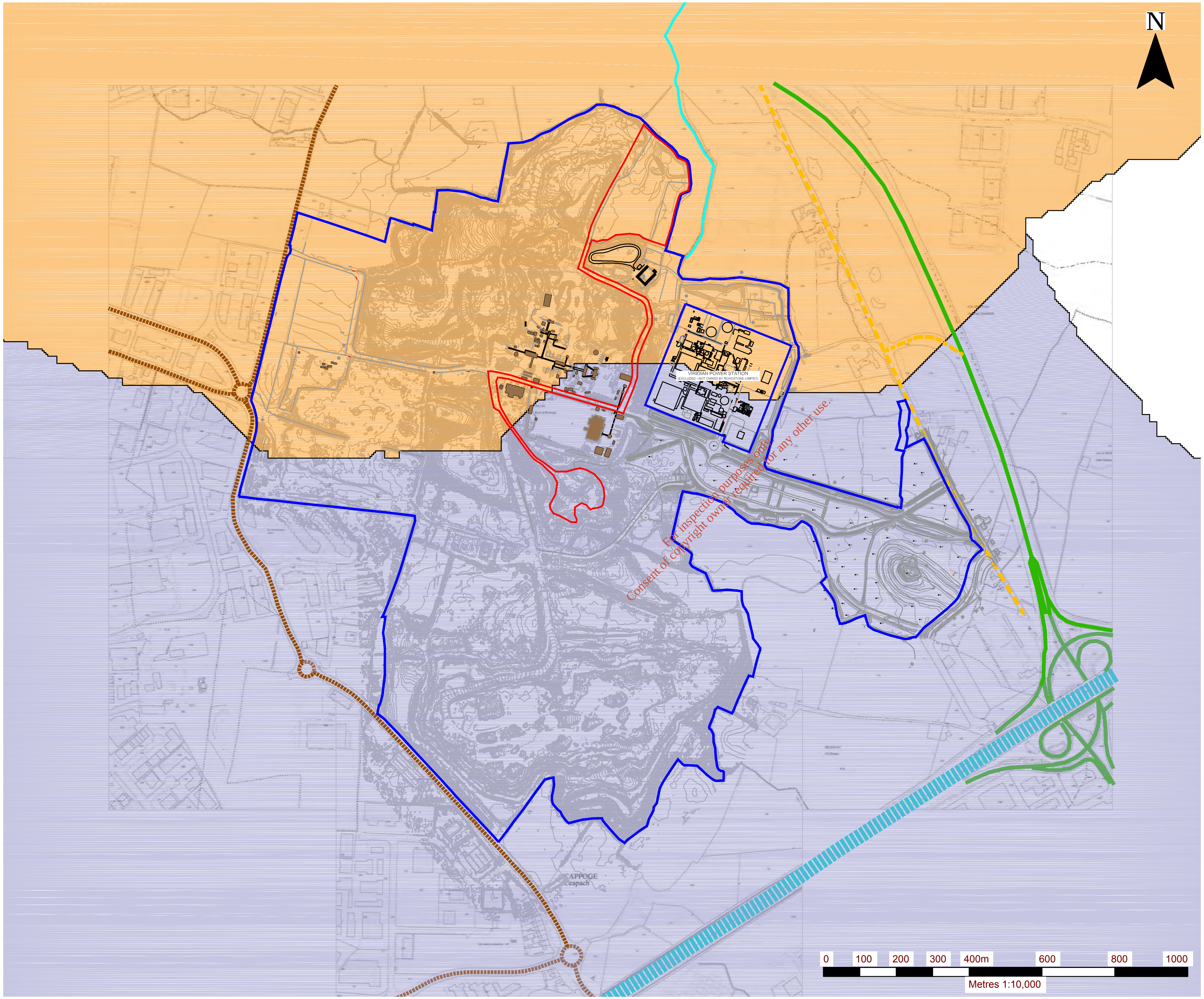
AQUIFER VULNERABILITY MAP

FIGURE 6-3

Scale	Date
1:25,000 @ A4	DECEMBER 2016

0180.00166.0.FIG_6-3.Aquifer Vulnerability Map.dwg



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2. ORDNANCE SURVEY IRELAND LICENCE NO. SU 0000716 (C) ORDNANCE SURVEY & GOVERNMENT OF IRELAND

LEGEND

- ROADSTONE LIMITED LAND INTEREST **(c. 200.3 ha)**
- APPLICATION AREA **(c. 8.27 ha)**
- M50 MOTORWAY
- N2 DUAL CARRIAGEWAY
- NORTH ROAD (R135)
- LOCAL ROAD
- WARD RIVER CATCHMENT
- TOLKA RIVER CATCHMENT

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SLR CONSULTING IRELAND
7 DUNDRUM BUSINESS PARK
WINDY ARBOUR
DUBLIN 14
T: +353-1-2964667
F: +353-1-2964676
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ENVIRONMENTAL IMPACT STATEMENT

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RIVER CATCHMENTS MAP

FIGURE 6-4

Scale	Date
1:10,000 @ A3	DECEMBER 2016

0180.00166.0.FIG_6-4.River Catchments Map.dwg