GH/MS W0032-03

Monday, 11 November 2013

Administration,
Licensing Unit,
Office of Climate, Licensing
And Resource Use,
Environmental Protection Agency,
Headquarters,
PO Box 3000,
Johnstown Castle Estate,
Co. Wexford

Dear Sir,

Re: Reg No. W0032-03 – Notice in Accordance with Article 14 (2) b (ii) of the Waste Management (Licensing) Regulations

I refer to the above reference application for a waste licence relating to a facility at Dungarvan Waste Disposal Site, Ballinamuck Middle, Dungarvan, Co. Waterford.

I attach herewith a response to the queries raised by the Environmental Protection Agency in accordance with Article 14(2)(b)(ii) of the Waste Management (Licensing) Regulations 2004 as amended from the Environmental Protection Agency (EPA) in your correspondence of the 29th August 2011 and the 30th September 2013.

Please note two hard copies of the information are attached, and two electronic versions are also included on two CD-ROM.

If you require any additional information, please contact the undersigned.

Yours faithfully,

_____
Gabriel Hynes,
Senior Engineer,
Environment

Encs.

Article 14 Response

Waste Licence Application W0032-03

Application by Waterford County Council for Waste Licence Application W0032-03 for Dungarvan Landfill, County Waterford

EPA Ref. Nº: W0032-03

Replies to Request for further information in accordance with Article 14(2)(b)(ii) of the Waste Management Regulations

November 2013

Dungarvan Landfill Waste Licence Application Article 14 Response

Table of Contents

1 INTRODUCTION..... 3

2 ARTICLE 12 COMPLIANCE REQUIREMENTS 4

2.1 ITEM 1 4

2.1.1 Response to Request 4

2.2 ITEM 2 8

2.2.1 Response to Request 8

APPENDIX 1 NATURA IMPACT STATEMENT

APPENDIX 2 REVISED NON TECHNICAL SUMMARY

1 INTRODUCTION

This report has been compiled to supply additional information in response to a Notice issued on the 29th August 2011 and the 30th September 2013 by the Environmental Protection Agency in accordance with Article 14(2)(b)(ii) of the Waste Management (Licensing) Regulations 2004 as amended from the Environmental Protection Agency (EPA)

- *With reference to article 12(l)(f) of the Waste Management (Licensing) Regulations, provide a revised Table B.7,1 and Table H.1(A) (updated versions of which are attached and are also available in the 2011 waste licence application form (at www.epa.ie) identifying the relevant classes of activity according to the Third and Fourth Schedules to the amended Waste Management Acts 1996 to 2011. (Amendment to the Acts was introduced by regulation 24 of the European Communities (Waste Directive) Regulations 2011).*

- *Provide information to address the requirements of article 12(l)(v) of the Waste Management (Licensing) Regulations, 2004, as amended, in relation to a description of how the waste hierarchy in section 21A of the amended Waste Management Acts 1996 to 2011 is applied. Please have regard to the requirements of section 29(2A) of the amended Acts in addressing this item. (Amendment to the Regulations was introduced by regulation 57 and amendment to the Acts regarding sections 21A and 29(ZA) by regulations 7 and I4 respectively of the European Communities (Waste Directive) Regulations 2011)*

- *The Agency has determined that due to the nature of the proposed discharge and proximity of the special protection area an Appropriate Assessment is required and notice of that determination is hereby given in accordance with Regulation 48(8)(a) of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No 477 of 2011). You are thereby required to submit a Natura Impact Statement, as defined in Regulation 2(1) of the aforesaid Regulations.You are furthermore advised to refer to the document Appropriate assessment of "Plans and Projects in Ireland – Guidance for Planning Authorities" issued in 2009 by the Department of the Environment, Heritage and Local Government and revised in 2010.*

2 ARTICLE 12 COMPLIANCE REQUIREMENTS

2.1 ITEM 1 of Notice issued on the 29th August 2011 by the Environmental Protection Agency in accordance with Article 14(2)(b)(ii) of the Waste Management (Licensing) Regulations 2004 as amended from the Environmental Protection Agency (EPA)

With reference to article 12(l)(f) of the Waste Management (Licensing) Regulations, provide a revised Table B.7,1 and Table H.1(A) (updated versions of which are attached and are also available in the 2011 waste licence application form (at www.epa.ie) identifying the relevant classes of activity according to the Third and Fourth Schedules to the amended Waste Management Acts 1996 to 2011. (Amendment to the Acts was introduced by regulation 24 of the European Communities (Waste Directive) Regulations 2011).

2.1.1 Response to Request

The notice received on 29th August 2011 references the 2011 waste licence application form. However since the issuance of this notice an updated waste licence application form was published by the EPA in 2012 and Tables B.7.1 and H.1(A) from the 2012 application form have been used below.

Waste Management Act 1996, as amended.					
	Third Schedule Waste Disposal Operations	**Y/N**		**Fourth Schedule Waste Recovery Operations**	**Y/N**
D 1	Deposit into or on to land (e.g. including landfill, etc.).	N	R 1	Use principally as a fuel or other means to generate energy: This includes incineration facilities dedicated to the processing of municipal solid waste only where their energy efficiency is equal to or above: -0.60 for installations in operation and permitted in accordance with applicable Community acts before 1 January 2009, -0.65 for installations permitted after 31 December 2008, using the following formula, applied in accordance with the reference document on Best Available Techniques for Waste Incineration: Energy efficiency = (Ep -(Ef + Ei)/ (0.97x(Ew+Ef) where— 'Ep' means annual energy produced as heat or electricity and is calculated with energy in the form of electricity being multiplied by 2.6 and heat produced for commercial use multiplied by 1.1(GJ/year), 'Ef' means annual energy input to the system from fuels contributing to the production of steam (GJ/year),	Y

				'Ew' means annual energy contained in the treated waste calculated using the net calorific value of the waste (GJ/year), 'Ei' means annual energy imported excluding Ew and Ef(GJ/year), '0.97' is a factor accounting for energy losses due to bottom ash and radiation.	
D 2	Land treatment (e.g. biodegradation of liquid or sludgy discards in soils, etc.).	N	R 2	Solvent reclamation/regeneration.	N
D 3	Deep injection (e.g. injection of pumpable discards into wells, salt domes or naturally occurring repositories, etc.).	N	R 3	Recycling /reclamation of organic substances which are not used as solvents (including composting and other biological transformation processes), which includes gasification and pyrolisis using the components as chemicals.	Y
D 4	Surface impoundment (e.g. placement of liquid or sludgy discards into pits, ponds or lagoons, etc.).	Y	R 4	Recycling/reclamation of metals and metal compounds.	Y
D 5	Specially engineered landfill (e.g. placement into lined discrete cells which are capped and isolated from one another and the environment, etc.).	N	R 5	Recycling/reclamation of other inorganic materials, which includes soil cleaning resulting in recovery of the soil and recycling of inorganic construction materials.	Y
D 6	Release into a water body except seas/oceans.	N	R 6	Regeneration of acids or bases.	N
D 7	Release to seas/oceans including sea-bed insertion.	N	R 7	Recovery of components used for pollution abatement.	N
D 8	Biological treatment not specified elsewhere in this Schedule which results in final compounds or mixtures which are discarded by means of any of the operations numbered D 1 to D 12.	N	R 8	Recovery of components from catalysts.	N
D 9	Physico-chemical treatment not specified elsewhere in this Schedule which results in final compounds or mixtures which are discarded by means of any of the operations numbered D 1 to D 12 (e.g. evaporation, drying, calcinations, etc.).	N	R 9	Oil re-refining or other reuses of oil.	N
D 10	Incineration on land.	N	R 10	Land treatment resulting in benefit to agriculture or ecological improvement.	N
D 11	Incineration at sea (this operation is prohibited by EU legislation and international conventions).	N	R 11	Use of waste obtained from any of the operations numbered R 1 to R 10.	Y

D 12	Permanent storage (e.g. emplacement of containers in a mine, etc).	N	R 12	Exchange of waste for submission to any of the operations numbered R 1 to R 11 (if there is no other R code appropriate, this can include preliminary operations prior to recovery including pre-processing such as, amongst others, dismantling, sorting, crushing, compacting, pelletising, drying, shredding, conditioning, repackaging, separating, blending or mixing prior to submission to any of the operations numbered R1 to R11).	N
D 13	Blending or mixing prior to submission to any of the operations numbered D 1 to D 12 (if there is no other D code appropriate, this can include preliminary operations prior to disposal including pre-processing such as, amongst others, sorting, crushing, compacting, pelletising, drying, shredding, conditioning or separating prior to submission to any of the operations numbered D1 to D12).	Y	R 13	Storage of waste pending any of the operations numbered R 1 to R 12 (excluding temporary storage (being preliminary storage according to the definition of 'collection' in section 5(1)), pending collection, on the site where the waste is produced).	Y
D 14	Repackaging prior to submission to any of the operations numbered D 1 to D 13.	N			
D 15	Storage pending any of the operations numbered D 1 to D 14 (excluding temporary storage (being preliminary storage according to the definition of 'collection' in section 5(1)), pending collection, on the site where the waste is produced).	P			

Table H.1(a). Quantities of Waste in Relation to Each Class of Activity Applied for

Waste Management Act 1996, as amended. 3rd Schedule (Disposal) Operations			Waste Management Act 1996, as amended. 4th Schedule (Recovery) Operations		
Class of Activity Applied For		Quantity (tpa)	Class of Activity Applied For		Quantity (tpa)
Class D 1			Class R 1		
Class D 2			Class R 2		
Class D 3			Class R 3		1,120
Class D 4			Class R 4		Note 2
Class D 5			Class R 5		Note 2
Class D 6			Class R 6		
Class D 7			Class R 7		
Class D 8			Class R 8		
Class D 9			Class R 9		
Class D 10			Class R 10		
Class D 11			Class R 11		252Note 3
Class D 12			Class R 12		
Class D 13			Class R 13		Note 1
Class D 14					
Class D 15		Note 1			

Note 1 –The proportions of waste to be stored on site pending off site disposal and recovery will vary but will be subject to the existing municipal waste limit as outlined in Schedule A.2 of W0032-2 (10,000 tonnes per annum)

Note 2 –Individual tonnages for Classes R 4 & R 5 of the Fourth Schedule are included in total stored pending off site recovery under Class R13 of the Third and Fourth Schedules of the Waste Management Acts 1996 as amended

Note 3-Class R 11 refers to the use of C&D waste such as clay which will be used in the restoration of the main landfill site and for landscaping around the civic amenity as required. This is included within the 20,000 tpa maximum inert waste limit over the lifetime of the facility. Note: The total amount of inert waste for restoration purposes to be accepted over the facility's lifetime as per Table H1(c) of the information dated 6 August 2010 is 48,990 tonnes (existing) plus 20,000 (proposed), a total of 68,990 tonnes over the facility lifetime

2.2 ITEM 2 of Notice issued on the 29th August 2011 by the Environmental Protection Agency in accordance with Article 14(2)(b)(ii) of the Waste Management (Licensing) Regulations 2004 as amended from the Environmental Protection Agency (EPA)

Provide information to address the requirements of article 12(l)(v) of the Waste Management (Licensing) Regulations, 2004, as amended, in relation to a description of how the waste hierarchy in section 21A of the amended Waste Management Acts 1996 to 2011 is applied. Please have regard to the requirements of section 29(2A) of the amended Acts in addressing this item. (Amendment to the Regulations was introduced by regulation 57 and amendment to the Acts regarding sections 21A and 29(ZA) by regulations 7 and I4 respectively of the European Communities (Waste Directive) Regulations 2011).

2.2.1 Response to Request

Dungarvan Landfill is currently licensed under W0032-02 to carry out activities under Classes 4 and 13 in accordance with the Third Schedule of the Waste Management Acts 1996 to 2003 (equivalent to Classes 4 and 15 of the Third Schedule of the Waste Management Acts as amended)

Under the waste license review (W0032-03) Waterford County Council are applying to carry out activities under the following classes in accordance with the Third Schedule of the Waste Management Acts 1996 , as amended:

- Class D4. Surface impoundment (e.g. placement of liquid or sludgy discards into pits, ponds or lagoons etc).
- Class D13. Blending or mixture prior to any of the operations numbered D1 to D12 (if there is no other D code appropriate, this can include preliminary operations prior to disposal including pre-processing such as, amongst others, sorting, crushing, compacting, pelletising, drying, shredding, conditioning or separating prior to submission to any of the operations numbered D1 to D12).
- Class D15. Storage pending any of the operations numbered D1 to D14 (excluding temporary storage (being preliminary storage according to the definition of 'collection' in section 5(1)), pending collection, on the site where the waste is produced).

Class D4 activities relate to the storage of leachate within the six wetland ponds that are currently being constructed as part of the capping works.

Class D13 activities relate to the mixture of water with the abstracted leachate. This is necessary to dilute the leachate before it is pumped into the wetland system.

Class D15 relates to the storage of waste in the waste transfer station prior to this waste being transferred to either composting facilities for recovery or Powerstown Landfill for disposal.

Dungarvan Landfill is currently licensed to carry out activities under Classes R1, R3, R4, R5, R11 and R13 in accordance with the Fourth Schedule of the Waste Management Acts 1996, as amended.

Under this waste license review Waterford County Council are applying to continue carrying out activities under the above classes as per Waste License W0032-02.

The principal activity at the site is Class D15 of the Third Schedule as detailed above.

In accordance with Waste Licence W0032-02 and in accordance with the Closure, Restoration and Aftercare Management Plan (CRAMP) previously issued to the Agency, a series of Integrated Constructed Wetlands (ICW) were developed at the site to treat the leachate and provide a public local amenity area.
While the primary objective of the constructed wetlands is for leachate treatment, the development and conservation of wildlife habitats is compatible as an afteruse. The layout, structure and composition of the wetlands is entirely compatible with the surrounding ecology and greatly increases the restored landfill's visual and wildlife amenity. Wetlands are important as habitats for invertebrates, marginal and aquatic vegetation, amphibians, fish and a range of breeding and wintering wildfowl as an area for nesting and feeding. The restored site will play an important role as a wildlife corridor in the area.

Regarding the environmental effects of discharging treated leachate to the river Colligan, analysis was provided in the responses to the Agency: *Report on Response to EPA on Request for Information on Leachate Treatment* (August 2008), and in September 2013, Appendix 3 *Leachate Abstraction and Treatment System – Description and Performance (August 2013)*. Full details can be found in the reports and September 2013 response.

In summary, the impact on the receiving water, the Colligan River, was assessed against EPA's proposed Environmental Quality standards in Rivers in Ireland (EPA 1997), "Parameters of Water Quality Interpretation and Standards", and EU-Salmonid regulations (SI No 293 of 1988. Although the Colligan is not a Salmonid river the limits in these standards was applied in the proposed assimilative calculations. A review of EPA 2011 Water Quality data for the Colligan River indicates that water quality is of satisfactory quality ranging from Q4-Q4-5 with no change from 2010. Biological assessment of the River Colligan at the location of the landfill was most recently carried out in 2009 and 2011, and suggested a fair to good water quality sampling sites. Both stations SW1 and SW2 are subject to tidal influences and may at times be brackish, depending on river flow and tidal range, and this may have an influence on relatively lower Q-value scores for the river location at the landfill compared to the EPA stations upstream. Ecological assessments carried out indicate the site and its surrounding environs continue to support a diversity of wildlife due to the variety of habitats present.

In accordance with the requirements of article 12(l)(v) of the Waste Management (Licensing) Regulations, 2004, as amended, in relation to a description of how the waste hierarchy in section 21A of the amended Waste Management Acts 1996 to 2011 is applied, the above emphasises the fact that the proposals put forward under the waste licence review (W0032-03) have taken measures to encourage the options which delivers the best overall environmental outcome for the facility.

ITEM 1 of Notice issued on the 30th September 2013 by the Environmental Protection Agency in accordance with Article 14(2)(b)(ii) of the Waste Management (Licensing) Regulations 2004 as amended from the Environmental Protection Agency (EPA)

1. The Agency has determined that due to the nature of the proposed discharge and proximity of the special protection area an Appropriate Assessment is required and notice of that determination is hereby given in accordance with Regulation 48(8)(a) of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No 477 of 2011). You are thereby required to submit a Natura Impact Statement, as defined in Regulation 2(1) of the aforesaid Regulations.
   You are furthermore advised to refer to the document Appropriate assessment of "Plans and Projects in Ireland – Guidance for Planning Authorities" issued in 2009 by the Department of the Environment, Heritage and Local Government and revised in 2010.

Response to Request

Find attached Natura Impact Statement in Appendix 1

ATKINS

Waterford County Council

Dungarvan Waste Disposal Site, Co. Waterford

Natura Impact Statement

October 2013

Plan Design Enable

Dungarvan Landfill (Waste Disposal Site), Co. Waterford

Natura Impact Statement

Waterford County Council

October 2013

Notice

This report was produced by Atkins for *Waterford County Council* for the Preparation of a Natura Impact Statement for Dungarvan Landfill as part of its EPA Waste License application.

This report may not be used by any person other than *Waterford County Council* without *Waterford County Council s* express permission. In any event, Atkins accepts no liability for any costs, liabilities or losses arising as a result of the use of or reliance upon the contents of this report by any person other than *Waterford County Council*.

Document History

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Plan Design Enable

Contents

Section Page

1.	**Introduction**	**1**
	Site Context	1
	Need for Appropriate Assessment	2
2.	**Methods**	**3**
	Appropriate Assessment Process	3
	Stage 1: Screening	3
	Stage 2: Appropriate Assessment	7
	Desktop Review	8
	Field Data	8
3.	**Site Operations**	**9**
	Dungarvan Landfill	9
	Landfill	9
	Green Waste Composting	10
	Waste Transfer	11
	Civic Amenity Area	11
	Leachate / Integrated Constructed Wetlands (ICWs)	12
	Classes of Activities	12
	Quantity and Nature of Waste Handled	13
	Raw and Ancillary Materials	13
	Site Operating Procedures	13
	Offsite Treatment of Waste	14
	Proposed Emission Limits	14
	Monitoring	15
4.	**Existing Environment**	**16**
	Habitats	16
	Rare plants	18
	Existing Water Quality Conditions	18
	Fauna	27
	Birds	28
5.	**Appropriate Assessment**	**34**
	Description of Natura 2000 Sites	34
	Stage 1 Screening	34
	Stage 2 – Appropriate Assessment	36
	Birds	39
	Dungarvan I-WeBS Data	39
6.	**Summary of Impacts**	**48**
	Direct Impacts	48
	Indirect Impacts	48

Conclusions Comments 50
Findings 51
7. References 52

List of Appendices

Appendix A Habitat Maps for 2010 & 2013; and plant species comparison 2008 & 2010 (WCC, 2013)

Appendix B Dungarvan Harbour SPA - Site Synopses

Appendix C Dungarvan Landfill. Response to EPA Request for Information on Leachate Treatment (RPS, Aug. 2013)

List of Tables

Table 3.1 Waste types accepted on site.

Table 3.2 Emission Limits.

Table 3.3 Target concentrations of each parameter in the River Colligan downstream of the site and the corresponding statutory limits.

Table 4.1 Dungarvan landfill integrated constructed wetland estimated loadings – present and (future expected).

Table 5.1 Conservation Objectives for Dungarvan Harbour SPA and the species for which the site has been designated.

Table 5.2 Population information for waterbirds at Dungarvan Harbour.

Table 5.3 Population trends for waterbirds at Dungarvan Harbour (from NPWS, 2011).

Table 5.4 Recent IWeBS count data (i.e. 2010/11) for Dungarvan Harbour.

Table 5.5 BWS count data (i.e. 2009/10) for Dungarvan Harbour.

Table 5.6 BWS count data (i.e. 2009/10) for Dungarvan Harbour - Ballyneety Bridge.

Table 5.7 BWS count data (i.e. 2009/10) for Dungarvan Harbour - Shandon Island.

Table 5.8 BWS flock data (i.e. 2010/11) for Dungarvan Harbour Subsites: Ballyneety Bridge and Shandon Island.

Table 5.9 Bird species recorded during the survey downstream of Ballyneety Bridge.

Table 5.10 Bird species recorded from Dungarvan landfill site. No full quantitative survey conducted in 2013, presence or absence noted during site visit. Counts are provided for the 2011 site visit.

List of Figures

Figure 1.1 Site Location

Figure 1.2a Natura 2000 sites

Figure 1.2b Sites of National Importance

Figure 3.1 Site Layout (copy of Dwg. No. MDR0350/DG0501; Rev F01; from Dungarvan Landfill Waste Licence Application, 2008)

Figure 3.2 Layout of Civic Amenity Area (copy of Dwg. No. MDR0350/DG0502, Rev R02; from 2012 AER)

Figure 3.3 Landfill Surface Water Drainage System (copy of Dwg. No. MDR0350/DG0714, Rev F01; from Dungarvan Landfill Waste Licence Application, 2008)

Figure 3.4a Integrated Constructed Wetlands (copy of Dwg. No. MDR0350/DG0504, Rev F01; from Dungarvan Landfill Waste Licence Application, 2008)

Figure 3.4b Leachate Abstraction & Treatment System Summary (copy of Dwg. No. MDR0350/FG002, Rev R01; from Dungarvan Landfill Remediation, Nov., 2012 – as built)

Figure 3.5 Monitoring Locations (copy of Dwg. No. MDR0350/ DG0505, Rev F01 (from Dungarvan Landfill Waste Licence Application, 2008)

List of Text Figures

Text Figure 2.1 Consideration of Plans and projects Affecting Natura 2000 sites from Annex III from Guidance issued by EC (2001).

Text Figure 4.2 Mean levels of selected pollutants recorded at Dungarvan Landfill 2012.

Text Figure 4.1 Mean levels of selected pollutants recorded at Dungarvan Landfill 2011.

Text Figure 4.3 Illustrates BOD levels in 2012 against baseline levels in 2001.

Text Figure 4.4 ICW inlet / outlet concentrations a) ammonia; b) phosphate and c) chemical oxygen demand.

Text Figure 4.5 COD trends 2011 – 2012.

List of Plates

Plate 1 Civic amenity area.

Plate 2 Green Waste Area.

Plate 3 Waste transfer station

Plate 4 The River Colligan and reedswamp on the northern banks.

Plate 5 River Colligan as it flows adjacent to the waste transfer station and Civic Amenity Area.

Plate 6 Leachate dilution tank to the northwest (behind) the waste transfer station.

Plate 7 Left - Leachate monitoring and dilution tank at south western corner of site. Right – Main control hut.

Plate 8 Grassland and scrub on Landfill slopes.

Plate 9 Pond 1a.

Plate 10 Pond 1b.

Plate 11 Pond 3.

Plate 12 Pond 4.

1. Introduction

1.1 In July 2013, Waterford County Council completed a Stage 1 Appropriate Assessment Screening for the retention of a Waste Licence at Dungarvan Landfill; the landfill, also known as the Dungarvan Waste Disposal Site is located at Ballynamuck Middle, Dungarvan, Co. Waterford, on the southern bank of the River Colligan (EPA file ref. W0032-03); Figure 1.1. In line with published best practice, the Council Screened the proposed licence retention against all Natura 2000 sites located within 15km of the landfill, with particular attention paid to the neighbouring Dungarvan Harbour Special Protection Area for birds (SPA; site code 004032), which adjoins the northern and south-eastern margins of the landfill site (WCC, 2013); Figure 1.2a. The Screening made a finding of no significant impact. However, the Council were requested by the Environmental Protection Agency (EPA) in September 2013 to complete a full Stage 2 Assessment and Natura Impact Statement.

1.2 In October 2013 Atkins were commissioned by Waterford County Council to complete a Stage 2 Appropriate Assessment / Natura Impact Statement (NIS) to accompany the EPA Waste License application for Dungarvan Landfill. This was based on an extensive body of work already undertaken by Waterford County Council; together with further desktop research and a site visit undertaken by Atkins ecologist on the 21st October 2013 and our knowledge of Dungarvan Harbour. With permission from Waterford County Council we have extracted relevant data or text from various Waterford County Council reports on Dungarvan Landfill; source material is referenced as appropriate throughout.

1.3 The objective of this assessment is to examine the potential for negative ecological impacts associated with the proposed landfill on the conservation objectives of Natura 2000 sites adjoining and out to 15km from the landfill. Key issues include e.g. the discharge from the leachate abstraction and treatment system in use at Dungarvan Landfill, with particular emphasis on the potential for negative impacts on Dungarvan Harbour SPA. However, in order to present as complete a picture as possible of the site we have also included information on the general ecology of Dungarvan Landfill and the potential for protected species to occur on site and in its immediate environs.

Site Context

1.4 Dungarvan Landfill site is located at Ballynamuck Middle, Dungarvan, Co Waterford northwest of the town of Dungarvan (Grid ref. X 245 948), and covers approximately 6.5 ha (Figure 1.1). The landfill is located in a large meander (exaggerated loop) of the River Colligan which borders the landfill on three sides (west, north and east); to the south the principal land use is agricultural (with maize having been grown in neighbouring fields last season; now harvested). The River Colligan flows under the N72 national primary road at Kildangan Bridge before turning east and flowing west-east past the landfill site. Immediately east of the landfill the river enters the estuary of the River Colligan (upper Dungarvan Harbour) at Ballyneety Bridge; this carries a tertiary road from Dungarvan to the N72 and is a combination of causeway and bridge over the River Colligan. Historically the landfill site was crossed by a railway line; the only remaining evidence being an old metal bridge over the River Colligan in the southwestern corner of the site. An old millrace also runs along the western boundary of the site. Historic (25"; http://www.osi.ie) mapping indicates that the upper limit of the normal tide is close to the northwestern corner of the site (Poulbeg). This is reflected in the areas of saltmarsh and reedswamp along this stretch of the river below the landfill; there is also evidence of recent river bank reinforcement works on the landfill boundary. There is also an "angler's path" running along the boundary of the site adjacent to the river on which there is a public right of way.

1.5 Adjacent to the site the River Colligan becomes tidal, with an extensive area of mudflats located further to the east of Ballyneety Bridge extending into Dungarvan Harbour. Dungarvan Harbour itself is designated as a Special Protection area for birds (SPA). A proposed National Heritage Area (pNHA) covers most of the bay and touches the western boundary of the landfill site.

1.6 After 30 years of operation, Dungarvan landfill was closed and capped in 2003. The site now operates as an integrated waste management facility and closed landfill under EPA Licence Reg. No. 32-2. Dungarvan landfill consists of a capped mound that is now completely vegetated, a green waste composting area, a waste transfer station and a civic amenity area. A series of constructed wetland cells installed to collect and treat residual leachate from the closed landfill in autumn 2008 now exhibit dense growth of submerged and emergent wetland vegetation. These wetlands will in time provide an important habitat for invertebrates, amphibians and wildfowl (e.g. Smooth newt has recently been recorded from comparable ICWs in the Annestown valley, Co. Waterford; along with a good diversity of dragonfly species). The major landscape feature in the vicinity of the landfill is the River Colligan which, as noted, flows along the northern perimeter of the site in a west to east direction.

1.7 Dungarvan Harbour is also a shellfish growing area as delineated by the Sea-Fisheries Protection Authority. The Sea Fisheries Protection Authority is responsible for classifying shellfish production areas as required under Directive 991/492/EEC) and by the 1996 Regulations (S.I. No 147 of 1996). Dungarvan Harbour is classified as Class B – requiring purification for 48 hours before shellfish can be placed on the market; the main product is Pacific oyster (*Crassostrea gigas*), which are grown on trestles on the seaward side of the Cunnigar. The DoEHLG published a Pollution Reduction Programme for Dungarvan Harbour in 2010 to ensure compliance with the standards and objectives established by the Quality of Shellfish Waters Regulations 2006 (S.I. No. 268) of 2001 as amended for the designated Shellfish growing waters (from Limosa, 2006).

Need for Appropriate Assessment

1.8 Special Areas of Conservation (SACs) and Special Protection Areas for birds (SPAs) form part of a network, known as Natura 2000 sites, to be designated across Europe in order to protect biodiversity within the European Union. SAC's are designated under the EU Habitats Directive (92/43/EEC; and as amended), as transcribed into Irish law by the European Communities (Birds and Natural Habitats) Regulations, 2011, while SPA's are designated under the EU Birds Directive (79/409/EEC, as amended and codified in 2009/147/EC) and further protected under the EU Habitats Directive and the 2011 Regulations.

1.9 Article 6(3) of the EU Habitats Directive (92/43/EEC and as amended) states that: "*Any plan or project not directly connected with or necessary to the management of the [Natura 2000] site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives*." Such an assessment is known as an Appropriate Assessment (AA). Further guidance on AA is provided by the European Commission (2000) and the Department of the Environment, Heritage and Local Government (DEHLG) (2009).

1.10 As noted, a Stage 1 Appropriate Assessment screening assessment was completed by Waterford County Council in order to consider the potential impacts of the Dungarvan Landfill on the conservation interests of surrounding and nearby Natura 2000 sites in July 2013. This included an evaluation of potential transfer of pollutants generated by the waste disposal on site to designated areas via vectors such as watercourses. However, the Council were requested by the Environmental Protection Agency (EPA) in September 2013 to complete a full Stage 2 Assessment and Natura Impact Statement. This is presented below along with further information on the site, its operation and its ecology.

2. Methods

Appropriate Assessment Process

2.1 Article 6(3) of the EU Habitats Directive states that: "*Any plan or project not directly connected with or necessary to the management of the [Natura 2000] site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives*." Such an assessment is known as an Appropriate Assessment (AA).

2.2 Methodology used to complete the Natura Impact Statement follows best practice guidance, including: -

- European Commission (2000) Managing Natura 2000 sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC
- European Commission (2002) Assessment of plans and projects significantly affecting Natura 2000 sites: Methodological guidance on the provisions of Articles 6(3) and (4) of the Habitats Directive 92/43/EEC
- European Commission (2007) Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC: Clarification of the concepts of: Alternative solutions, Imperative reasons of overriding public interest, Compensatory Measures, Overall Coherence, Opinion of the Commission
- Department of the Environmental Heritage and Local Government (2009) Appropriate Assessment of Plans and Projects in Ireland. Guidance for Planning Authorities.

2.3 The Natura 2000 network is comprised of both Special Areas of Conservation and Special Protection Areas for birds; these sites are designated for the protection of biodiversity across the European Union. SACs are designated under the EU Habitats Directive[1] (92/43/EEC), as transcribed into Irish law by the European Communities (Birds and Natural Habitats) Regulations, 2011, while SPAs are designated under the EU Birds Directive[2] (79/4089/EEC; and as amended 2009/147/EC).

2.4 Locations and boundaries of all Natura 2000 sites within a 15 km radius of Dungarvan Landfill were identified using the National Parks and Wildlife Service (NPWS) online map viewer. Boundary *shapefiles* were also downloaded from this site. Data obtained and reviewed included site synopses prepared by NPWS, lists of qualifying interests for Natura 2000 sites, and other information on the ecology of these sites.

2.5 The Appropriate Assessment process begins with **Stage 1 - Screening** to determine if a plan or project is likely to have a negative impact on a Natura 2000 site; see **Text Figure 2.1** for a summary of the steps involved in completing an Appropriate Assessment.

Stage 1: Screening

2.6 The first stage is to determine if the plan is directly connected with or necessary to the sites management for nature conservation. If the answer is no, it must be determined if the plan is likely to have significant

[1] For further information on the Habitats Directive refer to: - http://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm

[2] For further information on the Birds Directive refer to: - http://ec.europa.eu/environment/nature/legislation/birdsdirective/index_en.htm

effects on a Natura 2000 and/or Ramsar site(s)[3]. If the answer is yes to the latter, then the assessment advances to Stage 2 (see **Text Box 2.1**). Stage 1 screening involves the identification of the plan or project objectives, and a review of alternative methods to achieving the objectives where appropriate.

2.7 The AA screening begins with identification of Natura 2000 sites that could potentially be affected by the project; in this instance we have identified all Natura 2000 sites within Dungarvan Harbour and environs to a distance of 15km from the site. This is followed by collation of information relating to these sites. Such information is principally obtained from the National Parks and Wildlife Service (NPWS) of the Department of Arts. Heritage and the Gaeltacht (DAHG). The primary source of information on Natura 2000 sites are the: -

a) Conservation Objectives report for the site;

b) Standard Natura 2000 data forms;

c) Site synopses; and

d) Site boundaries.

2.8 All of the above can be obtained from the NPWS, while site boundaries can be viewed on the NPWS webpage (http://npws.ie/mapsanddata/); site boundaries can also be downloaded as *shapefiles*)[4].

2.9 The above information was supplemented by a site visit by Atkins ecologists; consultation with NPWS and ongoing liaison with relevant Waterford County Council staff in order to fully understand the proposed works and determine how they might impact on Natura 2000 sites.

2.10 This, together with information on the Natura 2000 sites described above, permitted evaluation of the following: -

- Individual elements of the proposed project (either alone or in combination with other plans or projects) likely to give rise to impacts on the Natura 2000 sites;
- Likely direct, indirect or secondary impacts of the project (either alone or in combination with other plans or projects) on the Natura 2000 site by virtue of: -
  - Reduction of habitat area;
  - Disturbance of key species;
  - Habitat or species fragmentation;
  - Reduction in species density; or
  - Changes in key indicators of conservation value.
- Likely changes to the Natura 2000 site arising as a result of interference with the key relationships that define the structure and function of the site;
- Indicators of significance as a result of the identification of effects set out above in terms of: -

[3] A Ramsar site is a site designated under the Ramsar Convention (The Convention on Wetlands of International Importance) an international treaty

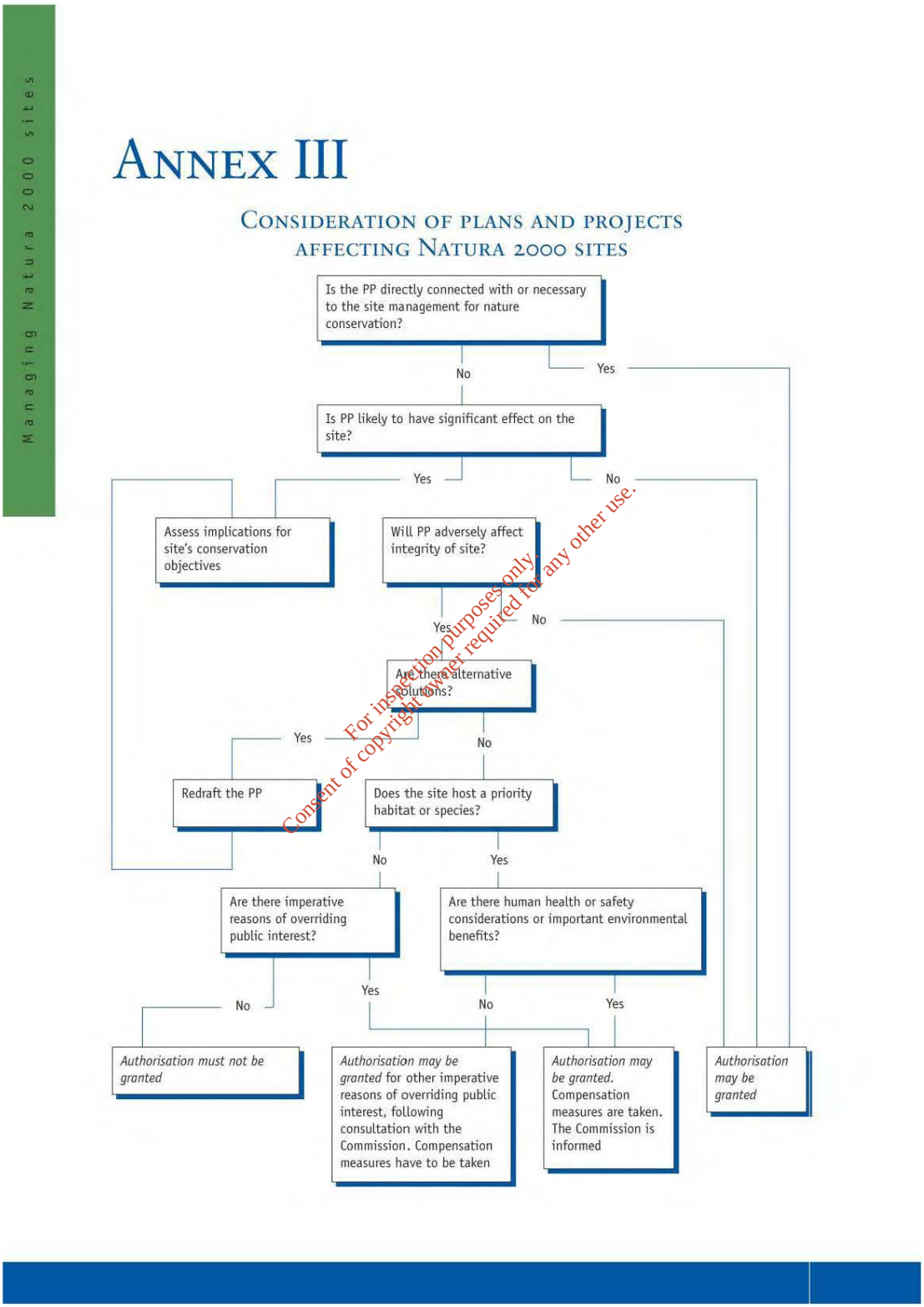
[4] All site information and associated shapefiles were downloaded from www.npws.ie on 2nd May 2013.

- Loss;
- Fragmentation;
- Disruption;
- Disturbance; and
- Change to key elements of the site.

- Elements of the Plan, or combination of elements, where the above impacts are likely to be significant or where the scale of magnitude of impacts is not known.

2.11 Where negative impacts on a Natura 2000 site cannot be discounted the Assessment must proceed to Stage 2; while it was not necessary in this case the objectives at Stages 3 and 4 are summarised in **Text Box 2.1**, below for completeness.

Text Figure 2.1 - Consideration of Plans and projects Affecting Natura 2000 sites from Annex III from Guidance issued by EC (2001).



Stage 2: Appropriate Assessment

2.12 Stage 2 is the Appropriate Assessment proper to determine if the plan is likely to affect the integrity of the Natura 2000 and/or Ramsar site(s). If the Stage 1 Screening process identifies that negative impacts cannot be ruled out the study progresses to Stage 2 at which point a detailed, targeted assessment of the nature and potential significance of direct and indirect impacts arising from the proposed variation must be completed. An assessment of cumulative impacts (both from the project objectives, and other policies, plans and programmes) must be carried out. Mitigation measures must be proposed to eliminate potential impacts, if possible. These mitigation measures must be consulted upon with the relevant agencies and the public and, following receipt of comments, if it can be concluded that no adverse impacts on the integrity of the site are likely, the proposed project can proceed for approval. If not, then the assessment advances to Stage 3.

2.13 With respect to Dungarvan Landfill the on-site measures for treatment of leachate etc. are taken as an integral element of the day-to-day management of the closed landfill.

Text Box 2.1 – Summary of Stages 3 to 4.

Stage 3: Assessment of Alternative Solutions

This Stage involves the identification of alternative solutions following a review of the outcomes of Stage 2. If there are no alternative solutions identified, then the assessment advances to Stage 4.

Stage 4: Assessment where no Alternative Solutions exist and where Adverse Impacts remain

Stage 4 examines whether there are imperative reasons of overriding public interest for the plan or project to go ahead. If the answer is yes, then compensatory measures need to be agreed with the European Commission, before the plan or project can proceed. If not, then the plan or project is rejected.

Desktop Review

2.15 A desktop review was carried out in order to determine if the proposed development site is located within or near any sites of conservation importance, including proposed Natural Heritage Areas (pNHA), Natural Heritage Areas (NHAs), Special Areas of Conservation (SACs), Special Protection Areas for birds (SPAs) and Ramsar sites or any non-designated sites of ecological interest. The distribution of non-designated sites, such as the NGO 'Shadow Sites' (Dwyer, 2000) was reviewed in addition to a review of any other available literature on species and habitats of conservation concern within and near the proposed development site. The latter included a review of previous ecological reports on the site (e.g. Limosa, 2006 & 2009; WCC, 2013); other published sources such as e.g. environmental reporting on the proposed N25 Dungarvan Bypass; a review of National Biodiversity Data Centre (NBDC) records (http://www.biodiversityireland.ie/) and data from the National Parks and Wildlife Service (NPWS) on records of species of conservation concern within the study area.

2.16 BirdWatch Ireland (BWI) provided Waterford County Council with Irish Wetland Bird Survey (IWeBS) data for Dungarvan Harbour; while data on the National Parks & Wildlife Service / BWI low tide survey of the harbour as part of the Baseline Waterbird Survey project were kindly provided by NPWS.

2.17 Consultation was undertaken with Bernadette Guest, Heritage Officer, Waterford County Council. Brian Duffy, Local Conservation Ranger, NPWS was also contacted. While, due to the short time available to Atkins there was limited opportunity for consultation, there has been an ongoing process of consultation undertaken by Waterford County Council as part of the closure and rehabilitation of the landfill. Atkins is also very familiar with the site and its associated bird fauna through ongoing work on shorebirds and aquaculture in the bay (c.f. Gittings, T. & O'Donoghue, PD (2012). *The effects of intertidal oyster (*Crassostrea gigas*) culture on the spatial distribution of waterbirds*. Unpublished report for the Marine Institute; one of the sites used in this study was Dungarvan).

Field Data

2.18 The current assessments draws on work previously undertaken as part of the ongoing management of the landfill site as presented in Dungarvan Landfill Ecology Report, 2013 prepared by Waterford County Council. A habitat map was compiled following best practice as outlined in the Heritage Council's *Best Practice Guidance for Habitat Survey and Mapping* (Smith et al., 2011); all habitats were classified in accordance with Fossitt (2000) *A Guide to Habitats in Ireland*. Habitat mapping was undertaken by Bernadette Guest, Heritage Officer, Waterford County Council; botanical assistance was provided by Paul Green, BSBI vice-county recorder for Co. Waterford. Complete plant species lists from 2008 and 2010 were included in Dungarvan Landfill Ecology Report, 2013 prepared by Waterford County Council; these are included in Appendix B of this report along with a habitat map from 2010 and 2013 (WCC, 2013).

2.19 Details of bird species recorded are also presented. Information on Otter *(Lutra lutra*) along the River Colligan came from Limosa (2006); from NBDC records and from the Mammals in a Sustainable Environment (MISE) Otter Survey, 2011-2013 (http://www.miseproject.ie/); Waterford County Council are a project partner.

Atkins ecologists walked the site on the 21st October 2013 to familiarise ourselves with the site and its general ecological condition.

3. Site Operations

Dungarvan Landfill

3.1 The landfill at Dungarvan has been described at length in the report *Dungarvan Landfill Remediation Works. Leachate Abstraction and Treatment System – Description and Performance* (RPS, Aug. 2013; included in full in Appendix A) prepared for Waterford County Council by RPS; elements of this report are included here with Waterford County Council's permission to provide a comprehensive description of the site and its operation. Together with the Waste Licence Application (WCC, 2013b) and the 2012 Annual Environmental Report (WCC, 2012) this forms the basis upon which the subsequent appropriate assessment is undertaken.

3.2 The site layout is illustrated in Figure 3.1 (copy of Dwg. No. MDR0350/DG0501; Rev F01 from Dungarvan Landfill Waste Licence Application, 2008). The site contains the following: -

- A closed landfill
- A green waste composting area
- A Waste Transfer Station
- A Civic Amenity Area

Landfill

3.3 The site itself consists of a landfill that has ceased accepting waste since 2003. The landfill covers an area of approximately 6.5 hectares (Figure 3.1). It is thought that filling on the site commenced in the late 1960's. Ownership of the landfill was passed to Waterford County Council in 1985. The landfill is an unlined landfill; i.e. it does not contain any engineered liner material underneath the waste. It does however contain a thick layer of low permeable clay which would prevent a significant amount of leachate ingression into the groundwater.

3.4 The wastewater produced by both the waste transfer station and composting area, and the leachate produced by the capped landfill are treated by a network of Integrated Constructed Wetlands (ICW) on site, prior to discharging into the River Colligan. Surface water run off from the civic amenity area is treated by a first flush, and subsequently a petrol interceptor before discharging into the River Colligan. The septic tank serving the 'washing area / toilet' in the civic amenity area also connects to the leachate treatment system. There is no discharge to foul sewer.

3.5 While the base of the landfill however is not lined, there is a thick layer of low permeability clay below it; there is subsequently a potential threat for leachate ingression of groundwater, albeit a reduced risk due to the underlying low permeability clay layer. The green waste composting area only accepts green waste such as trees, bushes, grass, and other plant material. The waste transfer station accepts and sorts compostable and residual municipal waste; which is subsequently transported within 48 hours off site, after which the facility is washed down.

3.6 The landfill site has recently been capped completely and now progresses to non-clean closure status as defined in the Environment Protection Agency's ELRA (Environment Liability Risk Assessment), Residuals Management and Financial Provision Guidance Document. In accordance with Waste Licence W32-02 and in accordance with the Closure, Restoration and Aftercare Management Plan (CRAMP) issued to the

Environment Protection Agency, a series of Integrated Constructed Wetlands (ICW) have been developed at the site to treat leachate arising from the landfill and to ultimately provide a public local amenity area and biodiversity gain. As the use of ICWs to treat landfill leachate in a new approach, the ICWs on site went through an initial programme of commissioning, testing and reporting on performance / results using ammonia as a proxy – these results have been previously reported on by Waterford County Council to the Environmental Protection Agency. Following successful testing the ICW's have now been fully commissioned.

3.7 While the primary objective of the constructed wetlands is for leachate treatment, the development and conservation of wildlife habitats is compatible as an after-use. The layout, structure and composition of the wetlands are compatible with the surrounding ecology and will greatly increase the restored landfill's visual and wildlife amenity. Wetlands are important as habitats for invertebrates, marginal and aquatic vegetation, amphibians and a range of breeding and wintering wildfowl as an area for nesting and feeding. The restored site will play an important role as a wildlife corridor in the area. Previous ecological reporting on the site has recommended on-going monitoring of the wildlife value of these wetlands in line with their management for treating leachate.

3.8 Capping works were completed in mid 2008. The final capping system generally comprises of a gas collection layer, LLDPE liner, drainage layer, subsoil layer and topsoil layer as follows: -

- 150-300mm layer of topsoil; underlain by;
- Subsoil such that thickness of topsoil and subsoil is at least 1m thick; underlain by;
- A surface water geocomposite layer; underlain by;
- 1mm LLDPE liner (a low permeability geomembrane material); and
- Geocomposite gas collection layer.

3.9 The capping layers provides protection from the ingress of rain into the site and thus minimise leachate generation. A drainage geocomposite layer is placed on the side slopes only as the constructed wetlands will effectively control surface water drainage on flat areas on top of the landfill; in addition the depth of subsoil/topsoil has been decreased from 1m to 0.3m in areas where the ponds are located as part of ICW design. Approximately 5,500m^2 of the side slopes on the southern side of Dungarvan landfill were capped in 2002 using a GCL as the low permeability layer. Geogrid was also placed on the side slopes as required for slope stability. Leachate extraction wells are located strategically across the site in order to maximise collection efficiency. Furthermore, rainwater will assist in the dilution of leachate within the constructed wetlands. The surface water drainage from the side slopes will run-off towards the surface water carrier drain, which runs along the northern and eastern boundary boundaries. This drain then discharges into the River Colligan at a number of locations (Figure 3.3; Surface Water Drainage System).

3.10 Landfill gases generated within the landfill body itself are collected by the landfill gas management system and burnt off.

Green Waste Composting

3.11 Waterford County Council ceased the acceptance of source segregated organic waste at the composting facility in 2007 due to odour concerns. In early 2008, the two enclosed in-vessel composting units were decommissioned and removed from site as they were no longer required. Currently the composting area on site only accepts green waste in the form of bushes, trees, grass etc. which is then collected and

transported to O'Toole Composting in Co. Carlow. The green waste composting area comprises a large open fronted (roofed) shed and associated hard-standing located at the western end of the civic amenity area. Behind the shed are a further series of unroofed concrete bays – since composting of green waste no longer occurs on site these are less frequently used; but may be used occasionally for material storage (e.g. on the 21st one bay was occupied by garden wastes; a second by mixed construction and demolition waste).

Waste Transfer

3.12 The final building – west of the civic amenity area and just inside the gate of the landfill proper – is a waste transfer station. The waste transfer station is licensed to accept 10,000 tonnes per annum. The building is 10m x 35m in size and is fully enclosed. An air handling unit of three overhead pipes is connected to three extractor fans to ventilate the building.

3.13 All waste accepted is unloaded within the transfer building itself. All waste remains in the building for a maximum of 48 hours prior to being loaded and transported to either Drehid Landfill in Co. Kildare or the composting facilities at O'Toole Composting in Co. Carlow. The facility is washed down and cleaned after compostable material is transferred. Compostable waste, residual municipal waste, and dry recyclables are collected on a three week cycle, but the transfer station deals only with the first two types. Dry recyclables go directly from collection routes to Waterford County Council's Materials Recycling Facility at Shandon, Dungarvan, and do not enter the transfer station

Civic Amenity Area

3.14 The civic amenity area is open to the public and subject to pricing structure depending on the amount of waste or type of vehicle or size of trailer (see Figure 3.2; copy of Dwg. No. MDR0350/DG0502, Rev F01 from Dungarvan Landfill Waste Licence Application, 2008). The facility accepts waste from 09:00 to 17:00 Monday to Friday and 09:00 to 13:00 on Saturday. All waste coming into the civic amenity area is inspected by staff prior to disposal. The civic amenity area accepts a range of wastes, including; glass, paper and cardboard, newspapers and magazines, plastics, garden waste, construction and demolition waste, wood, waste cooking oils, batteries, oil filters, waste paint, mixed residual waste, bulky waste (furniture, mattresses, etc.), WEEE, mixed dry recyclables including tetra park, textiles, scrap metal, aluminium and tin cans. All waste is inspected by staff prior to disposal. All waste is stored in series of containers, and hence does not contaminate the surface water run off.

3.15 Wastes accepted and stored in these closed and secure containers includes: -

- Paint;
- Bulky household waste;
- Fridges & freezers;
- Electrical and electronic goods;
- Special waste (i.e. waste cooking oil, car filters, car batteries, domestic batteries, aerosols & fluorescent tubing);
- There are also a series of glass recycling bins.

Leachate / Integrated Constructed Wetlands (ICWs)

3.16 It has been calculated, that excluding the influence of groundwater the capped landfill will produce approximately 50m^3 of leachate per month with an estimated maximum of 17 years to fully extract all leachate (RPS, 2013). In order to safely prevent the release of both leachate and gas from the capped landfill at Dungarvan, a combined landfill gas and leachate extraction system has been put in place. Both landfill gas and leachate are collected in a set of common wells, from which a collection of pipework and pumps relay the leachate to constructed wetlands and the gas is flared off after passing through the landfill gas management system.

3.17 The Integrated Constructed Wetland and associated leachate treatment system are illustrated in: -

- Figure 3.4a - Integrated Constructed Wetland System; copy of Dwg. No. MDR0350/DG0504, Rev F01 (from Dungarvan Landfill Waste Licence Application, 2008); and
- Figure 3.4b – Leachate Abstraction & Treatment System Summary; copy of Dwg. No. MDR0350/FG002, Rev R01 (from Dungarvan Landfill Remediation, Nov., 2012 – as built).

3.18 A full description of the Leachate abstraction system, landfill gas management system and associated constructed wetlands is provided in *Dungarvan Landfill Remediation Works – Leachate Abstraction and Treatment System – Description and Performance* prepared by RPS (RPS, 2013; see Appendix A).

3.19 With regard to leachate; to summarise, leachate extracted via the leachate extraction system is passed into a dilution tank, where the leachate is diluted if the concentration of ammonium is too high (i.e. >100 mg/l) prior to release to the ICW system; following which it passes through a series of five wetland ponds prior to its discharge into a leachate lagoon. If the treated leachate contains ammonium in excess of acceptable limits, the water is recycled back through the system until acceptable levels are met. This is achieved using a SCADA system to control the operation (i.e. Supervisory Control and Data Acquisition system; i.e. a computer run monitoring and control system). The final lagoon (located behind the waste transfer station) is in turn hydraulically connected to the River Colligan.

Classes of Activities

3.20 Dungarvan Landfill is currently licensed to carry out activities under Classes 4 and 13 in accordance with the Third Schedule of the Waste Management Acts, 1996 (as amended).

3.21 Under this waste license review Waterford County Council are applying to carry out activities under the following classes in accordance with the Third Schedule of the Waste Management Acts 1996 to 2005: -

- Class 4. Surface impoundment, including placement of liquid or sludge discards into pits, ponds or lagoons.
- Class 11. Blending or mixture prior to submission to any activity referred to in this Schedule.
- Class 13. Storage prior to submission to any activity referred to in a preceding paragraph of this Schedule, other than temporary storage, pending collection, on the premises where the waste concerned is produced.

3.22 Class 4 activities relates to the storage of leachate within the five wetland ponds that have been constructed as part of the capping works.

3.23 Class 11 activities relates to the mixture of water with the abstracted leachate. This is necessary to dilute the leachate before it is pumped into the wetland system.

3.24 Class 13 relates to the storage of waste in the waste transfer station prior to this waste being transferred to either composting facilities for recovery (O'Toole Composting, Co. Carlow) or for disposal (Drehid Landfill, Co. Kildare).

3.25 Dungarvan Landfill is currently licensed to carry out activities under Classes 2, 3, 4, 9, 11 and 13 in accordance with the Fourth Schedule of the Waste Management Acts 1996 to 2005.

3.26 Under this waste license review Waterford County Council are applying to continue carrying out activities under the above classes as per Waste License W032-02.

3.27 The principal activity at the site is Class 13 of the Third Schedule as detailed above.

Quantity and Nature of Waste Handled

3.28 The main types of waste handled at the facility are household (mixed residual waste and mixed dry recyclables), green waste and construction & demolition waste and commercial waste. The quantities and nature of waste that the facility is currently licensed to accept are shown in the table below.

Table 3.1 – Waste types accepted on site.

Waste Type	Tonnes / Annum
Municipal Waste	10,000
Hazardous Municipal Waste (including WEEE)	400
Inert Construction & Demolition (C&D)	20,000 (over lifetime of the facility rather than annually)
Garden Waste	1,120
Total tonnage / annum	11,520 (excl. C&D)

Raw and Ancillary Materials

3.29 The main raw material used on site is water for cleaning the hard standing areas namely the civic amenity area, the composting area and the waste transfer station. Electricity is used in the site lighting, weighbridge, office and garage buildings, and leachate pumping and treatment system.

Site Operating Procedures

3.30 Waste is delivered to the site mainly by Waterford County Council (WCC) and Dungarvan Urban District Council refuse collection trucks. This waste is domestic household waste. All trucks must pass over the weighbridge prior to admission to the waste transfer station where it is unloaded within the building itself. This mitigates odour, noise and dust emissions to the atmosphere. The waste is then inspected and is transported off site to either composting facilities (O'Toole Composting, Co. Carlow); for recovery (dry recyclables to Waterford County Council's recycling facility at Shandon, Dungarvan) or to Drehid landfill in Co. Kildare for disposal within 48 hours.

3.31 All waste accepted by the compost area (green waste only) and civic amenity area is inspected prior to admission. As noted in the past the facility included two enclosed in-vessel units for composting, but these were decommissioned and removed from site in 2008. This has significantly reduced issues with odour.

3.32 The civic amenity area is open to the public and accepts a range of household wastes as noted above; all are securely stored in metal bins / containers on the area of hardstanding at the site entrance. Waste is inspected by staff prior to admission and if the material is accepted, the public are directed to the required container(s).

Offsite Treatment of Waste

3.33 All outgoing waste from the Waste Transfer Station is sent to either composting facilities (O'Toole Composting in Co. Carlow) or to landfill (Drehid Landfill in County Kildare (Waste Licence W0201-01). All waste from the civic amenity area is sent to appropriate waste recovery facilities. Mixed dry recyclables are sent to the Materials Recovery Facility at Shandon, Dungarvan which is nearby and is also owned by the Applicant. All vehicles involved in the transportation of these wastes are fully enclosed and are in possession of the appropriate collection permits.

3.34 It is not proposed to treat any liquid waste, i.e. leachate from the landfill off-site.

Proposed Emission Limits

3.35 A detailed review of assimilative capacity in the River Colligan was undertaken by RPS on behalf of Waterford County Council; it is presented in section 5.1.1 of *Dungarvan Landfill. Response to EPA Request for Information on Leachate Treatment* (RPS, 2008). The EPA has proposed Environmental Quality Standards for BOD of 5 mg / l in rivers in Ireland; furthermore under the Salmonid Regulations (S.I. No. 293 of 1988) the concentration of NH_4 must not exceed 1 mg /l and the concentration of suspended solids must not exceed 25 mg / l. In the absence of guidance a figure of 0.03 mg /l MRP was used for phosphorus (RPS, 2008). While the Colligan is not a salmonid river RPS used these limits when assessing the assimilative capacity of the river to deal with proposed discharges from the landfill. It was determined that the River Colligan has ample assimilative capacity (Table 5.2 of RPS, 2008; p. A13) to receive large volumes of treated effluent from the ICW. However, it was proposed to abstract a maximum of 20m^3 of leachate per day; this would result in an average discharge from the system of 136.3m^3 / day.

3.36 The resultant proposed emission limits are as set out in Table 3.2.

Table 3.2 – Emission Limits.

Parameter	Emission Limit (all units in mg/l; except pH)
pH	6-9
BOD	45
Suspended Solids	50
Orthophosphate	2
Total Ammonia	5

3.37 Using the above limits the concentration of the above substances downstream of the discharge location was calculated by RPS. It was assumed that the concentration of each substance in the discharge was at its

maximum proposed concentration. Table 3.3 illustrates the concentration of each parameter in the River Colligan downstream of the site and the corresponding statutory limits for each parameter used in the assimilative capacity assessment.

Table 3.3 – Target concentrations of each parameter in the River Colligan downstream of the site and the corresponding statutory limits

Parameter	Concentration downstream	Statutory Limits
BOD (mg/l)	1.215	5
Suspended Solids (mg/l)	7.21	25
Orthophosphate (mg/l)	0.016	0.03
Total Ammonia (mg/l)	0.069	1

3.38 As can be seen the system should therefore deliver concentrations of key parameters well below the associated statutory limit.

Monitoring

3.39 Monitoring locations are illustrated on Figure 3.5 (Monitoring Locations; copy of Dwg. No. MDR0350/DG0505, Rev F01; from Dungarvan Landfill Waste Licence Application, 2008). This indicates the location of dust, noise, groundwater, surface water (including emission points), leachate and gas monitoring as submitted with the 2008 waste licence application.

3.40 Heavy metal levels in estuarine sediment and the flesh of blue mussel (*Mytilus edulis*) were also tested; most recent samples from 2008.

4. Existing Environment

Habitats

4.1 As noted the site was surveyed and mapped by Bernadette Guest in March 2013 (a botanical list was collated in 2010 by Paul Green to compare with Limosa study in 2008; see Appendix A). A site walkover was also conducted by Atkins ecologist on the 21st October 2013. The site was also habitat mapped and botanically surveyed by Dr. Lesley Lewis on a number of occasions in the 2000's as part of ongoing site monitoring. It should be noted, however, that the site has changed significantly as part of its management and rehabilitation post closure (e.g. leachate ponds have been constructed and vegetated). Habitats maps and extensive species lists for the site are included in Limosa (2006) and WCC (2013) and present a useful comparison as to how the site has evolved over time. The following discussion is not therefore meant to represent a detailed habitat / species survey of the site, but to give the reader an overview of ecological diversity within the landfill; comments are also included as appropriate on habitats along the River Colligan.

River Colligan

4.2 To the west of the site the River Colligan can be characterised as a depositing lowland river (FW2); further downstream there is an obvious tidal influence and the river can be classified as a tidal river (CW2). It is bordered by areas of wet grassland (GS4), scrub (WS1), upper saltmarsh (CM2) and a large expanse of reed and sedge swamp (FS1) (on the northern bank of the river). Dry meadows and grassy verges (GS2) also occur in some areas along the river bank, while mature hedges (WL1) and treelines (WL2) are restricted to the outer boundaries of the landfill. Mud shores (mudflat) (LS4) are also present close to Ballyneety Bridge. Downstream of the bridge the Colligan Estuary opens out into an area of mudlfats of importance for waterbirds for which Dungarvan Harbour SPA has been designated.

4.3 The river along this stretch has supported a pair of Kingfisher (Limosa, 2006) and is known to be important for sea-trout. Cormorant was noted flying upstream to feed on 21st October site visit (2013).

Constructed Wetlands / reedswamp

4.4 A series of 5[5] constructed wetlands have been established on the capped landfill and are designed to collect and treat residual leachate from the landfill. The wetlands were planted with a mix of wetland vegetation such as reeds and sedges, which have since become densely vegetated over time (reed and large sedge swamp, FS1). Though variously dominated by species such as common reed (*Phragmites australis*), Bulrush (*Typha latifolia*) or bur-reed (*Sparangium* sp.), *Carex* and *Scirpus*, they also contain a range of other aquatic plants. Open patches of water near the outflow pipes within the ponds are particularly diverse with a range of submerged and floating species, with duckweed (*Lemna* sp.), water-starworts (*Callitriche* sp.) and Water plantain (*Alisma plantago-aquatica*) observed (c.f. Plate 12: Right Centre). Originally these constructed wetlands would have been classed as Other Artificial Lakes and Ponds (FL8), but due to dense vegetative growth they are progressing towards Reed and Large Sedge swamps (FS1) in many areas (Plates 9-15).

4.5 Another artificial pond occurs in the south east of the landfill site also supporting some emergent vegetation, which for the most part could be considered as being FS1, though large open patches of water

[5] Pond 1a and 1b located at the top of the landfill are treated elsewhere as a single pond – hence in describing the leachate system 5 ponds are noted rather than 6.

within the pond should be classed as Other Artificial Lakes and Ponds (FL8) (Plate 16) – it is through this pond that treated leachate ultimately finds its way via hydraulic connection to the River Colligan.

4.6 This habitat has also formed naturally along the banks of the River Colligan, where it is represented by monodominant stands of common reed; interspersed with occasional thickets of willow scrub (Plate 14).

Grassland habitats

4.7 Excluding the stands of FS1 formed within the Integrated Constructed Wetlands, grassland habitats are the predominant habitat type covering the site; during the 2006 survey these areas were mainly recolonising bare ground (ED3). Currently they are dominated by re-seeded grassland, which at present is best described as amenity grassland (GA2); though in time with proper management these areas may continue to develop into a more species rich semi-natural grassland (GS); comparable to areas of Dry meadows and grassy verges (GS2) known to occur in some areas along the river bank.

4.8 An area of 0.75 ha at the south eastern end of the landfill was sown with native wildflower seed in May 2010 to enhance the biodiversity of the site. This will be monitored as part of ongoing ecological monitoring of the site.

4.9 In areas common rush (*Juncus effusus*) is frequent and gorse (*Ulex europeaus*) was also noted (Plates 7-8); some areas of grassland are likely to continue to develop towards GS4 (which is well represented outside the site; Plate 4) and gorse scrub (WS1) could develop if unmanaged on the side slopes on poorer draining soils.

4.10 Surrounding agricultural lands are a mix of improved agricultural grassland (GA1) and arable crops (BC1).

Scrub (WS1)

4.11 Though small shrubs are frequently scattered around the capped landfill, they seldom form enclosed mono-dominant stands that would be characterised as scrub. The ability of gorse to spread quickly will, however, likely mean a rapid succession from grassland to scrub cover on the landfill cap if unmanaged.

4.12 Willow scrub is also present within the study area, and was particularly evident along the artificial pond adjacent to the transfer station, and the northern boundary of the landfill on both banks of the River Colligan. The presence of willow around the wetland margins and eastern slopes will also encourage the acceleration of scrub cover within wet areas. Willows are also showing signs of colonising some of the ICW ponds.

Spoil and bare ground (ED2)

4.13 Spoil and Bare Ground (ED2) is limited to the access paths of exposed soil around the constructed wetland ponds; to 3m gravel access track entering the landfill; to a track around the boundary of the site and to areas of bare ground around some of the buildings However, much of the transitory / recolonising habitats (including ED2 & ED3) noted on site in 2006 have now been replaced by grassland.

Buildings and artificial surfaces (BL3)

4.14 This habitat category comprises areas of concrete and tarmacadam, metal storage containers, offices and ancillary structures and the road leading to the site. Due to the bare and artificial nature of this habitat plant life is scarce. This habitat encompasses the civic amenity area, the waste transfer station and the composting heap.

Rare plants

4.15 Wetlands within the landfill were observed to support Opposite-leaved pondweed (*Groenlandia densa*), a species listed on the Flora Protection Order, 1999, during recent surveys (2012 AER; WCC, 2012).

Existing Water Quality Conditions

4.16 A requirement of the amended Landfill waste licence is that a biological assessment of the River Colligan is undertaken as part of the annual environmental report. The most recent such report is the *Annual Environmental Report, 2012. Dungarvan Waste Disposal Site* (WCC, 2012). Current water quality data has been abstracted from this report.

4.17 The AER can be downloaded from –

http://www.epa.ie/terminalfour/waste/waste-view-filter.jsp?regno=W0032-02&filter=f&docfilter=go

4.18 Unless otherwise stated (e.g. surface water in the River Colligan) the following discussion of water and leachate quality is abstracted from Waterford County Council's 2012 Annual Environmental Report (WCC, 2012).

Existing Surface Water Quality

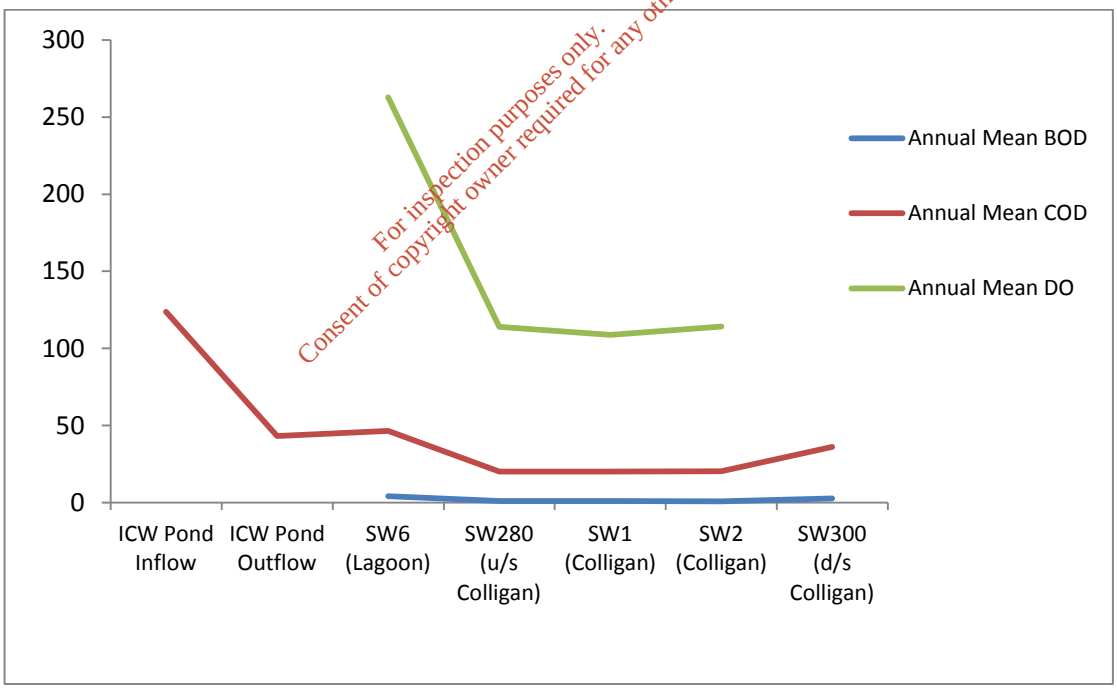
4.19 The constructed wetlands system at Dungarvan landfill consists of five number ponds that were constructed to assimilate leachate waste produced onsite. The pond system reduces the pollution loading of the effluent moving through prior to final discharge to an area of marsh adjacent to the River Colligan. Water can only enter the River Colligan by hydraulic connection through groundwater or through the soil layer given the absence of storm water overflows from the lagoon. The results of the water quality monitoring taken from the inflow to settlement pond 1 of the ICW system and the outflow of the final settlement pond 5 were compared in relation to the surface water sampling stations in the River Colligan. This facilitated a comparison of whether pollutants emanating from the landfill were causing a reduction in the water quality of the River Colligan while also examining the relative reduction in the pollution loading over the gradient of the system relative to the baselines recorded from the river. Essentially this facilitates an assessment of whether pollution from the landfill may be impacting the water quality of the river / estuarine environments. The surface water quality sampling locations are summarised below: -

- ICW inflow: - Inflow from leachate pump to ICW attenuation system;
- ICW outflow: - Outflow from 5 number attenuation ponds of the ICW system;
- SW2: - Surface water sampling point in the River Colligan north of the landfill (d/s of EPA station 280)
- SW1: - Surface water sampling point in the River Colligan north of the landfill (d/s of monitoring station SW2)
- SW280: - EPA water quality monitoring station immediately downstream of the westerly limit of the landfill site
- SW300: - EPA monitoring station in the estuarine reaches of the River Colligan downstream of the landfill

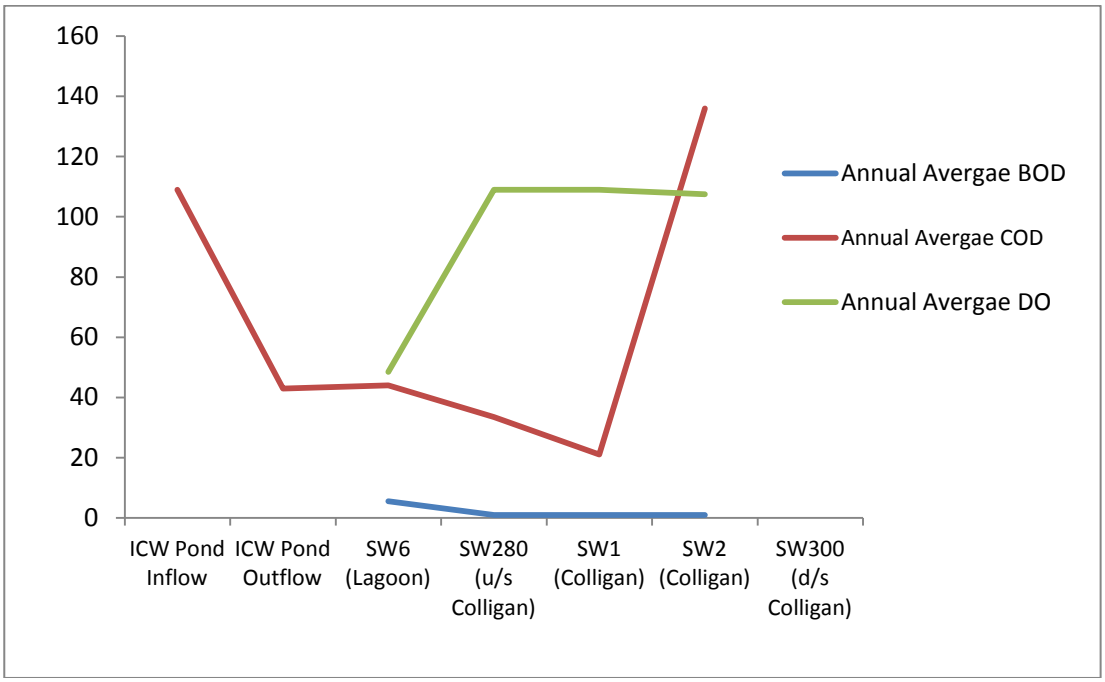
4.20 The results as presented in Text Figures 4.1 and 4.2; these illustrate a general reduction in the COD levels between the ICW system and the water quality in the River Colligan adjacent to the landfill. However, it was noted that a slight spike in COD was recorded during 2012 at sampling station SW2 in the River Colligan; this however is located upstream of the final discharge from of treated effluent. The cause of the spike in COD is unknown but was not observed during the previous year (i.e. 2011) when levels were consistently low across all riverine stations (between 20-36mg/l COD).

4.21 BOD levels were consistently low across all the riverine sampling stations (<2.7mg/l BOD) between 2011 and 2012, indicating no reduction in water quality as a result of the landfill operation. While slightly elevated levels were recorded in the lagoon during 2012 (max reading of 5.5mg/l BOD), these levels would not be considered of concern and are not causing any reduction in the BOD of levels in the River Colligan adjacent. The slightly elevated levels recorded in the lagoon would be still considered of good quality given that they result from the discharge of an ICW system treating landfill leachate (see Text Figures 4.2 & 4.3).

4.22 The dissolved oxygen levels were consistently high across all stations in the River Colligan and in excess of 100% saturation at all sampling stations. Variability in the dissolved oxygen was observed in the lagoon site only. This would be most likely be explained by algae in the pond producing oxygen during photosynthesis dependant on the time of day that samples were collected or the total algae crop size a given time of year. None the less levels within the River Colligan remain high and indicative of 'good status' water (i.e. 95% of the samples within 80%-120% saturation levels).



Text Figure 4.1 - Mean levels of selected pollutants recorded at Dungarvan Landfill 2011.



Text Figure 4.2 - Mean levels of selected pollutants recorded at Dungarvan Landfill 2012.

Existing Biological Water Quality

4.23 The most recent biological water quality sampling data was undertaken by Limosa Environmental in 2012 at surface water sampling stations SW2 and SW1 in the River Colligan (from 2012 AER; WCC, 2012). Given the brackish nature of the water Q analysis was not possible. However taxonomic diversity was used to qualitatively estimate water quality. The results of the survey indicated that Taxon richness was higher in the 2012 surveys compared to the Oct 2009 survey at SW1 (10 taxa in 2012 and 5 taxa in2009), but slightly lower for SW2 (8 taxa in 2012 and 11 taxa in 2009). The water quality however was summarised as of good quality based on the invertebrates recorded that included clean water caddis families (Goeridae, Seracostomatidae and Limnephilidae) in addition to the presence of the clean water mayfly family Ecdyonuridae.

4.24 The EPA no longer collect water quality data at stations 280 and 300; these have been replaced by station 250 at Killadangan upstream of the landfill where water quality is currently of moderate status (Q3-4). This represents a reduction in water quality from 'good status' that was recorded during sampling at the station between 2004 and 2010

Surface Waters discharging from site

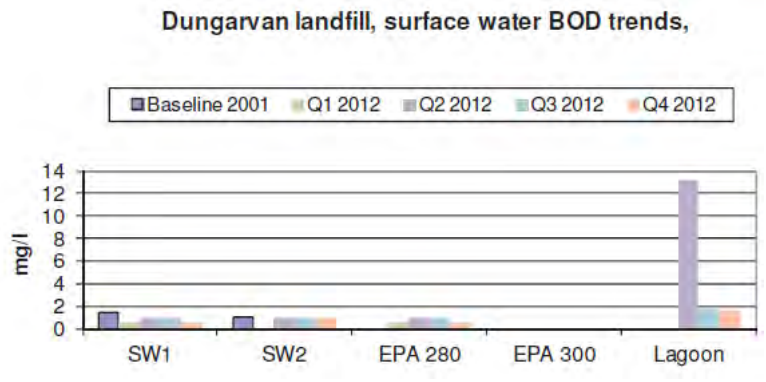
4.26 Sampling on the River Colligan was carried out by EPA and Waterford County Council personnel at sites SW1, SW2, EPA site 300, EPA Site 280 and the landfill lagoon (as per Figure 3.5). Analysis was carried out at EPA Laboratories in Kilkenny and Dublin. Sampling site EPA 300, at Ballyneety Bridge downstream of the landfill site, is subject to saline intrusion from Dungarvan Estuary. There are difficulties involved in monitoring surface water pollution from landfills adjacent to estuaries, as the salinity of the samples can interfere with many of the tests, (ammonia, COD, arsenic, copper). Additionally, many of the ions, which are considered indicators of leachate contamination, are also major components of sea/brackish water, (chloride, sulphate, sodium, magnesium, calcium, boron).

4.27 River and lagoon water quality was found to be satisfactory. In this testing Biological Oxygen Demand (BOD) is used as a key indicator (proxy) for water quality. The BOD test is a measure of the amount of oxygen consumed by microorganisms in breaking down organic matter in water. Respiration by phytoplankton or their decay, can also lead to oxygen depletion during the BOD test resulting in a high BOD value. Surface waters supporting fish life should have a BOD value < 4 mg/l BOD.

4.28 Text Figure 4.3 illustrates BOD levels in 2012 against baseline levels in 2001. Sampling locations are as follows (see Figure 3.5): -

- SW1 refers to Surface Water monitoring station 1 on the River Colligan – midway along the northern boundary of the landfill;
- SW2 is upstream of SW1 at the northeastern corner of the landfill;
- EPA 280 refers to the location of an EPA routine surface water monitoring station on the River Colligan [routine sampling at this site ceased after 2008 – upstream of the landfill – this has since been replaced by Station 250 at Killadangan Bridge];
- EPA 300 refers to an EPA routine surface water monitoring station on the River Colligan – downstream of Ballyneety Bridge;
- Lagoon refers to the last the pond in the southeastern corner of the site prior to discharge.

4.29 BOD levels were low at river sites and in the lagoon throughout the year. Other water quality tests were also satisfactory. Full water quality data is presented in Tables 5.1.1 – 5.1.4 of the 2012 AER (see above link).



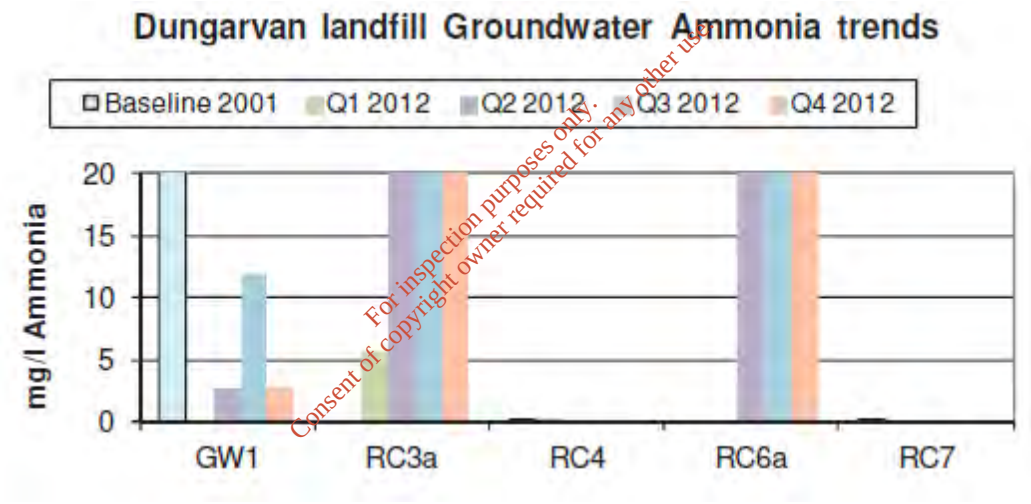
Text Figure 4.3 - illustrates BOD levels in 2012 against baseline levels in 2001

Ground Water from site

4.30 Sites GW1, GW2a, RC3a, RC4, RC6a, RC7 and RC8 were sampled during 2012 (Figure 3.5). RC1 is no longer in place. RC4 (south west of site) and RC7 (east of site) are outside the waste deposit area. All the other ground water stations are within the site boundary, either within or immediately adjacent to waste deposit areas. Ground-water flow through the site has previously been described as south to north.

4.31 Results for 2012 are presented on Tables 5.2.1 to 5.2.4 and appendices of the 2012 AER (WCC, 2012; see link above). High ammonia levels were detected at sites GW1, RC3a, and RC6a, within the landfill site. Metals levels were generally low, although high iron levels were detected at GW1, RC3 and RC7. Trace organics were not detected in groundwaters. Intermittently high conductivity levels detected at site RC7, outside the landfill boundary indicate likely saline intrusion from the estuary. In the case of elevated ammonia and iron the AER concludes that these values are not of environmental significance given available dilution and the estuarine nature of receiving waters.

4.32 A key parameter being monitored in order to assess the performance of the leachate management system and the ICW's is Ammonia. Groundwater levels of ammonia are summarised in Text Figure 4.4.



Text Figure 4.4 - illustrates Groundwater ammonia levels in 2012 against baseline levels in 2001

4.33 Ammonia was elevated at sites GW1, RC3a and RC6a (both on the southern side of the landfill). RC4 and RC7, outside the landfill area, had relatively low ammonia. RC7 had a high ionic content at times, possibly indicating brackish water intrusion.

4.34 Heavy metals and organics were not detected or else were present in low concentrations. The results of groundwater monitoring are in line with results from previous rounds of testing. The sites within and closely adjacent to the working area appear to be impacted by landfill leachate in terms of ammonia and iron concentration. Site RC4 at the south-western boundary had relatively good water quality. Site RC7, 200 metres east of the facility, and outside the landfill area had generally satisfactory water quality though iron levels were elevated at times and saline intrusion was evident.

Leachate testing

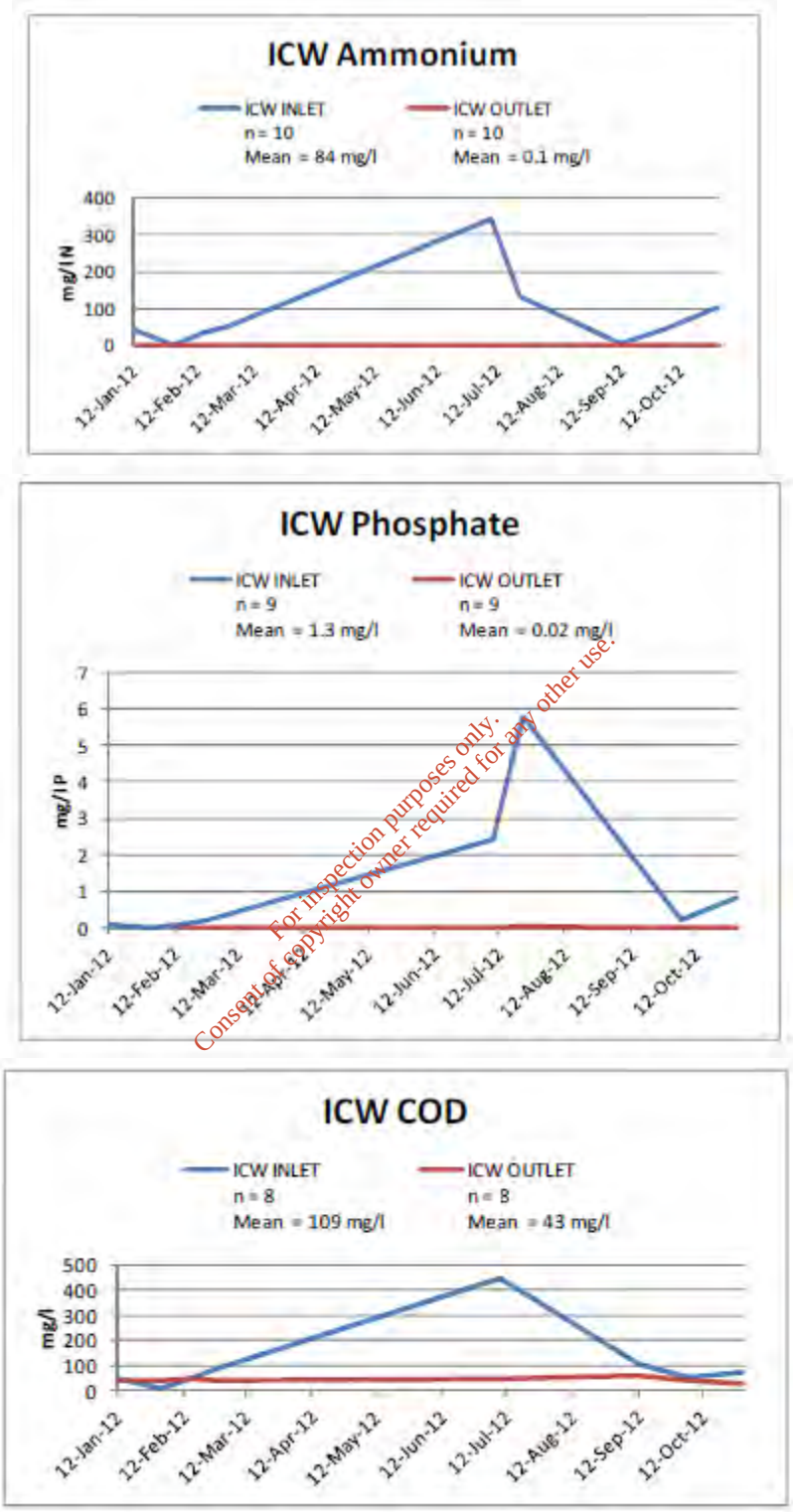
4.35 The leachate holding tank was sampled during 2012. Sampling from individual leachate boreholes was restricted due to access difficulties due to capping and landfill remediation works. As noted, in order to treat the leachate collected from the landfill an ICW consisting of five cells of varying size was constructed

on top of the capped landfill. Each ICW cell was constructed by creating 1m x 3-4m wide perimeter bunds. Each cell was lined with HDPE to contain the leachate and each cell has a 500mm depth of subsoil to support the establishment of the wetland helophytic (emergent) vegetation. The wetlands have a total surface area of 18,000 m^2. The ICW can be generally categorized as a surface flow wetland and strives to mimic natural wetlands of similar structure and vegetation. The dominant vegetation in the wetland consists of a range of helophytic genera (emergent plants) including amongst others *Typha*, *Glyceria*, *Carex* and *Iris* species. The sizing of the overall functional area of the ICW is based on an area loading of 0.2 litres of leachate per meter squared per day (0.2 l/m2/d).

4.36 The leachate, after dilution, is pumped to the first ICW cell and thereafter flows by gravity sequentially from cell to cell where it is comprehensively treated prior to intermittent discharge to the on-site surface water lagoon. Currently leachate from the interceptor tank and leachate boreholes 2 and 6 are mixed with groundwater from RC8 and pumped to the ICW for treatment. Flow and contaminant loadings to the wetland are presented in Table 4.1. Inlet and outlet concentrations for ammonia, phosphate and chemical oxygen demand are graphed in Text Figure 4.5. [for full 2012 data see Table 5.3.3 – 5.3.6 of the 2012 AER; see link above].

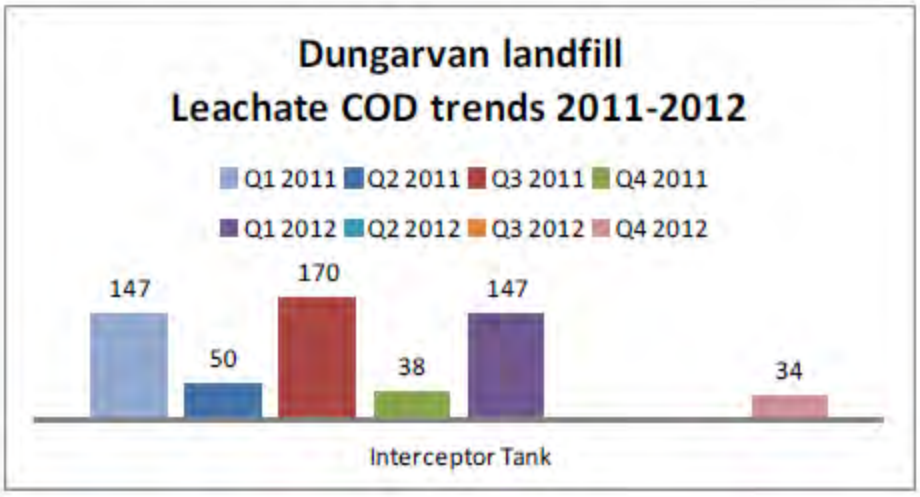
Table 4.1 – Dungarvan landfill integrated constructed wetland estimated loadings – present and (future expected)

ICW	
Number of ponds	5
Total working wetland area (m^2)	5,158
Total working wetland volume (c)	1,032
Hydraulic Flows	
Influent Volume m^3 / day	26.9 (50)
Hydraulic loading l/m^2/day	5.2 (12)
Loadings	
Ammoniacal Nitrogen loading (g/m^2/day)	0.5
Total Phosphorus loading (g/m^2/day)	0.003
COD loading (g/m^2/day)	0.6
Metals (mg/m^2/day)	<0.1



Text Figure 4.5 – ICW inlet / outlet concentrations a) ammonia; b) phosphate and c) chemical oxygen demand.

4.37 A key parameter to be monitored in leachate is COD; the COD test measures the organic matter in a sample that is amenable to chemical oxidation. The COD test is usually applied to polluted waters and waste-waters.



Text Figure 4.3 – COD trends 2011 – 2012.

4.38 Generally clean waters would have a COD of 10-20; the figures of ca. 150-200 shown in Text Figure 4.3 above for leachate would not be atypical for leachate (i.e. be equivalent to polluted waters).

Heavy Metal Testing

4.39 Testing of estuarine sediment and benthic macrofauna (i.e. blue mussel tissue) for heavy metals has also been undertaken as part of the Dungarvan Landfill Monitoring programme (as required under Condition 8.11 of the landfill licence). Samples were last collected on 16th December 2008 at 5 sampling points (extracted from the Annual Environmental Report, 2008 prepared by Waterford County Council): S1 – just upstream of the disused railway bridge upstream of the landfill site (i.e. EPA station 280);

- S2 – immediately upstream of the landfill site;
- S3 – opposite downstream drain from landfill;
- S4 – 150m downstream of the landfill; and
- S5 – Ballyneety Bridge, downstream of landfill (i.e. EPA station 300).

4.40 These are the most recent such data collected by Waterford County Council. Samples were tested by Environmental Services Laboratory, Cork. Results from 2008 are presented in Table 4.2, with data from 2003, 2004 and from a number of other studies presented for comparison. Table 4.2 – Dungarvan Sediment testing results, 2008.

Table 4.2 – Metal content in sediment, 2008.

Dungarvan Sediment Results, 2008 [2004] & (2003) results in brackets							Waterford Harbour EPA Survey, 2003 (Avg. of 5 samples)	Wexford Harbour EPA Survey, 2002 (Avg. of 4 samples)	Dungarvan Harbour EPA Survey, 2004 (Avg. of 4 samples)	Sediment Quality Standards Lower / Upper Limits [1]
Parameter	Units	S1	S2	S3	S4	S5				
Arsenic	mg/kg	1.7 [2.5] (5.2)	1.4 [2.7] (6.5)	1.2 [2.1] (3.7)	2.3 [3.5] (3.5)	1.6 [3.7] (4.6)	8	8.6	6.7	9 / 70
Cadmium	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5				0.7 / 4.2
Chromium	mg/kg	5.1	<5	<5	13.5	<5	20	31	22.8	120 / 370
Copper	mg/kg	<5.0 [6.1] (7.4)	<5.5 [5.7] (9.3)	<5.0 [6.6] (7.2)	7.3 [8.7] (6.4)	5.0 [204] (13.6)	9.8	11.4	23.4	40 / 110
Lead	mg/kg	6.1 [17.1] (13)	36.1 [5.7] (23)	7.6 [6.9] (10)	22.7 [35.2] (10)	7.3 [72] (14)	26	15	93	60 / 218
Zinc	mg/kg	62.0 [38.6] (43)	34.3 [40.8] (49)	35.9 [31.5] (88)	51.8 [38.8] (450)	55.0 [1526] (41)	141	70	102	160 / 410

Note: It should be noted that prior to their closure Dungarvan Crystal and Dungarvan Tannery were licenced to discharge lead and chromium to Dungarvan Harbour.

[1] From Cronin *et al.* (2006). *Guidelines for the Assessment of Dredge Material for disposal in Irish Waters*.

4.41 The assessment concluded that metals in sediment in 2008 were broadly in line with other years, and complied with sediment quality standards and were lower than results from other parts of the coast (from 2012 AER). However, while Zinc at S5 (Ballyneety Bridge) does significantly exceed guidance levels; all other values at S1-S4 are with recommended guidance; it is possible that this spike may not originate from the landfill.

4.42 With respect to sediment quality standards we have used the values as published by the Marine Institute in 2006 - *Guidelines for the Assessment of Dredge Material for disposal in Irish Waters* (Cronin *et al*., 2006) to re-examine these data. Values are presented as lower and upper guidance limits for dumping of dredge material, such as estuarine sediments, at sea. "Most upper level guidance values have been derived from samples collected at reference sites around the Irish coast deemed to be remote from point sources " (from Cronin et al., 2006); lower level guidance represents high background concentrations. Findings do not differ from those in the 2008 report.

4.43 Samples of blue mussel (*Mytilus edulis*) were collected at a location downstream of the landfill, at the N25 Bridge at Dungarvan bypass road, also on the 16th December 2008. Results are illustrated in Table 4.3.

Table 4.3 – Metal content in mussel, 2008.

Parameter	Units	Dungarvan Mussels, 2008 {2005} [2004] (2003)	Waterford Harbour EPA Survey, 2001 (Avg. of 4 samples)	Wexford Harbour EPA Survey, 2004 (Avg. of 4 samples)	Dungarvan Harbour EPA Survey, 2004 (Avg. of 4 samples)	Shellfish Quality Standards (Glynn *et al.* 2003) [1]	Marine Institute Studies max. values (Glynn *et al.*, 2003)
Arsenic	mg/kg (wet weight)	1.90 {2.2} [9.8] (2.6)	3.7	1.6	n/a		
Cadmium	"	0.14 {0.1} [0.34] (0.03)	0.4	0.1	0.2	1	0.44
Chromium	"	<1 {0.5} [n/a] (n/a)	1.1	0.9	0.9		0.86
Iron	"	14.24 {66.4} [212] (49)	115	62	140		
Lead	"	0.86 {2.1} [15.4] (3.8)	1.5	<0.4	7.5	1.5	0.77
Manganese	"	1.36 {2.4} [18] (1.4)	5.7	3.4	2.5		
Zinc	"	13.14 {11.6} [51] (13.2)	39	22.4	26		28.5

[1] From Glynn, D., Tyrell., L., McHugh, B., Rowe, A., Costello, J. and McGovern, E. (2003). Trace Metal and Chlorinated Hydrocarbon Concentrations in Shellfish from Irish Waters, 2000. *Marine Environment and Health Series No. 7.* Marine Institute.

4.44 Metal levels in mussels were similar to levels detected in recent years. Metal levels were compliant with relevant quality standards (where available) and were similar to or lower than comparable sites around the coast (from 2008 AER). Glynn *et al*. (2003) do not present values for arsenic, iron or manganese. While high iron levels are comparable to those from another south coast harbour; Waterford.

Fauna

4.45 The River Colligan is an important habitat for Otters which are protected under the EU Habitats Directive (92/43/EEC; as amended), as transposed in Irish law by the European Communities (Birds and Habitats) Regulations, 2011 (S.I. No. 477 of 2011) and by the Wildlife Act, 1976 and Wildlife (Amendment) Act, 2000. Numerous sprainting sites, some of which are obviously in long-term use, indicate that otters are resident

and successful along the River Colligan (Limosa, 2006; WCC, 2013). The high level of otter activity from previous surveys indicates that the River Colligan contains a healthy and reliable population of fish, again highlighting the biological health of the River Colligan. Furthermore, the abundance of frogspawn (*Rana temporaria*) provides a food source for Otter along the River Colligan; Dr. Lewis noted remains of frogs predated by Otter in her 2006 surveys (Limosa, 2006). Surveys of Otter activity along the Colligan commissioned by the MISE[6] in 2012 also indicate active use along this waterway corridor (WCC, 2013); e.g. Otter spraint were recorded on the north bank of the River Colligan immediately opposite the landfill and along the shore of the estuary immediately east of Ballyneety Bridge

4.46 Other mammals recorded on site include Rabbit, Fox, Brown Rat, American Mink, Pygmy Shrew and a bat (most likely Common pipistrelle) (Limosa, 2006; WCC, 2013). The River Colligan and surrounding environs provides a suitable habitat for a range of Irish bats, in particular Daubenton's bat which feeds along rivers such as the Colligan are is likely to occur upstream of the site. Common pipistrelle, Soprano pipistrelle and Leisler's bat are also likely to occur over the landfill; especially since the ICW's have been commissioned.

4.47 As noted there is also evidence of Common frog from on site. During 2012 an 2013, monitoring undertaken by Waterford County Council, noted abundant frogspawn in the landfill's wetland cells reflecting an increasing biodiversity and improvement of the water quality within these ponds

4.48 As part of routine biological sampling in the River Colligan Dr. Lesley Lewis recorded juvenile flounder in the brackish stations. Eel was recorded in 2008, but not the following year in 2009 (Limosa, 2009). Eel is a catadromous species that has recently declined to levels that have required EU member states to formulate National Eel management plans whose objective is to arrest further declines; eels absence in 2009 is therefore more likely to be symptomatic of a wider decline than any impact from the landfill.

Birds

4.49 For convenience the bird data is presented as part of the Stage 2 assessment of Dungarvan Harbour SPA.

[6] Mammals in Sustainable Environment.

Photographic Essay




Plate 1: Civic amenity area.


Plate 2: Green Waste Area.


Plate 3: Waste transfer station.


Plate 4: The River Colligan and reedswamp on the northern banks.


Plate 5: River Colligan as it flows adjacent to the waste transfer station and Civic Amenity Area.

Plate 6: Leachate dilution tank to the north west (behind) the waste transfer station.

Plate 7: Left - Leachate monitoring and dilution tank at south western corner of site. Right – Main control hut.

Plate 8: Grassland and scrub on Landfill slopes.


Plate 9: Pond 1a.


Plate 10: Pond 1b.


Plate 11: Pond 3.


Plate 12: Pond 4.


Plate 13: Pond 5




Plate 14: Reed and Large Sedge Swamps (FS1) on south east of capped landfill. Relatively large patches of open water can be considered to be Other Artificial Lakes and Ponds (FL8).

5. Appropriate Assessment

Description of Natura 2000 Sites

5.1 There are seven Natura 2000 sites located within 15km of the Dungarvan Landfill, namely: -

- Comeragh Mountains SAC (Site Code: 001952);
- Blackwater River (Cork / Waterford) SAC (Site Code: 002170);
- Glendine Wood SAC (Site Code: 002324);
- Helvick Head SAC (Site Code: 000665);
- Mid-Waterford Coast SPA (Site Code: 004193);
- Helvick Head to Ballyquinn SPA (Site Code: 004192);
- Dungarvan Harbour SPA (Site Code: 004032).

5.2 The location of these Natura 2000 sites is shown in Figure 1.2.a.

Stage 1 Screening

5.3 Of the Natura 2000 sites within 15km of Dungarvan Landfill, the following can be screened out as they will not be subjected to impacts from Dungarvan Landfill in its current state, due to the nature of their conservation objectives but more importantly their distance and direct lack of connectivity to the Landfill site. Conservation objectives for the following sites have not been reproduced here, but can be viewed on the NPWS mapviewer (http://www.npws.ie/mapsanddata/) at the following links: -

- Comeragh Mountains SAC (Site Code: 001952);
  http://www.npws.ie/protectedsites/specialareasofconservationsac/comeraghmountainssac/
- Blackwater River (Cork / Waterford) SAC (Site Code: 002170);
  http://www.npws.ie/protectedsites/specialareasofconservationsac/blackwaterrivercorkwaterfordsac/
- Glendine Wood SAC (Site Code: 002324);
  http://www.npws.ie/protectedsites/specialareasofconservationsac/glendinewoodsac/
- Helvick Head SAC (Site Code: 000665);
  http://www.npws.ie/protectedsites/specialareasofconservationsac/helvickheadsac/
- Mid-Waterford Coast SPA (Site Code: 004193);
  http://www.npws.ie/protectedsites/specialprotectionareasspa/mid-waterfordcoastspa/
- Helvick Head to Ballyquinn SPA (Site Code: 004192)
  http://www.npws.ie/protectedsites/specialprotectionareasspa/helvickheadtoballyquinspa/

5.4 Comeragh Mountains SAC, Glendine Wood SAC (designated for Killarney Fern) and Helvick Head SAC are all designated for terrestrial habitats and species which would not be impacted due to the nature of their conservation objectives, but more importantly their distance and direct lack of connectivity to the Landfill.

5.5 There is no connection between Dungarvan Landfill and the valley of the River Blackwater.

5.6 The Mid-Waterford Coast SPA (running between Dungarvan and Tramore) is designated for breeding Cormorant, Peregrine, Herring Gull and Chough. Helvick head to Ballyquinn SPA (west of Dungarvan) is designated for breeding Cormorant, Peregrine, Herring Gull, Kittiwake and Chough. Chough are commonly recorded in Clonea, east of Dungarvan, and on occasion in Ballynacourty on the east side of the Harbour; while they may occur also on the Cunnigar they are very unlikely to be recorded in the Colligan due to a lack of suitable habitat. Cormorant, Herring Gull and Kittiwake from these sites may enter the outer harbour; Herring Gull may also occur in the gull roost in the Colligan east of Ballyneety Bridge (this roost most likely developed when gulls were feeding at the landfill and using freshwater in the Colligan to bathe). Peregrine are commonly encountered hunting shorebirds in Dungarvan during the winter months. The location of the landfill at the top of the Colligan Estuary is such that the species breeding at these SPA's are not likely to be impacted by the landfill and hence these sites have been Screened Out.

5.7 There are a number of other notable Natura 2000 sites in Co. Waterford; while these are >15km from Dungarvan landfill the were assessed for completeness. These include: -

- Lower River Suir SAC (Site Code: 002137);
  http://www.npws.ie/protectedsites/specialareasofconservationsac/lowerriversuirsac/
- River Barrow & River Nore SAC (Site Code: 004028);
  http://www.npws.ie/protectedsites/specialareasofconservationsac/riverbarrowandrivernoresac/
- Tramore Dunes and Backstrand SAC (Site Code: 000671);
  http://www.npws.ie/protectedsites/specialareasofconservationsac/tramoredunesandbackstrandsac/
- Ardmore Head SAC (Site Code: 004159);
  http://www.npws.ie/protectedsites/specialareasofconservationsac/ardmoreheadsac/
- Blackwater Callows SPA (Site Code: 004094);
  http://www.npws.ie/protectedsites/specialprotectionareasspa/blackwatercallowsspa/
- Tramore Backstrand SPA (Site Code: 004027);
  http://www.npws.ie/protectedsites/specialprotectionareasspa/tramorebackstrandspa/
- Blackwater Estuary SPA (Site Code: 004028)
  http://www.npws.ie/protectedsites/specialprotectionareasspa/blackwaterestuaryspa/

5.8 The Blackwater Callows SPA is designated for wintering Whooper Swan, Teal, Wigeon and Black-tailed Godwit (and Waterbirds & Wetlands). Tramore Backstrand SPA is designated for wintering Light-bellied Brent Goose, Golden Plover, Grey Plover, Lapwing, Dunlin, Black-tailed Godwit, Bar-tailed Godwit and Curlew (and Waterbirds & Wetlands). While the possibility of movement of Black-tailed Godwit between the Blackwater Callows or Tramore and Dungarvan cannot be discounted, but is not likely to be significant; there is also the possibility of some movement of Light-bellied Brent Geese from Tramore to Dungarvan (McGrath, 2011), especially given the ongoing increase in numbers along the south coast.

5.9 Blackwater Estuary SPA at Youghal is designated for Wigeon, Golden Plover, Lapwing, Dunlin, Black-tailed Godwit, Bar-tailed Godwit, Curlew, Redshank and Waterbirds & Wetlands.

5.10 As noted all of these sites are located further than 15km away from the Landfill. Due to either the nature of their conservation objectives or their distance and lack of connectivity to the Landfill, they will not be impacted by continued operations at Dungarvan Landfill and hence are also screened out.

5.11 **These sites will not be considered any further as part of this assessment**.

5.12 While impacts on Dungarvan Harbour SPA are unlikely and were screened out by Waterford County Council in their Stage 1 Screening Report (July, 2013), the EPA requested that a Stage 2 Assessment / Natura Impact Statement be prepared in September 2013. **The Stage 2 – Appropriate Assessment is presented below**; this addresses the question as to whether the continued operation of the landfill, and the licence changes specified, pose any risk to the conservation objectives for which Dungarvan Harbour SPA is designated.

Stage 2 – Appropriate Assessment

Dungarvan Harbour SPA

5.13 Dungarvan Harbour is a significant wetland complex in Co. Waterford which supports notable numbers of wetland birds. The northern and eastern margins of Dungarvan Landfill adjoin the tidal reaches of the River Colligan, which is designated as part of Dungarvan Harbour SPA.

5.14 Dungarvan Harbour is recognised as a wetland of international importance under the Ramsar Convention of 1971 and was designated a Special Protection Area in 1994. The designated site covers an area of 2,219 hectares and extends along the River Colligan estuary as far upstream as Ballyneety Bridge. Dungarvan Harbour is also designated a Ramsar Site (site code 839; 1,041 ha) and as an Important Bird Area (IE094; 1,300 ha). The harbour is also designated as Dungarvan Harbour proposed Natural Heritage Area (site code 000663; the full site synopsis is included in Appendix B). The pNHA borders the eastern side of the landfill and extends down along the Colligan Estuary; the northern half of the civic amenity area lies within the pNHA site boundary. No other parts of the landfill are within the pNHA. The SPA boundary extends a little further upstream on the River Colligan than the pNHA.

5.15 Dungarvan Harbour SPA and the species and ecological traits for which it is designated are described in greater detail below.

Conservation Objectives of Dungarvan Harbour SPA

5.16 The conservation objectives published by NPWS for Dungarvan Harbour SPA are summarised in Table 5.1 (NPWS, 2012).

Table 5.1 – Conservation Objectives for Dungarvan Harbour SPA and species for which the site has been designated.

Site Name	Site Code	Conservation objectives	Habitats and / or Species for which the site has been designated (wintering unless otherwise stated)
Dungarvan Harbour SPA	004032	To maintain the favourable conservation condition of the bird species listed as Special Conservation Interests in Dungarvan Harbour SPA, which are defined by the following list of attributes and targets: - • Population Trend: Long term trend stable or increasing • Distribution: There should be no significant decrease in the numbers or range of areas used by waterbird species, other than that occurring from natural patterns of variation. To maintain the favourable conservation condition of the wetland habitat in Dungarvan Harbour SPA as a resource for the regularly occurring migratory waterbirds that utilise it. This is defined by the following attribute and target: - • The permanent area occupied by the wetland habitat should be stable and not significantly less than the area of 2,219ha, other than that occurring from natural patterns of variation.	• Great Crested Grebe (*Podiceps cristatus)* (wintering) [AE005] • Light-bellied Brent Goose (*Branta bernicla hrota*) (wintering) [A046] • Shelduck (*Tadorna tadorna*) (wintering) [A048] • Red-breasted Merganser (*Mergus serrator*) (wintering) [A069] • Oystercatcher (*Haematopus ostralegus*) (wintering) [A130] • Golden Plover (*Pluvialis apricaria*) (wintering) [A140] • Grey Plover (*Pluvialis squatarola*) (wintering) [A141] • Lapwing (*Vanellus vanellus*) (wintering) [A142] • Knot (*Calidris canutus*) (wintering) [A143] • Dunlin (*Calidris alpina*) (wintering) [A149] • Black-tailed Godwit (*Limosa limosa*) (wintering) [A156] • Bar-tailed Godwit (*Limosa lapponica*) (wintering) [A157] • Curlew (*Numenius arquata*) (wintering) [A160] • Redshank (*Tringa totanus*) (wintering) [A162] • Turnstone (*Arenaria interpres*) (wintering) [A169] • Wetlands [A999]

5.17 The following site synopsis for Dungarvan Harbour SPA is extracted from the NPWS site synopsis (NPWS, 2004).

> In landscape terms Dungarvan Harbour lies at the eastern end of the River Blackwater valley, though this river now turns south at Cappoquin, vacating its more obvious (and former) course. The Colligan River, running south from the Comeragh Mountains, enters the bay by Dungarvan itself. The River Brickey flows from the west while the Glendine River flows into the harbour from the north. The absence of a large river means that the bay is essentially a marine habitat though it dries out at low tide to give extensive mud and sand flats. The inner bay is extremely sheltered, the linear Cunnigar spit (which almost closes the bay on the east) adding to the effect of hills in the south and south-west.
>
> The rock type of most of the area is limestone though this is only exposed on flat rocks at Ballynacourty. Elsewhere saltmarsh, glacial drift and sand form the shore with a narrow stony beach in

places. he most natural saltmarsh occurs at Kilminnin on the north shore and west of the Cunnigar on the south. In several places the saltmarshes, having been reclaimed for a period, have been flooded again and are reverting to their natural vegetation. There is an abundance of Sea Rush (*Juncus maritimus*) in such places often mixed with grasses, with Reed (*Phragmites australis*) or Sea Club-rush (*Scirpus maritimus*) in drains. Sometimes this community gradually blends with a freshwater marsh including Tufted Hair Grass (*Deschampsia cespitosa*), Soft rush (*Juncus effusus*), Brown Sedge (*Carex disticha*) and Fleabane (*Pulicaria dysenterica*). Eelgrass (*Zostera* sp.) has been recorded in the area.

A major part of the ecological importance of the bay is the wintering birdlife which is present in large numbers. Surveys in the winters l984/85 - 1986/87 and from 1994/95 onwards showed that Brent Goose (616 in 1995), Black-tailed Godwit (l329 [952 in 1996]) and Bar-tailed Godwit (1593 in 1996) occurred in numbers of international importance, while thirteen other species were nationally important. These are Shelduck (1721 [995 in 1995]), Wigeon (1015), Red-breasted Merganser (50), Grey Plover (359), Golden Plover (6100 in 1996), Lapwing (3775 in 1996), Knot (996 in 1996), Sanderling (83), Dunlin (6100 in 1996), Redshank (930 [910 in 1996]) and Turnstone (254). A further ten species were found in numbers of regional or local importance emphasising that Dungarvan supports a greater diversity of species than any other site on the south coast except for Wexford Harbour.

The sand flats to the east of the Cunnigar support an extensive oyster farming operation. There is concern that displacement of waterfowl and disturbance may be a problem in the shellfish farming area.

Dungarvan Harbour SPA is of major conservation significance for the large numbers of many species of waterfowl that use it. The site regularly holds over 20,000 waterfowl and this qualifies the site as of International Importance. Two species that occur in important numbers are listed on Annex I of the E.U. Birds Directive, i.e. Bar-tailed Godwit and Golden Plover.

(Source: NPWS site synopsis, 2004).

5.18 Dungarvan supports internationally important numbers of Light-Bellied Brent Goose (*Branta bernicla hrota)*; while it is listed Annex II of the EU Birds Directive; i.e. a species that may be hunted under certain conditions; it cannot be hunted on its Irish wintering grounds. The population at Dungarvan has increased steadily since 2000 and has been fairly stable in recent winters at over 1,000 birds. The area supports two flocks of Brent Geese which tend to remain separate through the winter. The main flock tends to be distributed around Dungarvan eastwards to the Duck's Pool (Kilminnin) and Ballynacourty and upstream along the River Colligan. As noted they can be recorded in large numbers east of Ballyneety Bridge close in and around Shandon Island; they also graze a number of improved grassland fields on the north side of the estuary. The other flock is smaller; its activity is centred on Clonea, outside and to the east of Dungarvan Harbour.

Connectivity with Dungarvan Harbour SPA

5.19 The northern and north-eastern margins of the landfill site adjoin the lower tidal stretches of the River Colligan which in turn is designated as Dungarvan Harbour pNHA / SPA (See Figure 1.2a & b). Connectivity between the Landfill site and the nearby areas of Dungarvan Harbour SPA is maintained through direct surface water run-off from the landfill's hard surfaces in addition to discharges from the landfill's leachate treatment system which discharges treated leachate into the River Colligan following systematic abstraction and treatment. The manner of abstraction and treatment is outlined in greater detail in Chapter 5. The proposed landfill site is not connected to any other Natura 2000 sites by means of watercourses, waterbodies or any other ecological vectors.

Birds

Dungarvan I-WeBS Data

5.20 Dungarvan Harbour is a large, south-east facing circular bay, sheltered at its eastern extent, by Helvick Head to the south and Ballinacourty point to the north. The inner harbour is almost completely enclosed by the Cunnigar – a linear sand spit extending from Ballynacourty North creating a sheltered environment in the inner bay. The Colligan, Brickey and Glendine rivers drain into Dungarvan Harbour. The absence of a large river system entering the harbour results in a mainly marine habitat in the area.

5.21 Large expanses of intertidal mudflat and associated wetland habitats of Dungarvan harbour are important feeding and roosting areas for migratory wintering wading birds and wildfowl. The presence of "internationally" important populations of wintering waterbirds resulted in Dungarvan Harbour being designated a Special Protection Area (site code 004032). The qualifying interests for designation are internationally important wintering populations of Brent Goose, Black-tailed Godwit and Bar-tailed Godwit along with a range of other over wintering waterbird species. Dungarvan Harbour is also a Ramsar site (Ramsar Convention) and recognised as an Important Bird Area (Birdlife International).

5.22 The Irish Wetland Bird Survey (I-WeBS) is a national scheme which monitors wintering waterbirds in wetlands throughout Ireland. Counts are undertaken once a month from September to March by experienced volunteer counters as well as by professional counters from BirdWatch Ireland and National Parks & Wildlife Service (Crowe, 2005). Survey results are regularly summarised in published reports and peer reviewed papers prepared by the IWeBS Office, BirdWatch Ireland (e.g. Boland and Crowe, 2012). Waterbirds in Dungarvan Harbour are counted annually during winter as part of the Irish Wetland Bird Survey (I-WeBS). The count area includes the Colligan estuary as far upstream as Ballyneety Bridge. The review assesses recent waterbird data (2002/03- 20010/11) obtained from Birdwatch Ireland.

Waterbirds that occur in internationally important numbers

5.23 Internationally important numbers of birds are those that correspond to 1% or more of the individuals in a population and threshold levels are based on population status as published in Wetlands International (2006). Crowe *et al*. (2012) Current data shows that Dungarvan Harbour supports two species in internationally important numbers-Light-bellied Brent Goose and Black-tailed Godwit. The average number of Bar-tailed Godwits is close to the International threshold (Boland and Crowe, 2012). Although numbers show great variety between years the majority of years show wintering populations that surpass the international threshold.

Waterbirds that occur in nationally important numbers

5.24 A species that occurs in numbers that correspond to 1% or more of the individuals in the national population of a species or subspecies is said to occur in nationally important numbers. The current national threshold is defined by Birdwatch Ireland for each species (see Appendix 1 of Crowe *et al*., 2012). NPWS (2011) shows that Dungarvan Harbour continues to support Golden Plover, Dunlin, Bar-tailed Godwit (see also pg. 4.22), Redshank and Turnstone in nationally important numbers (i.e. 5 species). The following species are also identified as Special Conservation Interests (SCIs) of Dungarvan Harbour SPA as they were recorded in numbers of all-Ireland importance during the baseline period of 1995/96 to 1999/00; namely Shelduck, Red-breasted Merganser, Great Crested Grebe, Oystercatcher, Grey Plover, Lapwing, Knot and Curlew.

5.25 Over the period 2006/07 to 2010/11 Crowe *et al*. (2012) indicate that Shelduck, Oystercatcher, Golden Plover, Grey Plover, Knot, Dunlin, Bar-tailed Godwit, Curlew, Greenshank, Redshank and Turnstone have all occurred in nationally important numbers.

Waterbirds that occur that are listed on Annex 1 of the EU Birds Directive (EU/709/409)

5.26 During the winter months, Dungarvan Harbour supports four species that are listed on Annex 1 of the EU Birds Directive; Great Northern Diver, Little Egret (also breed nearby), Golden Plover and Bar-tailed Godwit. Kingfisher, which is also listed on Annex 1, is likely to also occur in the lower reaches of the River Colligan and the harbour in winter.

Total waterbird numbers across Dungarvan Harbour

5.27 The average number of total waterbirds found at Dungarvan Harbour based on the period 2006/07 to 2010/11 was 17,486 birds, making Dungarvan the 13th most important wetland site in Ireland and the second most important wetland site in the south-east after Wexford Harbour (Crowe *et al*., 2012).

Waterbird population numbers & trends at Dungarvan Harbour

5.28 Data on population counts from 1995/96 – 1999/00 and 2005/06 – 2009/10 are presented in Table 5.2. below (extracted from NPWS, 2011); with trends summarised in Table 5.3.

Table 5.2 - Population information for waterbirds at Dungarvan Harbour.

	Special Conservation Interests (SCIs)	Baseline Period (1995/96 – 1999/00)	Recent Site Data (2005/06 – 2009/10)
Site Selection Species	Light-bellied Brent Goose	723 (i)	1,424 (i)
	Golden Plover	4,980 (n)	3,454 (n)
	Dunlin	4,984 (n)	2,903 (n)
	Black-tailed Godwit	779 (i)	706 (i)
	Bar-tailed Godwit	1,068 (n)	913 (n)
	Redshank	731 (n)	941 (n)
	Turnstone	177 (n)	196 (n)
Additional Special Conservation Interests	Shelduck	538 (n)	339 (n)
	Red-breasted Merganser	52 (n)	31
	Great Crested Grebe	53 (n)	36
	Oystercatcher	767 (n)	898 (n)
	Grey Plover	444 (n)	493 (n)
	Lapwing	3,233 (n)	2,035
	Knot	698 (n)	715 (n)
	Curlew	766 (n)	452

(n) denotes nationally important (Crowe *et al*., 2008); (i) denotes internationally important (Wetlands International, 2006).

Table 5.3 - Population trends for waterbirds at Dungarvan Harbour (from NPWS, 2011).

Trend	Special Conservation Interests (SCIs)	Site Population Trend – 12 yr ('95/'96 – '07/'08)	Site Population Trend – 5 yr ('02/'03 – '07/'08)
Site Selection Species	Light-bellied Brent Goose	+91.1	+27.3
	Golden Plover	-18.5	-29.3
	Dunlin	-38.4	-16.6
	Black-tailed Godwit	+46.7	+2.6
	Bar-tailed Godwit	+6.7	-14.5
	Redshank	+65.5	+16.0
	Turnstone	+31.2	+34.8
Additional Special Conservation Interests	Shelduck	-21.9	-13.4
	Red-breasted Merganser	-15.4	-9.4
	Great Crested Grebe	-14.5	-20.0
	Oystercatcher	+51.2	+25.2
	Grey Plover	-11.2	-2.8
	Lapwing	-46.1	-28.9
	Knot	+10.0	+29.5
	Curlew	-19.6	-12.7

5.29 The trend data presented above can be summarised as follows (based on NPWS, 2011): -

- Light-bellied Brent Goose - has shown a trend for progressive increase at Dungarvan Harbour, which is consistent with the national trend (Crowe *et al.,* 2008).
- Golden Plover – there has been a sharp drop in numbers since 2004.
- Dunlin – numbers have declined progressively at Dungarvan Harbour in line with the national trend (Crowe *et al*., 2008); the same trend is evident in Northern Ireland and Britain (Calbrade *et al*., 2010; in NPWS, 2011).
- Bar-tailed Godwit – site numbers showed a slight increase up to 2004/05 then declined; they have, however, shown an increase since 2008/09.
- Redshank – consistent increase in numbers across the data period.
- Red-breasted Merganser – Numbers of this species have fluctuated widely between years. A period of higher numbers in the years 1997/98 to 1999/00 was followed by a decline. However the short-term trend suggests some recovery. [It should be noted, however, that subtidal species such as this are difficult to count as part of IWeBS from shore based count locations].
- Oystercatcher – exhibits a trend for consistent increase in numbers across the data period. Numbers recorded in 2008/09 and 2010/11were the highest since the data period began.
- Lapwing – numbers have declined steadily which is consistent with the all-Ireland trend (Crowe *et al*., 2008).

- Knot – numbers have fluctuated widely between years but the smoothed trend indicates a relatively stable site population across time with a recent increase; numbers recorded in 2007/08 and 2008/09 were the highest since the data period began.

5.30 Recent IWeBS counts (i.e. the winter of 2010 / 2011) are presented in Table 5.4. Nationally important numbers are shown in Green; internationally in Orange.

Table 5.4 – Recent IWeBS count data (i.e. 2010/11) for Dungarvan Harbour.

Species	1% National	1% International	Jan	Feb	Annual Peak
Mute Swan	110			2	2
Barnacle goose	90	710	3		3
Light-bellied Brent Goose		400	1110	917	1110
Shelduck	150	3000	399	371	399
Wigeon	820	15000	135	203	203
Teal	450	5000	414	290	414
Mallard	380	20000	77	50	77
Pintail	20	600	9	5	9
Shoveler	25	400	5		5
Ring-necked Duck		1470000	10		10
Goldeneye	95	11500	4	1	4
Red-breasted Merganser	35	1700	27	31	31
Red-throated Diver	20	3000		1	1
Great Northern Diver		50	1	4	4
Unidentified Diver			2		2
Little Grebe	25	4000	13	5	13
Great Crested Grebe	55	3500	36	58	58
Cormorant	140	1200	39	37	39
Shag		2000	1	15	15
Grey Heron	30	2700	17		17
Moorhen	20	20000	1		1
Oystercatcher	680	8200	1011	726	1011
Ringed Plover	150	730	84	86	86
Golden Plover	1700	9300	692	68	692
Grey Plover	65	2500	56	243	243
Lapwing	2100	20000	1564	428	1564
Knot	190	4500	340	551	551
Sanderling	65	1200	7	12	12
Dunlin	880	13300	1212	1381	1381
Jack Snipe		20000		1	1
Snipe		20000	9	17	17
Black-tailed Godwit	140	610	1648	223	1648
Bar-tailed Godwit	160	1200	1000	979	1000
Curlew	550	8400	564	763	763
Greenshank	20	2300	10	22	22
Redshank	310	3900	576	802	802
Turnstone	120	1400	251	300	300

Baseline Waterbird Survey Data

5.31 **Irish Wetland Bird Survey counts are primarily conducted at or near to high tide when birds are** concentrated at high tide roosts or closer to the shoreline. Data are collected to determine the number of birds using a site. However, it is also important to consider spatial utilisation of an estuary at low tide. BirdWatch Ireland was commissioned by National Parks & Wildlife Service to undertake a series of baseline low tide waterbird surveys at Special Protection Areas around the Irish coastline to compliment the ongoing programme of annual IWeBS counts (Cummins and Crowe, 2011).

5.32 Table 5.5 presents overall counts for Dungarvan Harbour from the NPWS baseline low tide waterbird surveys undertaken in the winter of 2009 / 2010. Four low tide counts were undertaken on the 7th October, 17th November and 17th December 2009 & 11th February 2010. A single high tide count was also undertaken on the 27th January 2010.

Table 5.5 – BWS count data (i.e. 2009/10) for Dungarvan Harbour.

Species	LT1 (Oct)	LT2 (Nov)	LT3 (Dec)	HT1 (Jan)	LT4 (Feb)
Mute Swan	3			1	
Whooper Swan			3		
Light-bellied Brent Goose	615	639	1205	1867	1305
Shelduck	56	192	250	251	269
Wigeon	80	50	226	120	148
Teal	20	135	115	210	63
Mallard	75	23	40	17	30
Goldeneye			1	2	
Red-breasted Merganser		9	30	32	15
Red-throated Diver	1				
Great Northern Diver		6	1	5	2
Little Grebe			9	5	4
Great Crested Grebe	11	12	11	8	9
Cormorant	69	27	32	24	8
Shag				1	
Little Egret	99	23	13	1	2
Grey Heron	40	24	33		13
Moorhen	1				
Oystercatcher	827	638	776	694	683
Ringed Plover	65	46	83	30	104
Golden Plover	1743	8990	6552	421	12
Grey Plover	128	163	165	410	184
Lapwing	101	963	1188	1768	1201
Knot	230	476	705	541	729
Sanderling	2		75	44	11
Dunlin	343	892	2680	1889	3150
Snipe	1	40	9	21	18
Black-tailed Godwit	1458	230	859	494	741
Bar-tailed Godwit	267	218	469	954	1023
Whimbrel	1				
Curlew	437	227	206	396	659
Greenshank	14	20	13	17	22
Redshank	1023	759	795	409	644
Turnstone	3	78	51	149	57

Species	LT1 (Oct)	LT2 (Nov)	LT3 (Dec)	HT1 (Jan)	LT4 (Feb)
Unidentified wader sp.		1			
Black-headed Gull	923	758	443	199	379
Common Gull	130	217	176	498	425
Lesser Black-backed Gull	44	30	54	539	258
Herring Gull	50	101	104	66	258
Glaucous Gull				1	
Great Black-backed Gull	66	12	32	50	141
Unidentified gull	1				

5.33 Table 5.6 presents counts from west of Ballyneety Bridge (i.e. adjoining the landfill) from the winter of 2009 / 20101; subsite OM411.

Table 5.6 – BWS count data (i.e. 2009/10) for Dungarvan Harbour - Ballyneety Bridge.

Species	1% (Nat.)	LT1(Oct)	LT2 (Nov)	LT3 (Dec)	HT1 (Jan)	LT4 (Feb)
Black-headed Gull		2	1	1		1
Cormorant	140	1				
Curlew	550	2				
Little Egret		1	1			
Grey Heron	30	1	1	1		
Lapwing	2100			110	20	40
Little Grebe	25					3
Oystercatcher	680				50	
Redshank	310	2	2	3		2
Snipe			22		2	
Teal	450			1		2
Turnstone	120			1		4

LT – low tide; HT – High tide.

5.34 Table 5.7 presents counts from the Shandon Island subsite (east of Ballyneety Bridge) from the winter of 2009 / 2010; subsite OM412 and runs east as far as the turn in the river.

Table 5.7 – BWS count data (i.e. 2009/10) for Dungarvan Harbour - Shandon Island.

Species	1%N	1%I	LT1 (Oct)	LT2 (Nov)	LT3 (Dec)	HT1 (Jan)	LT4 (Feb)
Bar-tailed Godwit	160	1200					1
Black-headed Gull		20000	96	91	64	24	15
Black-tailed Godwit	140	470	73	83	211		36
Cormorant	140	1200		1			1
Common Gull		16000		7	2	5	
Curlew	550	8500	16	42	32	2	53
Dunlin	880	13300					27
Little Egret		1300		1	1		
Greenshank	20	2300	2	2	1	2	
Goldeneye	95	11500			1		
Golden Plover	1700	9300			389		
Grey Heron	30	2700	1	1	1		
Herring Gull		13000		3	2		1
Lapwing	2100	20000	27	236	327	260	281
Lesser Black-backed Gull		4500			3		
Little Grebe	25	4000			9	4	1
Mallard	380	20000	5	3			8
Mute Swan	110	110				1	
Oystercatcher	680	10200	6	2	78	2	2
Light-bellied Brent Goose	220	260			662	600	611
Redshank	310	3900	51	77	38	21	45
Snipe		20000				4	6
Shelduck	150	3000					3
Teal	450	5000				2	4
Turnstone	120	1500				2	
Whooper Swan	130	210			3		

LT – low tide; HT – High tide.

5.35 As part of the BWS survey the major flocks of birds were also mapped, here the activity of the birds (i.e. roosting or feeding) was also recorded. A summary of these flocks for Ballyneety Bridge (OM411) and Shandon Island (OM412; downriver of Ballyneety Bridge) are presented in Table 5.8. Shandon Island is an important site for both roosting Light-bellied Brent Geese and Lapwing, as a large proportion of their populations within Dungarvan harbour (Table 5.8) can use this area. Lapwing can also use the area immediately upstream of Ballyneety Bridge. Beyond this the riparian character of the river dominates and waterbirds are less frequent.

Table 5.8 – BWS flock data (i.e. 2010/11) for Dungarvan Harbour Subsites: Ballyneety Bridge and Shandon Island.

Subsite	Species	7th Oct 2009		17th Nov 2009		11th Feb 2010	
		Feeding	Roosting	Feeding	Roosting	Feeding	Roosting
Shandon Island	Black-tailed Godwit	36	29		83		
	Lapwing	12	14	29	214		970
	Curlew				26		
	Dunlin					25	
	Light-bellied Brent						1,028
	Redshank					8	
Ballyneety Bridge	Lapwing						40

Additional Bird Data

5.36 A bird survey of Dungarvan landfill and environs was undertaken by in January 2011 mid way between high tide and low tide (WCC, 2013). The involved a survey of wetland birds of the river corridor adjacent to the Dungarvan landfill and extending downstream to approximately 500m below Ballyneety Bridge (undertaken midway between low tide and high tide high-tide). Survey results are presented in Table 5.9.

Table 5.9 - Bird species recorded during the survey downstream of Ballyneety Bridge.

Species	Numbers Recorded (2011)
Little Grebe	4
Brent Goose	3
Oystercatcher	5
Lapwing	>220
Curlew	6
Redshank	8
Gull species	67

Table 5.10 - Bird species recorded from Dungarvan landfill site. No full quantitative survey conducted in 2013, presence or absence noted during site visit. Counts are provided for the 2011 site visit.

Common Name	Numbers (2011)	2013
Grey Heron		1
Cormorant		1; flying upriver
Moorhen	4	Calling from ponds
Snipe		1 (flushed from ponds)
Jack Snipe		1 (flushed from ponds)
Sparrowhawk		1
Wood Pigeon	1	Present
Meadow Pipit		2
Mistle thrush		1
Robin	1	
Dunnock	2	
Jackdaw	20	Present
Hooded Crow	2	Present
Chaffinch		Present

6. Summary of Impacts

Direct Impacts

6.1 As the landfill site is not located within a site designated for nature conservation there will be no direct impacts to Dungarvan Harbour SPA.

6.2 There will be no reduction in habitat area or fragmentation of habitats or associated species. Therefore, *there will be no direct impacts on Natura 2000 sites* (i.e. no direct habitat losses, direct impacts on species, disturbance of key species or habitat fragmentation).

Indirect Impacts

6.3 No **noise** nuisance was indicated during the annual noise survey. The estuary downstream of Ballyneety Bridge is well screened from activity in the Civic Amenity Centre / Waste Transfer Station – disturbance to waterbirds using the estuary are highly unlikely. Disturbance to Otter using the River Colligan is also highly unlikely due to a combination of screening and opening times for the site (Otter are mainly crepuscular).

6.4 **Dust** levels were monitored on site and are significantly below the EPA recommended 350mg/m^2/day – the site visit on the 21st October highlighted no evidence of dust blanketing neighbouring vegetation / habitats.

6.5 Since composting has ceased on site **odour** is no longer a significant issue. Measure to ensure this includes:-

- All waste entering and leaving the transfer station does so in covered or enclosed vehicles;
- The handling of waste is restricted to within the waste transfer station;
- Waste is unloaded within covered buildings, reducing and containing noise emissions;
- All waste is removed from the transfer station within 48 hours of its arrival;
- During dry weather, hard standing areas are washed down;
- The composting area only accepts green waste.

6.6 Flaring of **gas** occurs close to the Civic Amenity Centre; remote from the river and estuary. There's no evidence to suggest that it is impacting on the SPA.

6.7 **Hazardous household wastes** accepted at the Civic Amenity Centre are carefully checked and stored in secure containers remote from the river and estuary.

6.8 The landfill no longer undertakes **composting** on-site; risk of generating associated high BOD run-off is therefore eliminated. Plant material is merely sorted and removed from site for composting elsewhere.

6.9 A number of other measures are in place to reduce other environmental nuisances, these include;

- The prevention of wind blown litter by regular cleaning of the site;

- Municipal waste is collected and stored within the waste transfer station and is never exposed to outside environment;
- A vermin control plan is currently in place, for which the site is regularly inspected;
- It is intended to continue carrying out the monitoring program set out by the EPA for the facility with its previous Waste Licence W32-02, in addition to monthly dust and odour monitoring.

6.10 In the case of unforeseen emergencies, such as spills, general fire / explosions, internal / external flooding, malicious damage, other unforeseen emergencies; a set of procedures have been developed in order for the facility to implement appropriate measures in order to prevent environmental pollution.

Water quality

6.11 The potential sources of water pollution arise from the surface run-off of the amenity and composting areas, wastewater produced while washing down the waste transfer station, and leachate from the capped landfill. Water pollution from these sources is avoided / reduced by the following measures;

- The civic amenity area, waste transfer station and the compost area are all paved. This subsequently allows for the collection of all surface water generated;
- The surface water collected from the civic amenity area is treated by both a first flush and subsequently a petrol / oil interceptor, prior to discharge into the River Colligan;
- Wastewater and surface run off from both the composting area and waste transfer station are directed towards the same leachate treatment system as the capped landfill.

6.12 The main potential indirect impacts from the Dungarvan Landfill that may affect Dungarvan Harbour SPA is therefore discharge from the leachate treatment system to the River Colligan which in turn flows into the Colligan Estuary, which is used by bird species for which Dungarvan Harbour SPA has been designated. However, the 2012 AER concludes: -

- Water quality, at the River Colligan surface water sites, in the vicinity of the landfill was satisfactory throughout 2012.
- The results of groundwater monitoring are in line with results from previous rounds of testing carried out since 1999. As indicated in previous reports, some of the boreholes within the current working area appear to be impacted by leachate from the landfill in terms of ammonia and iron; however groundwater outside the landfill site was generally satisfactory.
- Leachate quality was as expected for a landfill accepting mainly domestic and inert waste. Metal and trace organics concentrations were low. Based on leachate management, treatment in the on-site constructed wetlands, attenuation and dilution, no environmental effect from landfill leachate is expected.

6.13 As noted metal levels were also tested in benthic sediment and blue mussel tissues (last tested in 2008); recorded levels were broadly within guidance levels and were as expected for a landfill accepting mainly domestic and inert waste. Metal and trace organics concentrations were low, apart from a single elevated zinc reading downstream of Ballyneety – which may result from a non-landfill source, such as road runoff.

6.14 The site proper supports a range of semi-natural habitats, the conservation value of which is improving over time; most notably as the ICW's mature. These support a range of aquatic species including the Flora Protection Order, 1999 species – Opposite-leaved pondweed; spawning common frog and a range of bird

species (including e.g. Jack Snipe). Data is being collected on Otter activity in the area with indications that Otter use along the nearby stretches of the River Colligan, which indicates favourable ecological conditions within this stretch of the River Colligan. Kingfisher has also been known to nest along the River Colligan in this area.

Birds

6.15 There is no evidence to suggest that ongoing activities on site are disturbing birds for which Dungarvan Harbour SPA is designated.

6.16 There is no evidence to suggest that the ICW treatment system is allowing systematic organic pollution of the estuary used by these species; though it should be noted that limited organic enrichment may in fact be beneficial to species like Light-bellied Brent goose which feed on green algae such as *Enteromorpha* which benefit from nutrient enrichment.

6.17 As noted Dungarvan Landfill mainly accepted domestic and inert waste – there is no evidence of pollution of sediment in the Colligan by heavy metals. Equally blue mussel tissue was not found to be carrying heavy pollution loads that might bio-accumulate in predators such as Oystercatcher which feed on this species; in fact Oystercatcher numbers have been increasing at Dungarvan.

Other Projects / Impacts

6.18 There are two licensed facilities located on the upstream parts of the River Colligan namely Waterford Joinery Ltd and Radley Engineering Ltd. There is potential for cumulative impacts in terms of untreated run-off from the Landfill contributing or compounding levels of pollution arising upstream of the car park sites. Untreated or unregulated leachate run-off from the Dungarvan landfill would contribute to cumulative impacts on those proximal areas of Dungarvan Harbour SPA.

6.19 There are also extensive oyster trestles in the outer harbour – on the seaward side of the Cunnigar. An appropriate assessment of the impact of oyster cultivation on waterbirds of which Dungarvan Harbour SPA has been designated is currently been undertaken by Atkins on behalf of the Marine Institute.

6.20 There us currently no indication as to when a proposed N25 Dungarvan Bypass may be progressed.

6.21 There are proposals as part of the Eirspan Bridge maintenance projects being run by the National Roads Authority to undertake routine maintenance on the N72 Killadangan Bridge upstream of the site.

6.22 However, the findings of the site walkover survey and analysis of the IWeBS and biological and physicochemical water quality data, indicates that on-site regulation and mitigation is functioning and that there is no additional impact from the landfill to the River Colligan or those nearby parts of Dungarvan Harbour SPA.

Conclusions Comments

6.23 The development of wetlands and semi-natural grassland on the landfill serves to enhance the ecological network of natural habitats surrounding the landfill including the River Colligan and adjacent areas of wet grassland, marsh, brackish water and estuarine habitats.

6.24 Since 2008 with succession of habitats including establishment of 5 wetland cells, grassland and increasing scrub cover, it is apparent that the site is demonstrating increased biodiversity value providing good feeding grounds for a variety of birds and some mammal and invertebrate species along with amphibians.

As noted the FPO, 1999 species, Opposite-leaved pondweed has been recorded on site. A site visit in early 2013 observed an abundance of frogspawn in the wetland cells with 8 Snipe and 5 Moorhen noted within those habitats regenerating the capped landfill.

Findings

6.25 Provided the remediation measures used to treat and control untreated leachate effluent from the landfill remain, it can be concluded that there will be no significant adverse impacts posed to River Colligan and by extension Dungarvan Harbour SPA, or the conservation status of the wintering bird species for which the site has been designated.

6.26 Significant impacts to the River Colligan and Dungarvan Harbour can be ruled out and no further assessment is required.

6.27 The above **finding of no significant impacts** means that there is no requirement to proceed to Stage 3 of the Appropriate Assessment process; i.e. Assessment of Alternative Solutions. Therefore the Appropriate Assessment process can be concluded as Stage 2 for those reasons outlined above.

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Figures

N

Legend

- Dungarvan Landfill
- Dungarvan Harbour (SPA)

Client: Waterford County Council		
Project: Dungarvan Landfill Natura Impact Statement		
Title: Site Location		
Designed/Drawn: DK	Checked: ED	Authorised: PO'D
Date: Oct 2013	Date: Oct 2013	Date: Oct 2013
Drawing No: Figure 1.1		Rev: 0

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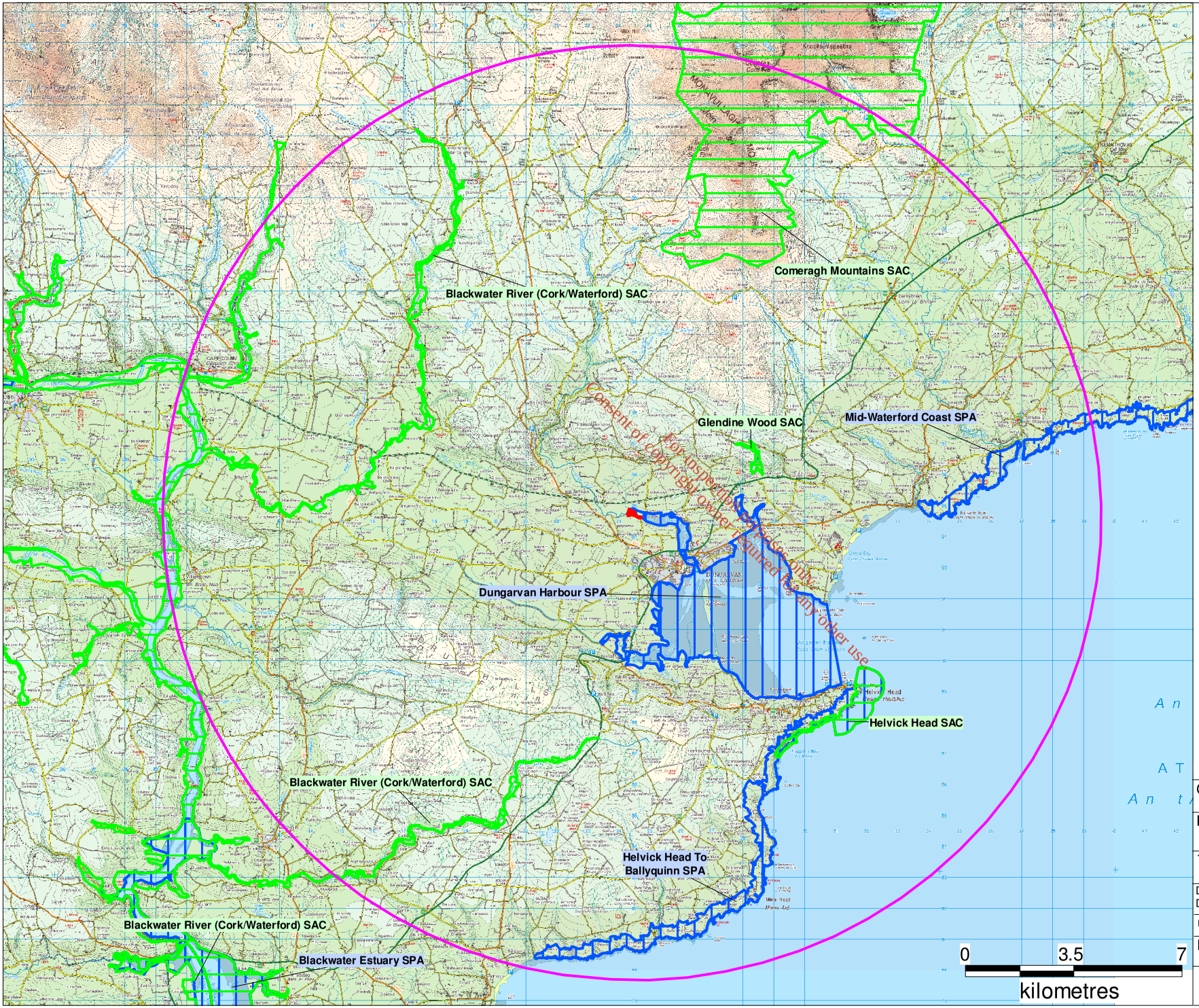

N

Legend

- Dungarvan Landfill
- 15km Buffer
- Special Area of Conservation (SAC)
- Special Protection Area (SPA)

Client: Waterford County Council		
Project: Dungarvan Landfill Natura Impact Statement		
Title: Natura 2000 Sites		
Designed/Drawn: DK	Checked: ED	Authorised: PO'D
Date: Oct 2013	Date: Oct 2013	Date: Oct 2013
Drawing No: Figure 1.2a		Rev: 0

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N

Legend

- Dungarvan Landfill
- 15km Buffer
- proposed Natural Heritage Area (pNHA)

Client: Waterford County Council		
Project: Dungarvan Landfill Natura Impact Statement		
Title: Sites of National Importance		
Designed/Drawn: DK	Checked: ED	Authorised: PO'D
Date: Oct 2013	Date: Oct 2013	Date: Oct 2013
Drawing No: Figure 1.2b		Rev: 0

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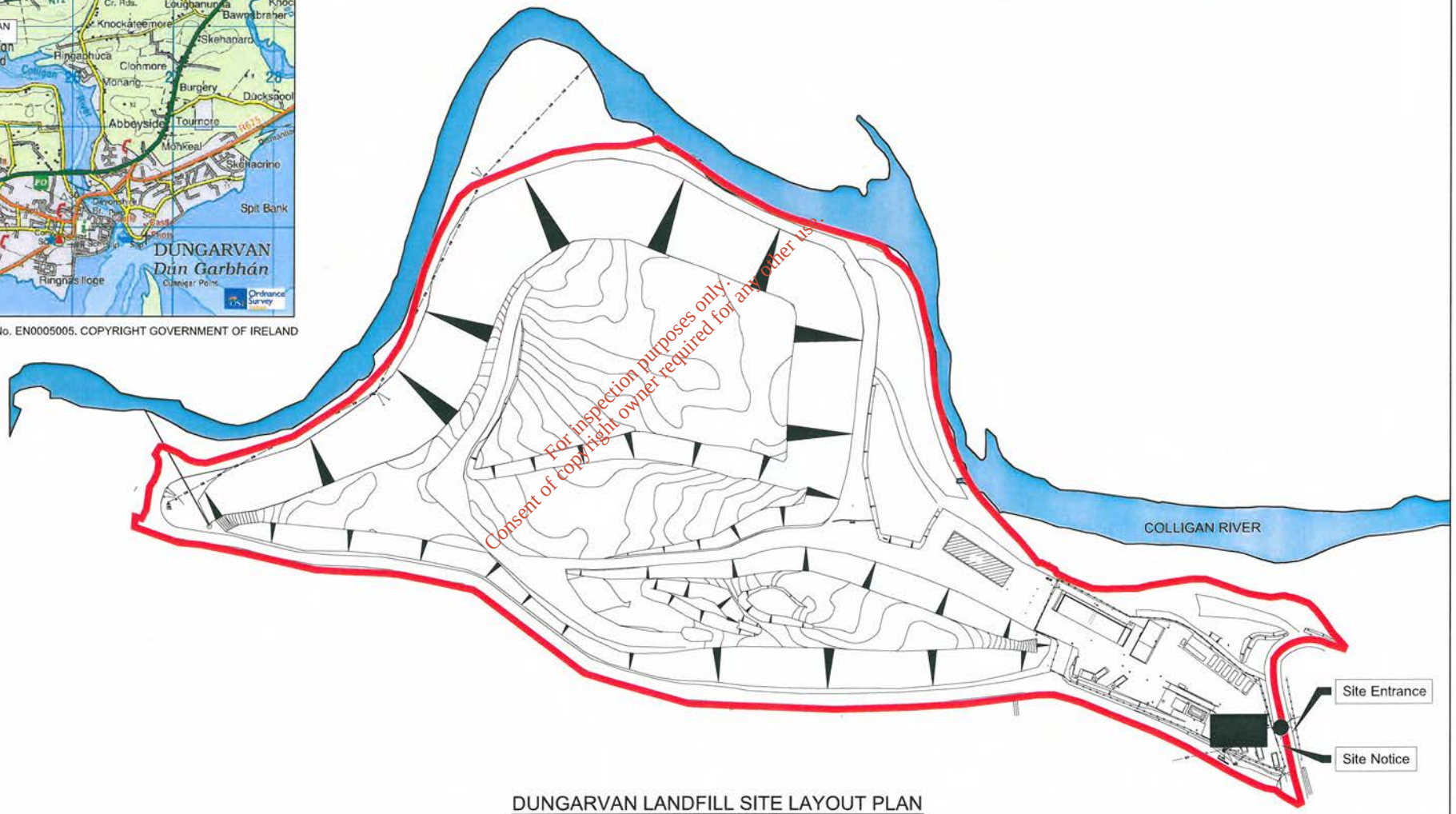
DUNGARVAN LANDFILL LOCATION PLAN

Scale 1:40,000 @ A3

ORDNANCE SURVEY LICENCE No. EN0005005. COPYRIGHT GOVERNMENT OF IRELAND

LEGEND

Site Boundary



DUNGARVAN LANDFILL SITE LAYOUT PLAN

Scale 1:2000 @ A3

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No.	Date	Amendment / Issue	App
F01	Dec 08	Final Issue	EB
A01	Aug 08	Issue for Approval	PM

Client: WATERFORD COUNTY COUNCIL
Comhairle Chontae Phort Láirge
Civic Offices, Dungarvan, Co. Waterford
Phone: 058 22000 Fax: 058 42911

Drawn By	Checked By	Approved By	Date
RH	BOK	MS	April 2008

RPS
West Pier Business Campus, Dun Laoghaire, Co Dublin
T +353 1 4905500
F +353 1 2830875
W www.rpsgroup.com/ireland
E ireland@rpsgroup.com

Project: DUNGARVAN LANDFILL WASTE LICENCE APPLICATION

Drawing Status: Final
Scale / Sheet Size: NTS @ A1 As shown @ A3

Drawing Number: MDR0350/DG0501
Rev: F01

Title: SITE LOCATION, SITE LAYOUT & LOCATION OF SITE NOTICE

Figure 3.2

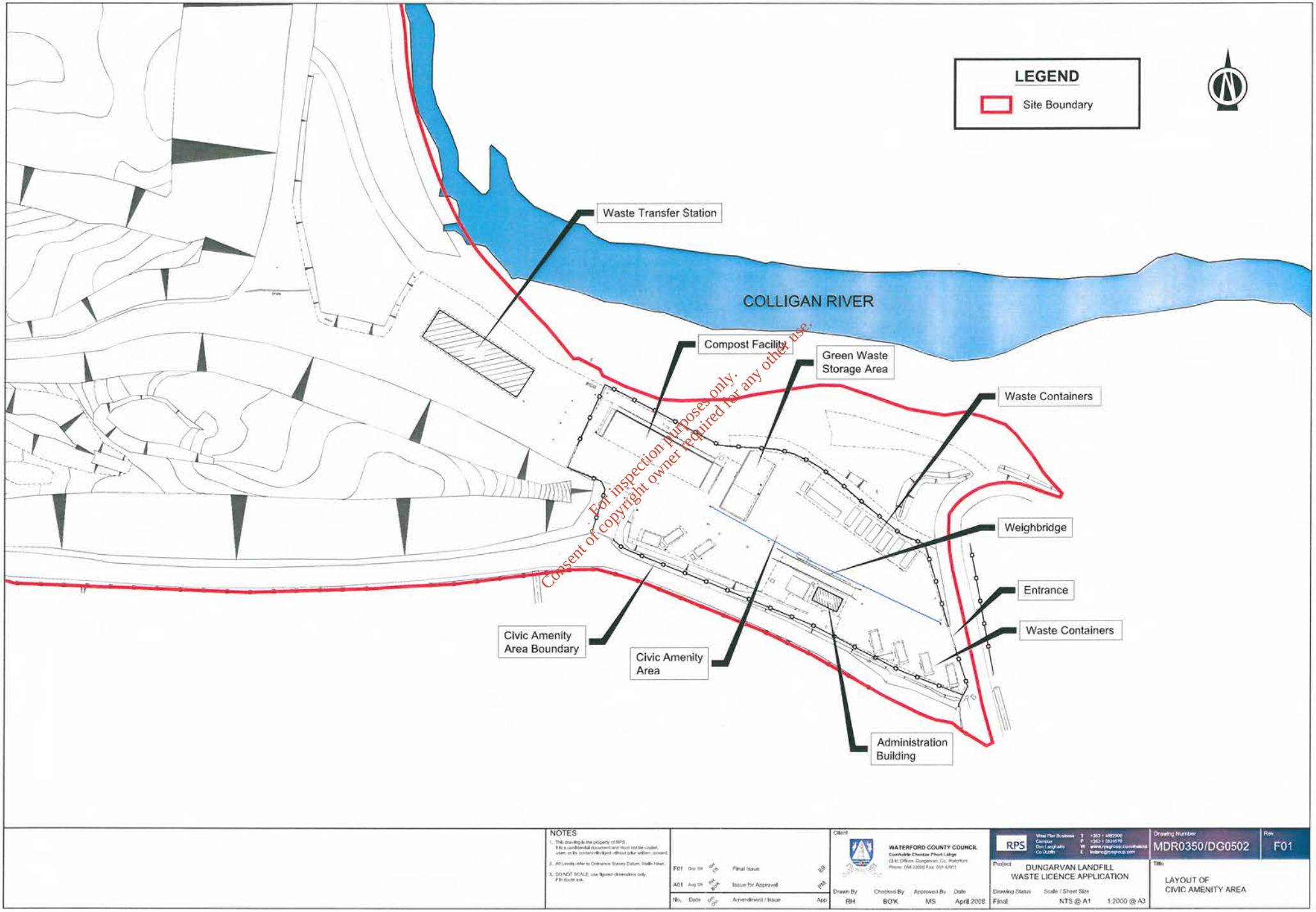
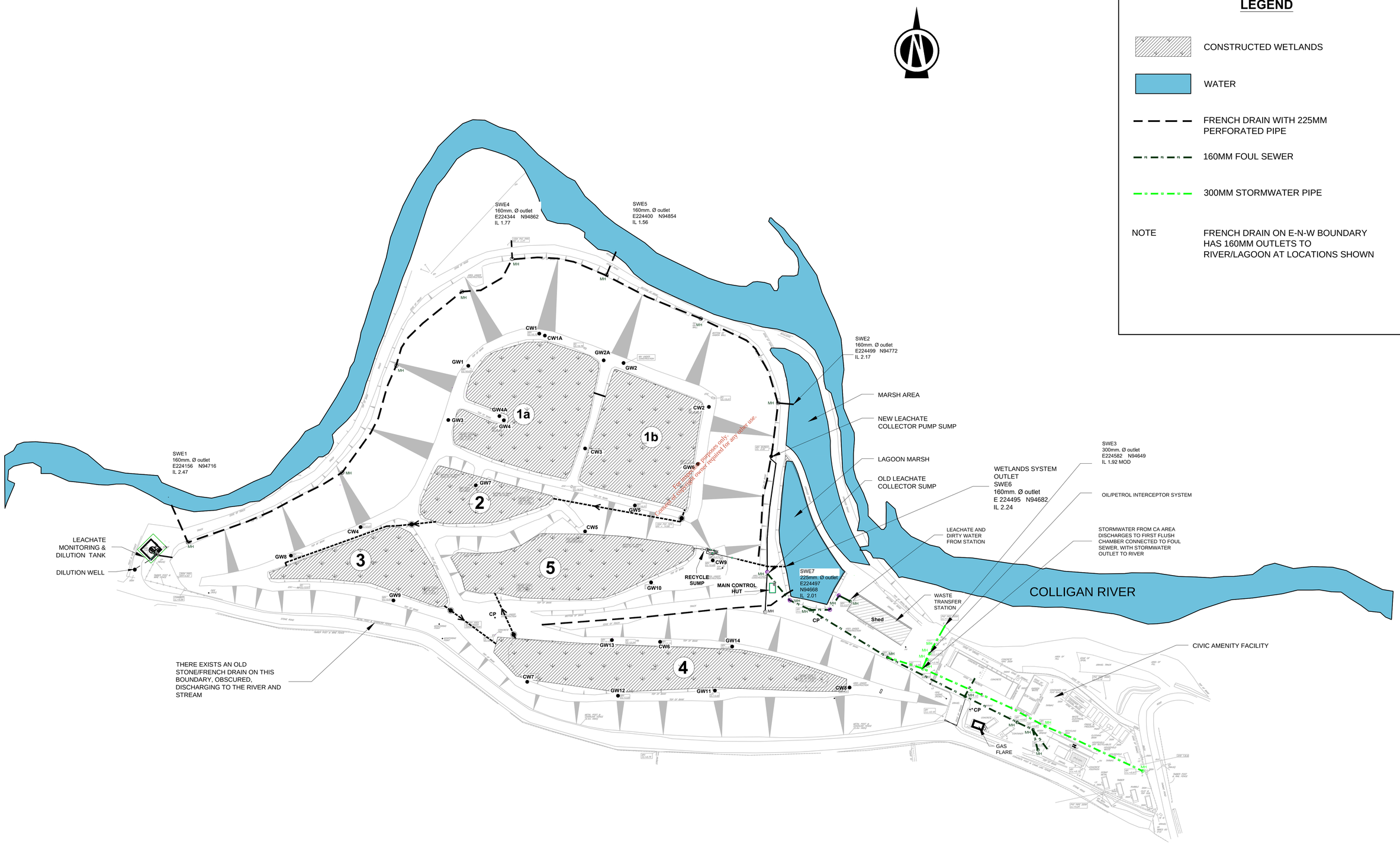


Figure 3.3

LEGEND

- CONSTRUCTED WETLANDS
- WATER
- FRENCH DRAIN WITH 225MM PERFORATED PIPE
- 160MM FOUL SEWER
- 300MM STORMWATER PIPE

NOTE — FRENCH DRAIN ON E-N-W BOUNDARY HAS 160MM OUTLETS TO RIVER/LAGOON AT LOCATIONS SHOWN



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No.	Date	Drn. / Chk.	Amendment / Issue	App
R02	Jul '13	RH / JB	As Built Issue	JB
R01	Nov '12	RH / JB	As Built Issue	JB

Client: **WATERFORD COUNTY COUNCIL**
Comhairle Chontae Phort Láirge
Civic Offices, Dungarvan, Co. Waterford
Phone: 058 22000 Fax: 058 42911

Drawn By	Checked By	Approved By	Date
JB	RH	JB	Nov 2012

RPS
West Pier Business Campus
Dun Laoghaire
Co Dublin
T +353 1 4882900
F +353 1 2835676
W www.rpsgroup.com/ireland
E ireland@rpsgroup.com

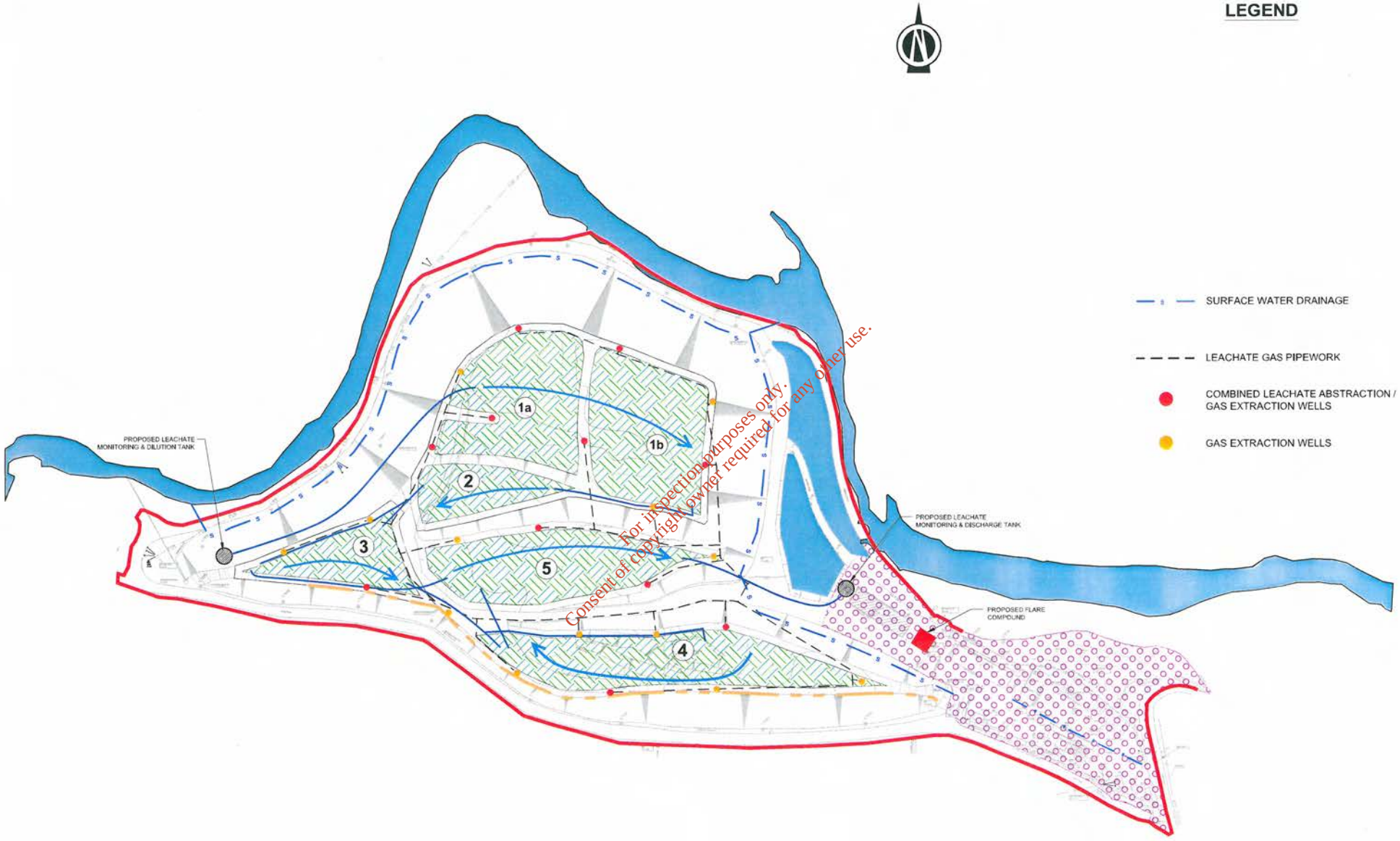
Drawing Number: MDR0350/DG0714
Rev: R02

Project: DUNGARVAN LANDFILL REMEDIATION

Title: LANDFILL SURFACE WATER DRAINAGE SYSTEM

Drawing Status	Scale / Sheet Size	
As Built	1:1000 @ A1	1:2000 @ A3

Figure 3.4a



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No.	Date	Chk'd	Amendment / Issue	App
F01	Dec 08	RH	Final Issue	ES
A01	Aug 08	BOK	Issue for Approval	PM

Client: WATERFORD COUNTY COUNCIL
Comhairle Chontae Phort Láirge
Civic Offices, Dungarvan, Co. Waterford
Phone: 058 72000 Fax: 058 47911

Drawn By	Checked By	Approved By	Date
RH	BOK	MS	April 2008

RPS
West Pier Business Campus, Dun Laoghaire, Co Dublin
T: +353 1 4952900
F: +353 1 2934478
W: www.rpsgroup.com/ireland
E: ireland@rpsgroup.com

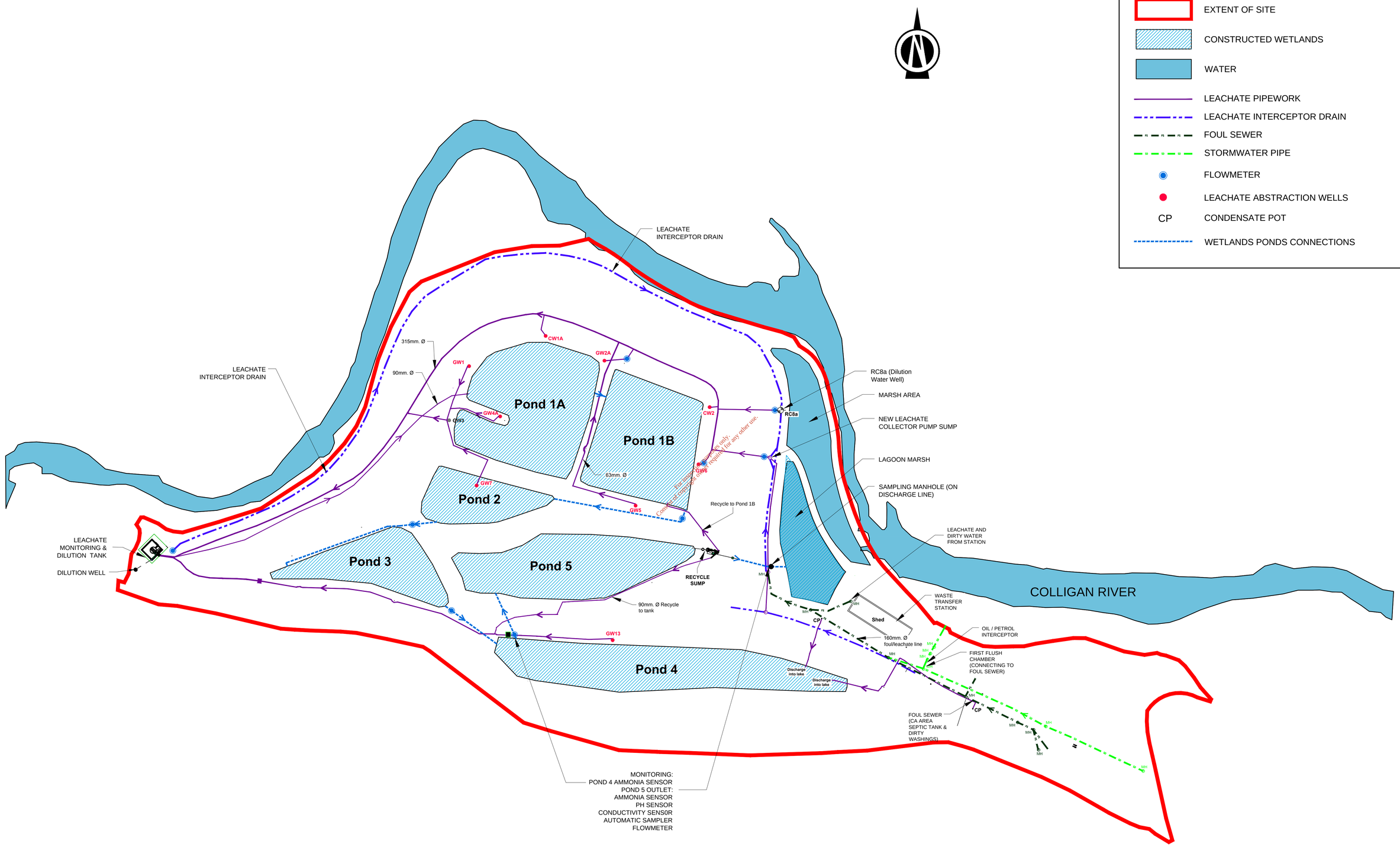
Drawing Number: MDR0350/DG0504
Rev: F01

Project: DUNGARVAN LANDFILL
WASTE LICENCE APPLICATION

Drawing Status: Final
Scale / Sheet Size: 1:1000 @ A1 1:2000 @ A3

Title: INTEGRATED CONSTRUCTED WETLAND SYSTEM

Figure 3.4b



R:\MDR0350\Dgn\AS-BUILT DRGS - DEC 2012\mdr0350FG0002R01 - LEACHATE SYSTEM SUMMARY.dwg

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R01	Nov '12	RH / JB	As Built Issue	JB

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Comhairle Chontae Phort Láirge
Civic Offices, Dungarvan, Co. Waterford
Phone: 058 22000 Fax: 058 42911

Drawn By	Checked By	Approved By	Date
RH	JB	JB	Nov 2012

RPS
West Pier Business Campus, Dun Laoghaire, Co Dublin
T +353 1 4882900
F +353 1 2835676
W www.rpsgroup.com/ireland
E ireland@rpsgroup.com

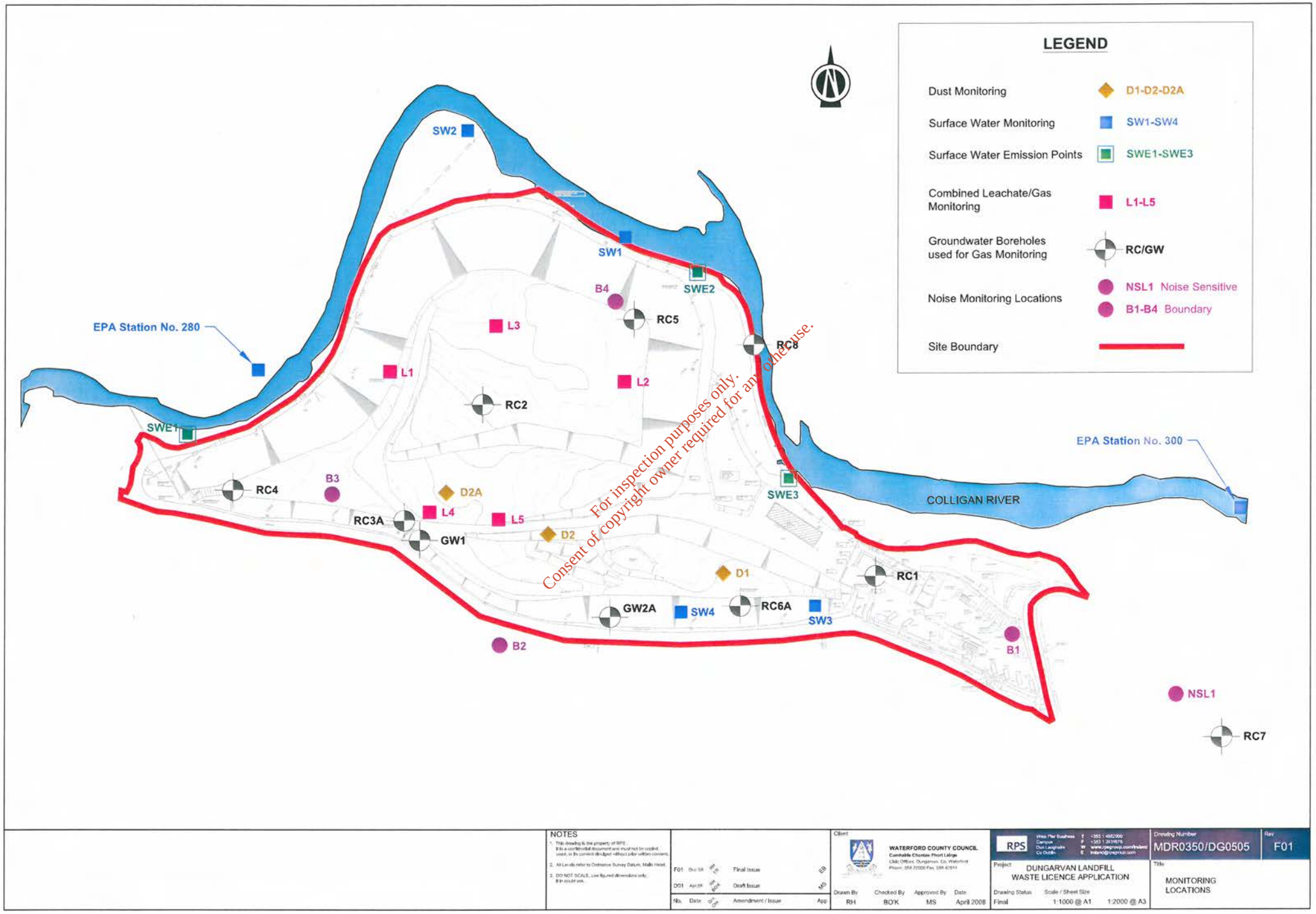
Drawing Number: MDR0350/FG002
Rev: R01

Project: DUNGARVAN LANDFILL REMEDIATION

Drawing Status: As Built
Scale / Sheet Size: 1:1000 @ A1 | 1:2000 @ A3

Title: LEACHATE ABSTRACTION AND TREATMENT SYSTEM SUMMARY

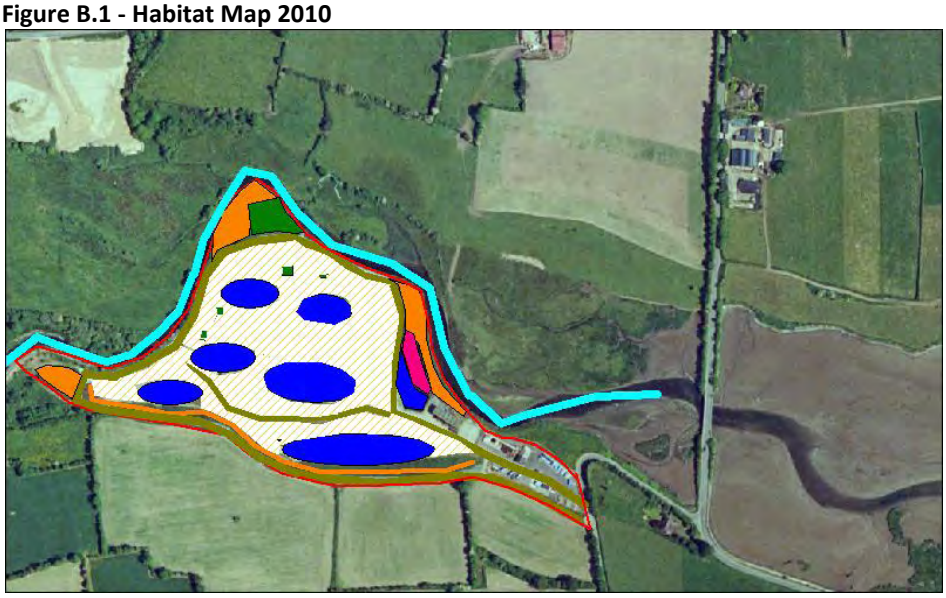
Figure 3.5



Appendix A –

Habitat maps for site in 2010 & 2013 (from WCC, 2013)

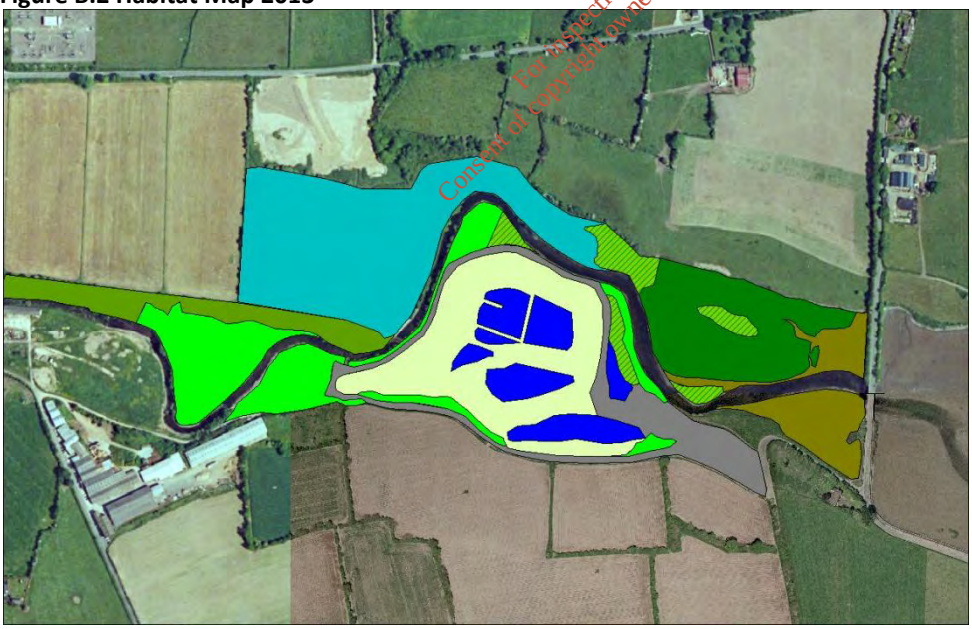
Figure B.1 - Habitat Map 2010



Habitat Key

Artificial lakes and ponds
Recolonising bare ground
Spoil and bareground
Reed and large sedge swamps
Scrub
Wet Grassland
River Colligan

Figure B.2 Habitat Map 2013



Habitat Key

Artificial lakes and ponds
Grassland
Spoil and bareground
Scrub
Reed and large sedge swamps
Wet Grassland
River Colligan

Table B1: Plant species list recorded in 2008 and 2010 (X denotes occurrence of species)

Species (Taxon)	Vernacular	2008 (Oct 22nd)	2010 (June 14th)
Acer pseudoplatanus	Sycamore	x	x
Achillea millefolium	Yarrow	x	x
Aethusa cynapium	Fool's Parsley		x
Agrostis capillaris	Common Bent	x	
Agrostis stolonifera	Creeping Bent	x	x
Alisma plantago-aquatica	Water-plantain		x
Alnus glutinosa	Alder	x	x
Alopecurus geniculatus	Marsh Foxtail		x
Anagallis arvensis subsp. arvensis	Scarlet Pimpernel	x	x
Anthriscus sylvestris	Cow Parsley		x
Aphanes arvensis	Parsley-piert		x
Apium nodiflorum	Fool's-water-cress	x	x
Arabidopsis thaliana	Thale Cress		x
Arctium nemorosum	Wood Burdock	x	x
Arrhenatherum elatius	False Oat-Grass	x	x
Aster trifolium	Sea Aster	x	
Athyrium filix-femina	Lady-fern		x
Barbarea vulgaris	Winter-cress		x
Bellis perennis	Daisy	x	x
Berula erecta	Lesser Water-parsnip		x
Bolboschoenus maritimus	Sea Clubrush	x	
Brassica nigra	Black Mustard		x
Brassica rapa subsp. campestris	Wild Turnip	x	x
Bromus hordeaceus	Soft-brome		x
Callitriche obtusangula	Blunt-fruited Water-starwort		x
Calystegia sepium subsp. sepium	Hedge Bindweed	x	x
Calystegia silvatica	Large Bindweed		x
Capsella bursa-pastoris	Shepherd's purse	x	
Carex sp	Sedges	x	x
Carex divulsa subsp. divulsa	Grey Sedge		x
Carex echinata	Star Sedge		x
Carex flacca	Glaucous Sedge		x
Carex otrubae	False Fox-sedge		x
Carex riparia	Greater Pond-sedge		x
Centaurea nigra	Common Knapweed	x	x
Centaurium erythraea	Common Centaury		x
Cerastium fontanum	Common Mouse-ear	x	x
Cerastium glomeratum	Sticky Mouse-ear		x
Chamerion angustifolium	Rosebay Willowherb	x	x
Chenopodium album	Fat-hen	x	x
Cirsium arvense	Creeping Thistle	x	x
Cirsium palustre	Marsh Thistle	x	
Cirsium vulgare	Spear Thistle	x	x
Cochleria officinale	Common Scurvey-Grass	x	
Conium maculatum	Hemlock		x
Crataegus monogyna	Hawthorn	x	x
Crepis capillaris	Smooth Hawk's-beard		x
Crocosmia x crocosmiiflora	Montbretia (C. aurea x pottsii)	x	x
Cynosurus cristatus	Crested Dog's-tail		x
Dactylis glomerata	Cock's-foot	x	x
Daucus carota subsp. carota	Wild Carrot	x	x
Eleocharis palustris	Common Spike-rush		x
Elodea canadensis	Canadian Waterweed		x
Elytrigia repens	Common Couch	x	x
Epilobium ciliatum	American Willowherb		x
Epilobium hirsutum	Great Willowherb	x	x

Species (Taxon)	Vernacular	2008 (Oct 22nd)	2010 (June 14th)
Epilobium obscurum	Short-fruited Willowherb		x
Epilobium palustre	Marsh Wilowherb	x	
Epilobium parviflorum	Hoary Willowherb		x
Equisetum arvense	Field Horsetail	x	x
Equisetum fluviatile	Water Horsetail	x	x
Euphorbia helioscopia	Sun Spurge	x	x
Fallopia japonica	Japanese Knotweed	x	x
Festuca rubra agg.	Red Fescue	x	x
Filipendula ulmaria	Meadowsweet	x	x
Fraxinus excelsior	Ash	x	x
Fuchsia magellanica	Fuchsia	x	x
Galium aparine	Cleavers	X	
Galium palustre subsp. palustre	Common Marsh-bedstraw	x	x
Geranium dissectum	Cut-leaved Crane's-bill	x	x
Geranium robertianum	Herb-Robert	x	x
Geum urbanum	Wood Avens		x
Glyceria declinata	Small Sweet-grass		x
Glyceria fluitans	Floating Sweet-grass		x
Glyceria maxima	Reed Sweet-grass		x
Groenlandia densa	Opposite-leaved Pondweed		x
Hedera helix subsp. hibernica	Atlantic Ivy	x	x
Heracleum sphondylium	Hogweed	x	x
Holcus lanatus	Yorkshire-fog	x	x
Hypericum maculatum subsp. obtusiusculum	Imperforate St John's-wort		x
Hypericum perforatum	Perforate St John's-wort		x
Hypericum tetrapterum	Square-stalked St John's-wort		x
Hypochaeris radicata	Cat's-ear		x
Iris pseudacorus	Yellow Iris	x	x
Juncus acutiflorus	Sharp-flowered Rush		x
Juncus articulatus	Jointed Rush	x	x
Juncus bufonius	Toad Rush		x
Juncus conglomeratus	Compact Rush		x
Juncus effusus	Soft-rush	x	x
Juncus inflexus	Hard Rush	x	x
Lapsana communis subsp. communis	Nipplewort		x
Lathyrus pratensis	Meadow Vetchling	x	x
Lemna minor	Common Duckweed		x
Leucanthemum vulgare	Oxeye Daisy	x	x
Ligustrum vulgare	Privet	x	
Linum catharticum	Fairy Flax		x
Lolium multiflorum	Italian Rye-grass		x
Lolium perenne	Perennial Rye-grass	x	x
Lonicera periclymenum	Honeysuckle	x	
Lotus corniculatus	Common Bird's-foot-trefoil	x	x
Lotus pedunculatus	Greater Bird's-foot-trefoil		x
Lychnis flos-cuculi	Ragged-Robin		x
Lythrum salicaria	Purple Loosestrife	x	
Matricaria discoidea	Pineappleweed	x	x
Medicago lupulina	Black Medick	x	x
Mentha aquatica	Water Mint	x	
Mimulus guttatus	Monkeyflower		x
Myosotis scorpiodes	Water Forget-me-knot	x	
Odontites vernus	Red Bartsia		x
Oenanthe crocata	Hemlock Water-dropwort		x
Persicaria amphibia	Amphibious Bistort		x
Persicaria maculosa	Redshank	x	x
Petasites fragrans	Winter Heliotrope		x
Phalaris arundinacea	Reed Canary-grass		x

Species (Taxon)	Vernacular	2008 (Oct 22nd)	2010 (June 14th)
Phragmites australis	Common Reed	x	x
Phyllitis scolopendrium	Hart's Tongue Fern	x	
Plantago lanceolata	Ribwort Plantain	x	x
Plantago major	Greater Plantain	x	x
Poa annua	Annual Meadow-grass	x	x
Poa pratensis	Smooth Meadow-grass		x
Poa trivialis	Rough Meadow-grass		x
Polygonum aviculare	Knotgrass	x	x
Polystichum setiferum	Soft Shield-fern	x	x
Potamogeton natans	Broad-leaved Pondweed		x
Potentilla anserina	Silverweed	x	x
Potentilla palustris	Marsh Cinquefoil	x	
Potentilla reptans	Creeping Cinquefoil	x	x
Primula vulgaris	Primrose		x
Prunella vulgaris	Selfheal	x	x
Prunus spinosa	Blackthorn	x	
Pteridium aquilinum	Bracken	x	x
Pulicaria dysenterica	Common Fleabane	x	x
Ranunculus acris	Meadow Buttercup		x
Ranunculus hederaceus	Ivby-leaved crowfoot	x	
Ranunculus repens	Creeping Buttercup	x	x
Ranunculus sceleratus	Celery-leaved Buttercup		x
Reseda luteola	Weld	x	x
Rorippa nasturtium-aquaticum	Water-cress	x	x
Rosa canina	Dog-rose	x	x
Rubus fruticosus agg.	Bramble	x	x
Rubus ulmifolius	Elm-leaved Bramble		x
Rumex acetosa subsp. acetosa	Common Sorrel	x	x
Rumex conglomeratus	Clustered Dock		x
Rumex crispus subsp. crispus	Curled Dock		x
Rumex obtusifolius	Broad-leaved Dock	x	x
Rumex sanguineus	Wood Dock		x
Sagina apetala	Annual Pearlwort		x
Sagina procumbens	Procumbent Pearlwort		x
Salix cinerea subsp. oleifolia	Rusty Willow	x	x
Sambucus nigra	Elder	x	x
Schoenoplectus tabernaemontani	Grey Club-rush	x	x
Scrophularia auriculata	Water Figwort	x	x
Scrophularia nodosa	Common Figwort	x	x
Senecio aquaticus	Marsh Ragwort	x	x
Senecio jacobaea	Common Ragwort	x	x
Senecio vulgaris	Groundsel	x	x
Sinapis alba	White Mustard		x
Sinapis arvensis	Charlock	x	x
Sisymbrium officinale	Hedge Mustard	x	x
Solanum dulcamara	Bittersweet	x	
Sonchus asper	Prickly Sow-thistle	x	x
Sonchus oleraceus	Smooth Sow-thistle	x	x
Sparganium erectum	Branched Bur-reed		x
Stachys palustris	Marsh Woundwort	x	x
Stachys sylvatica	Hedge Woundwort	x	x
Stellaria graminea	Lesser Stitchwort		x
Stellaria media	Common Chickweed	x	x
Taraxacum officinale	Dandeloin	x	
Trifolium dubium	Lesser Trefoil		x
Trifolium pratense		x	x
Trifolium repens	White Clover	x	x
Tussilago farfara	Colt's-foot		x

Species (Taxon)	Vernacular	2008 (Oct 22nd)	2010 (June 14th)
Triglochin maritium	Sea Arrowgrass	x	
Tripleurospermum inodorum	Scentless Mayweed	x	
Typha latifolia	Bulrush	x	x
Ulex europaeus	Gorse	x	x
Urtica dioica	Common Nettle	x	x
Veronica anagallis-aquatica	Blue Water-speedwell		x
Veronica arvensis	Wall Speedwell		x
Veronica beccabunga	Brooklime		x
Veronica chamaedrys	Germander Speedwell	x	x
Veronica persica	Common Field-Speedwell	x	
Veronica serpyllifolia subsp. serpyllifolia	Thyme-leaved Speedwell		x
Vicia cracca	Tufted Vetch	x	x
Vicia hirsuta	Hairy Tare		x
Vicia sativa subsp. segetalis	Common Vetch		x
Vicia sepium	Bush Vetch	x	x
Zea Mays	Maize	x	
Total no. of Species		103	162

Appendix B – Dungarvan Harbour SPA – Site synopsis

Dungarvan Harbour SPA Site Synopsis

In landscape terms Dungarvan Harbour lies at the eastern end of the River Blackwater valley, though this river now turns south at Cappoquin, vacating its more obvious (and former) course. The River Colligan, running south from the Comeragh Mountains, enters the bay by Dungarvan itself. The River Brickey flows from the west while the Glendine River flows into the harbour from the north. The absence of a large river means that the bay is essentially a marine habitat though it dries out at low tide to give extensive mud and sand flats. The inner bay is extremely sheltered, the linear Cunnigar spit (which almost closes the bay on the east) adding to the effect of hills in the south and south-west.

The rock type of most of the area is limestone though this is only exposed on flat rocks at Ballynacourty. Elsewhere saltmarsh, glacial drift and sand form the shore with a narrow stony beach in places. The most natural saltmarsh occurs at Kilminnin on the north shore and west of the Cunnigar on the south. In several places the saltmarshes, having been reclaimed for a period, have been flooded again and are reverting to their natural vegetation. There is an abundance of Sea Rush (*Juncus maritimus*) in such places often mixed with grasses, with Reed (*Phragmites australis*) or Sea Club-rush (*Scirpus maritimus*) in drains. Sometimes this community gradually blends with a freshwater marsh including Tufted Hair Grass (*Deschampsia cespitosa*), Soft rush (*Juncus effusus*), Brown Sedge (*Carex disticha*) and Fleabane (*Pulicaria dysenterica*). Eelgrass (*Zostera* sp.) has been recorded in the area.

A major part of the ecological importance of the bay is the wintering birdlife which is present in large numbers. Surveys in the winters l984/85 - 1986/87 and from 1994/95 onwards showed that Brent Goose (616 in 1995), Black-tailed Godwit (l329 [952 in 1996]) and Bar-tailed Godwit (1593 in 1996) occurred in numbers of international importance, while thirteen other species were nationally important. These are Shelduck (l72l [995 in 1995]), Wigeon (l0l5), Red-breasted Merganser (50), Grey Plover (359), Golden Plover (6100 in 1996), Lapwing (3775 in 1996), Knot (996 in 1996), Sanderling (83), Dunlin (6100 in 1996), Redshank (930 [910 in 1996]) and Turnstone (254). A further ten species were found in numbers of regional or local importance emphasising that Dungarvan supports a greater diversity of species than any other site on the south coast except for Wexford Harbour.

The sand flats to the east of the Cunnigar support an extensive oyster farming operation. There is concern that displacement of waterfowl and disturbance may be a problem in the shellfish farming area.

Dungarvan Harbour SPA is of major conservation significance for the large numbers of many species of waterfowl that use it. The site regularly holds over 20,000 waterfowl and this qualifies the site as of International Importance. Two species that occur in important numbers are listed on Annex I of the E.U. Birds Directive, i.e. Bar-tailed Godwit and Golden Plover.

(Source: NPWS site synopsis, 2004).

Dungarvan Harbour pNHA Site Synopsis

In landscape terms Dungarvan Harbour lies at the eastern end of the Blackwater valley, though this river now turns south at Cappoquin, vacating its more obvious (and former) course. All that remains to the Harbour is the small River Colligan, running south from the Comeragh Mountains to enter the bay by Dungarvan itself. The absence of the larger river means that the bay is essentially a marine habitat though it dries out at low tide to give extensive mud and sand flats. It is extremely sheltered, the linear Cunnigar spit (which almost closes the bay on the east) adding to the effect of hills in the south and south-west.

The rock type of most of the area is limestone though this is only exposed on flat rocks at Ballynacourty. Elsewhere saltmarsh, glacial drift and sand form the shore with a narrow stony beach in places. The most natural saltmarsh occurs at Kilminnin on the north shore and west of the Cunnigar on the south. It is a community in which Sea Purslane (*Atriplex portulacoides*), Sea Lavendar (*Limonium humile*), rushes (*Juncus gerardii*, J.*maritimus*) and sedges (*Carex distans*, *C. otrubae*) are prominent along with other typical species like Sea Spurrey (*Spergularia* spp.), Sea Arrowgrass (*Triglochin maritimum*) and, in the upper parts, Parsley Water Dropwort (*Oenanthe lachenalii*). In several places the saltmarshes, having been reclaimed for a period, have been flooded again and are reverting to their natural vegetation. There is an abundance of Sea Rush (*Juncus maritimus*) in such places often mixed with grasses, with Reed (*Phragmites australis*) or Sea Clubrush (*Bolboschoenus maritimus*) in drains. Sometimes this community gradually blends with a freshwater marsh including Tufted Hair Grass (*Deschampsia maritimus*) in drains. Sometimes this community gradually blends with a freshwater marsh including Tufted Hair Grass (*Deschampsia cespitosa*), Soft rush (*J. effusus*), Brown Sedge (*Carex disticha*) and Fleabane (*Pulicaria dysenterica*). Eelgrass (*Zostera* sp.) has been recorded in the area.

There are two beach and dune systems in the area, a tiny one where the old railway line crosses the bay at Skehacrine, and the major (2.6km) Cunnigar running north from the southern shore. The latter consists of narrow and low ridges separated at the southern end to give marshy `slacks' between them but running together to the north. The beach plants include such species as Yellow Horned Poppy (*Glaucium flavum*), Sea Holly (*Eryngium maritimum*), Sea Radish (*Raphanus raphanistrum*) and Sand Sedge (*Carex arenaria*) while the large Sharp Rush (*Juncus acutus*) as well as Knotted Pearlwort (*Sagina nodosa*) occur in wetter sites.

A major part of the ecological importance of the bay is the wintering birdlife which is present in large numbers. Surveys in the winters 1984/85 - 86/87 showed that Brent Goose (694), Black-tailed Godwit (1329) and Bar-tailed Godwit (1029) occurred in numbers of international importance, while thirteen other species were nationally important. These are Shelduck (1721), Wigeon (1015), Red-breasted Merganser (50), Grey Plover (359), Golden Plover (l095), Lapwing (2748), Knot (705), Sanderling (83), Dunlin (4559), Redshank (930) and Turnstone (254). All figures are average peak populations. A further ten species were found in numbers of regional or local importance emphasising that Dungarvan supports a greater diversity of species than any other site on the south coast except for Wexford Harbour. It is now a Special Protection Area under the E.U. Birds Directive.

The sand flats to the east of the Cannigar support an extensive oyster farming operation so there are clearly possible grounds for impact between these shellfish and the invertebrates on which some of the bird species depend. There is also concern that displacement of water fowl and disturbance may be a problem on the shellfish farming area. At present the bird numbers are higher than in the previous survey (l97l-75).

(Source: NPWS site synopsis, 13th February 1995).

Appendix C – Dungarvan Landfill. Response to EPA Request for Information on Leachate Treatment (RPS, August 2013)

Dungarvan Landfill Remediation Works

Leachate Abstraction and Treatment System – Description and Performance

DOCUMENT CONTROL SHEET

Client	Waterford County Council					
Project Title	Dungarvan Landfill Remediation					
Document Title	Leachate Abstraction and Treatment System – Description and Performance					
Document No.	MDR0450Rp1030					
This Document Comprises	DCS	TOC	Text	List of Tables	List of Figures	No. of Appendices
	1	1	57	-	-	-

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Consulting Engineers

TABLE OF CONTENTS

1 INTRODUCTION 3

1.1 GENERAL 3

1.2 SITE REMEDIATION BACKGROUND 3

1.3 WASTE LICENCE REQUIREMENTS 7

2 LEACHATE GENERATION AND ABSTRACTION 9

2.1 OVERVIEW 9

2.2 LEACHATE LEVEL MONITORING RESULTS 9

2.3 LEACHATE WELL PUMPING TRIALS 9

2.4 LEACHATE WELLS SELECTED 10

2.5 LEACHATE DISPERSION 11

2.6 PREDICTED LEACHATE GENERATION 11

2.7 LEACHATE ABSTRACTION VOLUMES 11

2.8 LEACHATE STRENGTH AND OTHER POLLUTED ARISINGS 12

2.9 TOTAL LOADINGS ARISING FROM LEACHATE AND OTHER POLLUTED SOURCES 12

2.10 CONCLUSIONS & RECOMMENDATIONS 13

3 INTEGRATED CONSTRUCTED WETLANDS TREATMENT SYSTEM 15

3.1 OVERVIEW 15

3.2 BACKGROUND 15

3.3 WETLANDS DESIGN SIZING PRINCIPLES 16

3.4 BRIEF OVERVIEW OF SYSTEM 16

3.5 INFRASTRUCTURE 16

3.6 MANAGEMENT & MAINTENANCE 17

3.6.1 Procedures in the Event of Flooding 18

3.6.2 Procedures in the Event of Non-Operation of the System 18

3.6.3 Measures to Establish the Cause of any Significant Pollution 19

3.7 POST CLOSURE CARE 19

3.8 SUMMARY MODE OF OPERATION OF CONTROL SYSTEM 19

3.9 FLOW VOLUMES 20

3.10 POND CAPACITY, FLOW HYDRAULICS, AND FREEBOARD 21

3.11 TREATMENT PROCESS 23

3.11.1 Introduction 23

3.11.2 Plant functions 23

3.11.3 Pollutant loadings and removal 24

3.11.4 Other ICW systems 24

3.12 DISCHARGE TO RIVER 26

3.12.1 Receiving water body quality 26

3.12.2 Assimilative Capacity 27

3.12.3 Proposed Emission Limits 28

3.13 IMPACT OF ICW DISCHARGE ON RECEIVING WATER 30
3.14 ECOLOGY OF SURROUNDING AREA 30
3.14.1 Biological assessment of the River Colligan 31
3.14.2 Sediment Quality 32
3.14.3 Shellfish 33
3.15 IMPACT OF ICW DISCHARGE ON SURROUNDING ECOLOGY 34
3.16 PROPOSED MONITORING REQUIREMENTS 34
4 PARTIAL LEACHATE ABSTRACTION-TREATMENT SYSTEM 2010-2012 36
4.1 DESCRIPTION OF PARTIAL LEACHATE SYSTEM 36
4.2 TREATMENT EFFICIENCY OF THE ICW 37
4.2.1 Leachate Collection – Flows & Quality (Ammonium) Prior to Treatment 37
4.2.2 Leachate Treatment – Quality (Ammonium) after Treatment 38
4.3 POND FLOW MONITORING 40
4.4 DILUTION WATER SOURCE 44
5 FULL SCALE LEACHATE ABSTRACTION AND TREATMENT SYSTEM - INFRASTRUCTURE & EQUIPMENT, OPERATIONS 45
5.1 OVERVIEW 45
5.2 LEACHATE ABSTRACTION BOREHOLES 45
5.3 LEACHATE COLLECTOR DRAIN PUMP SUMP 46
5.4 GROUNDWATER ABSTRACTION WELL RC8A 46
5.5 DILUTION WELL 46
5.6 DILUTION TANK 46
5.7 WETLAND PONDS 48
5.8 RECYCLE SUMP 48
5.9 MONITORING 49
5.10 CONTROL SYSTEM, HMI, AND SCADA 50
5.10.1 Alarms and text alert set-up 50
5.11 WEATHER STATION 51
5.12 CARETAKING AND MAINTENANCE 51
6 PERFORMANCE OF FULL LEACHATE ABSTRACTION-TREATMENT SYSTEM – INITIAL 9 MONTHS 52
6.1 PROCESS DESCRIPTION 52
6.2 TREATMENT EFFICIENCY OF THE ICW 52
6.2.1 Leachate Collection – Flows & Quality (Ammonium) Prior to Treatment 53
6.2.2 Leachate Treatment – Quality (Ammonium) after Treatment 53
6.2.3 System flows 55
6.3 CONCLUSION 55
REFERENCES 56
APPENDIX A DRAWING LIST 57

1 INTRODUCTION

1.1 GENERAL

This document presents a description of the Leachate Abstraction and Treatment System completed at Dungarvan Landfill in 2012, together with results of its performance to date. System process proving commenced on 24/09/2012, and has been operating for just over 9 months at the time of writing.

This report has been prepared by RPS Consulting Engineers on behalf of Waterford County Council and should be read in conjunction with the following documents:

1. Closure Restoration & Aftercare Management Plan (January, 2008)
2. Report on Response to EPA on Request for Information on Leachate Treatment (August 2008)
3. Waste Licence W0032-02
4. Dungarvan Landfill Remediation Works - Final Construction Report (December 2012)
5. Leachate Abstraction and Treatment System - Design and Operation Manual (December 2012)

1.2 SITE REMEDIATION BACKGROUND

Works to remediate the landfill commenced in July 2007 and the landfill site was completely capped in accordance with the Waste Licence in September 2008. A series of Integrated Constructed Wetlands (ICW) were developed on top of the landfill as part of the capping works. The purpose of the ICWs is to treat the leachate generated at the landfill and also to provide a possible future public local amenity area.

A combined landfill gas and leachate extraction system was installed where gas and leachate are collected from a common set of collection wells. A series of leachate collection pipework and pumps relays leachate to the wetlands, while the landfill gases generated within the landfill body itself are collected by the landfill gas management system and flared off. Wellheads are adapted to accept both gas control valves and leachate pump. In total, 23 wells were installed and it was designed that a total of 9 wells would be used for leachate extraction.

The ICWs and the extraction system are shown on Figure 1 and Drawing DG0606, and all works including the leachate extraction, ICW treatment system, gas extraction, and flare system are complete. A Supervisory Control and Data Acquisition (SCADA) system controls and collects information on the leachate system e.g. pumps on/off/alarms, flow rates, leachate quality and flow trends.

Pond 3 in 2009 while the reeds were still establishing

A leachate interceptor drain was laid along the northern boundary as shown on Drawing DG0606. The drain comprises slotted HDPE pipes laid in a gravel surround and any leachate collected in the drain is directed towards a leachate pump sump where it is also pumped to the ICW for treatment. In addition, leachate from the old leachate drains beneath the landfill, leachate from the leachate cut-off drain at the toe of Pond 4 and leachate and washings from the waste transfer station drain, including those from the septic tank and first flush storm system in the civic amenity area are collected in the pump sump and directed to the ICW for treatment.

A temporary leachate abstraction and treatment system was commissioned in May 2010 in order to test the system, operating using two leachate wells out of nine, and this operated successfully until March 2012 when it was decommissioned to make way for the full system. A summary of results is presented in this report. The last remaining element of work, the full leachate abstraction and control system, was completed in September 2012, and thus all works required to remediate the landfill are complete. Full details can be found in Dungarvan Landfill Remediation Works - Final Construction Report (December 2012) and associated drawings.

The River Colligan and bank protection works at the landfill

Figure 1 Overview of leachate abstraction and treatment system

1.3 WASTE LICENCE REQUIREMENTS

Waste licence W0032-02 specifies the following in relation to management of leachate and trade effluent:

Condition 3.19 Leachate Management and Trade Effluent Infrastructure

3.19.1 The existing unlined leachate pond and associated leachate sump shall be decommissioned within one month of the date of grant of this licence.

3.19.2 Leachate management infrastructure at the landfill facility shall be installed and commissioned at the facility from the date of grant of this licence. The infrastructure shall provide for the abstraction of leachate from the waste, the collection of leachate in a leachate collection drain around the entire perimeter of the landfill, the collection of trade effluent from the composting area, CWF and Waste Transfer Station, leachate treatment at a suitable treatment works and the monitoring of the effectiveness of the leachate collection drain. The leachate collection drain shall be maintained in accordance with the details shown on Drawing No. Dun EIS-004 Rev.O dated March 1999 unless otherwise agreed in advance with or specified by the Agency.

3.19.3 The licensee shall provide and maintain a lined leachate storage lagoon at the facility to facilitate the storage of leachate abstracted/collected from the waste and closed landfill.

3.19.4 The lining system for the leachate storage lagoon shall comprise the following (or equivalent): a composite liner consisting of at minimum a basal soil/clay layer of at least 1m in thickness with a permeability of less than 1 x 10^{-9} ms^{-1} overlain by a 2mm thick high density polyethylene (HDPE) layer. The side walls shall be designed and constructed to achieve an equivalent protection.

Condition 3.20 Groundwater Management

Effective groundwater management infrastructure shall be provided and maintained at the facility during construction, operation, restoration and aftercare of the facility. As a minimum, the infrastructure shall protect the groundwater resources from contamination by the waste activities (including restoration of the facility) and the storage of leachate and contaminated surface water at the facility.

3.15 Waste Inspection and Quarantine Areas

3.15.3 Drainage from the quarantine area shall be directed to the leachate management system.

3.17 Compost facility

1.17.1 (b) All wastewater from composting operations shall be collected and reused in the composting process where possible. Any wastewater from the composting operations that is not re-used shall be either discharged to the leachate drainage system or tankered off-site for treatment at a location to be agreed in advance with the Agency.

5.5 Emissions to Surface Water

5.5.1 Unless otherwise agreed by the Agency no trade effluent or leachate shall be discharged to surface water drains and courses.
5.5.2 There shall be no direct emissions to groundwater.

B.3. Emissions Limits for Treated Leachate Discharged to Surface Water

To be agreed by the Agency in advance

Schedules C2.3 Leachate Monitoring and C6 Receiving Water Monitoring are also relevant.

View from pond 5 at the landfill looking down towards the tidal estuary on the left, waste transfer station and civic amenity site, lagoon in forefront and green leachate system control house

2 LEACHATE GENERATION AND ABSTRACTION

2.1 OVERVIEW

Since the site has been capped with a geomembrane liner in 2008, ongoing leachate generation due to infiltration of rainfall is assumed to be negligible, approximately 2% of precipitation. However, as the site is unlined, groundwater will contribute to some leachate generation as will some leachate disperse into groundwater. In addition the waste body will retain some reservoirs of leachate particularly between the layers of clay that would have been placed historically as daily cover. Assessments of leachate volumes at the landfill site had been made at several stages during the design process, including:

- In 2008 during abstraction and ICW systems design, as summarised in *Report on Response to EPA on Request for Information on Leachate Treatment (August 2008)*
- In 2010 in the report: *Leachate System Status and Design Update Report*

The following sections summarise and update the findings.

2.2 LEACHATE LEVEL MONITORING RESULTS

Leachate levels in the extraction wells were recorded from 2008 to 2012. The results show that the average leachate level at the site has decreased since the site was capped in 2008 from 7.74 to 5.85 in 2012. The leachate levels for each year 2008-2011 were also plotted at their well locations across the site and a contour map showing the leachate head for each year was prepared as shown on Figure FG0010. The contour maps show that the main body of leachate in 2008 is located in the centre of the landfill. However, since 2008, the main body of leachate has reduced in size and in 2011 is concentrated to the north of the site with a leachate head of approximately 6-8mOD. There is also another body of leachate in the south east of the site with a leachate head of approximately 5mOD. It should also be noted that the leachate head in GW2 has reduced significantly since extraction commenced at this well in May 2010.

Leachate levels are also monitored at leachate monitoring wells every month, however several of these monitoring wells were damaged from 2007-2011 when they were re-drilled, so results are limited.

2.3 LEACHATE WELL PUMPING TRIALS

Pumping trials were undertaken at three extraction wells (CW3, CW5, GW2) in April 2010 and at eight extraction wells in September 2010 (CW3, CW5, CW6, GW3, GW1, GW13, CW8, CW4). The testing was carried out using a 1-2 m^3/hr borehole pump. The leachate head in each well was taken before and after the test, and then again either later that same day or the following day. Test duration and flows were recorded.

Table 2.1: Pumping Trial Results

Well	Duration Hrs	Approximate Flow m3 (total)	Drawdown	Recovery
CW3	0.50	0.2	Poor drawdown	limited recovery in 24 hours
GW2	2.00	3	Good drawdown	recovery in 12 hours
CW5	0.15	2.3	Good drawdown	recovery in 24 hours
GW6	2.00	9	Excellent drawdown	recovery in less than 24 hrs
GW3	0.50	0.9	Poor drawdown	recovery in 24 hours
GW1	2.1	9	Good drawdown	recovery in less than 24 hrs
GW13	0.80	1.9	Good drawdown	recovery in 24 hours
CW8	0.30	0.8	Poor drawdown	limited recovery in 24 hours
CW4	0.52	0.9	Poor drawdown	limited recovery in 24 hours

As described in Section 4, a partial leachate extraction system was operated from May 2010 to March 2012, and this utilised GW2 from May 2010 and GW6 from October 2010. GW2 pumped on average 1 m^3/d and GW6 1.4 m3/d.

It should be noted that although leachate extraction wells exist in areas with a high leachate head, some wells will be more productive than others due to factors such as the permeability of the surrounding waste or potential clogging of the wells.

Well pumping during the nine months of the full abstraction system (September 2012 to June 2013) has confirmed that well yields are highly variable, and generally quite modest. The long term yield of the well system will become evident over time. The current estimate is that approximately 5 m3/d will be achievable with the current set of nine wells. Three replacement wells were drilled in 2011 due to problems with settlement interfering with the existing wells, ensuring sufficient areal coverage / zone of influence is maintained. It is possible that the age of the landfill and settlement over the years has resulted in a highly compacted fill, with limited yields. However, as discussed in following sections, leachate strength is quite high.

2.4 LEACHATE WELLS SELECTED

Based on the monitoring and test pumping results, the following wells were selected for leachate abstraction:

GW1, GW2, GW4, GW5, GW6, GW7, GW13, CW1, and CW2

These wells are located to reduce the leachate head in the two areas where the leachate head is highest.

2.5 LEACHATE DISPERSION

Results from the 2012 Annual Environmental Report, show that groundwater wells located to the east and west of the facility are not affected by leachate contamination and surface water monitoring results are satisfactory.

2.6 PREDICTED LEACHATE GENERATION

Using the EPA's water balance calculation provided in the Landfill Manual on Site Design, a further leachate generation calculation was undertaken based on the long term mean annual rainfall and assuming a water infiltration rate through the liner of 2% reflecting a welded UDPE liner installed under a strict CQA regime. The area of the landfill is approximately 7 hectares with a waste/lined area of 5.34 Ha.

Table 2.2 Estimated Leachate Generation in 2010 at Dungarvan Landfill

Restored Area subject to leachate Extraction	Mean Rainfall	Evapo-transpiration (assuming 650)	Effective Rainfall	m^3/year based on 2% Infiltration
53,400	1207	650	557	595 (approx. 50m^3/month)

Therefore, based on the above calculations, it can be expected that approximately 50 m^3/month (approximately 1.67 m3/d) of leachate will be generated from infiltration. However, this does not take into consideration any groundwater influence. This low level of leachate generation explains why the leachate head has reduced since the site was capped in 2008.

2.7 LEACHATE ABSTRACTION VOLUMES

The objective of the full abstraction system is to abstract leachate and therefore reduce the leachate head across the landfill. Section 2.3 showed that leachate levels were at an average of just under 6 mOD in 2012, and this compares to an average surrounding groundwater level of 1-2 mOD, and a waste bottom level of 1-2 mOD.

The full waste area of the landfill is 5.34 Ha, with an estimated 25% saturation. It is estimated that an area of 5000 m2 has an extractable head of 5m, another 10,000 m2 has an extractable head of 2m, and the remaining area of 38,400 m2 has a possible extractable head of 1m, depending on leachate head pathways and pumping zones of influence, giving a total leachate volume of 20,850 m3.

Taking into account the well yields discussed in Section 2.3, it is estimated that 5 m3/d of leachate can be abstracted from the landfill, and allowing that 1.67 m3/d is infiltration recharge, thus it would take 17 years to finish abstraction. However, given the gradually falling leachate head, this period may be shorter.

Overall, it can be said that well leachate abstraction rates are variable, quite modest, and the total volume and time needed is uncertain. In any case, once abstraction and treatment continues, the system is performing its function.

2.8 LEACHATE STRENGTH AND OTHER POLLUTED ARISINGS

Polluted arisings come from the following sources, and are all directed to the ICW for treatment:

1. leachate from the waste body
2. Leachate from the cut-off drain around the landfill
3. leachate from the old leachate drains beneath the landfill
4. leachate from the leachate cut-off drain at the toe of Pond 4
5. leachate and washings from the waste transfer station drain, the septic tank and first flush storm system in the civic amenity area, all collected in a pump sump
6. Well RC8A – this well is adjacent to the main body of waste, and occasionally has an elevated ammonium concentration as well as other pollutants

Ammonium concentrations were recorded between June and December 2010 at GW2, the leachate collector pump sump, and well RC8A. Ammonium is the primary parameter of concern in regards to ICW treatment of leachate and important in terms of discharge to river.

Ammonium concentrations in GW2 varied from 2,500 to almost 4,000 mg/l NH_4. One result of 470 mg/l NH_4 (not shown on graph) was available at GW6.

Initial concentrations at RC8a were in the 100-300 mg/l range when tested in June to September 2010, but levels reduced to average 90 mg/l following continual pumping from October 2010 onwards.

Similarly, ammonium concentrations at the leachate collector pump sump ranged from 500-1500 mg/l when tested in June to September 2010, but levels reduced to average 110 mg/l following continual pumping from October 2010 onwards.

2.9 TOTAL LOADINGS ARISING FROM LEACHATE AND OTHER POLLUTED SOURCES

The following lists the estimated loadings from the various polluted sources directed to the ICW for treatment:

Leachate from the waste body – estimated at 5 m3/d and a maximum of 2500 mg/l ammonium. Likely average case scenario is 5 m3/d at 1500 mg/l.

Leachate from the pump sump, comprising the cut-off drain around the landfill, leachate from the old leachate drains beneath the landfill, leachate from the leachate cut-off drain at the toe of Pond 4, leachate and washings from the waste transfer station drain, including those from the septic tank and first flush storm system in the civic amenity area, all collected in a pump sump:

– this averaged 9.4 m3/d during the partial system period in 2010/11. The estimated maximum during design was 20 m3/d at a maximum of 150 mg/l ammonium. The likely average case scenario estimated was 15 m3/d at 110 mg/l.

Well RC8A – the degree of pumping from this well is decided by the operator, with a maximum possible of 48 m3/d. The maximum case considered was 20 m3/d at 150 mg/l ammonium, and the likely case scenario was 20 m3/d at 100 mg/l.

In the case of the pump sump and well RC8A, previous results indicate that a higher pump rate coincides with slightly lower concentrations.

Thus the following table summarises the estimated maximum and average loadings case scenarios:

Table 2.3 Estimated maximum and average loadings case scenarios (design)

Source	Maximum loading			Likely average loading		
	m3	ammonium mg/l	Kg/d	m3	ammonium mg/l	Kg/d
Leachate from the waste body	5	2500	12.5	5	1500	7.5
Leachate from the pump sump	20	150	3.0	15	110	1.7
Well RC8A	20	150	3.0	20	100	2.0
Total	45		18.5	35		11.2

The ICW treatment system can provisionally cope with 186 m3/d at 100 mg/l, equivalent to 18.6 kg/d of ammonium, pending process proving and satisfactory performance.

2.10 CONCLUSIONS & RECOMMENDATIONS

The following conclusions can be made from the above leachate generation and abstraction assessment:

- The leachate head at the site has reduced since the site was capped in 2008 (as shown on Figure FG0010).

- The main body of leachate is concentrated to the north of the site with a smaller pocket in the south west of the site.

- Well leachate abstraction rates are variable, quite modest, and the total volume and time needed is uncertain. In any case, once abstraction and treatment continues, the system is performing its function. The current estimate is that 5 m3/d will be achievable with the current set of nine wells.

- Leachate strength from the wells appears to be quite strong, with results varying from 470 mg/l ammonium to almost 4000 mg/l. This must be accommodated in treatment operations.

- The estimated loadings from all polluted sources directed to the ICW for treatment is estimated at 18.5 kg/d and 11.2 kg/d, respectively, for maximum and average loading case scenarios, in terms of the key parameter ammonium. The treatment system can provisionally cope with 18.6 kg/d of ammonium, pending process proving and satisfactory performance.

The following recommendations were made based on these conclusions:

- the following wells were selected for leachate abstraction: GW1, GW2, GW4, GW5, GW6, GW7, GW13, CW1, and CW2

- Continue leachate level monitoring at all other extraction & monitoring wells in order to assess the reduction in leachate head across the landfill.

- Examine leachate extraction rates for each of the extraction wells on a monthly basis to determine the ongoing effectiveness of wells to reduce the leachate head. Leachate wells can become clogged over time, which would affect the effectiveness of the wells.

- Examine surface water and ground water quality monitoring results on a quarterly basis to understand the extent of any off site contamination.

- The pollutant loading characteristics must be taken into account during control system design and operation to ensure consistency with ICW treatment capacity

3 INTEGRATED CONSTRUCTED WETLANDS TREATMENT SYSTEM

3.1 OVERVIEW

The leachate treatment system at Dungarvan landfill utilises a set of ICW's. Leachate is extracted from the borehole system, diluted to acceptable strength, and then passes through the series of five wetland ponds, before discharging to the leachate lagoon (which is hydraulically connected to the Colligan River). A SCADA system controls the operation, and outlet monitoring records the discharge quality. Treated leachate from the final pond can be recycled back through the system.

Waterford County Council worked in conjunction with Dr Rory Harrington, Senior Scientist/Programme Manager, Integrated Constructed Wetlands Initiative, Department of Environment, Heritage and Local Government, to develop an ICW system to treat leachate at Dungarvan Landfill with a view towards discharging the treated effluent to the River Colligan.

ICWs have been used to treat polluted water in Ireland in recent years, in particular in the treatment of point source pollution from agriculture. To date, ICWs have not been used in the treatment of landfill leachate in Ireland; it is intended to appropriately monitor the performance of the Dungarvan ICW system with a view towards producing peer-reviewed publication(s).

A report, *Response to EPA on Request for Information on Leachate Treatment* was produced in August 2008 containing information requested by the Environmental Protection Agency (EPA) relating to the proposal to use an Integrated Constructed Wetlands (ICW) System for the treatment of leachate from Dungarvan Landfill.

The following sections reiterate the above report, updating and adding as appropriate to the final design and construction of the treatment system ICW's.

3.2 BACKGROUND

An integrated constructed wetland (ICW) is a surface flow wetland, which mimics the role and structure of natural wetlands. Wetlands are effective in cleansing nutrients and pollutants. These wetlands have shallow water depths and are planted with emergent plant species and can cleanse liquids through physical, chemical and biological processes.

ICWs are a specific design approach to the widely used concept of constructed wetlands. ICWs are distinguished from other constructed wetland approaches because they are designed to facilitate the widest possible range of ecological conditions normally found in natural wetlands, including those of soil, water, plant and animal ecology. In addition the ICW concept strives to achieve 'Landscape fit' and 'Habitat Restoration/Creation' into its designs. These added values necessitate the required larger land areas used in the ICW design compared with those generally used in other constructed wetland designs. This relatively larger land area facilitates a greater range of the physical, chemical and biological processes that occur in the wetland environment including those required for the removal of the more difficult contaminants.

The primary vegetation types used in ICWs are emergent plant species (helophytes). These species have evolved to enable them to root in soils with no available or limited oxygen, growing vertically through the water column with most of their leaves in the air. They have specially adapted tissues that facilitate oxygen storage and its transportation from the leaves through the stem to the roots. Soil and water characteristics influence the type and performance of plant species for each wetland segment of an ICW.

The ICW system consists of five fully lined ponds with 300mm depth of subsoil that will allow for the establishment of vegetation and provide for the protection of the geosynthetic barrier layer.

3.3 WETLANDS DESIGN SIZING PRINCIPLES

The surface area available for the ICW system at Dungarvan was limited by the existing profile of the raised landfill waste body. The surface area of the wetlands is approximately 18,650m^2, slightly less (9%) than the design target of 20,500m^2 due to construction space constraints. Sizing of ICW is typically based on an average requirement of 100m^2 per 1m^3 through-flow of diluted leachate per day; this would equate to a maximum daily loading of 186m^3.

3.4 BRIEF OVERVIEW OF SYSTEM

The ICW consists of a series of six wetland ponds (pond 1 is split into two: ponds 1A and 1B) through which the leachate is passed sequentially where it will be treated by means of the plants within the ponds before being discharged to the Colligan River. A leachate dilution tank, leachate collection pipework, and monitoring equipment are operated in tandem with the wetlands themselves to ensure that the system operates as designed. See drawing DG0706 for an overview of the system.

Leachate abstracted from the site via the leachate abstraction boreholes is pumped to the Dilution Tank. Monitoring equipment in this tank analyses the leachate and determines the concentration of ammonium and therefore whether dilution of the leachate is required or not. The maximum concentration of ammonium allowable is 100mg/l, to prevent shock loading of the wetland plants at the inlet point.

If dilution of the leachate is required water from the recycle sump (pond 5 discharge water) or water from the dilution well is used to dilute the leachate to the required concentration in the tank before being pumped to the wetland system. If no dilution is required the leachate will be pumped directly from the tank to the wetland system.

Once leachate is discharged to the wetland system it flows sequentially through Ponds 1-5 before being discharged to the recycle sump at the outlet of pond 5. The treated leachate is monitored in the sump before recycle or discharge. The control system may be set so that the majority or all treated effluent is recycled as dilution water or back to pond 1B, and thus little or no discharge occurs, or to recycle a minimum and allow discharge, provided the effluent meets standards. Heavy rainfall events will first result in a level rise and retention within the ponds, together with increased recycle flows to pond 1B if so set, and then finally discharge to the leachate lagoon (which is hydraulically connected to the river).

3.5 INFRASTRUCTURE

Connection:

The ICW consists of a series of five individual cells each connected to the preceding cell by means of a HDPE pipe buried within the subsoil layer of the capping system. As previously discussed untreated leachate is discharged to the first cell and then flows through each of the cells before being discharged to a recycle sump for monitoring and either recycle to the ponds or discharge to the leachate lagoon (which is hydraulically connected to the Colligan River). The flow is regulated through the wetlands to ensure adequate retention time is achieved within the ponds before being monitored prior to discharge. A SCADA system controls flows to the ICW, leachate dilution tank and sumps, and outlets, and regulates flows based on parameter monitoring to ensure compliance with outlet parameters and avoid overloading the wetlands.

Capping:

The landfill was capped prior to the construction of the wetlands. As part of the final capping works the surface of the landfill was re-graded to specific levels to ensure a suitable flow of leachate from cell to cell in the wetlands. Each cell was levelled so leachate could be contained within the cells. Once re-

graded the landfill was capped with a layer of gas geocomposite and a layer of LLDPE liner. The LLDPE liner provides the base for the wetland system.

Once the LLDPE liner was installed, the floor of each of the cells was covered with 300mm of clay and the sides of the ponds were constructed by means of clay berms (1000mm high). The berms were then lined with LLDPE liner. The liner was secured by means of an extrusion weld to the existing capping liner on the inside of the ponds and by means of an anchor trench at the top of the berms.

Leachate Flow:

The leachate flow is monitored and regulated by means of a series of tank/sumps, pipework and monitoring systems. The monitoring results are relayed back to the software system which is stored in the control building and dependent on these results the leachate is either discharged to the leachate lagoon (which is hydraulically connected to the Colligan River) or back into the wetland system. This is discussed in more detail in Section 3.8.

Dilution Tank and recycle sump:

The dilution storage tank is an above ground glass-fused-to-steel tanks which is constructed to BS 7543:1992 and ISO 15686. It has a nominal capacity of 25m^3 and an effective working volume of 20 m3 including for overflow and freeboard. The tank is bunded to 110% of the total liquid volume.

The recycle sump at pond 5 is a buried concrete ring type construction with a nominal capacity of 3.8 m3 and an effective working volume of 3 m3 including for overflow and freeboard.

Plants:

Each cell has been planted with a variety of different plant species. Included in the planting scheme were 8,000 *Glyceria maxima* (sweet water grass), 3,000 *Typha latifolia* (reedmace), 10,000 *Carex riparia* (common sedge) and a mix of 9,000 *Typha angustafolia* (lesser reedmace), *Scirpus lacustris* (bulrush), *Iris pseudacorus* (yellow flag iris) and *Sparganium erectum* (burreed). The planting density is approximately 1 plant / 0.6m^2.

3.6 MANAGEMENT & MAINTENANCE

A fundamental requirement of the ICW concept and its design is that they be as self-managing and as self-maintaining as possible. Their initial management requirements must be achieved within the physical, chemical and biological dynamics of wetland ecosystem function. The key operational necessity to achieve this is that water depths (100-200 mm) for the various ICW segments should be maintained.

If left unmanaged the accumulation of sediment and decaying organic matter combined with changing vegetation structure will eventually cause channelling-type flow to develop thus reducing retention time and plant contact. To minimise such channelling, surface flow must be maintained through the incremental raising of the water level in the various wetland segments. This is achieved through raising and lowering pipe invert levels, as appropriate. The pipe invert levels will only have to be raised subject to the increase in the depth of the bed in the ponds, i.e. the depth of the initial clay base and the depth of the accumulating sediment and decayed organic matter. It is envisaged that the pipes will only have to be raised every 3-5 years.

Given the nature of the through-flowing water it is not expected that there will be a need for much more than inspection (initially on a daily basis, subsequently on a weekly basis) to ensure that through-flow is being maintained after initial installation. These inspections will be carried out by Waterford County Council in conjunction with Dr. Rory Harrington. The presence of biological indicator species such as emergent macrophytes, which are to be planted at the outset, will also be monitored

as part of these inspections. If these are not thriving it is an indication that there is too much ammonia or too much salt in the system.

The ICW concept is particularly focused on fluxes in through-flows, this combined with its elevated position, make it is extremely unlikely that the risk from flooding is significant; in addition, sufficient freeboard has been allowed within the system to allow for extreme rainfall events. Similarly, during periods of drought there is little likelihood of problems arising as the vegetation has an innate capacity to cope with this. In the event that additional water must be added to the system in drought periods it can be abstracted from the dilution well.

As water depth and contaminant concentration, especially that of ammonia-N composition, can impact synergistically on emergent plants (a key element in this exercise), the overall impact of increasing the water depth on the vegetation must be anticipated and carried out in small incremental steps. In addition, it is undesirable to radically reduce a wetland cell's water level through the release of water from one segment to the next as water, especially from the more polluted upper segments, as this may contain excessive ammonium, which could negatively impact on more sensitive vegetation. If there is a need to reduce levels, lowering the pipe/sluice when there is freeboard or by small incremental amounts over protracted periods, is appropriate.

In brief the establishment and monitoring of the ICW system has/will proceed as follows:

- Hydrate the ICW.
- Plant the specified plant species.
- Once the plants are established begin introducing the leachate incrementally.
- Monitor the condition of the wetland ecosystem.
- The monitoring will allow a balance to be established between the volume of leachate being treated and the performance of the ICW system.
- The development of the biological indicator species will be the limiting factor in determining the performance of the system.

3.6.1 Procedures in the Event of Flooding

Each cell has been constructed such that there is 500mm of freeboard in each cell at all times. This freeboard makes it extremely unlikely that flooding will occur due to overtopping of the cell walls. The largest one day rainfall (as per Rosslare records) was 79.1mm. The freeboard within the ponds is of ample size to cope with this level of rainfall.

3.6.2 Procedures in the Event of Non-Operation of the System

Routine caretaking and troubleshooting is carried out several times per week, with text-out warning for key events such as any equipment malfunction. As part of the SCADA control system a maintenance contract is entered into with the system supplier. This contract includes a quarterly systems check and will also include for emergency call outs in the event of non-operation of the SCADA control system.

The control system has significant self-diagnostic and emergency provisions that automatically shuts down abstraction of leachate and attempts to recycle treated effluent in the event of effluent non-compliance or equipment failures. All such events and failures are alarmed to the operator. The key pumps at the dilution tank and recycle sump are dual provisioned, duty/standby. In the event that effluent cannot be recycled automatically (e.g. during heavy rain or because of multiple pump failures), then the operator can manually adjust the pond outflow to retain a large additional volume as described below.

With regard to the wetland itself the monitoring detailed in section 3.16 of this report will ensure that any operational issues are identified early and that suitable remedial works are undertaken.

3.6.3 Measures to Establish the Cause of any Significant Pollution

Owing to the nature of the construction of the ICW it is anticipated that if pollution were to occur it would be due to the one of the following:

1. The control or monitoring system having failed
2. The wetland cell walls having failed or having been overtopped.
3. One of the tanks/sumps having failed.

In the event that the control or monitoring system has failed and effluent cannot be recycled automatically (e.g. during heavy rain or because of multiple pump failures), then the operator can manually adjust the pond outflow to retain a large additional volume as described below.

In the event that the control system is not at fault, the wetland walls and tanks/sumps will be inspected immediately. If the inspection reveals that the failure has occurred, the pumps in the abstraction boreholes will be shut down and works to repair any faults will be instigated immediately.

Measures have been taken at the design and construction stage to minimise the possibility of any of the above occurring. The wetland cell walls have been constructed from compacted clay and the LLDPE lining has been inspected by an independent quality control inspector. The cells walls have also have a 500mm freeboard which minimises the risk of overtopping. All the cells are also interlinked by gravity feeds. The dilution tank is a glass fused to steel and has been constructed to BS 7543:1992 and ISO 15686. A reinforced concrete base provides a stable platform for each tank. As discussed in the section above, a maintenance contract is entered into with the suppliers of the monitoring system ensuring that the system is regularly inspected and tested.

3.7 POST CLOSURE CARE

Heavy metals will be contained in the detritus and necromass of the ICW system. They can be removed as appropriate and the metals recovered through combustion for thermal energy or by dewatering and removal to landfill. It should be noted however that the expected lag-time for this is about 30 –100 years and as it is determined by berm-height (holding capacity) which may be increased by additional appropriate earthworks.

Once it has been established that treatment of the leachate is no longer required the ICW may be decommissioned. The SCADA system, storage tanks and pumps will all be decommissioned, re-used if possible and disposed of appropriately otherwise.

Possible options for the utilisation of the site will be examined on closure of the ICW system.

3.8 SUMMARY MODE OF OPERATION OF CONTROL SYSTEM

A full description on operation of the control system is detailed in Section 5. The following summarises the process:

1. Leachate is extracted from the 9 combined wells and pumped to the leachate-balancing and dilution tank.

2. Once a certain level has been reached in the tank, inflow is stopped and the concentration of the leachate (from the 9 different wells) is analysed to determine the concentration of NH_4. The maximum concentration of the diluted leachate to enter the wetland cells is 100mg/l NH_4.
3. Based on the concentration analysis of the leachate in the tank, the feed source pump will pump water from the recycle sump or dilution well to dilute the leachate sample to the required NH_4 concentration of less than 100mg/l NH_4.
4. Once the required dilution has been achieved, the diluted leachate is pumped to Wetland cell 1A.
5. The diluted leachate flows sequentially through each of the five ponds.
6. Flow from the last wetland cell (pond 5) discharges to a recycle sump. The concentration of the treated effluent is continuously monitored to determine the concentration of NH_4.
7. The control system may be set so that the majority or all treated effluent is recycled as dilution water or back to pond 1B, and thus little or no discharge occurs, or to recycle a minimum and allow discharge, provided the effluent meets standards.
8. When sufficient rainfall causes increased flow through the ponds system, such that the retention and balancing of the ponds and recycle pumping system is exceeded, then the control system gradually opens an actuated valve to discharge, or the overflow level in the sump allows discharge at even higher flows.
9. If the treated effluent achieves the discharge limit values, it can be discharged to the river Colligan. If the sample is above the discharge limit values the sample is redirected to the tank or Wetland Cell 1B. In this case, all leachate abstraction is ceased until the outlet sample comes back within standards, the actuated valve closes thus raising pond 5 water levels and maximising storage therein, and recycle pumping to pond 1B is maximised.
10. In the event of an emergency whereby the effluent is above standards, and the retention and balancing of the ponds and recycle pumping system is exceeded, there is provision to allow manual adjustment of the pond outlets to further retain effluent, thus bringing into effect significant additional storage volume using the available freeboard. The outlets should be lowered following this event, to ensure security of the ponds from overtopping.

3.9 FLOW VOLUMES

As the concentration of leachate within the landfill varies considerably; the concentration of leachate within the dilution tank determines the dilution required and consequently the volumes of diluted leachate to be treated. Table 3.1 below illustrates the flow volumes through the system for various abstraction rates from the landfill, under average rainfall/P.E. conditions.

Table 3.1: Leachate Mass Balance

Leachate Abstracted (m^3/d)	Leachate sump and RC8A[1] (m^3/d)	Plus Dilution Water[2] (m^3)	Plus Precipitation[3] (m^3)	Less P.E.[4] (m^3)	Flow (m^3/day)
1	30	15	49.2	32.9	62
2	30	30	49.2	32.9	78
3	30	45	49.2	32.9	94
5	30	75	49.2	32.9	126
8	30	120	49.2	32.9	174
9	30	135	49.2	32.9	190

Note 1: Average leachate strength and volumes are considered
Note 2: A dilution factor of 15 has been assumed using an average NH_4 level of 1500mg/l in the raw leachate based on analysis of the leachate within the landfill.
Note 3: Precipitation has been taken from Rosslare weather station. The annual total has been distributed evenly throughout the year.
Note 4: Potential evapotranspiration has been taken from Casement Aerodrome and has been distributed evenly throughout the year.

Leachate analyses from monitoring points and abstraction wells show that concentrations of ammonium range from 210 mg/l to 3900 mg/l. The plants being used in the system can tolerate levels of ammonium up to 100mg/l. In addition, the ICW system has a hydraulic design load of 186 m3/d. At the upper end of leachate concentrations, the capacity to dilute becomes a factor when the hydraulic capacity of the ICW is considered, for example, at 2000 mg/l the maximum capacity is 7.8 m3/d of raw leachate, or at 4000 mg/l the maximum capacity is 3.9 m3/d of raw leachate. However, it is not considered likely that all wells would produce very high strength leachate, and even if this occurred, the leachate daily volume estimate is approximately 5 m3/d, and thus the treatment system is adequately sized.

3.10 POND CAPACITY, FLOW HYDRAULICS, AND FREEBOARD

The available surface area in the six wetland cells is approximately 18,650m^2. The depth of the wetlands system is designed on the basis of 300mm of soil on top of the capping system covered by 200mm depth of diluted leachate with approximately 500mm of freeboard. This gives a normal capacity of 3,700m^3 with a maximum capacity of 13,000m^3 if required. Retention times will depend on the daily input to the system; retention times for a range of input values are illustrated in the table below.

The minimum retention time will be determined empirically. Initial loading of the wetlands will be minimal. Once it is established that the wetlands are adequately treating this loading (based on monitoring of the effluent) the loading will be increased. As before, if this increased loading is treated adequately the volume of leachate being discharged to the wetlands will be again augmented. This process will continue until such time as the maximum volume of leachate that can be abstracted from the landfill is being treated or until monitoring demonstrates that the ICW cannot treat the volume of leachate being discharged to it. In this case the volume of leachate being discharged to the ICW will be decreased to a level to which the ICW has sufficient capacity to treat.

The integrity of the ICW ecosystem will be maintained at all times through visual inspections and by the sampling and monitoring of the influent and effluent.

Daily input of diluted leachate (m^3)	Retention time* (Days)
30	123
50	74
70	53
100	37
150	25
190	19

* Based on normal capacity of 3,700m^3, includes average precipitation less evapotranspiration.

Table 3.2: Retention Times of the ICW

The wetlands system together with the connected dilution and discharge tank must not overflow due to operational or rainfall events. Taking a 100 year design return period, the expected maximum one day rainfall is 75mm, increasing to 100 mm to allow for climate change. The expected maximum intensity rainfall is 200mm/hr in 2 mins, total 6.7 mm, allow 8mm.

The pond level is controlled by the inter-pond gravity pipe at higher flows (the inlet is a vertical pipe). The following table illustrates the system hydraulics.

Table 3.3 Tank and inter-pond flow hydraulics

	Area	Operational depth	Freeboard	Total Depth	Min outfall gradient	Pipe size	Max outflow	Max outflow	Max outflow	
	m2	mm	mm	mm		mm	l/s	m3/hr	mm/hr	
Dilution tank	9.16	2000	300	2634	RM	90	5.6	20.0	5	into pond 1A
Pond 1A	4219	200	500	700	1 in 70	160	25	90.0	25	into pond 1B
Pond 1B	3535	200	500	700	1 in 70	160	25	90.0	61	into pond 2
Pond 2	1485	200	500	700	1 in 100	160	26.5	95.4	47	into pond 3
Pond 3	2014	200	500	700	1 in 150	160	18	64.8	16	into pond 4
Pond 4	3962	200	500	700	1 in 150	160	12.4	44.6	13	into pond 5
Pond 5	3430	200	500	700	1 in 70	160	25	90.0	35433	into recycle sump
Recycle sump	2.54	2200	800	3000	1 in 100	160	23	82.8	n/a	into lagoon

With a standard 160mm pipe connecting each pond, and the final discharge from pond 5 to the lagoon, the pass forward flow is limited to between 18 and 26 l/s by the capacity of the gravity pipe connection.

The table shows the corresponding equivalent in mm/hr rise in the next pond, varying from 13 mm/hr from pond 4 to pond 5 (i.e. pond 5 rises by 13 mm/hr), to 61 mm/hr from pond 1B to pond 2 (the smallest pond). Practically, once the outflow level is reached, flow will commence to the next pond and the rise in level will slow and eventually drop as rainfall and flows reduce. The restrictions on outflow are beneficial in terms of treatment retention and flow balancing across the system.

The worst case scenario concerns the 100 year event discharging through the pond system at maximum capacity. Each pond has a freeboard of 500mm, and calculations show that one day rainfall of 100mm and 1 hour rainfall are within the storage capacity. In a scenario where pond 5 outflow is throttled, a simple calculation with no account for rainfall profile gives a maximum input to pond 5 of 100mm rainfall falling on all ponds plus 200 m3 of diluted leachate, inputting at 19 mm/hr (18 l/s) from pond 4 plus direct rainfall, and assuming a worst case of 5 mm/hr (5 l/s) outflow presuming some restriction/blockage (actual is 23 l/s). The maximum rise at pond 5 would theoretically be 290mm, within freeboard. In reality, the event profile and characteristics of the ponds outlets would cause each pond to rise and discharge more slowly than this simple model allows, and therefore the actual rise in level would be less.

It is notable that the pond 3 to pond 4 connection showed an apparent maximum flow of 6.5 l/s during flow monitoring in 2011-12, as presented in Section 4. There possible that the flat section of this pipe along pond 4 could cause this low maximum capacity, and this could possibly cause flooding problems in extreme events at pond 3. However results are as yet limited, in the interim the pond will be monitored closely and further flowmeter data will be analysed.

Thus the tank, ponds, and discharge pipework, together with the ponds freeboard, are designed adequately to cope with the envisaged flows, including severe rainfall events.

3.11 TREATMENT PROCESS

3.11.1 Introduction

ICWs are ecologically engineered systems. They are distinguished from most other constructed wetlands because they are designed at the outset to facilitate the widest possible range of structures and processes found in natural wetland ecosystems, including those of soil, water, plant and animal ecology. They are particularly designed to achieve sufficient hydraulic residence time for the capture of phosphorous, the parameter demanding most surface area. The preference for the use of local soil material to achieve appropriate water infiltration/retention and a wide variety of native/local wetland plant species in ICWs are features that particularly distinguish them from ‘reed bed’ systems that typically feature only a single species.

3.11.2 Plant functions

The macrophytic vegetation used in the ICW design essentially performs a variety of functions; its primary function is the support of biofilms (slime layer) which carry out the principal cleansing function of the wetland. It also facilitates the sorption of nutrients and acts as a filter medium and through the use of appropriate emergent vegetation can control odours and pathogens. While the vegetation has the capacity to filter suspended solids it also increases the hydraulic gradient, thus increasing residence time. The appropriate choice of plant species and the density at which they are planted are important in the overall functioning of the wetland.

3.11.3 Pollutant loadings and removal

The leachate composition results available for Dungarvan landfill indicate that the composition of leachate from different parts of the landfill varies greatly; leachate composition varies considerably according to the type of waste deposited, landfill age and the degree of waste stabilisation. The range of values for different parameters measured within the landfill over the last three years are indicated in the table below.

Table 3.4: Pre-Treatment Leachate Analysis Data

Parameter	Leachate	Sump	RC8A	Typical Leachate Analysis (EPA, 1997)
Ammonium mg/l N	490 - 3900	10 - 1465	10 - 280	453
BOD mg/l O_2	200 - 320	n/a	0 - 23	270
COD mg/l O_2	900 - 2900	30 - 1235	30 - 365	954

As the main focus of this wetland is the removal of ammonia-N and the capture of other pollutants, particularly heavy metals, the necessary recycling of the through-flow and the fact that it is an open system that is subject to precipitation, make it is extremely difficult to give a treatment efficiency at this stage.

There is no previous experience of the efficiencies for landfill leachate management using the ICW concept. Nevertheless, there is evidence of very successful performance for ICW systems treating and managing farmyard dirty water with very variable concentrations of contaminants and that include the degrees of contamination expected in the leachate. The threshold parameter, ammonia-N concentration, is known to be the factor limiting vegetation growth and this will be managed through re-cycling through-flow.

As discussed, initial assumptions are that the first wetland cell, pond 1A, receives diluted leachate at 100 mg/l, and that hydraulic flow is limited to 186 m3/d. This may be adjusted based on treatment system response over time.

3.11.4 Other ICW systems

Within the Annestown-Dunhill catchment area (25km^2) a network of ICWs have been constructed. These ICWs primarily capture farmyard run-off from the 19 working farms within the area. The run-off typically consisted of yard and diary washings, rainfall on open yard and farmyard roofed areas and silage and manure effluents.

A total of 13 ICWs were constructed within the catchment area between 2000 and 2001. A monitoring programme has since been carried out and a summary of some of the results of this programme can be seen below.

Table 3.5: Summary of results from ICW systems In Annestown - Dunhill

		BOD (mg/l)		SS (mg/l)		NH_4^+-N (mg/l)		PO_4^{3-}-P (mg/l)	
	ICW	In[3]	Ef[4]	In	Ef	In	Ef	In	Ef
Mean[1]	1	6040.8	11.1	1013.2	11.6	153.6	0.3	75.69	0.22
N[2]		23	26	24	24	26	27	25	28
Mean	2	429.9	12.9	146.2	146.2	64.6	0.4	15.46	0.27
N		21	26	24	24	28	27	28	28
Mean	3	417.1	19.8	112.6	112.6	62.9	1.3	18.13	3.38
N		28	34	30	30	48	60	49	62
Mean	4	619.5	27.6	1019	1019	110.6	2.5	22.75	1.62
N		43	35	49	49	69	55	71	59
Mean	5	357.7	17.3	180.6	180.6	71.8	0.5	14.33	0.24
N		24	25	24	24	24	27	25	28
Mean	6	213.2	16.3	192.3	192.3	41.2	0.3	10.76	0.13
N		22	25	23	23	26	26	27	28
Mean	7	337.6	17.2	286.3	286.3	52.2	22.5	7.51	5.25
N		25	27	26	26	32	63	33	64
Mean	8	56.1	11.9	39.2	39.2	19.4	0.2	1.46	0.04
N		22	22	24	24	25	26	26	27
Mean	9	520.2	11.9	408.6	408.6	41	0.6	11.59	0.44
N		30	34	29	29	51	57	52	58
Mean	10	149.6	8.8	306.5	306.5	26.6	0.2	5.27	0.06
N		3	18	4	4	5	40	5	40
Mean	11	569.7	20.2	309.4	309.4	42.2	0.4	12.02	0.96
N		47	41	54	54	109	109	112	114
Mean	12	317.3	18.3	210	210	129.5	1.1	43.67	0.53
N		6	35	4	4	12	51	14	52
Mean	13	45.8	15.1	171.3	171.3	10.5	0.1	0.94	0.06
N		19	19	21	21	22	24	21	24

Note 1: the mean is the average of all the results taken.
Note 2: N is the number of readings taken.
Note 3: Influent
Note 4: Effluent

As can be seen from the table there are significant reductions in all parameters in each of the individual ICW ecosystems.

The effluent from each of the ICWs flows into the Annestown Stream. The biological water quality status of the stream has improved from a rating of Q2 (seriously polluted) in 1999 to a rating of Q3/4 (slightly polluted) in 2001 (EPA 2002). Further evidence suggests that the water quality has since improved to Q4 (unpolluted). Sea trout have returned to the stream after many decades of absence. The common newt has become abundant in all ICWs in the catchment [Scholz et al 2007].

3.12 DISCHARGE TO RIVER

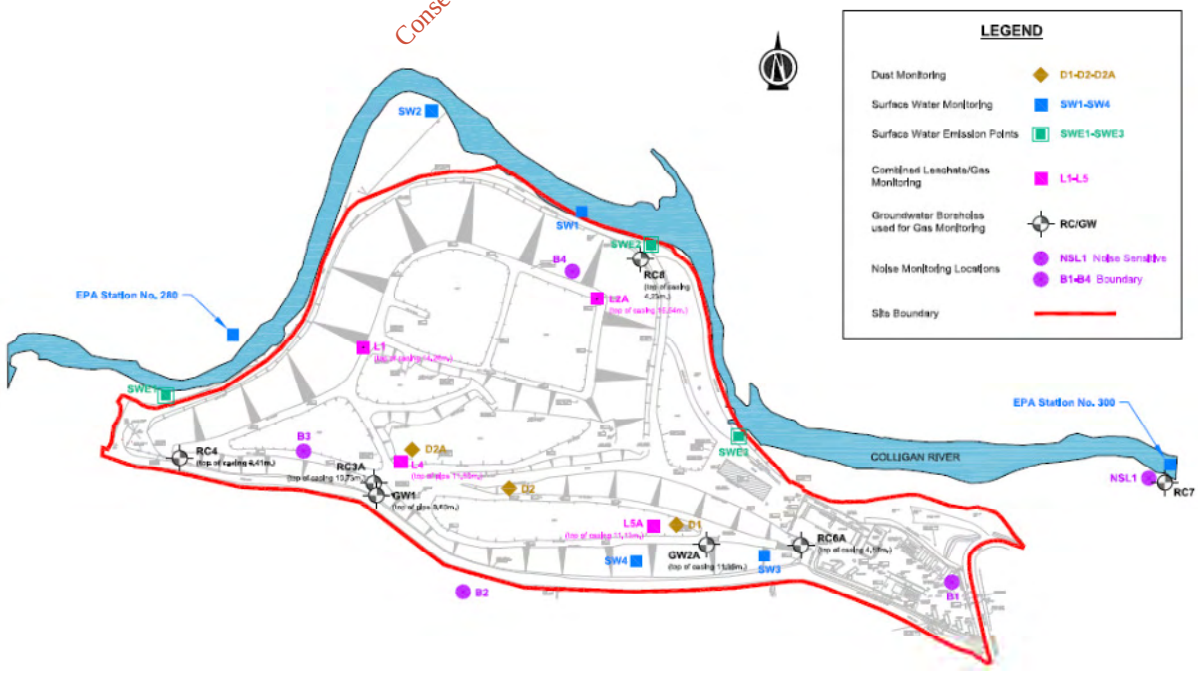
The treated leachate is monitored in the sump before recycle or discharge. The control system may be set so that the majority or all treated effluent is recycled as dilution water or back to pond 1B, and thus little or no discharge occurs, or to recycle a minimum and allow discharge, provided the effluent meets standards. Heavy rainfall events will first result in a level rise and retention within the ponds, together with increased recycle flows to pond 1B if so set, and then finally discharge to the leachate lagoon (which is hydraulically connected to the river). In the event of an emergency whereby the effluent is above standards, and the retention and balancing of the ponds and recycle pumping system is exceeded, there is provision to allow manual adjustment of the pond outlets to further retain effluent, thus brining into effect significant additional storage volume using the available freeboard, and further recycle and dilution can occur to bring the effluent to standard, or in exceptional cases the effluent can be sent to a local wastewater treatment plant.

The following sections summarise the assessment that was carried out during design in 2008 as submitted to the EPA in *'Report on Response to EPA on Request for Information on Leachate Treatment' (August 2008),* together with updated analysis based on quality results from 2010-2012.

3.12.1 Receiving water body quality

Historical flow measurements for the River Colligan are available from the Poulnaskeha Hydrometric Station; given that this station is no longer in operation the most recent measurements available are from July 2003. The 95%ile flow at the Poulnaskeha Station was estimated at 0.5m³/s. The DWF at the Poulnaskeha Station was estimated at 0.32m³/s.

There is one EPA monitoring station immediately upstream of the landfill site, EPA station 280, as well as two monitoring stations, SW1 and SW2, adjacent to the landfill site. These monitoring stations are sampled and monitored quarterly. Not all relevant parameters are monitored at each station consistently from the period first analysed in 2006-2007 through to the most recent results in 2010-2012, and as such, results from Station 250 upstream at Killadangan Bridge are also included for comparison (not shown on graphic below).



During design of the system, the following results were used. The average of the highest result, for each parameter, from each monitoring event in 2007, has been calculated and is shown in the table below. Orthophosphate results were taken from 2006, the last period from which results are available.

Parameter	Average of sampling stations		
	2006/07	2007-2009	2010-2012
Total Ammonia (mg/l N)	0.05	0.01	0.02
O-Phosphate (mg/l P)	<0.006	0.02	0.02
BOD (mg/l O_2)	1	0.9	0.8
Dissolved Oxygen (%)	117	106	113
COD	20	n/a	37
Conductivity (µS/cm)	281	139	n/a
PH	7.8	7.8	n/a
Suspended Solids (mg/l)	7	n/a	<5
Chloride (mg/l Cl)	43	13	n/a

Table 3.10: Monitoring Results from the Colligan River

The above results have been assessed as consistent with good water quality and a nominal Q rating of 3-4. See Section 3.14.1 for further details regarding good water quality and a nominal Q rating of 3-4.

3.12.2 Assimilative Capacity

The EPA has proposed Environmental Quality standards for BOD of 5mg/l in Rivers in Ireland (EPA 1997), with a desirable maximum of 4 mg/l to support fish life. According to the EU-Salmonid regulations (SI No 293 of 1988) the concentration of NH_4 must not exceed 1 mg/l in the river and the concentration of suspended solids must not exceed 25 mg/l. Although the Colligan is not a Salmonid river the limits in these standards will be applied in the proposed assimilative calculations.

There is no limit included in the Salmonid Regulations for phosphorous, however according to the Interim Statutory Standards for Rivers as per the EPA document “Parameters of Water Quality Interpretation and Standards” a limit of 0.03 mg/l P (MRP) should be applied to rivers with a Q rating 3-4. Ecological monitoring undertaken at the landfill site in 2009 and 2011 concluded that the Colligan River had a water quality of fair to good around the site. Q ratings could not be assigned to the stretch of river around the site due to the tidal nature of the river at this point.

The average of the highest results from 2010 to 2012 at each of the three monitoring stations, as detailed above, has also been applied in the calculations.

The allowable concentrations in the effluent have been estimated based on the allowable concentrations in the river, taking into consideration the flow of the Colligan and the flow of effluent to be discharged. The calculations have been carried out as follows.

The concentration of a chemical substance downstream of the discharge point can be estimated as:

$C_a = (Q_i C_i + Q_s C_s)/(Q_i + Q_s)$; where

Q_i = Flow of the River upstream of the discharge point
C_i = Concentration of the substance upstream of the discharge point
Q_s = Flow of effluent from the discharge point
C_s = Concentration of the substance in the effluent

From the above equation it is seen that the concentration of substance in the effluent can be estimated as:

$C_s = (C_a Q_i + C_a Q_s - C_i Q_i)/Q_s$.

The concentration of NH_4 upstream of the proposed discharge point is 0.02 mg/l N. By inserting the maximum allowable concentrations in the river of NH_4 the maximum allowable concentration in the effluent for a range of discharge rates have been compiled in the table below.

Table 3.7 Maximum allowable concentrations of P, NH_4, BOD and Suspended Solids

Daily Discharge		Allowable Maximum Concentrations in Discharge			
(m^3/day)	(L/s)	O-Phosphate (mg/l P)	NH4 (mg/l)	BOD (mg/l O2)	Suspended Solids (mg/l)
40	0.46	9.0	676	2,195	13849
60	0.69	6.0	451	1,465	9241
80	0.93	4.5	339	1,100	6937
100	1.16	3.6	271	880	5555
120	1.39	3.0	226	734	4633
140	1.62	2.6	194	630	3975
160	1.85	2.3	170	552	3481
186[1]	2.15	2.0	146	475	2998

[1] maximum design flow – discharge in excess of this figure would arise from heavy rainfall events

This analysis was carried out both in 2008 based on 2006-2007 river water quality values, and the 2010-2012 values shown above. There is no significant change in water quality over the period and thus no significant change in the assimilative capacity, except for ortho-P. For ortho-P, the results from 2006-2007 were lower, and based on current results, the allowable concentration in the effluent would decrease from the original assessment of 3.6 mg/l to 2.0 mg/l at maximum design flow.

3.12.3 Proposed Emission Limits

As can be seen from the table above the Colligan River has ample assimilative capacity to receive large volumes of treated effluent from the ICW, but with some restriction based on allowable ortho-phosphate limits.

The table below details the proposed emission limits that are to be applied to the treated effluent.

Parameter	Emission Limit (all units in mg/l except pH)
pH	5 - 9
BOD	45
Suspended Solids	50
Orthophosphate (mg/l P)	2
Total Ammonium (as N)	15

Table 3.8: Proposed Emission Limits

The discharge standards above are updated from the previous submission *'Report on Response to EPA on Request for Information on Leachate Treatment' (August 2008):*

- A change to the previous submission pH standard from 6-9 changing to 5-9, reflecting the acidic nature of the wetlands system observed in results to date, which is currently showing pH values less than 6. There is no adverse effect predicted on the receiving water, as discharge volumes are less than 1% of DWF.
- A change to the total ammonium standard from the previous proposal of 5 mg/l to 15 mg/l, since the assimilative capacity allows over 100 mg/l with no adverse effects predicted

Using the above limits the concentration of each of the above substances downstream of the discharge location was calculated. It was assumed that the concentration of each substance in the discharge was at its maximum proposed concentration, and the treatment system discharges at its design flow of 186 m3/d. The table below illustrates the concentration of each parameter in the Colligan River downstream of the site and the corresponding statutory limits for each of these parameters.

	BOD (mg/l)	Suspended Solids (mg/l)	Orthophosphate (mg/l)	Total Ammonia (mg/l)
Conc. Downstream	1.1	5	0.03	0.12
Statutory Limits	5	25	0.03	1

Table 3.9: Downstream Concentration of Emission Parameters

As can be seen from the above table the concentration of each of the parameters in the effluent is significantly below both the statutory limits as detailed in the previous section as well as the assimilative capacity of the Colligan River, aside from ortho-P, which is at the limit.

It is not anticipated that the treatment system will operate at the maximum design flow and maximum allowable ortho-P value, the averages of both will be less, and thus the analysis above takes the worst case scenario.

3.13 IMPACT OF ICW DISCHARGE ON RECEIVING WATER

As discussed above when calculating discharge limits for the treated effluent, limits taken from the EU Salmonid Regulations were applied. In addition to this, the proposed emission limits are well below the assimilative capacity of the receiving water. The implementation of both these control measures will ensure that there is negligible impact on the receiving waters. The SCADA monitoring system will ensure that both these measures are implemented fully.

3.14 ECOLOGY OF SURROUNDING AREA

An ecological survey of the landfill and its surrounding areas is carried out annually in accordance with condition 8.1 of Waste Licence 32-02.

According to the reports the site and its surrounding environs continue to support a diversity of wildlife due to the variety of habitats present. Dungarvan Landfill Site lies in close proximity to Dungarvan Bay, a designated SPA on account of its importance for feeding and roosting areas for migratory wintering wading birds and wildfowl such as Brent Goose, Black-tailed Godwit and Bar-tailed Godwit. The SPA extends along the River Colligan estuary as far upstream as Ballyneety Bridge. Dungarvan Harbour is also a Ramsar site and recognised as an Important Bird Area (Birdlife International). Review of I-WeBs data indicates continuing favourable conservation status of Dungarvan Bay SPA for qualifying interests including Brent Geese and Bar-tailed Godwits. Annex 1 bird species such as the Little Egret and Kingfisher are known to use the stretch of River Colligan near the landfill site.

With regard to mammal surveys of the area the River Colligan is an important habitat for Otters. Numerous sprainting sites, some of which are obviously in long-term use, indicate that otters are resident and successful there. The high level of otter activity from previous surveys indicates that the River Colligan contains a healthy and reliable population of fish, highlighting the biological health of the River Colligan. The abundance of frogspawn in wetlands on the landfill provides a food source for Otter along the River Colligan. Surveys of Otter activity along the Colligan commissioned by the MISE project in 2011 and 2012 indicate active use along this waterway corridor.

Bat species such as Daubentons also probably use the river corridor as a feeding habitat.

Habitats occurring in the Dungarvan landfill site can be categorised as either semi-natural (e.g. scrub (WS1); wet grassland (GS4); reed and large sedge swamps, (FS1) or artificial and modified e.g. amenity grassland (GA2) recolonising bare ground (ED3), spoil and bare ground, ED2; artificial lakes and ponds (Fl8); buildings and artificial surfaces (BL3). These habitats initially had relatively low ecological value, as they were subject to intermittent disturbance. However, since 2008 with succession of habitats including establishment of 6 wetland cells, grassland and increasing scrub cover it is apparent that the site is demonstrating increased biodiversity value providing good feeding grounds for a variety of birds and some mammal and invertebrate species along with amphibians. The 2013 site visit observed an abundance of frogspawn in the wetland cells and 8 Snipe and 5 Moor Hen were noted whilst walking the site.

The development of wetlands and grassland on the landfill also serves to enhance the ecological network of natural habitats surrounding the landfill including the River Colligan and adjacent areas of wet grassland, marsh, brackishwater and estuarine habitats.

The majority of plant species recorded on the landfill site is considered abundant and widespread throughout Ireland. However one of the recorded plant species is listed on the Flora Protection) Order, 1999- Opposite-leaved Pondweed (Groenlandia densa) which is only known to occur in a couple of places in the county.

3.14.1 Biological assessment of the River Colligan

It is notable that a review of EPA 2011 Water Quality data for the Colligan River indicates that water quality is of satisfactory quality ranging from Q4- Q4-5 with no change from 2010. Biological assessment of the River Colligan at the location of the landfill was most recently carried out in 2009 and 2011, and suggested a fair to good water quality sampling sites. Both stations SW1 and SW2 are subject to tidal influences and may at times be brackish, depending on river flow and tidal range, and this may have an influence on relatively lower Q-value scores for the river location at the landfill compared to the EPA stations upstream.

2009 Assessment

Limosa Environmental was commissioned by Waterford County Council to conduct a biological monitoring survey at selected sites. The licence requirements for ecological / biological monitoring were amended in 2009 from the former broader monitoring requirements to that of aquatic biological quality Q rating at three locations, two on the River Colligan and one in a drainage ditch which runs along the southern boundary of the site.

The results of the 2009 biological assessment of the River Colligan sites indicated good water quality status at both river sampling sites following analysis of the surface water quality and biological water quality data recorded. As in previous years the diversity of invertebrates decreased moving downstream in the brackish water reaches of the river from sites SW2 to SW1. An increase in the macroinvertebrate diversity was noted at site SW2 compared with 2008, whereas a slight decrease in the species diversity was recorded at site SW1 compared to 2008. However, this decrease is due to the absence of two species found in 2008, that of eels and stickleback. Other than this the macro-invertebrates recorded in the current survey remained very similar to those recorded in 2008 and thus it is considered that there has been no change in water quality.

These findings coupled with the review of water quality measurements taken on site and EPA chemical water quality data between 2008 and 2009, show continued good water quality indicating that Dungarvan Landfill site is not negatively impacting the River Colligan.

Although the European Eel was not recorded within in the current survey it has been recorded previously and it is likely that they are still present in the river in the tidal reaches of the River Colligan.

2011 Assessment

Sampling of macro invertebrates was carried out at River Colligan sites SW1 and SW2 adjacent to Dungarvan Landfill on 16/1/12. Identification and counting of biota, using various freshwater macro invertebrate identification keys, was carried out on 17/1/12. The EPA Q-rating scheme was applied to the results in order to get a Q value for each site. However, it should be noted that both stations are subject to tidal influences and may at times be brackish, depending on flow of freshwater and extent of tide.

Both stations SW1 and SW2 are subject to tidal influences and may at times be brackish, depending on river flow and tidal range. A small Flounder fish, common to shallow water areas such as estuaries and tidal areas, was caught in the sample at SW1. Nominal Q-scores of Q3-4 for SW1 and Q3 for SW2 are assigned for this survey in order to comply with licence requirements, aid interpretation of the species count and to allow trends to be tracked. However, as the Q index system is designed for freshwaters, standard interpretation of the Q score is not possible for these tidal and possibly brackish stations. Therefore, Q Score should be removed from the licence requirements as such biological indices are not appropriate for these tidally influenced brackish stations.

Comparison with previous surveys and between stations is possible and it is seen that the species list of this survey in January 2012 was similar to that found sampled by Dr Lewis of Limosa Environmental

Ltd in Oct 2009. Taxon richness was higher at SW1 in January 2012 compared to the Oct 2009 survey. In this survey here was a slight increase in taxon richness and nominal Q score between the upstream station SW2 and the downstream station SW1. Taxon richness and species present at both stations indicate good water quality. Results were similar to the previous survey of 2009.

3.14.2 Sediment Quality

Small concentrations of metals exist naturally in the environment and living organisms require trace amounts in order to exist. However some metals can be hazardous to the environment if concentrations exceed certain thresholds. Monitoring of the sediment in the Colligan River was required under previous Waste License 32-01, but not under the current licence. The last monitoring event for which results are available was carried out in 2005, the results of which are shown below.

Background trace metals in estuarine sediments generally reflect the occurrence and abundance of metals in the geological formations in the catchment area of the estuary, and any metals discharged to the environment due to human activities.

Prior to their closure, Dungarvan Crystal and Dungarvan Tannery were licensed to discharge lead and chromium to Dungarvan Harbour.

Samples of sediment (approx 2 kg) were taken on 18/8/05 at five sampling points:

- S1 – just upstream of disused railway bridge upstream of landfill (EPA stn 280)
- S2 – immediately upstream of the landfill site
- S3 – opposite most downstream drain from the landfill
- S4 – 150 m downstream of landfill
- S5 – Ballyneety Bridge, downstream of landfill (EPA stn 300)

The samples were hand mixed on-site, and a portion (approx 200g) taken for analysis. The samples were dried at 105 deg for two days, and pulverized with mortar and pestle in Adamstown laboratory. Portions of the powdered samples were analysed for metals at Euro Environmental Services Laboratory, Drogheda. QC and reference materials were processed with the samples.

Table 3.11: Sediment Quality Results

Site	Arsenic[1] (mg/kg)	Chromium[1] (mg/kg)	Copper[1] (mg/kg)	Lead[1] (mg/kg)	Zinc[1] (mg/kg)
S1	**1.6** [2.5] (5.2)	**5.5**	**5.9** [6.1] (7.4)	**4.5** [17.1] (13)	**23.8** [38.6] (43)
S2	**1.4** [2.7] (6.5)	**5.9**	**6.2** [5.7] (9.3)	**5.7** [5.7] (23)	**48.8** [40.8] (49)
S3	**1.9** [2.1] (3.7)	**9.6**	**9.5** [6.6] (7.2)	**8.2** [6.9] (10)	**35.7** [31.5] (88)
S4	**1.3** [3.5] (3.5)	**5.9**	**5.1** [8.7] (6.4)	**7.2** [35.2] (10)	**27.9** [38.8] (450)

S5	**1.5** [3.7] (4.6)	**6.0**	**4.7** [204] (13.6)	**5.4** [72] (14)	**21.8** [1526] (41)
Waterford Harbour EPA survey, average of five samples (2003)	**8.0**	**20.0**	**9.8**	**26**	**141**
Wexford Harbour EPA survey, average of four samples (2002)	**8.6**	**31.0**	**11.4**	**15**	**70**
Dungarvan Harbour EPA survey, average of four samples (2004)	**6.7**	**22.8**	**23.4**	**93**	**102**
Sediment Quality Standards (Jeffery et al)			**50.0**		**100**

Note 1: Results from [2004] and (2003) are shown in brackets.

As can be seem from the above table the sediment quality in 2006 is broadly similar to that of 2004 and 2005. The sediment also compares extremely favourably to samples taken from other parts of the south-east coastline.

3.14.3 Shellfish

Mussels samples (Mytilis edulis) were taken at a location downstream of the landfill, at the N25 Bridge at Dungarvan bypass road, on 11/12/06. Twelve individual mussels, of 6 cm average length, yielding approximately 30 grams wet weight of flesh were sampled.

Mussels were depurated overnight in clean aerated estuarine water before de-shelling. The flesh was blotted dry and dried at 60deg for 3 days. The dried flesh was ground to powder and portions were analysed for metals at Euro Environmental Services Laboratory, Drogheda. QC and reference materials were processed with the samples. The results of this analysis are shown in Table 3.12 below.

Table 3.12: Mussel Sample Analysis

Site	Arsenic (mg/kg)[2]	Cadmium (mg/kg)[2]	Chromium (mg/kg)[2]	Iron (mg/kg)[2]	Lead (mg/kg)[2]	Manganese (mg/kg)[2]	Zinc (mg/kg)[2]
Dungarvan Mussels[1]	**1.9** {2.2} [9.8] (2.6)	**0.07** {0.1} [0.34] (0.03)	**0.15** {0.5}	**15.8** {66.4} [212] (49)	**0.72** {2.1} [15.4] (3.8)	**0.65** {2.4} [18] (1.4)	**8.3** {11.6} [51] (13.2)
Waterford Harbour EPA survey	**3.7**	**0.4**	**1.1**	**115**	**1.5**	**5.7**	**39**
Waterford Harbour EPA survey	**1.6**	**0.1**	**0.9**	**62**	**<0.4**	**3.4**	**22.4**
Dungarvan Harbour EPA survey	**-**	**0.2**	**0.9**	**140**	**7.5**	**2.5**	**26**
Shellfish Quality Standards	**-**	**1.0**	**-**	**-**	**1.5**	**-**	**-**
Marine Institute Study	**-**	**0.44**	**0.86**	**-**	**0.77**	**-**	**28.5**

Note 1: {2005}, [2004] and (2003) results are in brackets.
Note 2: Wet weight

The level of heavy metals present within the mussels sampled in 2006 is similar to that of the preceding years with most parameters actually decreasing in quantity. The mussels sampled downstream of the landfill also compare favourably with those sampled from other locations along the southeast coastline.

3.15 IMPACT OF ICW DISCHARGE ON SURROUNDING ECOLOGY

As discussed above there will be a strict control and monitoring regime associated with the ICW ecosystem. This regime will ensure that effluent will only be discharged when it meets the emission limits set down in this report. Once these limits are not breached the impact of the effluent on the surrounding waters and flora and fauna will be minimal.

3.16 PROPOSED MONITORING REQUIREMENTS

The following monitoring requirements are proposed, updated from the submission *'Report on Response to EPA on Request for Information on Leachate Treatment' (August 2008):*

1. Total ammonium: fortnightly – at least 26 samples per annum
2. pH, BOD, SS, Ortho-P: monthly – at least 12 samples per annum
3. A full suite of parameters monitored once per annum as listed below
4. System control monitoring using online sensors for total ammonium, pH, and conductivity. These online sensors are to be used only for system control and not for emission limit compliance.
5. An outlet autosampler allowing 24 hour composite sampling and flow proportional sampling techniques to be used. A 24 hour composite sample will be taken from the effluent each day and stored on site. Once a week/month one of the composite samples will be chosen at random and tested for the appropriate parameters.

The following are the proposed changes compared to the 2008 submission:

- A change in the monitoring frequency for grab sampling and testing the parameters BOD, suspended solids and Orthophosphate from once per week to once per month, following successful performance of the treatment system in the first 9 months.
- A change in the monitoring frequency for grab sampling and testing the parameter ammonium from once per week to once per fortnight, following successful performance of the treatment system in the first 9 months. It is also notable that the online ammonium sensor built into the system monitors continuously, as thus would give early warning of any performance issues in between grab sample tests.
- It is <u>not</u> proposed that the online ammonium sensor at the outlet of the treatment system is used for emission limits compliance purposes. This sensor is intended for system treatment control purposes. It needs to be regularly cleaned and re-calibrated, and accuracy will drift between inspections. The process of calibration and cleaning will also produce inconsistencies at the time, which could be misinterpreted as non-compliances.

It is proposed that compliance is based on the following sampling-compliance schedule:

- 8-16 samples taken; maximum number of samples which fail to conform = 2
- 17-28 samples taken; maximum number of samples which fail to conform = 3
- 29-40 samples taken; maximum number of samples which fail to conform = 4

Annual grab monitoring parameters:

- BOD
- COD
- Chloride
- Ammoniacal Nitrogen
- Electrical Conductivity
- pH
- Metals / non-metals[1]
- Cyanide (total)
- Fluoride
- List I/II organic substances
- Mercury
- Sulphate
- Orthophosphate
- Total Oxidised Nitrogen

Note 1: to include boron, carbon, cadmium, chromium (total), calcium, copper, iron, lead, magnesium, manganese, nickel, potassium, sodium and zinc

4 PARTIAL LEACHATE ABSTRACTION-TREATMENT SYSTEM 2010-2012

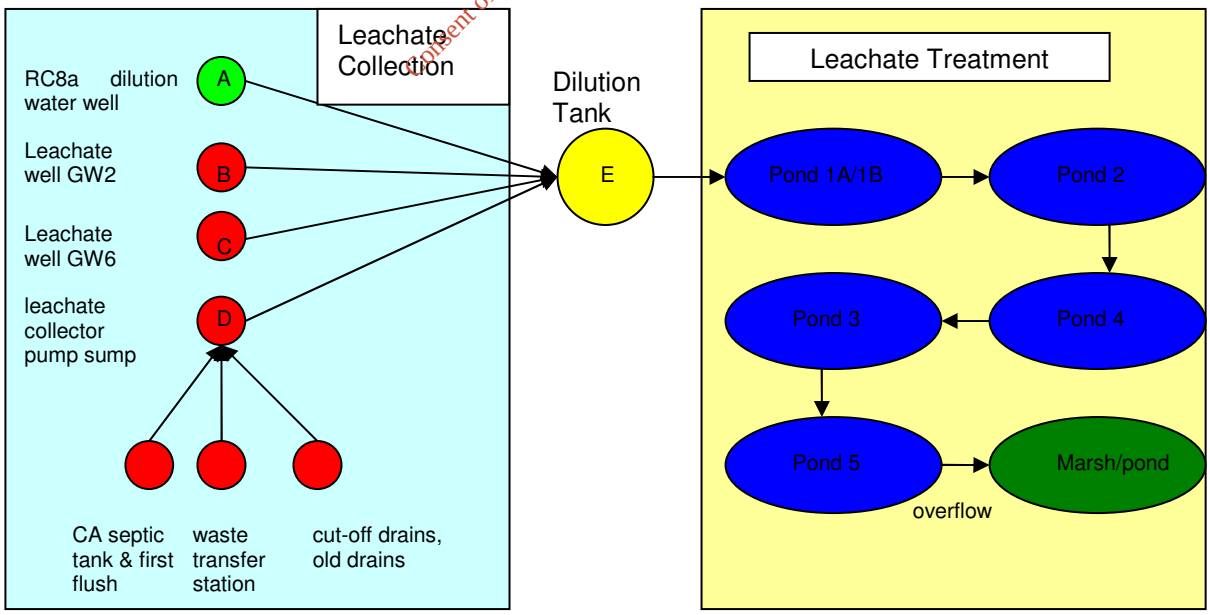
In order to assess the treatment efficiency of the ICWs, it was decided that only part of the leachate extraction and control system would be setup initially so as to test the viability of the ICW to treat the landfill leachate before implementing the full scale leachate extraction and control system. This assessment was carried out from June 2010 to March 2012. The following sections outline details of this partial system and presents results of the assessment of the effectiveness of the ICW to treat the landfill leachate.

4.1 DESCRIPTION OF PARTIAL LEACHATE SYSTEM

Two wells, GW2 and GW6 were selected to extract leachate, based on leachate level monitoring and pump testing of selected wells (see Section 2). Leachate from these wells discharges into the Dilution Tank. A new groundwater well, RC8a, was installed to provide dilution water. The ICWs can handle an ammonium level of approximately 200mg/l for short periods but work best when ammonium concentrations do not exceed 100mg/l. Therefore, as much higher concentrations of ammonium are found in the landfill leachate, it requires dilution prior to treatment by the ICW. However, it should be noted that as RC8a is adjacent to the main body of waste, it has an ammonium concentration ranging from 50-150 mg/l. Therefore, prior to treatment, the extracted leachate and the dilution well water are tested for ammonium and levels are set up so that a dilution of ammonium is achieved in the tank. A pump then discharges the diluted leachate to pond 1A (via a rising main).

Leachate from the cut-off drain around the landfill, leachate from the old leachate drains beneath the landfill, leachate from the leachate cut-off drain at the toe of Pond 4 and leachate and washings from the waste transfer station drain, the septic tank and first flush storm system in the civic amenity area are collected in a new pump sump, which is also directed to the ICW for treatment via the dilution tank.

A process diagram below illustrates the leachate system operation. It is divided into three stages, leachate collection, leachate dilution and leachate treatment:



In summary, the partial leachate extraction system was setup as follows:

- Approximately 2 m^3/day total (1 m^3/day each), was extracted from leachate boreholes GW2 and GW6 and discharged to the Dilution Tank (timer based, consistent daily volume)
- the new leachate collector pump sump was float switch based, with variable daily volume
- Dilution water was extracted from groundwater borehole RC8a, intended to dilute water in the tank to less than 100 mg/l ammonium depending on concentration of leachate.

It should be noted that the temporary dilution system was not always adequate to dilute landfill leachate to less than 100 mg/l ammonium. Testing during the initial 6 month period showed ammonium levels in RC8a at an average of 160 mg/l, and therefore ammonium levels in the tank were at 200 mg/l and higher than recommended. However, results post November 2010 showed an improvement in both dilution water and tank ammonium levels. A transfer-to-wetlands concentration of 100 mg/l is recommended, however the relatively small volumes and loadings produced in the partial system were presumed to be easily treated by the ICW.

Sampling and testing was carried out at least twice monthly at ponds 1-5, and as required at the other elements of the leachate collection system for monitoring and adjustment.

The main objective of monitoring was to ensure that the discharge quality from pond 5 was within the proposed emission limits. A second objective was to monitor ammonium levels in each pond in order to analyse treatment efficiency in each pond. In addition, each input was sampled (leachate, dilution water, etc.) and should ammonium concentrations in the tank be found to be over 200 mg/l, then the dilution well is adjusted to add dilution water. In the event that final discharge concentrations were found not to be within required limits, then the outlet pipework at each pond and the final outlet could be adjusted to temporarily stop flows until the cause was ascertained and the system adjusted or rectified. In an exceptional case, the system could be shut down completely and a temporary pump or tanker used to re-circulate diluted leachate until the system was adjusted or rectified.

4.2 TREATMENT EFFICIENCY OF THE ICW

There is no previous experience of the efficiencies for landfill leachate management using the ICW concept. Nevertheless, there is evidence of very successful performance for ICW systems treating and managing farmyard dirty water with very variable concentrations of contaminants and that include the degrees of contamination expected in the leachate. The threshold parameter, ammonia-N concentration, is known to be the factor limiting vegetation growth and this will be managed through dilution of leachate containing high concentrations of ammonia-N.

As the main focus of the ICW is the removal of ammonia-N and the capture of other pollutants, particularly heavy metals, the necessary recycling of the through-flow and the fact that it is an open system that is subject to precipitation, make it difficult to assess the treatment efficiency without testing the system first, hence the decision to extract and treat a smaller volume of leachate initially.

4.2.1 Leachate Collection – Flows & Quality (Ammonium) Prior to Treatment

The leachate pumping and treatment system commenced treating leachate in June 2010, and elements of the current system were gradually commissioned between June & October 2010, when the system was operating fully and consistently. The leachate pumping system flows and wetland pond monitoring results were monitored and tested during the period May 2010 to December 2011 and July 2010 to December 2011, respectively. A full set of results is available in the project files. The results of flow monitoring are summarised as follows:

- **GW2** - pumped 306 m3 from 20/05/2010 to 21/06/2011. It is likely that GW2 had effectively malfunctioned since March 2011, and the flow issues were noted at that time, but the well collapse wasn't confirmed until August. It is estimated that GW2 pumped an average of 1 m3/d to March 2011

- **GW6** – pumped 811 m3 from 14/10/2010 to 14/12/2011, average 1.4 m3/d

- **Leachate Collector Pump Sump** - pumped 5411 m^3 from 21/06/2010 to 14/12/2011, average 9.4 m3/d

- **RC8a dilution water well** - pumped 8888 m^3 from 20/05/2010 to 14/12/2011, average 15.5 m^3/d

- **Dilution tank** - pumped 11514 m^3 from 20/05/2010 to 14/12/2011, an average of 20.1 m3/d.

The total sum of the inputs to the tank was 33% higher than the tank pump flows, and should be approximately equal. There were limitations to the flow monitoring regime installed, and the figures do not need to be very accurate at this relatively modest loading level.

Ammonium concentrations in GW2 vary from 2,500 to almost 4,000 mg/l . At GW6, only one result of 470 mg/l was available.

Initial concentrations at RC8a (dilution water source) were in the 100-300 mg/l range during system setup in June to September 2010, but levels reduced to average 90 mg/l following continual pumping.

Similarly, ammonium concentrations at the leachate collector pump sump ranged from 500-1500 mg/l during system setup in June to September 2010, but reduced to average 110 mg/l thereafter.

Ammonium concentrations in the dilution tank were all above 200 mg/l during system setup from June to September 2010, but the result in November 2010 showed 69 mg/l , much reduced from previous results, and reflecting the lower concentrations in all inputs since steady conditions were reached, with the much improved dilution water concentration assisting matters considerably. There was no further testing after this time.

The estimated average ammonium loading during the period was 7.2 kg/d.

4.2.2 Leachate Treatment – Quality (Ammonium) after Treatment

Figure 4.1 summarises the ammonium concentrations found at the outlet of each of the ponds in the ICW.

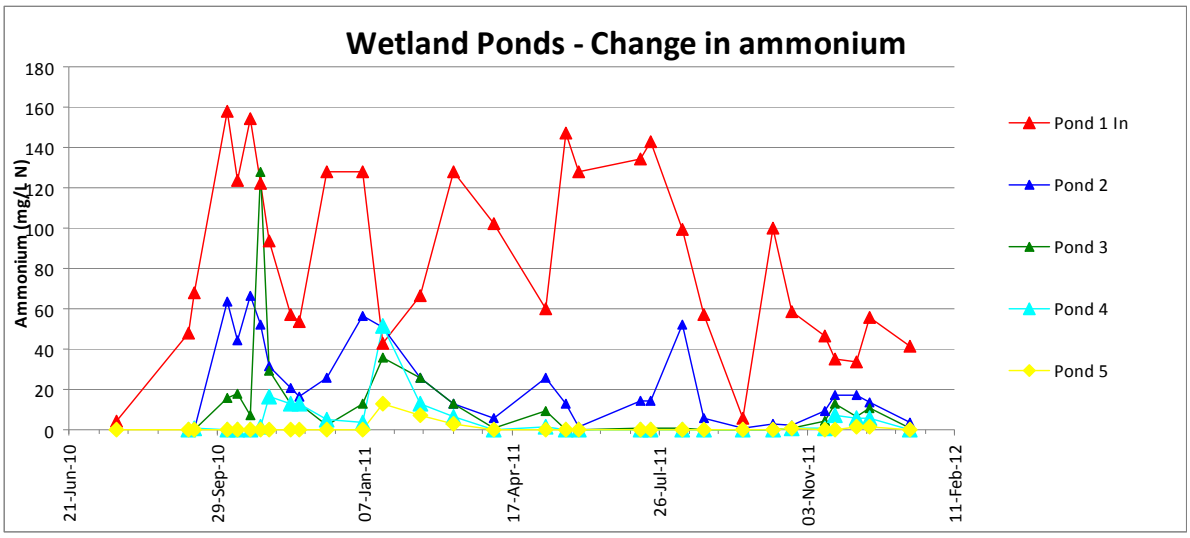


Figure 4.1: Ammonium Concentrations recorded from July 2010 to January 2012 at Ponds 1 -5

As discussed above, the dilution tank pumps diluted leachate into pond 1 at strength of approximately 100 - 200 mg/l. The effect on pond 1 can be seen from the graph above, with ammonium concentrations rising to over 150 mg/l during Sept-Oct 2010, but then falling back to below 100 mg/l as the pumping system flows settled post commissioning.

Pond 2 remained reasonably steady at an average of around 22 mg/l and a maximum of 66 mg/l. Pond 3 has an average of 12 mg/l apart from one spike in October 2010 reaching 128 mg/l. Pond 4 showed initially very low levels of ammonium until late 2010 to early 2011, with a maximum recorded of 51 mg/l at that time, thereafter reducing, and had an overall average of 5 mg/l.

Ammonium results in January and February 2011 were higher than normal due to system problems at the time, caused by tripped and blocked pumps exacerbated by a flow shortcut from pond 1 to pond 5 caused by a blockage and overflow. The latter issue was resolved and is unlikely to re-occur as the outlet MH and flowmeter configuration was changed thereafter

Pond 5, the final pond before discharge from the wetlands treatment system, has an average input of ammonium from the previous ponds of just under 2 mg/l (not shown on graph), and an average outlet concentration of just under 1 mg/l. There were two instances, in January and February 2011 where the results were 12.8 mg/l due to the systems problems described above.

4.2.2.1 Leachate Treatment – Quality (Other Parameters) after Treatment

The following concentrations were recorded at pond 5 outlet

- pH varies from 7.3 to 7.9, well within the proposed range of 6 – 9.
- BOD averages 3 mg/l with a maximum of 18 mg/l, well within the proposed standard of 45 mg/l
- Suspended Solids results are in the range 0-30 mg/l, well within the proposed standard of 50 mg/l

- Orthophosphate (mg/l P) averages 0.014 mg/l with a maximum of 0.13 mg/l, well within the proposed standard of 2 mg/l

In summary, the wetlands treatment system performed well during the proving period, with discharge concentrations lower than the proposed emission limits.

There is also an annual monitoring proposal for additional parameters included in the waste licence review application which will be adhered to.

4.3 POND FLOW MONITORING

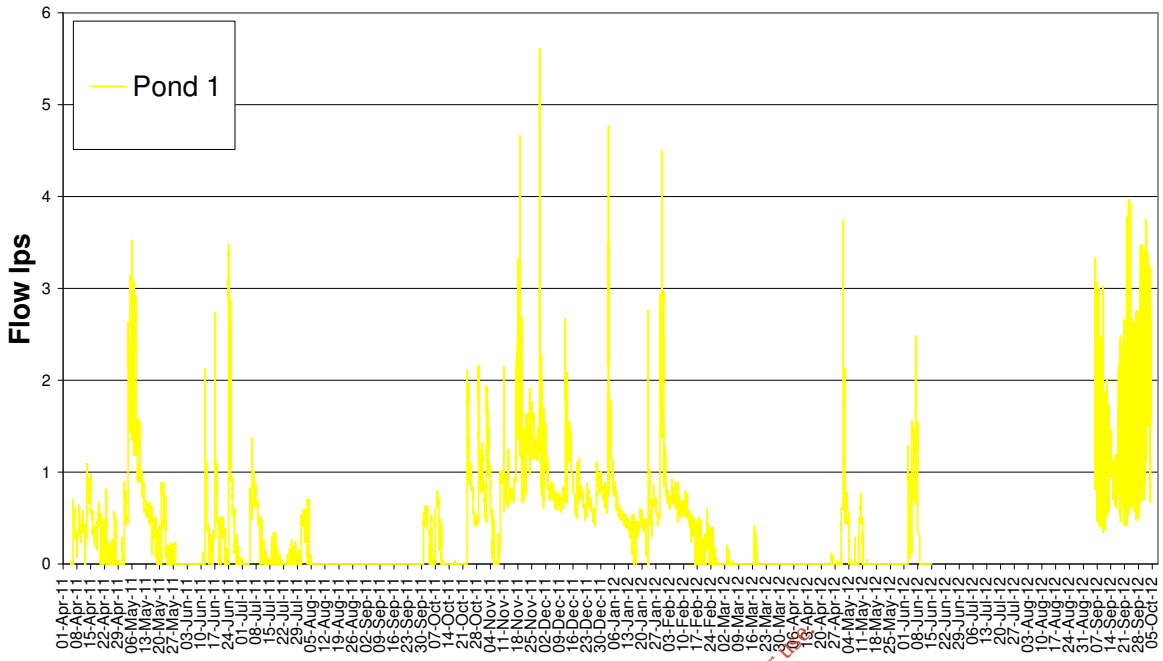
Five (5) No. inter-pond flowmeters were utilised to measure pond flows during 2011-2012. The data availability varies as the commencement time varies and also there were battery problems from April 2012 resulting in some missing data.

The following summarises the results, presenting the June-11 to April-12 period when all flowmeters had full data, and also a note on maximums from all available data (where this differs):

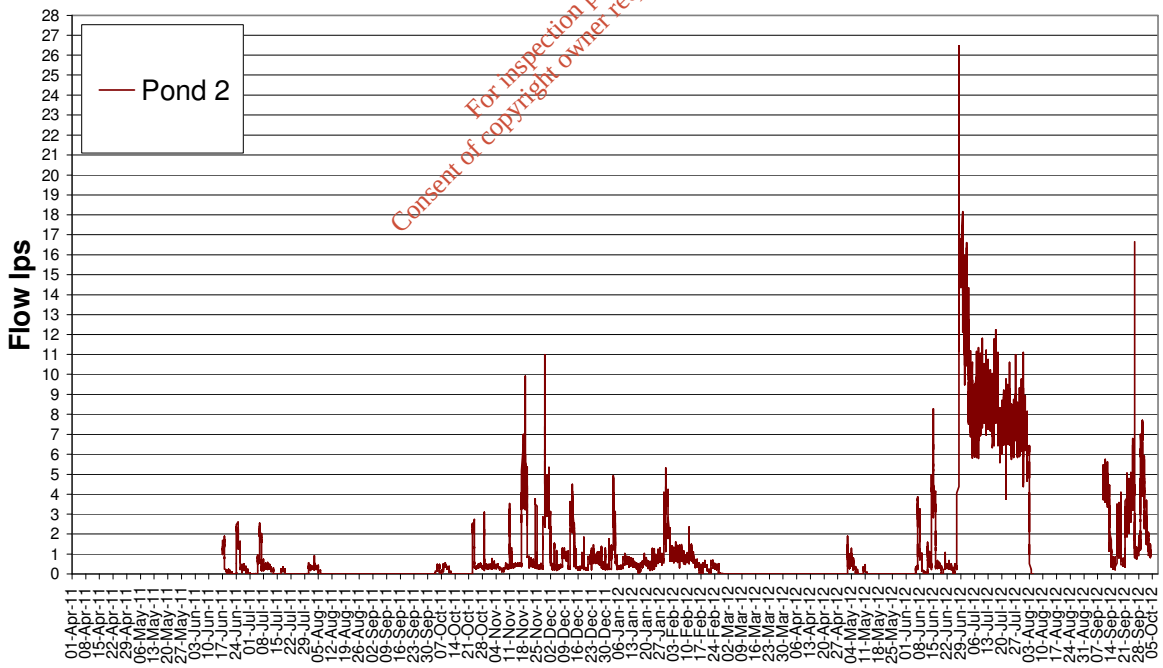
- Pond 1 had an average flow of 1.4 m3/hr, maximum 20.2, minimum 0, median 0.2. The peak flow recorded was 5.6 l/s in Nov-11.
- Pond 2 had an average flow of 1.5 m3/hr, maximum 39.5, minimum 0, median 0.5. The peak flow recorded was 26.5 l/s in June-12.
- Pond 3 had an average flow of 1.8 m3/hr, maximum 28.2, minimum 0, median 0.3. The peak flow recorded was 6.5 l/s in June-11. The level in the pipe and chamber is rising above the top of pipe into the chamber, but since there is no weir, this must be due to the flat nature of the pipe.
- Pond 4 had an average flow of 1.5 m3/hr, maximum 21.7, minimum 0, median 0. The peak flow recorded was 12.4 l/s in Sept-12. The level in the pipe and chamber is rising above the top of pipe into the chamber, and there is a weir in the pipe, however, it appears preferable to retain this weir as it improves low flow characteristics.
- Pond 5 had an average flow of 2.2 m3/hr, maximum 56.5, minimum 0, median 0.6. The peak flow recorded was 15.7 l/s in Nov-11.
- The data shows that pond 1 has a more regular outflow than pond 5 (given the regular input of diluted leachate), and that ponds 2 and 5 have a more flashy nature.
- Note the following on data availability:
    - pond 1: commenced April 2011, no data from Mid Jun-12 to early Sept-12
    - pond 2: commenced June 2011, no data from early Aug-12 to early Sept-12
    - pond 3: commenced June 2011, no data from late May-12 to Oct-12 (not yet re-commenced, awaiting replacement battery)
    - pond 4: commenced April 2011, no data from late Apr-12 to early Sept-12
    - pond 5: commenced April 2011, no data from early Apr-12 onwards (decommissioned, however, June-12 onwards data is available from SCADA flowmeter)

The graphs following illustrate the results from April 2011 to October 2012.

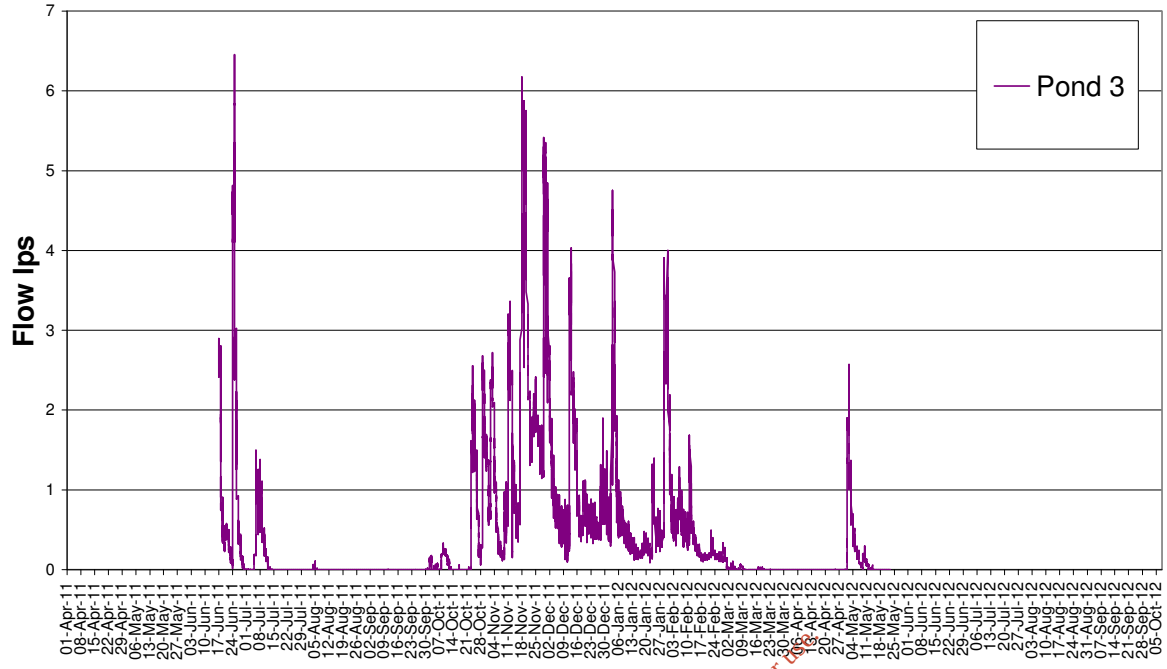
Dungarvan Landfill Pond 1 flowmeter



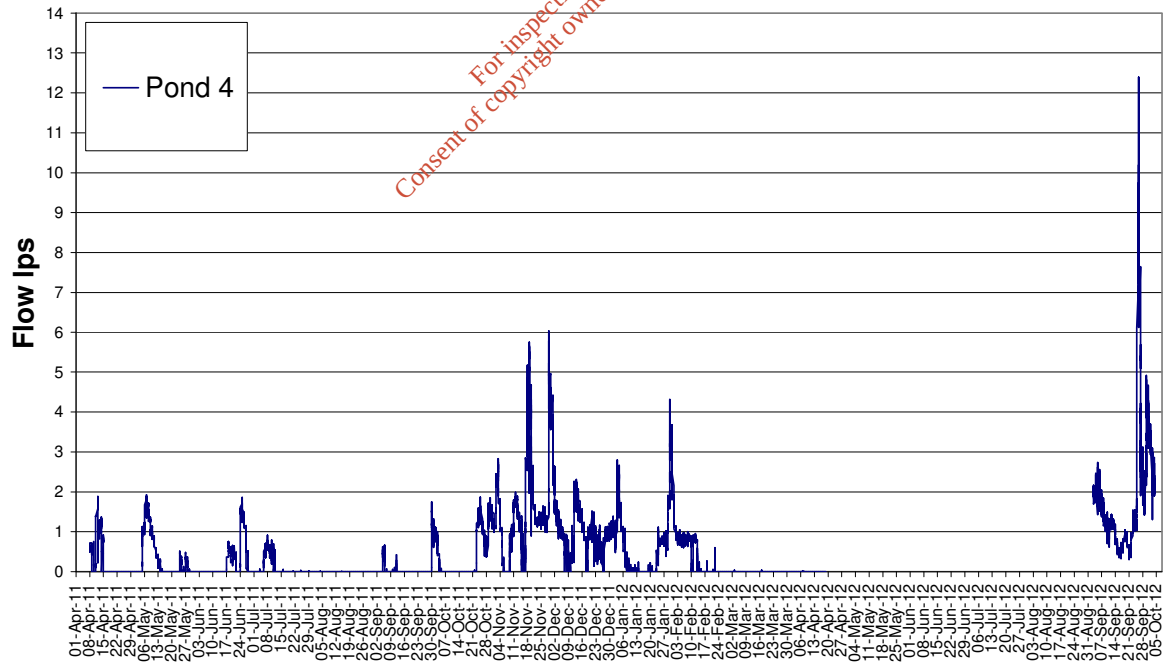
Dungarvan Landfill Pond 2 flowmeter



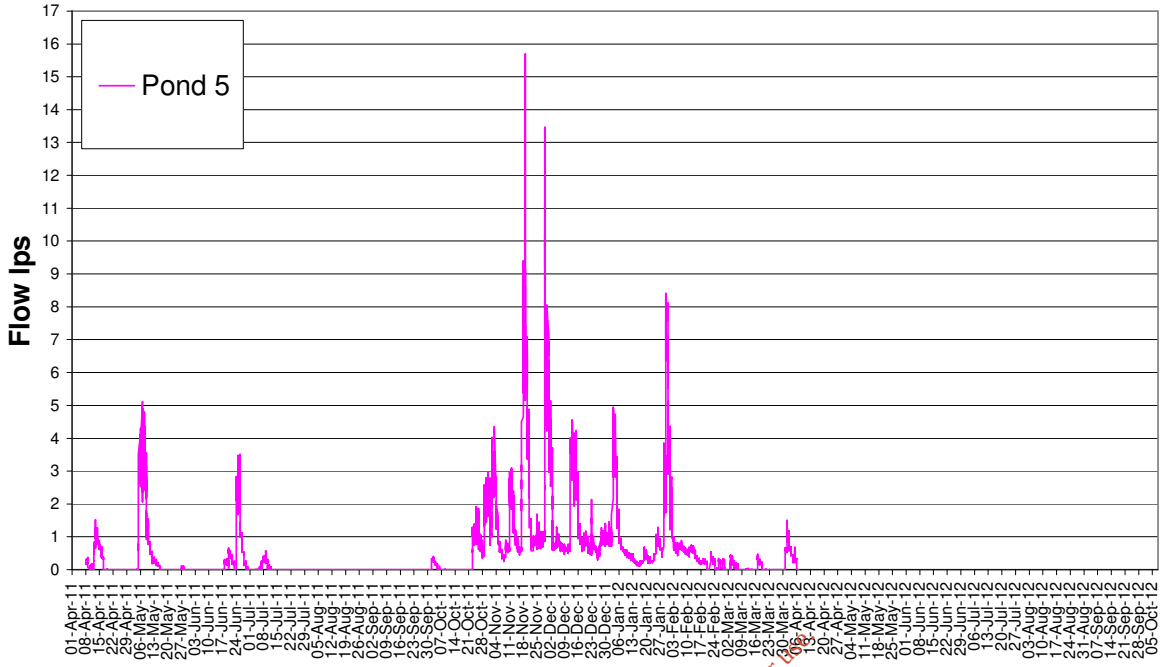
Dungarvan Landfill Pond 3 flowmeter



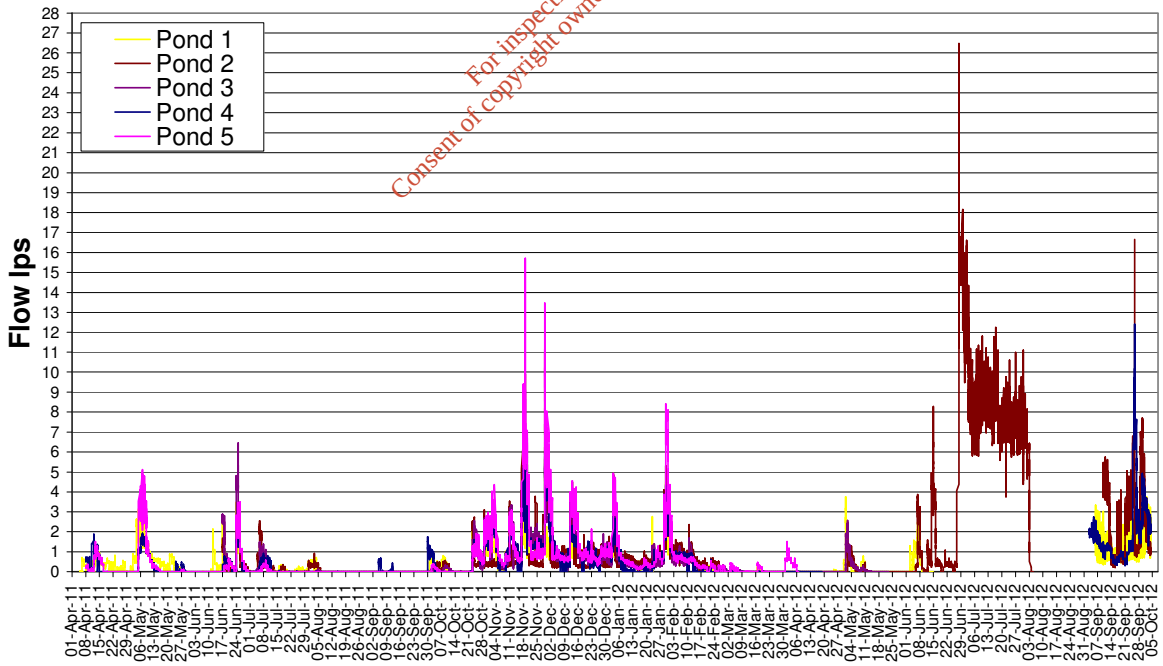
Dungarvan Landfill Pond 4 flowmeter



Dungarvan Landfill Pond 5 flowmeter



Dungarvan Landfill Pond flowmeters



The data available is intended to allow detailed analysis of the response of the ponds to rainfall and leachate inputs over time. Meteorological data (and new onsite weather station data from Oct-12) together with available pumping flows into the wetlands can be combined with pond catchment areas to analyse detailed pond response. This is not carried out in this report; rather, it is to form part of a future analysis.

4.4 DILUTION WATER SOURCE

It was understood during system design that WCC and the EPA considered it preferable to extract dilution water from wells located on the periphery of the site, as a more environmentally sustainable water source than the originally designed river water alternative. A dilution well, RC8A, was installed during the partial abstraction works, and supplies dilution water for this system. This well was yield tested to ascertain its possible suitability for larger scale abstraction of dilution water for the full leachate abstraction system, but was not adequate on its own for this purpose, and was augmented by an additional well.

The second issue arising during the partial abstraction works concerned contamination of the RC8A dilution water source. RC8A exhibited ammonium concentrations averaging 90 mg/l, making it practically impossible to dilute raw leachate down to 100 mg/l ammonium or less. The new clean water well drilled overcame this issue, with further details in following sections.

5 FULL SCALE LEACHATE ABSTRACTION AND TREATMENT SYSTEM - INFRASTRUCTURE & EQUIPMENT, OPERATIONS

5.1 OVERVIEW

This section presents summary details of the infrastructure and equipment for the full scale leachate abstraction and treatment system. Further details on landfill infrastructure can be found in the *Dungarvan Landfill Remediation Works Final Construction Report – December 2012* and drawings.

The following summarily describes the leachate abstraction and treatment system, as shown on Drawing DG0606:

1. 9 no. leachate abstraction boreholes equipped with 2m3/hr pumps
2. a network of leachate collection pipework all discharging to a dilution tank
3. a leachate collector pump sump as described in Section 2, with 1 m3/hr pump
4. groundwater abstraction well RC8A, equipped with 1 m3/hr pump
5. a 'clean water' dilution well, pump capacity 25 m3/hr
6. a dilution tank, nominal capacity 25 m3, effective working volume 20 m3 (maximum, user adjustable), with 2 pumps, capacity 20 m3/hr each, pumping to wetland pond 1A via a 90mm RM
7. six no. wetland ponds (ICW's) in series, pond 1A, 1B, 2, 3, 4, 5, approximately 18,650m^2, with a normal capacity of 3,700m^3 and a maximum capacity of 13,000m^3
8. a recycle sump at pond 5 outlet, nominal capacity 5 m3, effective working volume 3 m3 (maximum, user adjustable), with 2 pumps, capacity 20 m3/hr each, pumping to either wetland pond 1B or the dilution tank via 90mm RM's
9. monitoring equipment: online ammonium sensors at the dilution tank, pond 4 outlet, and pond 5 outlet; pH and conductivity sensors at pond 5 outlet; flow monitoring at tank pumps, dilution well, all pond outlets, and recycle sump pumps, and an flow proportional automatic sampler at pond 5 outlet
10. A motor control centre, PLC, Supervisory Control and Data Acquisition system (SCADA) is provided, with a control hut located near pond 5 outlet, and a SCADA computer in the Civic Amenity building. Remote weblink access and alarm text-out is also provided.

5.2 LEACHATE ABSTRACTION BOREHOLES

The following wells were equipped with pumps and associated requirements for leachate abstraction: GW1, GW2, GW4, GW5, GW6, GW7, GW13, CW1, and CW2.

The bore-log details of each well are provided in the Final Construction Report, December 2012. Each pump has a capacity of 2 m3/hr, and is equipped with a level sensor to control pump operations.

The operation of each pump is controlled using the system HMI, by setting the number of abstraction cycles per day, the pumps to be used in each cycle, and the minutes run per cycle. This allows a volume of leachate abstracted per day to be set and adjusted.

5.3 LEACHATE COLLECTOR DRAIN PUMP SUMP

The leachate collector drain pump sump collects contaminated water from the leachate interceptor drain laid along the northern boundary, leachate from the old leachate drains beneath the landfill, leachate from the leachate cut-off drain at the toe of Pond 4, and leachate and washings from the waste transfer station drain, including those from the septic tank and first flush storm system in the civic amenity area, as shown on Drawing DG0606. The leachate collector drain pump sump operates on a float switch automatically and pumps to the leachate collector pipework and on to the dilution tank.

5.4 GROUNDWATER ABSTRACTION WELL RC8A

RC8A is a 160mm diameter 9m deep groundwater abstraction well that is contaminated from landfill leachate, on average containing 90 mg/l ammonium (and has shown up to 276 mg/l), and other pollutants. Its original purpose was to provide dilution water for the partial system in 2010-2012, but is unsuitable as a dilution source given the ammonium content and requirement to dilute leachate to less than 100 mg/l. It is now operated to abstract polluted groundwater from beneath the landfill and is well located in this regard, being on the edge of the downstream end of the landfill body..

The operation of this pump is controlled using the system HMI, and was initially set to 3 runs for 2 hours, total 6 hours, approximately 9 m3/d. The well can pump up to 36-48 m3/d.

5.5 DILUTION WELL

The dilution well provides clean well water for dilution of leachate in the tank, and is equipped with a 25 m3/hr borehole pump. The operation of the pump is controlled automatically by the dilution logic and marshalled by the level setpoints on the system HMI. It is notable that there is an enable/disable setting on the HMI which controls whether this is the primary source of dilution water (or not). Disabling this will mean that dilution water is drawn from the recycle sump if available and to standard, and if these conditions are not met, dilution water will be drawn from the well irrespective of the disabled setting.

The dilution well is located just west of the dilution tank and is outside the waste body and upstream of groundwater flow which is towards the river. A test well was drilled through 6m of boulder clay and silty clay and 66m of fractured limestone to a total of 72m (based on water ingress observations). The test well was yield tested, and simultaneously the public water supply boreholes at Ballynamuck were monitored to ensure there was no drawdown effect. Having established the yield, the test well was grouted. The final well was drilled to 72m, comprising 6m bentonite lined steel casing, and 66m depth of screen. The final yield test gave 17-18 m3/hr, adequate for leachate system dilution requirements.

5.6 DILUTION TANK

The dilution tank receives all polluted arising from the landfill via leachate collector pipework connected to the tank. Dilution water is automatically pumped into the tank from either the recycle sump or dilution well to dilute the contents of the tank to the required value (operator variable, normally 100 mg/l). Once the required dilution has been achieved, the diluted leachate is pumped to Wetland cell 1A via a transfer pump.

Dilution tank

The specifications of the dilution tank and equipment are as follows:

Size:	Nominally 3415mm diameter, 2900mm high
Relevant levels: tank bottom overflow IL top of tank	 2.75 mOD 5.20 mOD 5.50 mOD
Operational limits: Bottom limit Top limit	2 m 3.10 mOD 5.10 mOD
Operational volume	20 m3 maximum, limits are operator adjustable
Inlet pipework	315mm HDPE, TOP 2.85 mOD (through wall of tank at bottom)
Outlet pipework	90mm HDPE, IL 2.87 mOD (through wall of tank at bottom)
Level control	Ultrasonic level sensor, limits are operator adjustable
Mixing	Submersible mixer operating off tank level sensor, limits are operator adjustable
Monitoring	Online ammonium sensor Flowmeter on outlet RM
Transfer pumps	Two no. dry mounted 25 m3/hr duty/standby
Control Panel	Local control panel as per O&M manual details, summarily with isolators, status and on/off/auto controls for dilution and transfer pumps, flowmeter loggers, hours run

The operation of the pumps is controlled by the level setpoints on the system HMI, and the volume pumped per batch is thereby controlled. An ammonium sensor together with a level sensor at the tank allows this operation to be monitored and controlled. In the event that ammonium concentrations in the tank exceed setpoints, an emergency logic actuates to add dilution water and incrementally lower the tank while continually adding dilution water until the system returns to normal parameters. There is a dilution well enable/disable setting on the HMI which controls whether this is the primary source of dilution water (or not). Disabling this will mean that dilution water is drawn from the recycle sump if available and to standard, and if these conditions are not met, dilution water will be drawn from the well irrespective of the disabled setting.

5.7 WETLAND PONDS

The six wetland ponds, 1A, 1B, 2, 3, 4, and 5 receive diluted leachate from the dilution tank, initially into pond 1A, and the diluted leachate flows sequentially through each of the six ponds by gravity. The inlet at pond 1A consist of a 110mm flat pipe with adjustable T-pieces that allow manual adjustment of the incoming flow and ensure dispersion across the width of the pond to avoid short circuiting and local overload. 160mm pipework connects each pond, and an upturned bend at the outlet of each pond can be adjusted to alter the depth of water in the pond, or to increase storage temporarily.

Flow from the last wetland cell (pond 5) discharges to a recycle sump. The treated leachate is monitored in the sump before recycle or discharge. The control system may be set so that the majority or all treated effluent is recycled as dilution water or back to pond 1B, and thus little or no discharge occurs, or to recycle a minimum and allow discharge, provided the effluent meets standards. Heavy rainfall events will first result in a level rise and retention within the ponds, together with increased recycle flows to pond 1B if so set, and then finally discharges to the leachate lagoon (which is hydraulically connected to the river).

If the treated effluent achieves the discharge limit values, it can be discharged to the river Colligan. If the sample is above the discharge limit values the sample is redirected to the tank or Wetland Cell 1B. In this case, all leachate abstraction is ceased until the outlet sample comes back within standards, and the actuated valve and pond 5 storage maximises retention.

In the event of an emergency whereby the effluent is above standards, and the retention and balancing of the ponds and recycle pumping system is exceeded, there is provision to allow manual adjustment of the pond outlets to further retain effluent, thus bringing into effect significant additional storage volume using the available freeboard.

5.8 RECYCLE SUMP

The recycle sump receives treated effluent from pond 5 and normally pumps back to either the dilution tank (when called by the dilution logic) or else to pond 1B. In the event that effluent exceeds a setpoint standard that is unsuitable for dilution water, pumping is to pond 1B only (this is variable by operator). When inflow exceeds pumping capacity and the level in the sump rises, an actuated valve gradually opens and controls outlet flows until either the level/flow returns to normal parameters, or a high level is reached in the sump, in which case flow discharges through the overflow to the lagoon. In the event that effluent standards exceed allowable setpoints, the actuated valve automatically closes and pumping continues to attempt to retain effluent insofar as possible, with excess flows discharging through the overflow to the lagoon.

The specifications of the sump and equipment are as follows:

Size:	Nominally 1800mm diameter, 2000mm high
Relevant levels: tank bottom overflow IL Pond 5 Outlet top of tank	 8.84 mOD 10.67 mOD minimum, operator adjustable bend to approx maximum of 10.90 mOD 10.66 mOD operator adjustable bend, min -300mm, max +300mm 11.10 mOD
Operational limits: Bottom limit Top limit	1.5 m 9.34 mOD (bottom +500mm) 10.90 mOD (top slab invert level)
Operational volume	3.8 m3 maximum, limits are operator adjustable
Inlet pipework	160mm PVC, IL 9.13 mOD (through wall of tank at bottom) (note that inlet flow is effectively set by level of pond 5 outlet)
Outlet pipework	Bottom outlet: 160mm PVC, IL 8.84 mOD (discharges to actuated valve chamber and onwards to main outlet pipe into lagoon) Overflow outlet: 160mm PVC, 10.67 to 10.90 mOD adjustable (discharges to main outlet pipe into lagoon)
Level control	Ultrasonic level sensor, limits are operator adjustable
Valvework	Valve chamber with automatic valves directing to pond 1B or dilution tank
Monitoring	For chemical monitoring see following sections Flowmeter in chamber on 160mm outlet pipework to lagoon
Recycle pumps	Two no. submersible 20 m3/hr duty/standby
Control Panel	Main control house panel as per O&M manual details, summarily with isolators, status and on/off/auto controls for pumps and valves, flowmeter loggers, hours run, etc.

The operation of the pumps is controlled by the level setpoints on the system HMI. The 'Ammonia High level Stop Pond 5 Outlet' setpoint is normally set to 5 mg/l, well below the proposed discharge standard of 15 mg/l.

5.9 MONITORING

The following monitoring is in effect and logged:

- Online ammonium sensors at the dilution tank, pond 4 outlet, and pond 5 outlet (recycle sump)
- Conductivity and pH at pond 5 outlet
- Flowmeters: online at the dilution well, dilution tank outlet, discharge pipe to lagoon (after pond 5 and recycle sump), recycle pumping to dilution tank or pond 1 B

- Indirect flow measurement via pump run hours is available and logged for: RC8A, leachate collector sump, leachate wells, and condensate pumps 1 and 2

- Hours run is available and logged for all pumps

- All control system events are logged on the SCADA, ranging from normal events such as pump runs, to failures such as pump trips or ammonium warnings

A flow actuated autosampler is setup sampling from the recycle sump and actuated by the outlet flowmeter (and thus only samples actual discharges from the system). This sampler may also be set to timed sampling in which case it will sample at set intervals irrespective of whether discharge or recycle is occurring.

There is no discharge standard proposed for conductivity, rather the more normal SS is specified (50 mg/l). It is proposed to develop a correlation between conductivity and SS over time, and then set a warning on the SCADA system when high conductivity levels indicate a possible SS problem.

Ammonium sensors are calibrated utilising an onsite spectrometer to ensure accurate onsite readings.

5.10 CONTROL SYSTEM, HMI, AND SCADA

A main control house is located near the outlet from pond 5 to the lagoon, and houses the main control panel, PLC, HMI (Human Machine Interface), together with monitoring facilities as referred to in earlier sections. This facility allows control of all aspects of the system, aside from certain tank/dilution local control panel functions.

The main control panel contains the power isolators, allows selection of auto/hand/off for all pumps and equipment, together with visual display of run, trip, hours run, ammeters for pumps, and open/closed status for valves. The tank/dilution local control panel is located at the dilution tank and provides the same controls for the tank and dilution well, including the pumps and mixer.

The HMI allows selection of all control settings and setpoints via an LCD touch screen.

The SCADA computer is located in the CA area main building and allows viewing and adjustment of a significant proportion of the HMI functions as described below. The SCADA computer also allows trending and download of system data. Remote access is available to the SCADA computer by means weblink program ‘logmein’ (with appropriate passwords).

5.10.1 Alarms and text alert set-up

All events, operational and fault/alarms are logged on the system, and can be sent by text if enabled. No text alarms are sent at present until the proving period is well established (to avoid repetitive and snag issue alarms).

Alarms to be activated are:

1. Text for ANY pump trip/fail

2. Text for ammonium sensors failure

3. Text for w/l in dilution tank > HWL

4. Text Pond 4 monitoring ammonium = warning

5. Text Pond 5 monitoring ammonium > setpoint (normally 5 mg/)

6. Power loss

5.11 WEATHER STATION

A 'Davis Vantage Pro 2' weather station is installed adjacent the flare in the CA area, with the data logger and display located in the main CA building. The system measures and logs rainfall, wind-speed, wind direction, temperature, and humidity.

This weather station is not connected to the SCADA system and must be downloaded manually on a regular basis to ensure data security, e.g. once per month.

5.12 CARETAKING AND MAINTENANCE

A caretaking schedule is in effect onsite by the Landfill Manager, and includes a weekly and monthly set of tasks, checks, and records. System maintenance is carried out by the installation contractor (EPS) during their maintenance period (post construction), and thereafter will be continued by contract.

6 PERFORMANCE OF FULL LEACHATE ABSTRACTION-TREATMENT SYSTEM – INITIAL 9 MONTHS

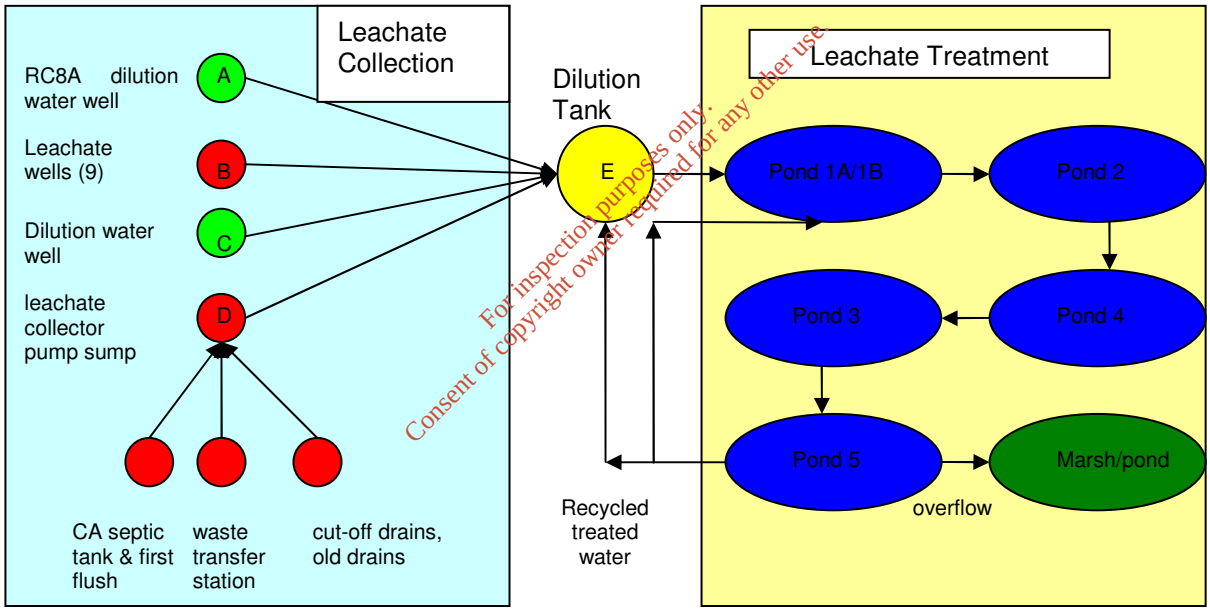
This section presents analysis of the performance of the full leachate abstraction and treatment system for the initial 9 month proving period from September 2012 to June 2012. The system was substantially completed in late June 2012, and the proving period commenced on 24/09/2012.

Treatment process proving commenced on 24/09/2012 albeit still with some snags still affecting the operation and/or monitoring of the system, but nonetheless allowing for ramp-up of loadings to the treatment system and monitoring thereof. All significant snags were completed by mid-October.

6.1 PROCESS DESCRIPTION

The leachate abstraction and treatment system at Dungarvan landfill is shown in the process diagram below, comprising 9 No. leachate abstraction wells, and the ICW's (wetlands).

The process can be divided into three stages, leachate collection, leachate dilution and leachate treatment:



6.2 TREATMENT EFFICIENCY OF THE ICW

The main objective of monitoring was to ensure that the discharge quality from pond 5 was within the proposed emission limits and therefore that the treatment system was performing as intended.

As discussed in the section on the partial system, the threshold parameter, ammonia-N concentration, is known to be the factor limiting vegetation growth and this will be managed through dilution of leachate containing high concentrations of ammonia-N. The main focus of the ICW is the removal of ammonia-N and the capture of other pollutants, particularly heavy metals.

The wetlands are designed to accept up to 186 m3/d of diluted leachate at 100 mg/l NH_4. The estimated leachate and polluted arising loadings are 11 kg/d ammonium (average) and 18.6 kg/d maximum.

The system is currently setup to dilute leachate to 100 mg/l ammonium or less before transfer to wetlands pond 1, and it is expected to treat this diluted leachate to better than 5 mg/l at the outlet of pond 5 (the proposed standard is 15 mg/l). There are also ortho-P, BOD, and SS standards as discussed following.

6.2.1 Leachate Collection – Flows & Quality (Ammonium) Prior to Treatment

The following loadings were in effect during the period from 24th September 2012 to June 2013.

1. leachate: initially set at 1 m3/d on 24th September, ramped up to 3 m3/d on 18th October, and to 5 m3/d on the 3rd of December. However, looking at the meter readings from the pumps, an estimated 2.7 m3/d was actually pumped, as the pumps only operate when there is a certain minimum head of leachate. The current setting gives an estimated 4 to 7 kg/d of ammonium, and is below the anticipated medium to long term leachate abstraction volume, but is of course subject to change according to conditions.

2. leachate collector pump sump: operating at an average of 26 m3/d, with an estimated strength of 105 mg/l, and a loading of 2.7 kg/d ammonium

3. well RC8A – set to 8 runs for 1 hour, total 8 hours, approximately 12 m3/d, a loading of 1.1 kg/d ammonium

There is no facile method to accurately measure raw leachate abstraction volumes and strength due to the nature of the system, however the above estimates are based on pump run times and historical leachate concentration measurements. Thus the current total loading is estimated at 8 to 10 kg/d, using this method. As a check, the volume transferred from the dilution tank to pond 1 was on average 71 m3/d, at 99 mg/l, which is 7 kg/d, lower than the estimated medium to long term average loading, 38% of the estimated maximum capacity, and similar to the 7 kg/d loading during the partial leachate system operation in 2010-12.

6.2.2 Leachate Treatment – Quality (Ammonium) after Treatment

Figure 6.1 summarises the ammonium concentrations found at the outlet of pond 5.

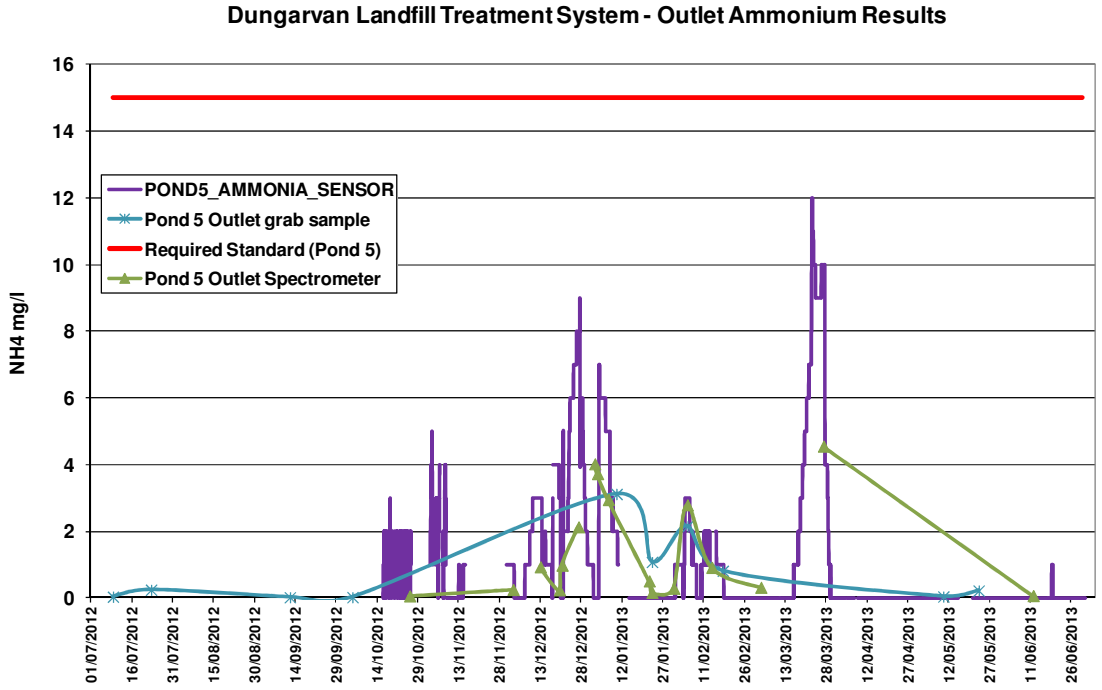


Figure 6.1: Ammonium Concentrations recorded from July 2012 to June 2013 at Pond 5

As discussed above, the dilution tank pumped diluted leachate into pond 1 at an average strength of 99 mg/l.

The graph above shows pond 5 grab sample results for the period from July 2012 to June 2013 and online ammonium sensor readings and onsite spectrometer tests from mid-October onwards (when these were functioning correctly). The proposed standard is 15 mg/l ammonium.

Pond 5, the final pond before discharge from the wetlands treatment system, had an average outlet concentration of 1.2 mg/l, and a maximum recorded of 12 mg/l, from the online sensor. There were 7 grab samples analysed in the period, all below5 mg/l. There were 16 spectrometer tests during the period, again all of these were below 5 mg/l.

The above results are similar to those during the partial leachate system in 2010-12, with an average ammonium concentration of less than 1 mg/l at pond 5.

Grab sample type monitoring is the designated method for testing the system adherence to standards, and as such the system is compliant for all samples. The spectrometer is designed to allow onsite calibration of the online ammonium sensors, and provides a frequent validation of outlet ammonium concentrations. The online ammonium sensors should not be used to determine adherence to standards, as these sensors are for process control purposes only, and are subject to drift and correction.

6.2.2.1 Leachate Treatment – Quality (Other Parameters) after Treatment

The following concentrations were recorded at pond 5 outlet:

- pH varies from 5.7 to 7.9, within the proposed range of 5 – 9

- Only one BOD result was available in the period; 3 mg/l, well within the proposed standard of 45 mg/l

- Suspended Solids results are all at 1 mg/l or less, except one result at 45 mg/l. It is assumed that this was a sampling/testing issue, as no other parameters were elevated, and no issues evident onsite at the time. The proposed standard is 50 mg/l.

- Orthophosphate (mg/l P) averages 0.02 mg/l with a maximum of 0.04 mg/l, well within the proposed standard of 2 mg/l

In summary, the wetlands treatment system performed well during the proving period, with discharge concentrations well within the proposed emission limits.

There is also an annual monitoring proposal for additional parameters included in the waste licence review application which will be adhered to.

6.2.3 System flows

Flows are measured online at the dilution well, dilution tank outlet, discharge pipe to lagoon (after pond 5 and recycle sump), recycle pumping to dilution tank or pond 1B, and inter-pond flows. Full data is available in the project files and SCADA system, and this section concentrates on outlet (discharge) flows since full system commencement in September 2012.

Pond 5 outlet flows are influenced by the pond outlet pipe and recycle sump, including the recycle pump settings and actuated valve. The recycle settings were varied during the period, initially set to recycle as much as possible (up to 480 m3/d), and then gradually reduced as the system treatment results proved acceptable, and currently set at 20 m3/d (i.e. minimal recycle to pond 1B, used primarily as a dilution water source to tank). The average recycle flow during the period was 86.5 m3/d.

Pond 5 had an average flow of 70 m3/d, a maximum of 99 **m3/hr**, and a minimum of 0.

This compares to the partial leachate system during 2010-12 which showed an average flow of 53 m3/d, maximum 56.5 m3/hr, and a minimum of 0.

6.3 CONCLUSION

The full leachate abstraction and treatment system has been operational from late September 2012 to date, a period of 9 months. The current total loading is 7 kg/d ammonium, which is somewhat under the estimated medium to long term average loading of 11 kg/d, and 38% of the estimated maximum capacity. There was a degree of ramp-up of loadings in the period, and thus the medium to long term loadings may increase.

The system has been performing well, with an average outlet concentration of 1.2 mg/l for the key parameter ammonium, and a maximum recorded of 4.6 mg/l from the grab samples. The other monitoring parameters, BOD, SS, pH, and Ortho-P are all well within standards, both on average and maximum.

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APPENDIX A DRAWING LIST

List of Drawings

Drawing No.	Title	Status / comments
MDR0350 FG001 R02	Leachate Extraction and Treatment System – Partial System 2010-2012	Final
MDR0350 FG002 R01	Leachate Extraction and Treatment System – Summary	Final
MDR0350 FG0010 F01	Leachate Head Years 2008-2011	Final
MDR0350 DG0706 R01	Leachate Abstraction and Treatment System	Final

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Cork
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Fax +353 21 4290360

Atkins House
150-155 Airside Business Park
Swords, Co Dublin
Telephone +353 1 890 9000
Fax +353 1 890 9001

2nd Floor
Technology House
Parkmore Technology Park
Galway
Telephone +353 91 786050
Fax +353 91 779830

www.atkinsireland.ie
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APPENDIX 2

REVISED NON TECHNICAL SUMMARY

Attachment A.1 – Non-Technical Summary

A.1.1 Background & Nature of the Facility

Dungarvan Landfill is located in Ballynamuck Middle Co. Waterford approximately 2km north west of Dungarvan, off the N25 road on the Southern Bank of the Colligan River. The landfill site is located on a meander of the Colligan River, immediately to the west of Ballyneety Bridge. Adjacent to the site the Colligan River becomes tidal, with an extensive area of mudflats located further to the east of Ballyneety Bridge extending into Dungarvan Harbour. Dungarvan Harbour itself is designated as a Special Protection area (SPA) which extends from Helvic Head to Ballyneety Bridge. A National Heritage Area (NHA) covers most of the bay and touches the western boundary of the landfill site.

The topography of the area is a gentle south facing slope and is bounded by a low ridge running east-west to the north of the Waterford-Cappoquin Road. The general character of the landscape is one of good quality agriculture with a relatively high level of visual amenity. Land use in the vicinity of the site is primarily agricultural pastureland with some isolated patches of cropland. There is urbanisation in the form of ribbon development on the county roads around the site. There is also an "angler's path" running along the boundary of the site adjacent to the river on which there is a public right of way.

The site contains the following:

- A closed landfill
- A green waste composting area
- A Waste Transfer Station
- A Civic Amenity Area

Landfill

The site itself consists of a landfill that has ceased accepting waste since 2003. The landfill covers an area of approximately 6.5 hectares. It is thought that filling on the site commenced in the late 1960's. Ownership of the landfill was passed to Waterford County Council in 1985. The landfill is an unlined landfill i.e. it does not contain any engineered liner material underneath the waste. It does however contain a thick layer of low permeable clay which would prevent a significant amount of leachate ingression into the groundwater.

The landfill site has recently been capped completely and now progresses to non-clean closure status as defined in the Agency's ELRA, Residuals Management and Financial Provision Guidance Document. In accordance with Waste Licence W32-02 and in accordance with the Closure, Restoration and Aftercare Management Plan (CRAMP) issued to the Agency, it is intended to develop a series of Integrated Constructed Wetlands (ICW) at the site to treat the leachate and provide a public local amenity area.

While the primary objective of the constructed wetlands is for leachate treatment, the development and conservation of wildlife habitats is compatible as an afteruse. The layout, structure and composition of the wetlands will be entirely compatible with the surrounding ecology and will greatly increase the restored landfill's visual and wildlife amenity. Wetlands are important as habitats for invertebrates, marginal and aquatic vegetation, amphibians, fish and a range of breeding and wintering wildfowl as an area for nesting and feeding. The restored site will play an important role as a wildlife corridor in the area.

Capping works were completed in mid 2008. The final capping system generally comprises of a gas collection layer, LLDPE liner, drainage layer, subsoil layer and topsoil layer as follows:

- 150-300mm layer of topsoil; underlain by
- Subsoil such that thickness of topsoil and subsoil is at least 1m thick; underlain by
- A surface water geocomposite layer; underlain by
- 1mm LLDPE liner (a low permeability geomembrane material).
- Geocomposite gas collection layer.

The capping layers will provide protection from the ingress of rain into the site and thus minimise leachate generation. In addition to the capping detail as required by the licence it is proposed that wetland ponds be constructed for the purpose of treating leachate. The drainage geocomposite layer is placed on the side slopes only as the constructed wetlands will effectively control surface water drainage; in addition the depth of subsoil/topsoil will be decreased from 1m to 0.3m in areas where the ponds are located. Approximately 5,500m^2 of the side slopes on the Southern side of Dungarvan landfill were capped in 2002 using a GCL as the low permeability layer. Geogrid was also placed on the side slopes as required for slope stability. The drainage geocomposite layer is placed on the side slopes only as the constructed wetlands effectively control surface water drainage on the flat areas. Leachate extraction wells are located strategically across the site in order to maximise collection efficiency. Furthermore, rainwater will assist in the dilution of leachate within the constructed wetlands. The surface water drainage from the side slopes will run-off towards the surface water carrier drain, which runs along the northern boundary.

The landfill gases generated within the landfill body itself will be collected by the landfill gas management system and flared off.

Green Waste Composting Area

Waterford County Council ceased the acceptance of source segregated organic waste at the composting facility in 2007 due to odour concerns. In early 2008, the two enclosed in-vessel composting units were decommissioned and removed from site as they were no longer required.

Currently the composting area on site only accepts green waste in the form of bushes, trees, grass etc. A mobile shredder is brought onto site once a month at a minimum or whenever a sufficient amount of green waste is to be shredded.. Following shredding, the material is placed in a curing bunker where it is allowed to decompose with the aid of aeration slots and a biofilter.

Waste Transfer Station

The waste transfer station is licensed to accept 10,000 tonnes per annum. The building is 10m x 35m in size and is fully enclosed. An air handling unit of three overhead pipes is connected to three extractor fans to ventilate the building.

All waste accepted is unloaded within the transfer building itself. All waste remains in the building for a maximum of 48 hours prior to being loaded and transported to either Powerstown Landfill in County Carlow or the composting facilities at Veolia in Waterford City or Milltown Composting, Fethard, Co. Tipperary. The facility is washed down and cleaned after compostable material is transferred. This is collected on a three week cycle together with municipal waste and dry recyclables.

Civic Amenity Area

The civic amenity area is open to the public and subject to a pricing structure depending on the amount of waste or type of vehicle or size of trailer. The facility accepts waste from 9.000am to 17.00pm Monday to Friday and 9.00am to 1.00pm on Saturday. All waste coming into the civic amenity area is inspected by staff prior to disposal. The civic amenity area accepts the following waste;

- Glass
- Paper & Cardboard
- Newspapers/magazines

- Plastics
- Garden Waste
- Construction & Demolition waste
- Wood
- Waste cooking oils
- Batteries
- Oil Filters
- Waste paint
- Mixed residual waste
- Bulky waste (furniture, mattresses etc.)
- WEEE
- Mixed dry recyclables including tetra-pak
- Textiles
- Scrap metal
- Aluminium & tin cans

A.1.2 Classes of Activities

Dungarvan Landfill is currently licensed to carry out activities under Classes 4 and 13 in accordance with the Third Schedule of the Waste Management Acts 1996 to 2003(equivalent to Classes 4 and 15 of the Third Schedule of the Waste Management as amended).

Under the waste license review (W0032-03) Waterford County Council are applying to carry out activities under the following classes in accordance with the Third Schedule of the Waste Management Acts 1996, as amended::

- Class D4. Surface impoundment, (e.g. placement of liquid or sludgy discards into pits, ponds or lagoons etc.)
- Class D13. Blending or mixture prior to any of the operations numbered D1 to D12 (if there is no other D code appropriate, this can include preliminary operations prior to disposal including pre-processing such as, amongst others, sorting, crushing, compacting, pelletising, drying, shredding, conditioning or separating prior to submission to any of the operations numbered D1 to D12).
- Class D15. Storage pending any of the operations numbered D1 to D14 (excluding temporary storage (being preliminary storage according to the definition of 'collection' in section 5(1)), pending collection, on the site where the waste is produced).

Class D4 activities relate to the storage of leachate within the six wetland ponds that are currently being constructed as part of the capping works.

Class D13 activities relate to the mixture of water with the abstracted leachate. This is necessary to dilute the leachate before it is pumped into the wetland system.

Class D15 relates to the storage of waste in the waste transfer station prior to this waste being transferred to either composting facilities for recovery or Powerstown Landfill for disposal.

Dungarvan Landfill is currently licensed to carry out activities under Classes R1, R3, R4, R5, R11 and R13 in accordance with the Fourth Schedule of the Waste Management Acts 1996, as amended.

Under this waste license review Waterford County Council are applying to continue carrying out activities under the above classes as per Waste License W0032-02.

The principal activity at the site is Class D15 of the Third Schedule as detailed above.

A.1.3 Quantity and Nature of Waste Handled

The main types of waste handled at the facility are household (mixed residual waste and mixed dry recyclables), green waste and construction & demolition waste and commercial waste. The quantities and nature of waste that the facility is currently licensed to accept are shown in the table below.

WASTE TYPE	TONNES PER ANNUM
Municipal Waste	10,000
Hazardous Municipal Waste (including WEEE)	400
Inert C & D	20,000 over the lifetime of the facility
Garden Waste	1,120
Total	**11,520**

A.1.3 Raw and Ancillary Materials

The main raw material used on site is water for cleaning the hard standing areas namely the civic amenity area, the composting area and the waste transfer station. Diesel is used to run the shredder however this is not permanently on site. Electricity is used in the site lighting, weighbridge, and in the office and garage buildings.

A.1.4 Site Operating Procedures

Waste is delivered to the site mainly by Waterford County Council (WCC) and Dungarvan Urban District Council refuse collection trucks. This waste is domestic household waste. All trucks must pass over the weighbridge prior to admission to the waste transfer station where it is unloaded within the building itself. This mitigates odour, noise and dust emissions to the atmosphere. The waste is then inspected and is transported off site to either composting facilities for recovery or Powerstown landfill in County Carlow for disposal within 48 hours.

All waste accepted by the compost area (green waste only) and civic amenity area is inspected prior to admission. In the past the facility accepted source segregated organic waste and to facilitate the composting of this material, two enclosed in-vessel units were commissioned to allow a 14 day maturation period. As the facility ceased accepting source segregated organic waste for composting, the two in-vessel units were decommissioned and removed from site in 2008. Every month or sooner as required, a mobile shredder is brought to site to shred the green waste into chips. This is then transferred to one of the concrete curing bunkers of that contain aeration slots and biofilters that facilitate decomposition and odour control. The civic amenity area is open to the public free of charge. Waste is inspected by staff prior to admission and if the material is accepted, the public are directed to the required container(s).

A.1.6 Nature & Impacts of Emissions at the facility

Emissions to Air

The potential emissions to air that arise from the operation of the facility are noise, dust and odour. The majority of these emissions result from waste coming into and leaving the transfer station. These emissions are mitigated by ensuring that all incoming waste is unloaded within the building itself thus reducing the emissions to the atmosphere. In addition, all biodegradable waste coming into the facility is removed within 48 hours.

Dust levels at the facility established during monitoring undertaken indicate that dust generation at the facility are significantly below the EPA recommended level of 350mg/m^2/day.

The main source of odour nuisance is potentially generated from the composting area. Because the compost area no longer accepts kitchen waste, odour nuisance is minimal.

Emissions to Groundwater

As mentioned previously, the landfill body itself is unlined resulting in the threat of leachate ingression into the groundwater. Although this is a potential issue, a thick layer of low permeability clay exists underneath the landfill which reduces the potential for leachate migration. In addition to this the fully engineered landfill cap that is being constructed in accordance with Waste Licence 032-2 will prevent the ingression of moisture into the waste body of the landfill, thus mitigating against future leachate generation. Because the landfill is now closed and recently capped, the amount of leachate generated on an annual basis will deplete over time.

Emissions to Surface Water

Surface water generated from the slopes of the landfill will be collected via a series of stone filled carrier drains that will discharge into the River Colligan.

Surface water from the civic amenity area is collected and passed through a petrol interceptor before being discharged to the Colligan River.

Wastewater from the composting area and the waste transfer station will be directed to the leachate treatment system.

Noise Emissions

The primary source of noise emissions coming from the facility relate to activities concerning the waste transfer station. These emissions are minimised by carrying out all loading and unloading of vehicles within the main building. Another source of noise emissions would be the auger that shreds the green waste, however due to the fact that this runs approximately once a month, it is perceived that this is not an issue.

A.1.7 Provision of Information related to Section 40(4) of the Waste Management Act

Compliance with Emission Standards

Waterford County Council will operate the facility so as to comply with all emission standards and limits set out by the Environmental Protection Agency in the Waste Licence.

Avoidance of Environmental Pollution

The facility is designed and operated to ensure that the operation of the facility will not cause environmental pollution; some of the design features and operational practices that ensure this are outlined below:

Avoidance of Emissions to Air

- All waste related to the waste transfer station is transferred in enclosed or covered vehicles.
- All waste-handling is restricted to inside the waste transfer station.
- All waste disposed of at the waste transfer station is removed off site within 48 hours of delivery.
- Water-spraying of hardstanding areas is carried out in periods of dry weather.
- Only green waste is accepted at the compost area.

Avoidance of Emissions to Water

- The civic amenity area, the waste transfer station and the compost area are paved allowing collection of all surface water generated.
- All surface water from the civic amenity area is passed through a petrol/oil interceptor before being discharged to the Colligan River.
- Wastewater from the composting area and waste transfer station will be directed to the leachate treatment system.

Avoidance of Other Environmental Nuisances

- The site is cleaned regularly to prevent wind blown litter.
- Municipal waste collected by WCC is stored within the main waste building and is not exposed.
- A vermin control plan was developed by a pest-control specialist and is being implemented and the site is regularly inspected.
- Regular monitoring of agreed parameters as set out in the existing Waste Licence will ensure that environmental controls are monitored for performance.

Best Available Technology (BAT)

Waterford County Council adheres to BAT principles to avoid any environmental pollution and prevent and mitigate any nuisance emissions from the facility.

Fit and Proper Person

Mr. David Regan has responsibility for the day to day operations at the site. Mr. Regan has completed the course and obtained the FAS Waste Management Certificate.

No employee of the applicant, Waterford County Council, has been convicted of an offence under the Waste Management Act 1996.

Technical Competence & Site Management

Waterford County Council is required as a Local Authority to follow instructions set out by the EPA and has extensive experience in waste management. Waterford County Council has also extensive experience and in operating licensed facilities and will operate the facility in strict accordance with the Waste Licence. The table and organisational chart in Attachment
C.1 sets out the staff structure for the management of the facility.

Financial Provision

Waterford County Council, as a Local Authority, are fully aware of their responsibilities to make financial provision in respect to the operation of a waste recovery facility as set out in Section 53 of the Act.

A.1.8 Monitoring and Sampling Arrangements

It is proposed to continue the monitoring programme as set out by the EPA for the facility in the previous Waste Licence W32-02. In addition it is proposed to carry out monthly dust monitoring at monitoring locations B1-B4 and D2, D2A, D3 and D4. It is also proposed to conduct monthly odour monitoring at locations OM1 – OM2 and daily odour inspections at locations Oi1 – Oi4.

It is proposed that monitoring at such locations will allow emissions generated from the landfill, civic amenity area, composting area and waste transfer facility to be detected.

Monitoring locations are specified on drawing number MDR0350DG0505 (Rev F02).

A.1.9 Off-site Treatment of Waste

All outgoing waste from the Waste Transfer Station is sent to either composting facilities or Powerstown Landfill in County Carlow (Waste Licence W0025-02). All waste from the civic amenity area is sent to appropriate waste recovery facilities. Mixed dry recyclables are sent to the Materials Recovery Facility at Shandon, Dungarvan which is nearby and is also owned by the Applicant. All vehicles involved in the transportation of these wastes are fully enclosed and are in possession of the appropriate collection permits.

It is not proposed to treat any liquid waste, i.e. leachate from the landfill off-site.

A.1.10 Emergency Procedures

A set of emergency procedures have been developed for the facility to implement appropriate measures to prevent environmental pollution in the event of any emergency situation. Under these emergency procedures specific staff members have designated responsibilities. Events that would constitute and emergency would include:

- Spills
- General fire/Explosion
- Internal/External Flooding
- Malicious Damage
- Other Unforeseen Emergencies

A.1.11 Closure, Restoration & Aftercare of the Site

It is envisaged that the site (with the exception of the landfill) will operate in the long-term. A Closure, Restoration and Aftercare Management Plan (CRAMP) has been submitted to the Agency and was drawn up in accordance with Waste Licence W0032-02. The facility will continue to be monitored in the aftercare period until it is fully decommissioned and until there is no potential for emissions to the environment