Glaslough – Castle Leslie
Integrated Constructed Wetland

Introduction

Glaslough is a historic village located some 10 km NE of Monaghan town and has developed around the renowned Castle Leslie and the picturesque Glaslough Lake. This paper describes the background, construction and early operation of the Glaslough – Castle Leslie Pilot Integrated Constructed Wetland (ICW), which has been constructed to treat domestic sewage effluent from the village of Glaslough. This project is part of a unique initiative by the Department of Environment Heritage and Local Government (DEHLG) in treating liquid waste streams in shallow vegetated ponds. It is a co-operative undertaking by Monaghan County Council (MCC), Castle Leslie Estate, DEHLG, and the University of Edinburgh.

Background

The sewerage collection system serving the village of Glaslough is combined and up to 2001 delivered flows to a small treatment works (dating back to the 1940's) consisting of primary settlement tanks, a single pass biological filter and a humus tank. Effluent discharged to a nearby stream, a tributary of the Mountain Water River. By the 1990s the plant was heavily overloaded and a manifestly poor quality of effluent was being produced, leading to prosecution of MCC by the Eastern Regional Fisheries Board (ERFB).

In 2001 the sewerage system was extended and a temporary package plant supplied by FM Environmental was installed with the treated effluent now discharging directly to the Mountain Water River. By early 2003 the FM plant was in turn 'experiencing difficulties' leading to further written complaints from the ERFB.

In the meantime Consulting Engineers, Nicholas O'Dwyer & Partners (NOD), had prepared a Preliminary Report for the construction of a traditional plant with a design capacity of 350 population equivalent (pe) and a final effluent standard of 20/30 (BOD/SS). The preliminary estimated cost (in October 1989) was IR£205,000. By January 2002 the design capacity had been revised upwards to 650pe and the cost estimate had risen to €950,000. (Applying construction cost inflation this equates to an estimated 2007/2008 cost of €1,530,000 for a traditional plant of 650pe capacity).

Integrated Constructed Wetlands (ICWs)

In May 2003 Dr Rory Harrington of the Heritage Service of the DEHLG and Paul Carroll of Waterford County Council gave a presentation in Monaghan on the use of ICWs in the Anne Valley in Waterford. By allowing liquid waste streams (from a variety of sources) to flow sequentially through a number of vegetated ponds, ICWs (through a combination of physical, chemical and biological processes) have the capacity to produce a high quality effluent. In the Anne Valley, during the 1990s a

number of on-farm ICWs had been constructed to treat farmyard dirty water. An ICW had also been constructed to treat domestic effluent from the village of Dunhill. Prior to 1990 the water in the Annestown Stream was of very poor quality with little or no fish life.
It is hardly a coincidence that sea trout returned to the Annestown stream after an absence of many years.
Nearby in Kimeaden a large ICW was successfully treating liquid waste from the Kilmeaden food plant.

In August 2003 Mark Johnston (SEE, MCC) and the author accompanied Samantha (Sammy) Leslie on a field trip to the Anne Valley, hosted by Dr Harrington. As a landowner/developer the support of Sammy Leslie was essential. She was enthusiastic about the ICW concept from the outset and on her return she contacted the Sunday Times - resulting in an article by Scott Millar, in support of ICWs, being published on 31st August 2003. Sammy subsequently played a vital role in convincing the Trustees of Castle Leslie to approve a land lease and allow the ICW to be constructed within the Estate Walls.

Design, Land Lease and Planning

From 2004 onwards Dr Harrington frequently made the long trip from Waterford to Monaghan. The proposed site located within the estate walls, on the banks of the Mountain Water River and surrounded by woodland, demanded sensitive development in terms of landscape fit, biodiversity, amenity and habitat enhancement. With input from Mark Johnston and the author a design and pond layout emerged. The design capacity was 1750pe. (The current loading is approximately 700pe). This allowed a 'footprint' map to be drawn up and negotiations to commence on a 99year lease of the 6.74 hectares (ha) of land required. (The water surface of the constructed ponds measures 3.25 ha.) The lease agreement included the provision of equestrian riding trails on the banks of the wetland ponds.

Site investigation works were carried out by IGSL in September 2005.

GSI Ground Vulnerability Maps prepared by the Geological Survey of Ireland (GSI) indicate that the site is located in an area of low vulnerability to groundwater contamination.

A (Part 8) Planning Application was submitted on 8th July 2005 and Planning Permission was granted on 5th September 2005 (Planning Ref 05/8008)

A land lease agreement was signed with the Trustees in September 2006 - at an up-front cost of €233,000 (incl. legal fees) and a nominal annual fee thereafter.

6 No piezometers were installed (by hydraulic excavator) to allow groundwater around and under the wetland system to be monitored.

Tender drawings and documents were prepared (by Mark Johnston) and advertised in the National Press and e-tenders website on 29th September 2005. The tender documents were not comprehensive in that the extent of the riding trails to be

provided was still under negotiation with Castle Leslie. Likewise requirements for sampling and monitoring equipment were still being considered. And furthermore, subsequent to tender, an opportunity arose to secure approximately 5,000m^3 of boulder clay material from construction work on the nearby N2 Bypass of Monaghan town. This allowed the area of the initial receiving ponds to be raised and avoided secondary pumping across the Mountain Water River.

The successful tenderer was Eamon Sherry Plant Hire Ltd, a local contractor, who regularly features on MCC's Annual Tender List.

Site Clearance, Construction and Planting

The chosen site, within the estate walls and straddling the Mountain Water River, presented a number of construction difficulties – not least being the felling of trees and removal of tree roots within the affected area. A tree survey was carried out by Land Survey Services (Joe Finlay MSIF) during April 2005. A tree felling licence (No 4775) was granted to Castle Leslie by the Department of Agriculture on 13th May 2005. The majority of good quality trees along the estate walls and the river were retained.

Tree felling commenced in September 2005 with commercial timber being stockpiled for use or sale by Castle Leslie. A hydraulic wood chipping machine proved of limited success in dealing with tree roots. Roots and wood debris were subsequently stockpiled on site, creating a wildlife habitat.

Earthworks commenced in October 2006 – post lease signing - and (following a winter break) continued through 2007. The attached photographs give a good indication of the construction process.

Planting, using a variety of wetland species, was carried out by Aila Carty, VESI Environmental, Little Island, Cork. Planting commenced in November 2006 and likewise continued through 2007. During dry spells (not that frequent!) water was pumped from the river to prevent the plants drying out.

Ductwork, cabling and sampling and monitoring equipment (as described below) were installed in Summer/Autumn 2007.

The ICW system was commissioned on 26th October 2007. The temporary FM plant was decommissioned and taken off site.

Finishing works (including hardcore surfacing of riding trails) were completed during 2008.

Sampling and Monitoring.

While the ICW concept is essentially a low-tech and low maintenance system of water cleansing the ICW at Glaslough does include a substantial suite of hi-tech sampling and monitoring equipment:

- Computer-linked ETEC magmeters record all significant flows into, within and out of the wetland system.
- These are linked to automatic samplers, which sample the liquid as it progresses through the system.
- 8No No Lysimeters installed under the early wetland ponds give an 'upper-limit' indication of infiltration through the subsoil. [Note: Site Investigation work by IGSL in September 2005 indicated a soil coefficient of permeability of 9.07^{-11} metres/second].
- A weather station is located beside the inlet pump sump.
- 6 no piezometers allow the groundwater around and under the wetland system to be monitored.

As Constructed Layout (see attached drawing)

As stated above the 'land take' measures some 6.74ha while the water surface of constructed ponds measures 3.25ha. The design capacity is 1750pe with a current load of approx 700pe.
No pre-treatment is carried out. The influent is pumped directly to a receiving pond. There are two such receiving ponds, which can be used alternately to allow for desludging (on an annual basis). Thereafter the liquid flows by gravity through 5 No sequential vegetated ponds and effluent discharges directly to the Mountain Water River.

Refinements to the original layout included the following:

- The Glaslough stream, which originally flowed ***through*** the site, was diverted (and substantially widened) around the perimeter of Pond 4, with excavated material being used to construct the banks of Pond 4. By slowing the flow in the stream and planting with wetland plants an improvement in water quality in the stream (which is otherwise independent of the wetland system) is expected.
- A dam was constructed upstream with a valved and metered pipeline installed to link with Pond 3. This allows the wetland system to be kept hydrated in prolonged dry spells (remember these?) when the volume of influent would evaporate before reaching the outfall.
- A valved and metered pipeline was installed linking Pond 3 back into the inlet pump sump. This allows partially treated liquid to be recirculated through the system – the subject of further study in 2009.
- 2 footbridges were constructed – one substantial steel bridge across the Mountain Water River and a smaller wooden bridge across the widened Glaslough stream linking Pond 4 with Castle Leslie.

Capital Costs

The total Capital Cost of providing and constructing the Glaslough ICW (including land lease and monitoring equipment) is **€770,000 including VAT complete.** This is made up as follows:

Item No	Item Description	€ Cost (incl. VAT)
1.1	Land Lease (incl. legal fees)	**233,000**
2.1	Preliminary Items (site survey, tree survey, aerial photos, site investigation, tree clearance etc)	27,000
2.2	Earthworks, Pipework & Planting (E Sherry & A Carty)	186,000
2.3	Hardcore riding trails	145,000
2.4	2No footbridges	25,000
	Sub-total(2)	**383,000**

	Monitoring	€
3.1	Comm. ducting, manholes etc	41,000
3.2	Broadband connection	4,000
3.3	Lysimeters	3,000
3.4	Etec Magmeters & Samplers	90,000
3.5	Weather Station	2,000
3.6	Marker posts & signs	10,000
3.7	Piezometers	4,000
	Sub-total (3)	**154,000**
	Total Capital Cost (1 +2+3)	**€770,000**

In addition MCC have entered a contract with **Edinburgh University** to provide one full time and one part time PhD student to conduct **research** on the project under the direction of Dr Miklas Scholz at a total cost of some **€165,000 over 3 years**

As mentioned above the estimated cost of a traditional treatment facility of 650pe capacity was **€1,530,000** at 2007/2008 prices. Even including the monitoring equipment costs (for research) and the cost of surfacing the riding trails, ***the ICW still provides nearly 3 times the capacity at half the price.***

In nearby Emyvale village an existing traditional plant has been recently extended /largely replaced with a design pe of approximately 2000, at a cost **€1,400,000**. The plant was commissioned in Sept 2008.

Results

I'd like to introduce Oliver Hofmann, from the University of Edinburgh, who will speak to you briefly on results to date. Oliver is originally from Bavaria in Germany.

Early results for Glaslough ICW are summarised on the attached graphs. These are very encouraging with effluent quality, during the first year of operation, consistently

matching the quality of the receiving Mountain Water River. The system can robustly cope with large variations in volumetric and Biological Oxygen Demand (BOD) loadings of the influent.

The influent at Emyvale is approximately half the strength of the Glaslough ICW influent. The final effluent results for Emyvale (based on a small number of samples) are:

- BOD – good at 8mg/l
- COD – good at 78mg/l
- Ammonia – is higher than Glaslough ICW
- Total Phosphate – is higher than Glaslough ICW

How do ICWs work?

To quote Louis Gilmartin (formerly of the DEHLG) "I am just a simple Engineer" and I make no claims to understand the chemical and biological processes that occur in wetlands (any more than I understand such processes in traditional sewage treatment works). However I find the following perspective useful: If we consider human excreta from a microbial perspective we are not looking at 'waste' at all but at 'food' – the basis of a food chain that stretches to the abundant birdlife (and beyond) that has taken up residence in the Glaslough ICW in its first year of operation. I have little doubt that at a microbial level, beneath the serene beauty of the wetlands, the predatory holocaust of the natural world is played out on a daily basis. So be it.

Beauty is nothing but the beginning of terror, which we still are just able to endure. And we are so awed because it serenely disdains to annihilate us.
Rilke.

The shallow emergent vegetation (and stable food supply) of the wetlands provides an ideal habitat for the microbes to go about their work. The microbial world is itself a fascinating, vital and little understood realm.
The long residence time (which is of the order of 80 days in Glaslough - indeed in dry spells there is no surface discharge at all) allows ample time for the necessary aerobic and anaerobic processes to occur and insulates the wetland system from the effects of shock loadings which would overwhelm a traditional plant.
The large footprint area required is sometimes quoted as a downside of ICWs. But in Glaslough the amenity value of the affected area has been greatly enhanced and complements the tourism-based activities of Castle Leslie and the equestrian centre.
The detritus in the beds of the ponds provides a storehouse of carbon, phosphorous and other nutrients. This again would provide a fruitful area of future study.

While we may question (with the woman from the TV programme) the wisdom of using treated drinking water as a means of transport (a bus) to ferry domestic waste out of sight (particularly in the light of the passenger's reluctance to disembark at the terminus!) I do take pleasure in seeing people using the landscape of the ICW for recreational walks.

I believe that the extensive monitoring work being undertaken at Glaslough ICW will help promote the ICW concept and its application to a range of water-quality management issues such as:

- leachate (from landfills).
- sewage & drinking water sludges.
- drinking water source protection.
- flood amelioration (SUDS).

My thanks to:

Monaghan County Council (for supporting the project and allowing me to speak to you tonight)
Dr Rory Harrington (DEHLG)
Mark Johnston (MCC)
Sammy Leslie (Castle Leslie)
Oliver Hofmann and Miklas Scholz (UoE)
Eamon Sherry (Contractor)
Aila Carty, (VESI Environmental)
Waterford County Council (Paul Carroll and Sue Cook)
Don McEntee (Dublin City Council)
And of course ICE and Engineers Ireland for the facilities.

Footnote: SEPA (The Scottish Environmental Protection Agency) recently published the Constructed Farm Wetlands Design Manual (prepared by Aila Carty) on the SEPA website:

http://www.sepa.org.uk/land/land_publications.aspx

Dan Doody
Senior Engineer, Water Services
Monaghan County Council

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