DBFL
CONSULTING ENGINEERS

Engineering
Sustainable
Futures

PTNZ - Thought Leadership

Nature Based Drainage Solutions

February 2025

Contents

1. Introduction

DBFL Consulting Engineers is a fully Irish-owned firm specializing in the planning, engineering design and delivery within the property, infrastructure, environmental & energy sectors. We are dedicated to delivering innovative, resilient and sustainable engineering solutions. Our core values of Sustainability, Integrity, Adaptability, Excellence, Innovation, and Inclusivity are the foundation of everything we do, guiding our approach to each project and helping us stay true to our mission of Engineering Sustainable Futures. DBFL provide a high level of personal service to both public and private clients across Ireland, UK, and Europe. DBFL have a workforce of approximately 200 staff across offices in Dublin, Waterford, Cork and Galway.

Over our 35+ years in operation, we have gained substantial experience in the design of drainage infrastructure. Historically, our drainage design approach focused on robustness and flood resilience infrastructure. Alignment with nature based solutions and biodiversity was a secondary consideration. In response to the climate crisis and our commitment to sustainable engineering solutions, DBFL has introduced a transformative shift in our approach to drainage design over the past 10 years. We are now leaders in the design of nature-based drainage solutions at regional and site level to mitigate the effects of extreme weather events and promote biodiversity. Our design approach focuses on replicating the natural drainage regime while ensuring robust and maintainable systems for our clients and future generations.

In November 2021, DBFL committed to the Association of Consulting Engineers of Ireland's Pledge to Net Zero, a partner to the United Nations' Race to Zero Campaign. By registering for this commitment, DBFL joined the group of leaders in the civil, structural and transportation engineering sectors taking strong actions to mitigate the most significant impacts of climate change and agreeing to deliver upon three commitments as set out in Figure 1.1.

Figure 1.1: Pledge to Net Zero Commitment

With ACEI support, DBFL's aim is to achieve NetZero in operational GHG emissions by 2030. DBFL, working with the ACEI, will establish the route to reducing operational emissions and ultimately achieving Net Zero.

Through this report, DBFL hope to share some of our knowledge and experience on the design and implementation of Nature Based Drainage Solutions to aid the industry in the design and construction of sustainable engineering infrastructure, as part of the overarching aim of the Pledge to Net Zero.

Section 2 of this report will provide detail on our approach to the design of Nature Based Drainage Solutions, why and where we implement them, and the biodiversity gain of Nature Based Drainage Solutions.

Section 3 will include a number of case studies where we have successfully implemented Nature Based Drainage Solutions.

Section 4 will discuss the challenges to the implementation of Nature Based Drainage Solutions through the statutory planning processes and Local Authority taking in charge of developments.

Section 5 will discuss the further research and training we are undertaking on Nature Based Drainage Solutions.

A summary of the report will be provided in Section 6.

2. Approach to the Design of Nature Based Drainage Solutions

2.1 General Approach

Our design approach focuses on replicating the natural drainage regime while ensuring robust and maintainable systems for our clients and future generations. This approach ensures the functional requirements of on-site drainage systems are achieved while also respecting the flood protection of downstream assets and receptors.

2.2 Where we implement Nature-Based Drainage Solutions

We implement Nature-Based Drainage Solutions throughout the built environment. Attenuation ponds, swales and wetlands are designed within residential and commercial development through detailed coordination with the landscape proposals. Green and blue roofs are proposed on more condensed high-density development where opportunities for ground level solutions are limited. Our active travel and street projects provide an unique opportunity to retrofit nature-based drainage to the existing built environment by introducing rain gardens, swales and tree pits to existing streets where sustainable drainage had not been previously considered.

A significant net gain in terms of biodiversity and surface water management can be achieved where nature-based drainage is retrofitted to the existing built environment.

Figure 2.1: Detention Basin with Residential Development

2.3 Why we implement Nature-Based Drainage Solutions

The benefits of Nature-Based drainage solutions can be summarised in the following 5 points which align with our commitment to sustainability while working with natural materials where possible.

2.3.1 Biodiversity Gain

Nature-Based drainage such as attenuation ponds, wetlands, open water streams and swales provide nature rich habitats for wildlife and ecosystems. Where newly constructed nature-based features are linked with existing eco systems on sites, such as rivers, hedgerows and vegetation, a net benefit for biodiversity can be established. Traditionally, biodiversity would be eradicated in these development sites.

Figure 2.2: Biodiversity Gain of Open Water

2.3.2 Replicate the Natural Drainage Process

As school students, we learn about the natural hydrologic cycle of evaporation, transpiration, precipitation, run-off, infiltration and percolation. At DBFL, our aim is to replicate this process in the built environment by implementing nature-based solutions.

Evaporation, infiltration and percolation can be replicated by providing open water in swales, ponds and streams. Transpiration is replicated by diverting surface water into tree pits and rain gardens where plants and trees absorb water.

Figure 2.3: Open Water Incorporated with Residential Development at Naas, Co. Kildare

2.3.3 Recharge of Groundwater Resources

Surface water generated in the natural greenfield environment, initially infiltrates to the underlying soils and geology before the ground becomes saturated and overland flow occurs to watercourses. This process naturally recharges the groundwater within underlying aquifers. Traditionally in the built environment, hardstanding areas inhibits infiltration. The incorporation of permeable paving, tree pits, swales and open water bodies allows water to infiltrate before entering watercourses and pipe networks therefore replicating the greenfield scenario.

Figure 2.4: Permeable Paving Driveways to promote Infiltration

2.3.4 Site Flood Protection

At DBFL, we engineer sustainable futures which include flood resilient homes and businesses. By implementing Nature-Based Drainage, we are controlling surface water at source within developments to protect homes and businesses from flood waters in flood events.

2.3.5 Downstream Flood Protection

Climate change is predicted to result in more extreme weather events which will increases the risk of flooding along coastlines and watercourses. A key measure to mitigate downstream flooding is to control surface water at source (i.e. where rain falls). The implementation of Nature-Based Drainage Solutions within development sites reduces the volume and intensity of surface water leaving the site and mitigates downstream flood risk.

3. Case Studies

3.1 Case Study 01: Clonburris

DBFL's Role: Civil, Structural & Transportation Engineering
Project Type: Residential & Infrastructure
Location: Clonburris, West Dublin
Status: First Phase Complete

3.1.1 Project Overview

Clonburris is new sustainably built neighbourhood in West Dublin. It involves the development of a major new town on a greenfield site with a population target of over 20,000 people. The Clonburris SDZ is exemplar in sustainable community development which puts Nature Based Solutions at its heart. DBFL have been extensively involved in the development, both in the design & delivery of key shared infrastructure for the new town, and as part of the design team for the individual residential cells. DBFL also prepared the overall Surface Water Management Plan for the SDZ which established overall catchments and the design of Regional SuDS features. It also identified SuDS Objectives and Requirements for individual sites.

Figure 3.1: Clonburris Phase 1

3.1.2 The Challenges

Over 70,000m^3 of regional attenuation will be provided for the SDZ, primarily via regional ponds. These measures ensure the pre-development greenfield runoff characteristics can be maintained to avoid an impact on downstream flood risk. DBFL, working with a multidisciplinary design team including Landscape Architects and Ecologists, have designed the attenuation features to be carefully integrated into the Open Space and Parkland Network. The regional features have been designed to achieve benefits in each of the Four Pillars of Suds. In addition to managing Water Quantity to reduce flood risk, they improve Water Quality and also delivering Amenity and Biodiversity Benefits.

3.1.3 Sustainable Initiatives

At a site level within the development cells, Nature Based Drainage Solutions have been incorporated into each streetscape to replicate natural drainage processes. Rainwater runoff from hard surfaces are directed to SuDS features such as rain gardens, bioretention areas, filter strips and tree Pits. Hard surfacing is eliminated where possible through the use of permeable and vegetated surfacing and the use of green roofs. These elements create a dynamic mosaic of habitats within the development creating substantial Biodiversity and Amenity benefits. The SuDS measures control surface water at source to reduce the volume and intensity of rainfall entering drainage networks. Furthermore they support filtration of pollutants from runoff, recharge of groundwater via infiltration and provide increased climate resilience. The use of vegetated features at surface also offsets traditional piped systems which greatly reduce the embodied carbon of construction materials.

Figure 3.2: Detention Basin at Clonburris

Figure 3.3: Bio Retention Area at Clonburris

3.2 Case Study 02: Oscar Traynor Road (Woods) LRD

DBFL's Role: Civil, Structural & Transportation Engineering
Project Type: Residential
Location: Coolock , Dublin 9
Status: Under Construction

3.2.1 Project Overview

Oscar Traynor Woods is a large-scale residential project at Coolock with a total of 853 no. residential dwellings including 4 large apartment buildings within a large site area of circa 17 hectares. Following the successful procurement process by Glenveagh Homes to develop the site on behalf of Dublin City Council, DBFL provided engineering services as part of a multidisciplinary design team through the planning and detailed design stages of the scheme, and is currently involved in the construction stage of the development.

As part of the project, DCC requested the diversion and daylighting of the previously culverted Naniken Stream through the Site. DBFL's solution included an open channel with integrated wetland / urban planted space / pond within the development's main park which also provided regional attenuation benefit to the Santry River Catchment.

3.2.2 Daylighting the Naniken Stream

Although the word, ''Naniken Stream'' is used, it is important to note that this section of the Naniken was culverted and diverted towards the Santry River around 1966,

over 59 years ago. The existing culvert discharges a large urbanised catchment (15ha) west of the Swords Road (N1) , including the Santry Avenue Industrial Estate and Whitehall Residential Area.
The main benefit of capturing the discharge of the Naniken Stream beyond the provision of regional attenuation is to intercept and daylight the large peak inflow of largely untreated surface water into a considerable (<6,500m2) natured based environment providing ample opportunity for 3rd stage surface water treatment and biodiversity benefit. In addition, the central wetland also provides the same benefits by receiving the majority of the stormflows captured within the new residential development, however stormflows from the development included additional stages of treatment, maximising the ecological receptors within the central wetland.

Figure 3.4: Proposed Central Wetland

3.2.3 Design Proposals Maximising Nature Based Drainage Solutions

Due to the severity of incoming peak flow rates from the upstream Naniken Stream Catchment, the proposed central wetland was split into two unique areas, namely an upstream and downstream basin. The upstream basin intercepts large peakflows and mobilizes the required regional attenuation volumes therefore limiting stormflows in downstream areas intended to maximise treatment of received stormwater from areas potentially high in contaminants such as hydrocarbons.

The upstream basin will be a reeded wetland intended to receive the brunt of the stormflows from the Naniken Stream and mobilize the regional storage upstream. The basin is split over a proposed boardwalk with a bridge over a narrow constricting weir. The constricting weir reduces aggressive peak flows intercepted from the

culvert towards the downstream section, which is intended to be a more accessible area for residents except during extreme flood events.

Within the downstream basin, proposed flow control devices consist of a combination of an orifice chamber discharging the cumulative greenfield outflow of both the development and the Naniken Culvert into the existing stormwater network on Coolock Lane, and an overflow structure that diverts excess flows back into the newly diverted Naniken Culvert.

The intention of the downstream basin's overflow structure is to balance incoming stormflows from both the development and the upstream basin, ensuring that the development's own attenuation storage is mobilized through the lower orifice chamber, while intercepting and diverting large flows up to 500l/sec back into the diverted Naniken Culvert at the south-east section of the development. This approach extends the duration of critical storms and consequently provides more opportunity for treatment within Nature Based Drainage Solutions.

Simulated hydrograghs of storm flows shown in Figure 3.5 illustrate the prolonged attenuation time within the basin which provides downstream flood protection and increased opportunity for surface water treatment.

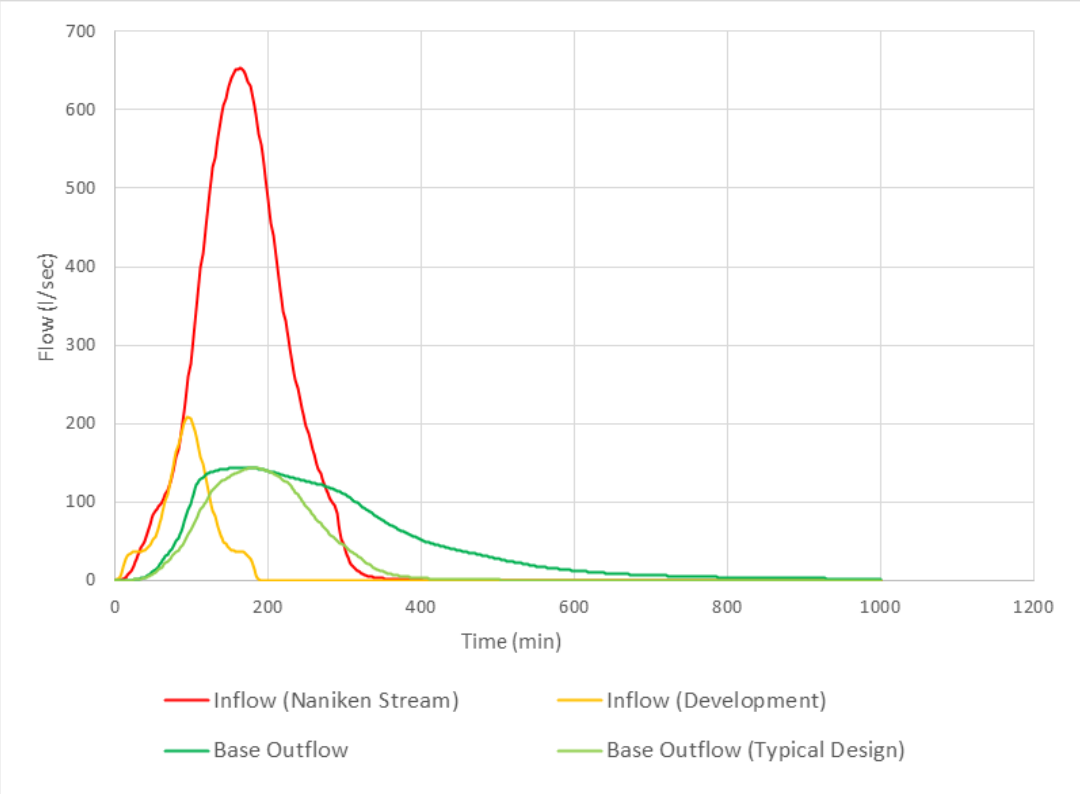

Figure 3.5: Lower Basin Hydrograghs

Figure 3.6: Proposed Central Wetland

Figure 3.7: Drone Images of the Central Wetland under construction (Captured 17/02/2025)

4. Challenges to the implementation of Nature Based Drainage Solutions

4.1 Introduction

The benefits of Nature Based Drainage Solutions are generally widely accepted by all stakeholders but there are often challenges to the successful implementation of the these solutions due to conflicting requirements of future maintenance authorities, end users, various local authority departments and flood resilience. Collaboration with the project landscape architect and the client coupled with early engagement with the local authority is fundamental to the successful implementation of Nature Based Drainage Solutions.

4.2 Local Authorities

The majority of local authorities have now introduced SuDS / Nature Based Drainage Guidelines which set out guidance and requirements for the design and implementation of these solutions in developments. These guidelines have reduced the conflicting requirements of local authority departments. Early engagement with the local authority through pre-planning and pre-construction stage ensures the taking in charge, usable amenity, drainage and maintenance requirements of the local authority are balanced.

4.3 Construction Stage

While the planning and design of Nature Based Solutions are fundamental to their success, the quality of the construction is of equal importance. The key to success is making the Contractor aware of the functionality of the SUDS feature. This can be achieved through pre-start meetings with the construction team, the design engineer and the landscape architect. Similar to Consultants, Contractors are becoming more familiar with the implementation of Nature Based Drainage Solutions where lessons have been learned from poor design and construction. In our experience, quality nature based drainage solutions are constructed where the design team and contractor work in a collaborative manner and a shared understanding of the design exists.

5 Further Research & Training

5.1 Introduction

All our Civil Engineers are trained in the fundamentals of drainage design through our Graduate Development Programme. Regular lunchtime knowledge sharing sessions are held on the topics of drainage, flooding and sustainable urban drainage.

Our Civil Engineers are also encouraged to attend external courses and seminars on the subject to ensure we are familiar with the latest advancements in our industry. We also undertake a lessons learned approach to our designs to ensure that our designs are evolving with the latest experience and knowledge from recent projects.

5.2 Lessons Learned

Following completion of a project, the design team typically presents a lunchtime knowledge sharing session to their colleagues so that lessons learned including nature based drainage can be implemented on future projects. Further to this on the Clonburris project, DBFL undertook a joint lessons learned session with South Dublin County Council's drainage, parks and biodiversity departments. A site walk was first undertaken followed by an in-person workshop to highlight the successful aspects of the nature based drainage solutions constructed and where improvements could be made on future phases.

5.3 Further Research

Considering Nature Based Drainage Solutions are relatively new in an Irish context, there is limited research on the effectiveness and benefits of the solutions on typical infrastructure projects. This leads to a conservative approach being adopted in the design, where the benefits are not taken into consideration, resulting in less efficient designs than may be possible. For example, runoff coefficients and infiltration factors are often underutilised due to a lack of evidence and guidance on quantifying the actual benefits.

DBFL are currently undertaking research in conjunction with Cairn Homes and ÁIT Urbanism and Landscape Ltd. to monitor the actual benefits of Nature Based Drainage Solutions . The research includes the installation of rain gauges and flow monitors to assess the actual run off reduction from permeable paving and rain garden installations. It is envisaged that the results can be used to quantify possible

6 Conclusion

6.1 Introduction

This report summarises how DBFL have approached the implementation of Nature Based Drainage Solutions to promote sustainable and resilient infrastructure. We have focused on the benefits of Nature Based Drainage Solutions while also balancing the flood resilience of existing and proposed infrastructure. We work on a wide variety of challenging infrastructure projects where the incorporation of nature based solutions requires detailed consideration and innovation to achieve successful results. Our case study projects demonstrate where we have successfully collaborated with stakeholders to develop solutions which benefit the build environment, water quality and biodiversity.

As a company, DBFL are passionate about our ability to collaborate and reach solutions which balance the needs of all stakeholders. The implementation of Nature Based Drainage Solutions requires collaboration and consultation from project inception to handover to ensure the design is initially agreed and also implemented to a high standard. DBFL are strongly committed to minimising the impact that our designs have on global warming and climate change. We are investing in research to ensure the benefits of Nature Based Drainage Solutions are quantified and can be utilised to provide more efficient and sustainable infrastructure for future generations.

DBFL
CONSULTING ENGINEERS

EngineeringSustainableFutures

Dublin Office
+353 1 400 4000
Ormond House
Upper Ormond Quay
Dublin 7
D07 W704

Cork Office
+353 21 202 4538
14 South Mall
Cork
T12 CT91

Galway Office
+353 91 33 55 99
Odeon House
7 Eyre Square
Galway
H91 YNC8

Waterford Office
+353 51 30 95 00
Suite 8b The Atrium
Maritana Gate, Canada St
Waterford
X91 W028