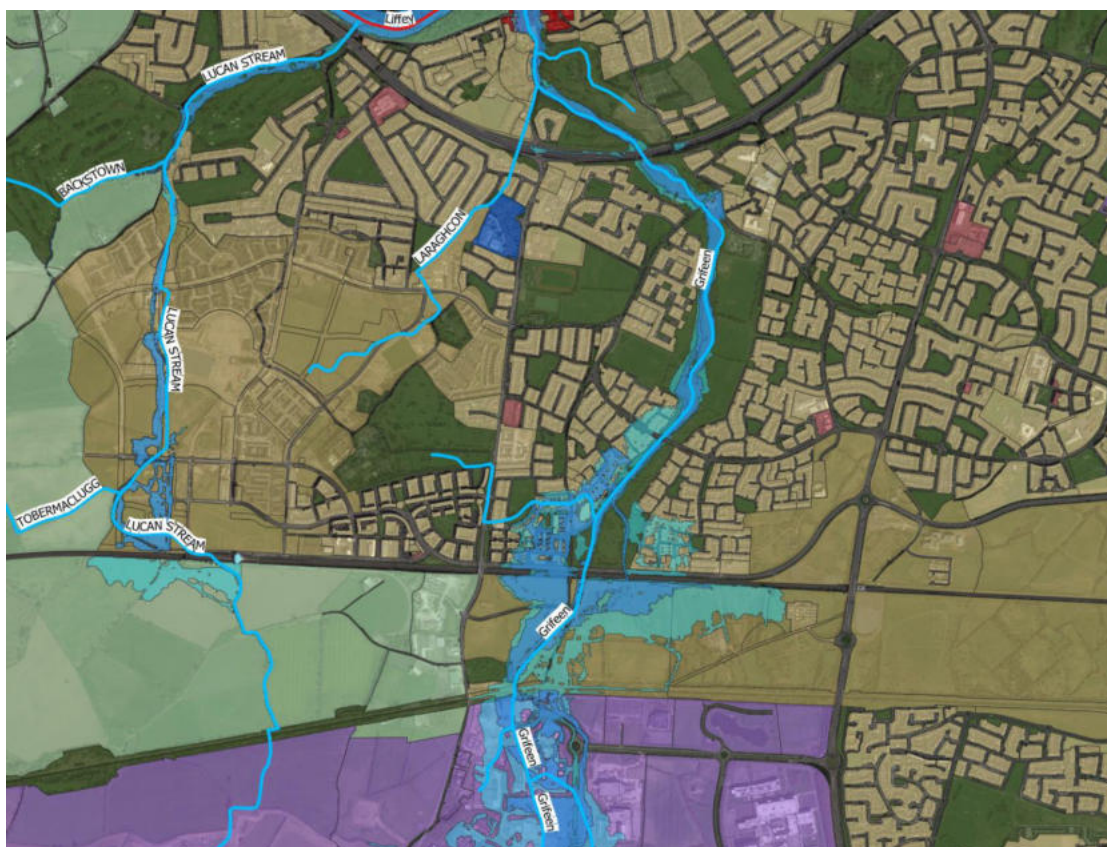


### 5.2.3.3 Clonburris SDZ



**Figure 5.3 Clonburris flood extents over laid on zoning maps**

Flooding from the Griffeen is indicated south of the rail line (between the R120 Newcastle-Lucan Road and the R136 Grange Castle Road), north of the rail line (Griffeen Valley Park) and north of Lucan Bypass. Areas affected are currently zones as “OS – To preserve and provide for open space and recreational amenities”, “SDZ - To provide for strategic development in accordance with approved planning schemes” and “EE - To provide for enterprise and employment related uses”.

- 1) ***The urban settlement is targeted for growth under the National Planning Framework, Regional Spatial and Economic Strategy, statutory plans or under the Planning Guidelines or Planning Directives provisions of the Planning and Development Act 2000, as amended.***

The National Planning Framework (NPF), supported by the National Development Plan (NDP), is the Government’s high-level strategic plan for shaping the future growth and development of the Country, centred around ten National Strategic Outcomes (NSOS), which are underpinned by National Policy Objectives (NPOs). The Eastern and Midland Regional Spatial and Economic Strategy 2019-2031 (EMRSES) is a strategic plan to support implementation of the NPF and NDP, with the approach guided by sixteen Regional Policy Objectives (RPOs). The RSES policy framework for the region is split into three Functional Urban Areas (FUA), with South Dublin County located within the Dublin Metropolitan Areas, with a significant portion of the county also located within the settlement identified as Dublin City and Suburbs. The development within the DMA forms a central part of the policy within the RSES guided by the Dublin Metropolitan Area Strategic Plan (MASP), with two of the five strategic core areas located within South Dublin.

Clonburris forms part of Dublin City and Suburbs within the Settlement Hierarchy of the EMRA Regional Spatial and Economic Strategy.

**2) The zoning or designation of the lands for the particular use or development type is required to achieve the proper planning and sustainable development of the urban settlement and, in particular:**

**i) Is essential to facilitate regeneration and/or expansion of the centre of the urban settlement:**

It is considered that development of Clonburris is essential to allow for growth and expansion of South Dublin in order to meet the targets as set out in the EMRA RSES.

**ii) Comprises significant previously developed and/or under-utilised lands:**

The Clonburris SDZ comprises undeveloped lands suitable for a residential and mixed-use type development, proximate to the existing services.

**iii) Is within or adjoining the core of an established or designated urban settlement:**

Clonburris forms part of Dublin City and Suburbs within the Settlement Hierarchy of the EMRA Regional Spatial and Economic Strategy.

**iv) Will be essential in achieving compact and sustainable urban growth:**

The future development of these lands is essential in achieving compact and sustainable urban growth.

**v) There are no suitable alternative lands for the particular use or development type, in areas at lower risk of flooding within or adjoining the core of the urban settlement:**

There are no alternative unzoned lands available for significant development with equivalent proximity to developing areas, infrastructure and services.

**3) A flood risk assessment to an appropriate level of detail has been carried out as part of the Strategic Environmental Assessment as part of the development plan preparation process, which demonstrates that flood risk to the development can be adequately managed, and the use or development of the lands will not cause unacceptable adverse impacts elsewhere.**

N.B. The acceptability or otherwise of levels of any residual risk should be made with consideration for the proposed development and the local context and should be described in the relevant flood risk assessment.

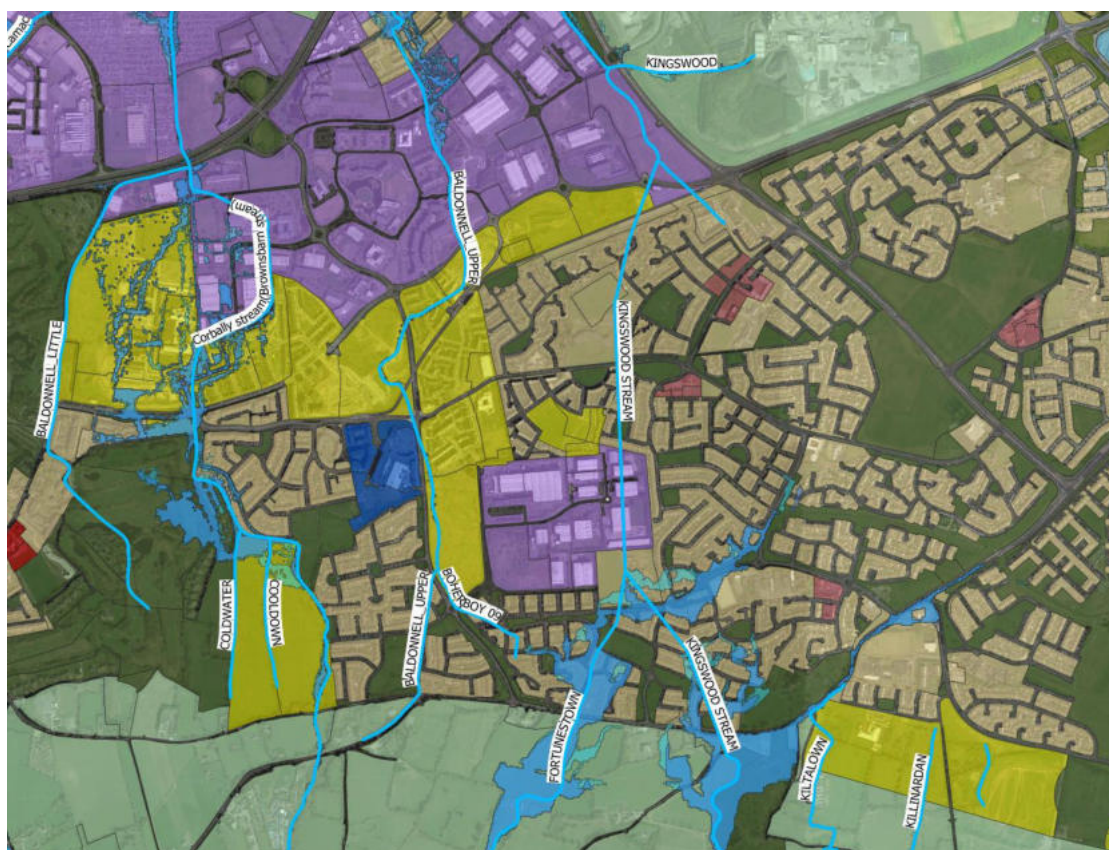
The SDZ lands has been subject to a Strategic Flood Risk Assessment (FRA) including the application of the sequential approach in the land use strategy of the approved plan and appropriate flood risk assessment at planning application stage. There is no overlap between zoned undeveloped lands that are subject to vulnerable uses and Flood Zone A or B in the current climate scenario.

All new developments shall be subject to a Site-Specific Flood Risk as per The Guidelines. An FRA of appropriate detail should accompany applications for development to demonstrate that they would not have adverse flood risk impacts. The FRA should consider the following:

- The sequential approach should be applied through site planning and should avoid encroachment onto, or loss of, the flood plain.
- Development in Flood Zone A should consist of water compatible development only.
- Highly Vulnerable Development shall not be permitted in Flood Zone A or B. Traveller accommodation shall be considered highly vulnerable infrastructure as per the OPW Guidelines.

- FRAs should address surface water management for development, demonstrating consideration of GSDS policies and incorporation of SuDS in accordance with SDCC SuDS Guidance policy.
- FRAs should consider the hydromorphological impacts on riparian corridors.
- Existing open spaces and water compatible uses in Flood Zones A and B should be retained to maintain flood storage areas.
- FRAs should examine residual risk associated with culvert blockages, defence failure and climate change (High End Future Scenario) to set finished flood levels where appropriate. The FRAs should ensure development does not block flow paths, does not increase flood risk elsewhere, is designed to appropriate standard of flood resilient construction and demonstrates emergency evacuation procedures during flood events.
- Additional development such as extensions or changes of use can generally be considered appropriate, but an appropriately detailed flood risk assessment will be required in support of any planning application. The level of detail will vary depending on the risks identified and the proposed land use. The FRA should be aimed at setting finished floor levels and demonstrating no increase in flood risk elsewhere.

#### 5.2.3.4 Fortunestown



**Figure 5.4 Fortunestown Flood extents over laid on zoning maps**

The subject lands are zoned 'RES-N' in the 2022 – 2028 Development Plan and as such, are generally categorised as undeveloped, zoned lands at risk of flooding. Fortunestown is an area within the identified Moderate Sustainable Growth Town of Saggart/ Citywest. Objective RES-N 'to provide for new residential communities in accordance with approved area plans' is applied to 108 ha of land in the area. To determine the appropriateness of the zoning at Fortunestown, the sequential approach has been applied, which has culminated in application of the Justification Test.

- 1) ***The urban settlement is targeted for growth under the National Planning Framework, Regional Spatial and Economic Strategy, statutory plans or under the Planning Guidelines or Planning Directives provisions of the Planning and Development Act 2000, as amended.***

The National Planning Framework (NPF), supported by the National Development Plan (NDP), is the Government's high-level strategic plan for shaping the future growth and development of the Country, centred around ten National Strategic Outcomes (NSOS), which are underpinned by National Policy Objectives (NPOs). The Eastern and Midland Regional Spatial and Economic Strategy 2019-2031 (EMRSES) is a strategic plan to support implementation of the NPF and NDP, with the approach guided by sixteen Regional Policy Objectives (RPOs). The RSES policy framework for the region is split into three Functional Urban Areas (FUA), with South Dublin County located within the Dublin Metropolitan Areas, with a significant portion of the county also located within the settlement identified as Dublin City and Suburbs. The development within the DMA forms a central part of the policy within the RSES guided by the Dublin Metropolitan Area Strategic Plan (MASP), with two of the five strategic core areas located within South Dublin.

- 2) ***The zoning or designation of the lands for the particular use or development type is required to achieve the proper planning and sustainable development of the urban settlement and, in particular:***

- i) ***Is essential to facilitate regeneration and/or expansion of the centre of the urban settlement:***

It is considered that the lands at Saggart/ Citywest (Fortunestown LAP 2012 extended to 2022) are essential to allow for growth and expansion of South Dublin in order to meet the targets as set out in the EMRA RSES.

- ii) ***Comprises significant previously developed and/or under-utilised lands:***

The subject lands consist of significant underutilised land suitable for a higher density type development, in close proximity to the Luas.

- iii) ***Is within or adjoining the core of an established or designated urban settlement:***

The lands at Saggart/ Citywest fall within the Metropolitan Area Strategic Plan.

- iv) ***Will be essential in achieving compact and sustainable urban growth:***

The future development of these lands will be in accordance with the approved Fortunestown LAP 2012 (as extended to 2022) prepared in accordance with Ministerial guidance documents.

- v) ***There are no suitable alternative lands for the particular use or development type, in areas at lower risk of flooding within or adjoining the core of the urban settlement:***

There is no alternative unzoned site available for significant development such as that envisaged at Saggart / Citywest with equivalent established infrastructure and services: There are no alternative unzoned site available for significant development such as that envisaged at Fortunestown with equivalent established infrastructure and services.

**3) A flood risk assessment to an appropriate level of detail has been carried out as part of the Strategic Environmental Assessment as part of the development plan preparation process, which demonstrates that flood risk to the development can be adequately managed, and the use or development of the lands will not cause unacceptable adverse impacts elsewhere.**

N.B. The acceptability or otherwise of levels of any residual risk should be made with consideration for the proposed development and the local context and should be described in the relevant flood risk assessment.

A SFRA has been carried out as part of the Strategic Environmental Assessment as part of the development plan preparation process. The SFRA mapping identifies Flood Zone A and B on a portion of the overall RES-N lands within the Fortunestown LAP boundary.

The lands within Flood Zone A are undeveloped. The Fortunestown Local Area Plan 2012 (as extended to 2022) was prepared having regard to the best available flood data at the time and consideration of the strategy in the LAP. Although residential uses have been identified for the overall area, the LAP identified flood risk areas and the overall strategy was prepared having regard to the sequential approach within the plan boundary, focusing the residential housing in Flood Zone C and directing open space, roads and gardens in Flood Zones A and B. Objective GI7 of the LAP states that all planning applications for residential and/or commercial floorspace on sites in areas at risk of flooding shall be accompanied by a Flood Risk Assessment that is carried out at the site-specific level in accordance with 'The Planning System and Flood Risk Management – Guidelines for Planning Authorities' (2009). The scope of flood risk assessment shall depend on the type and scale of development and the sensitivity of the area.

All new developments shall be subject to a Site-Specific Flood Risk as per The Guidelines.

demonstrate that they would not have adverse flood risk impacts. The FRA should consider the following:

- The sequential approach should be applied through site planning and should avoid encroachment onto, or loss of, the flood plain.
- Development in Flood Zone A should consist of water compatible development only.
- Highly Vulnerable Development shall not be permitted in Flood Zone A or B. Traveller accommodation shall be considered highly vulnerable infrastructure as per the OPW Guidelines.
- FRAs should address surface water management for development, demonstrating consideration of GSDS policies and incorporation of SuDS in accordance with SDCC SuDS Guidance policy.
- FRAs should consider the hydromorphological impacts on riparian corridors.
- Existing open spaces and water compatible uses in Flood Zones A and B should be retained to maintain flood storage areas.
- FRAs should examine residual risk associated with culvert blockages, defence failure and climate change (High End Future Scenario) to set finished flood levels where appropriate. The FRAs should ensure development does not block flow paths, does not increase flood risk elsewhere, is designed to appropriate standard of flood resilient construction and demonstrates emergency evacuation procedures during flood events.
- Additional development such as extensions or changes of use can generally be considered appropriate, but an appropriately detailed flood risk assessment will be required in support of any planning application. The level of detail will vary depending on the risks identified and the proposed land use. The FRA should be aimed at setting finished floor levels and demonstrating no increase in flood risk elsewhere.

## **6. RIPARIAN CORRIDORS**

### **6.1 The Need for Riparian Corridor Assessments**

Riparian Corridors protect watercourses and their natural processes including: ecological, biogeochemical, hydromorphological and flood resilience in the face of climate change. These zones act as the interface between rivers and adjoining lands and are key to managing flood risk within catchments of all sizes. Maintaining and enhancing Riparian Corridors creates “room for the river” and the benefits that entails including reducing risk to persons and property from flooding. The sustainable management of riparian zones is crucial to meeting our objectives under the Water Framework and Floods Directives.

Recent decades have seen an increased awareness of the role of riparian zones in controlling the movement and processing of waterborne pollutants. This research was built upon growing interest in the interactions along aquatic-terrestrial fringes initially in relation to fisheries and more recently the effect of ecosystem diversity and resilience to climate change. The relationship between Riparian Corridors and nutrient processing is widely known, by acting as buffers between upland areas and open water, they help treat pollutants.

### **6.2 Riparian Vegetation**

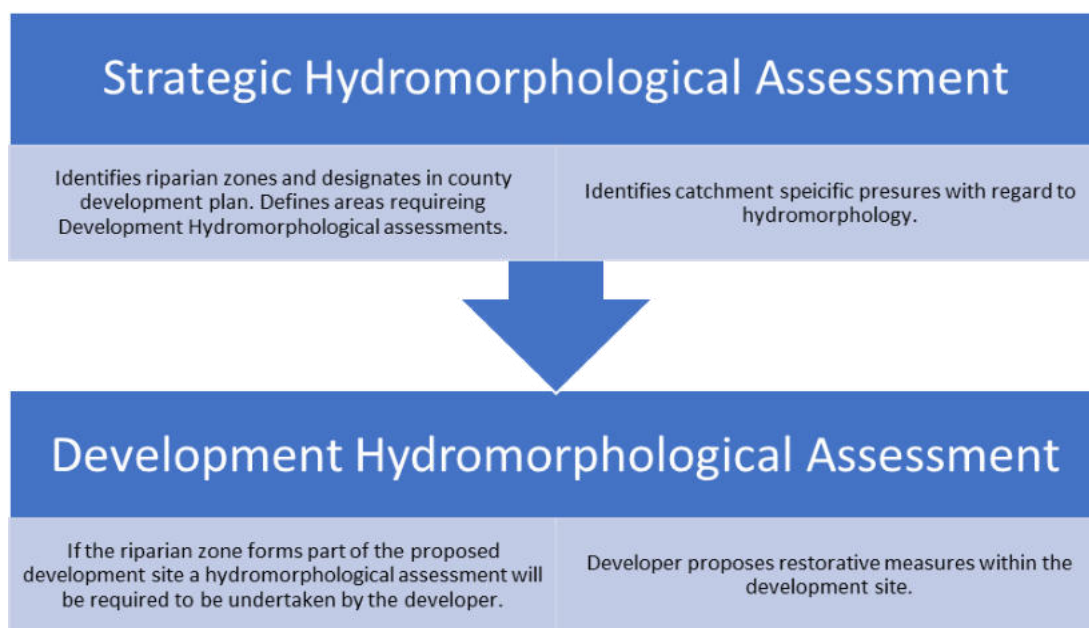
Riparian vegetation acts with flow, sediment and topography to influence channel form, instream habitat, nutrient dynamics, temperature and flow patterns. Therefore, removal of upland and riparian vegetation through agriculture and urbanisation disrupts land-water linkages leading to reductions in water quality, simplification of stream channels, less stable thermal and flow regimes, and ultimately, reduced ecosystem integrity. Riparian vegetation is a key source of beneficial in-stream nutrients and carbon, provides shade aiding thermally sensitive species (e.g. salmonids) and directly influences channel morphology (bank stabilisation, source of Large Woody Debris).

Designating and maintaining riparian corridors along the along major watercourses and their tributaries is key to maximising ecosystem services provided by the watercourses. Vegetative riparian buffers ecosystem services include:

- Interception and reduction of potential pollutants from both agricultural and urban sources,
- Attenuating flood waters,
- Bank stabilisation,
- Reducing runoff volumes
- Habitat provision and refuge,
- Ecological corridors
- Vegetal debris that falls into the watercourse is an important source of nutrients for instream biota.
- Thermal shading of watercourse,
- Amenity value.

### **6.3 Development Hydromorphical Assessment and Restorative Measures**

The strategic assessment has informed the requirements for Development Hydromorphological assessments as outlined in the figure below.



Development Hydromorphological Assessments are to be undertaken where lands are partially or wholly within the Riparian Corridors identified as part of the Development Plan. The Development Hydromorphological Assessment will include the following considerations:

- An assessment of the existing river reach, identify existing hydromorphological pressures, determine deviation from a “Natural” form and propose restorative measures to improve Hydromorphological integrity and resilience throughout the river reach.
- Key assessment parameters shall include: Flow, River Continuity, Planform, Sediment Regime, & Riparian Vegetation.
- Where proposed development lands are within the Riparian Corridor but are not directly adjacent to a watercourse, measures should focus on SuDS to manage the quality and quantity of surface water runoff and promote biodiversity.
- In general restorative measures should create “Room for the River” and in time allow river systems to return to a state of equilibrium with rich biodiversity, developed ecosystem service provision and resilience to future shocks such as climate change. Potential restorative measures are described below.

### 6.3.1 Flood Zoning

Lateral connectivity should be maintained where possible throughout catchments. Assessing and zoning floodplains throughout the catchment is key to defining appropriate land use practices and future sustainable development. Much of the historic floodplains within the catchment are defined as part of previous flood studies. Nonetheless, the impacts of climate change should be taken into account as the areas liable to flood in the near future may increase significantly over present-day extents and within the Riparian Corridors identified within this SFRA.

### 6.3.2 Riparian Buffer

The immediate riparian buffer should be “re-wilded” as much as possible. Any development within the riparian buffer strip, including pedestrian/cycle paths and highly managed parkland, should be minimised. Within these riparian buffer zones explicit care should be given to the variety of plant species. The vegetation within the

riparian buffer should be native and appropriate to the location and soil water regime, preferably from a local source. Inclusion of riparian trees is important as currently the majority of catchments in the Dublin region have very little tree cover.

Providing buffer strips adjacent to the watercourses and limiting instream works maintains existing flow/flood regimes as well as important ecological corridors for aquatic and terrestrial flora and fauna.

### 6.3.3 Sustainable Agriculture Practices

The nature of land ownership in Ireland means that the majority of riparian land is privately owned. As such educating and involving riparian landowners is key to enhancing riverine environments. This includes:

- Educating farmers on the correct use of nitrates and agricultural fertilisers,
- Use of stock fencing as to minimize livestock access pressure have been seen to result in:
  - a decrease in sediment loads
  - woody vegetation cover increases,
  - increase resistance to erosion,
  - increase in vegetation increases roughness,
  - trapping sediment, which builds banks;
- Designated crossing / access points for livestock along the banks of a watercourse will aid in reducing bank erosion and sediment from entering the watercourse. At such points, the banks could be reinforced to aid in the prevention of bank erosion.
- The provision of riparian buffers and Integrated Constructed Wetlands (ICW) systems adjacent to rivers has been seen to greatly reduce pollutants in agricultural runoff (e.g. effluent, fertilisers & pesticides, etc.) from entering freshwater systems.
- The provision of ICW systems on agricultural lands within the LAP can provide storage to agricultural runoff, slow runoff, create aquatic and riparian habitat and absorb and/or retain CO<sub>2</sub>, however incentives would possibly need to be in place for the general public to adopt such systems.
- Educating the general public on the potential negative impacts of such activities can also help mitigate this pressure.

### 6.3.4 Instream Works and Channel Modifications

The methodologies outlined above have been chosen as to be minimally invasive. However, as with the majority of urban watercourses in Ireland, some of the primary pressures within the South Dublin catchments are the significant morphological alterations as a result of culverting, canalisation and construction of flow regulation structures such as weirs. Key ecosystem services and habitat types can not return to the urban catchments without some River Restoration measures being undertaken within the main river channel. Possible options include:

- De-culverting of Watercourses
- Introduction of Large Woody Debris,
- Establishment of in-stream vegetation,
- New meander in impounded river channel,
- Reconnecting a remnant meander,
- Current deflectors,

- Narrowing channel with aquatic ledges,
- Creating a sinuous low-flow channel in an over-widened channel,
- Creation of on-line bays,
- Fixing whole trees into the river bank for flow diversity,
- Gravel reworking to restore a low-flow channel,
- Weir removal
- Review of/reduction in maintenance.

The impact of these measures on the current channel morphology and maintenance practices varies significantly. Options such as introducing Large Woody Debris would likely have a minimal impact on flooding while providing substantial benefits in the form of flow heterogeneity and habitat creation.

#### **6.4 Riparian Corridor Objectives:**

- 1) To ensure that hydromorphological assessments are undertaken where proposed development is within lands which are partially or wholly within the Riparian Corridors identified as part of this Development Plan.
- 2) To require development proposals that are within riparian corridors to demonstrate how the integrity of the Riparian Corridor can be maintained and enhanced having regard to flood risk management, biodiversity, ecosystem service provision, water quality and hydromorphology.
- 3) To promote and protect native riparian vegetation along all watercourses and ensure that a minimum 10m vegetated riparian buffer from the top of the riverbank is maintained/reinstated along all watercourses within any development site.

## **7. STORMWATER MANAGEMENT STRATEGY AND SUDS RETROFIT**

### **7.1 SUDS Overview**

#### **7.1.1 Introduction**

The SuDS philosophy is to mimic the natural hydrological cycle by promoting; infiltration, evaporation, evapotranspiration, the harvesting of rainwater at source and the temporary storage of water (ponding), through the construction of a combination or series of components to form a 'management train'. Whilst there is no internationally agreed definition for SuDS – as the understanding of the SuDS philosophy correlates to the extent to which it is embedded in policy and practice over time, the three 'pillars' of sustainable stormwater management practice are generally accepted as;

- (i) Reducing the rate and quantity of stormwater discharge,
- (ii) Improve the quality of stormwater discharges and receiving water bodies and
- (iii) Provide amenity and biodiversity value.

Consideration of the sensitivity of the surrounding environment and downstream water quality is fundamental to the successful implementation of SUDS systems, particularly as we face into the uncertainties of a changing climate.

#### **7.1.2 Benefits of SuDS**

Traditional surface water drainage design is relatively simple, using the Rational method to size pipes to ensure that surface water is removed as quickly as possible to ensure flooding does not take place on hardstanding areas. Unfortunately, this philosophy is flawed as, in more rapidly transferring the surface water downstream, it provides the potential for flooding of other areas. This accelerated run-off gives rise to higher flood levels and the corresponding loss of groundwater recharge results in reduced low flows in rivers thus increasing environmental vulnerability. In addition, the pollution in the run-off is conveyed into the natural environment.

SuDS offer multiple benefits over traditional drainage practices managing discharge rates, volumes and diffuse pollution as well as providing the flexibility for adaptation to future drainage needs through a modular implementation. Climate change predictions suggest that some types of extreme events will become more frequent, such as heat waves, flooding caused by extreme rainfall and drought. The SuDS approach is more robust and adaptable than the traditional approach of underground piped drainage systems. In shallow surface-based systems, such as swales, water levels rise gradually and visibly. When the capacity of the SuDS feature is exceeded, the excess water can be directed to safe storage zones. This allows the general public, and road owners and operators to prepare for flood events more effectively. Conversely, flooding from underground piped drainage systems can occur suddenly and rapidly when the design capacity is exceeded. Furthermore, shallow, visible surface-based systems can be designed to offer greater flexibility to adapt to Climate Change. SuDS systems can enhance more readily and cheaply, compared to underground drainage systems. Lower river flows; caused by drought, result in reduced dilution of pollutants following rainfall events. The treatment of surface water runoff, through SuDS, helps to protect and enhance the quality of receiving watercourses, which assists in the attainment of our objectives under the Water Framework Directive.

### **7.1.3 Factors Influencing the Design of SuDS**

There is no unique solution and each situation must be evaluated on its own merits and suitable SuDS solutions applied, although the means to achieving these objectives are many and varied. Factors such as site suitability, available space, cost, maintenance regimes and community acceptance must be considered to ensure successful implementation. The various SuDS features can generally be categorised as 'hard' SuDS and 'soft' SuDS. Soft SuDS resemble natural features and include techniques such as swales, ponds and wetlands. Hard SuDS are more similar to traditional drainage methods but incorporate SUDS principles. Examples of these are permeable pavements and proprietary SUDS features such as filtration systems and vortex separators.

### **7.1.4 The Management Train**

The SuDS philosophy, and effective stormwater management in general, requires a series of SuDS features, linked together, to form a stormwater management system to treat and attenuate surface water runoff as close to the source of runoff as possible, before being conveyed downstream for further treatment and storage.

## **7.2 Opportunities for SuDS Systems in a Changing Climate**

The principal treatment processes in a SuDS system are Sedimentation and Biodegradation.

### **7.2.1 Sedimentation**

Sedimentation is one of the primary removal mechanisms in SuDS. Most pollution in stormwater runoff is attached to sediment particles and therefore the removal of sediment will achieve a significant reduction in pollution loading to receiving water bodies. Sedimentation is achieved through the reduction in flow velocities to a level at which the sediment particles fall out of suspension.

### **7.2.2 Biodegradation**

Biodegradation is a natural biological treatment process that is a feature of several SuDS systems - systems that are subject to both wet and dry conditions. In addition to the physical and chemical processes of SuDS systems, biological treatment may also occur. Microbial communities may be established in the ground using the oxygen within the free-draining materials and the nutrients supplied with the inflows, to degrade pollutants such as hydrocarbons and grease.

The level of bioremediation activity will be affected by environmental conditions such as temperature and the supply of oxygen and nutrients. It also depends on the physical conditions within the ground such as the suitability of the materials for colonisation.

### **7.2.3 'Wet and Dry' SuDS Systems Perform Best**

The presence of vegetation adds a physical filtration aspect to SuDS systems in the case of filter strips leading to swale/basins, the majority of hydrocarbons are removed by the first stage. If vegetation has been affected by drought, this element of the treatment train will be absent (in a worst-case scenario or significantly diminished at best). Maintenance of filter strips, swales and detention basins typically involve grass cutting. It is worth noting that hydrocarbons are also broken down by UV light in a process called photolysis, but where increasing levels of contaminants are building up in the soil (in the swale, basin, pond or wetland) the affected soil is likely to require removal and will more than likely be classified as contaminated waste.

The most recent published literature suggests that ponds and wetlands do not seem to benefit from the enhanced biological treatment of hydrocarbons found in the oxygen-rich conditions of the swales and basins (which are not designed to hold a permanent volume of water). Nonetheless, ponds and wetlands have been utilised extensively as the default treatment system serving roads and motorways in Ireland and UK, with little supporting literature to justify such initiatives.

In the selection of the most resilient and enduring suds systems, this fact is important:

*Only SuDS features that experience both wet and dry conditions benefit from this added biological treatment - ponds and wetlands are proposed as polishing stage options as part of a treatment train.*

The temperature dependence of these aerobic microbes (responsible for this additional layer of treatment) means that the chemical and biological treatment mechanisms found in SuDS systems are enhanced with increasing temperature.

#### **7.2.4 The Benefits of Vegetative Systems**

The successful implementation of bioremediation systems requires the establishment of appropriate plants and /or microorganisms at the containment site. Factors to be considered include: (i) selection of appropriate plant species, (ii) the influence of contaminants on seed germination, (iii) the use of native versus non-native plants and (iv) the effectiveness of inoculating contaminated soils with microorganisms. Furthermore, the plant species must be well adapted to the soil and climate of the region, making soil characteristics, length of growing season, average temperature and annual rainfall important considerations in plant-assisted bioremediation / biodegradation planning. The rate of microbial degradation generally doubles for every 10-degree centigrade increase in temperature.

Indirect benefits include enhanced soil quality through improvements in soil structure, increased porosity and therefore water infiltration, providing nutrients, accelerating nutrient cycling and increasing soil organic carbon. The use of plants also stabilises the soil thus preventing erosion and direct human exposure.

### **7.3 SuDS Objectives**

#### **7.3.1 Quantity Control Processes**

Several techniques can be implemented to control the quantity of runoff from a development. Each technique presents different opportunities for stormwater control, flood risk management, water conservation and groundwater recharge.

- a) Infiltration
  - Soaking of water into the ground
  - Most desirable solution to runoff management as it restores the natural hydrologic process
  - Impacted by groundwater vulnerability and infiltration ability of subsoil
- b) Detention / Attenuation
  - Slows down surface water flows before their transfer downstream
  - Usually achieved through use of a storage volume and constrained outlet
  - Should be above ground
  - Reduces peak flow rate but total volume of runoff remains the same
- c) Conveyance