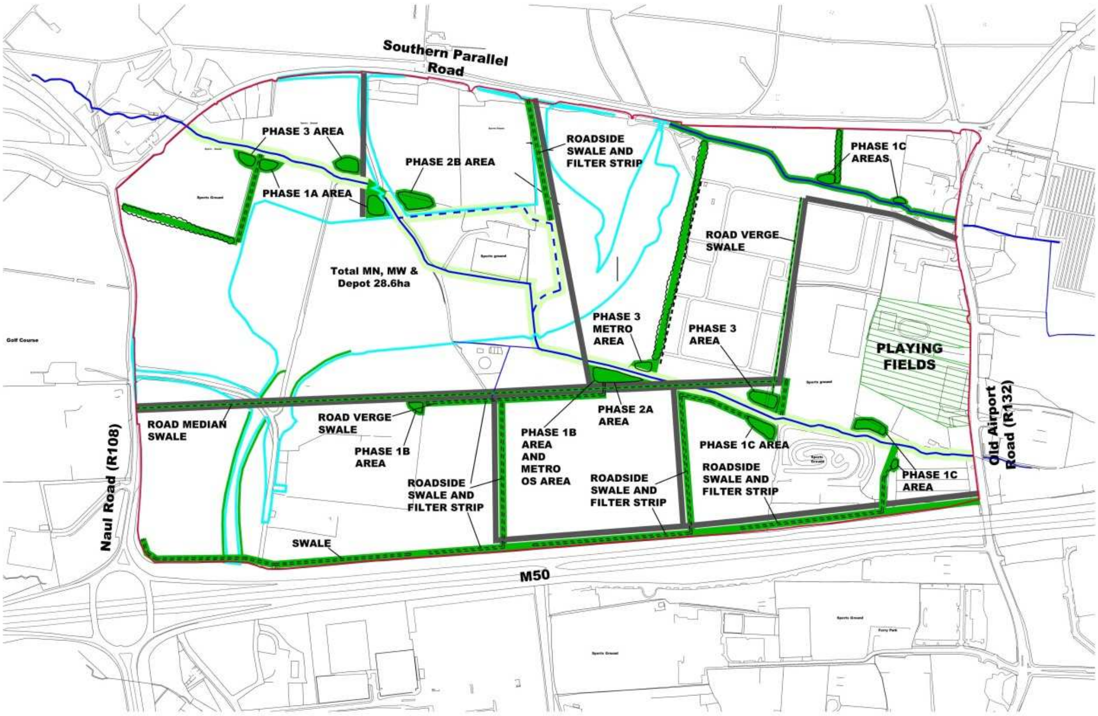
Draft Dardistown Local Area Plan

Sustainable Urban Drainage Systems

Strategy Report



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Comhairle Contae Fhine Gall

Fingal County Council

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CONTENTS

APPENDICES:

1. INTRODUCTION

1.1. Background

The Dardistown LAP lands are situated approximately eight miles to the north of Dublin City centre, less than 1 mile south of Dublin Airport, mid-way between Swords and Dublin City centre, as shown on Figure 1.1. They comprise a rectangular shaped parcel of land that extends to approximately 153ha. The lands are bounded to the North by the Dublin International Airport, to the south by the M50, to the west by the Naul Road and the east by the Swords Road.

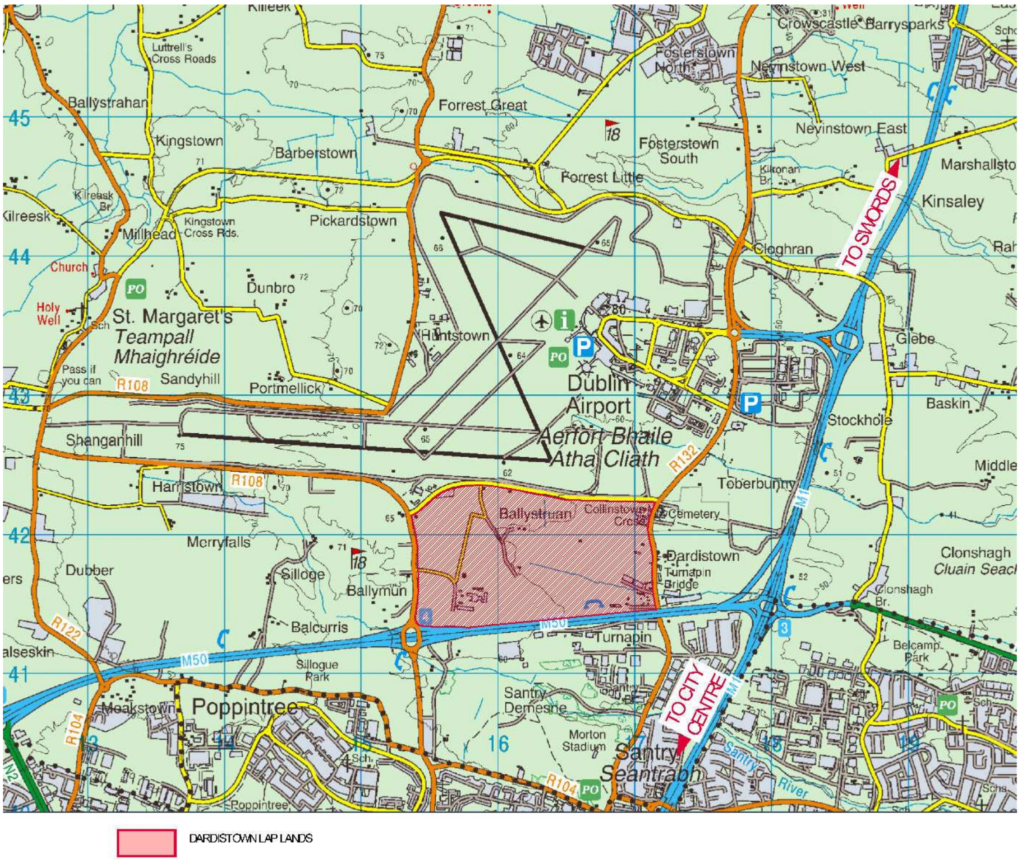


Figure 1.1 Location of Dardistown LAP lands

A significant proportion of the LAP area is currently in agricultural use. Development that has occurred within the LAP boundary includes industrial, commercial and sports and recreational uses. Industrial and commercial uses include St. Anne's Business Park to the west of the site, primarily frontage development along the Swords Road on the eastern fringe of the LAP lands, which includes Airport related uses e.g. car parking and car hire, hotel and industrial/enterprise units, a Vehicle Test Centre and a go-karting track. The lands also accommodate sports and recreational facilities provided by the Royal College of Surgeons, Ballymun Kickhams GAA, Parnell's GAA and Whitehall Rangers AFC.

The topography of the LAP lands is generally flat, rising gently from the south-east to the north-west, with a steeper rise from the south-east to the south-west of the site. There are a few existing paths and hedgerows from north to south, and a number of watercourses crossing from west to east. There is a verge of dense vegetation along the M50.

The lands are the subject of a Local Area Plan in accordance with the strategic guidelines set out in the Fingal County Council Strategic Vision for Swords 2035 and will be prepared in the context of the Fingal County Development Plan 2011-2017. The Draft Dardistown Local Area Plan is in progress and will incorporate sustainable development objectives, in particular in the context of surface water drainage which discharges to the Turnapin Stream which flows into the Mayne River which in turn discharges to Portmarnock Estuary at Mayne Bridge. This estuary is a designated SPA, SAC and pNHA site under the EU Habitats Directive.

The reservation for the Metro North rail line traverses the LAP lands from north-east to south-west. Metro West enters the lands from the north-west and connects with Metro North at an interchange to the west of the Dardistown Stop. The Dardistown Stop services both lines and is located centrally within the LAP lands. A depot for the Metro North line is provided on an area of 16ha to the north of the Dardistown Stop, along with a 300 space Park and Ride facility and 180 parking spaces for staff. The LAP reserves and protects the permitted alignment of Metro North, the Metro North Depot site, and the Metro West alignment. The total area reserved for these developments within Dardistown LAP is 28.6ha. The RPA have signed an agreement allowing the development of the LAP lands in tandem or advance of the proposed Metro North scheme. In light of the decision to defer the construction of the Metro North and Metro West projects until 2016, the RPA fully support the early development of the LAP lands in a phased manner.

The LAP implementation strategy for the period of the LAP (2012-2018) supports the established QBCs on the Naul and Swords Road and the provision of an internal linking QBC which will also service the Airport. The upgrading of existing quality bus corridors, in particular the Ballymun/Airport/Swords corridor, has been identified as a priority in the medium term in government's Infrastructure and Capital Investment Plan 2012-2016.

The Fingal County Development Plan 2011-2017 contains two safety designations in the vicinity of Dublin Airport relating to the safety of the aircrafts using the runways and the safety of persons on the ground. The LAP lands are located substantially within the Inner Airport Noise Zone with the south-western corner of the LAP lands falling outside the Inner Noise Zone but within the Outer Noise Zone. The majority of the subject lands are zoned as General Employment (GE) in the Fingal County Development Plans 2011-2017, the objective of which is to provide opportunities for general enterprise and employment. These lands comprise an L-shaped parcel and coincide with the airport's designated Outer Public Safety Zone. The remainder of the LAP lands, to the south and west of the Outer Public Safety Zone, is zoned High Technology (HT), the objective of which is to provide for office, research and development and high technology/manufacturing type employment in a high quality built and landscaped environment.

The location of the LAP lands adjacent to the airport and integrally connected to the national transport grid will attract a broad range of businesses, including those involved in logistics and warehousing to Science & Technology, High Tech, R&D and office based uses. Support services including conferencing, hotels, short-stay business accommodation and 24 hour leisure and recreational facilities will also be required.

Development on the Dardistown lands will occur in a phased manner, initially capitalising on the existing and potential QBCs in a manner that will also support and reinforce the economic case for Metro North. The proposal allows for appropriate densities of development to proceed immediately in appropriate locations, while reserving later phases, close to the Metro/Bus Interchange at Dardistown until public transport has been significantly upgraded. The phasing also identifies opportunity sites which will be reserved for major landmark developments. Figure 1.2 provides an overview of the proposed development phasing and areas at Dardistown as follows:

Phase 1 - Dardistown LAP Period 2012 to 2018

Phase 1A (8.13Ha): The area within this phase will be suitable for commercial and logistics & warehousing uses. This phase can benefit from road access to the Naul Road and from the Quality Bus Corridor to be developed along this route, providing links with the Airport, Ballymun and the city centre. Development should be focused on the north western section of the site where access to the external road network is good and conflict with the construction of Metro North would be avoided.

Phase 1B (12.42Ha): Development in this phase can become more focused around the high intensity core of the site, including higher density commercial, office, leisure, hotel, conference and retail developments, graduating in intensity as it moves closer to the transport interchange. A high quality park is proposed with a pedestrian spine running north/south of the area and parkways running east/west with new buildings framing these green/open spaces. This phase can proceed independent of the Metro based on the excellent bus based potential of the Dardistown Development site.

Phase 1C (22.20Ha): This area contains a number of established commercial, leisure and amenity uses, with the majority of the lands falling both within the Inner and Outer Public Safety Zones. Uses will be appropriate to these designations and the zoning of the lands as General Employment and could potentially include low intensity/density uses such as logistics, warehousing, commercial car parks and transport depot(s).

Open Spaces/Sports (4.36Ha): These areas to the east of the LAP lands are to be retained for open space and sports uses.

Phase 2 - Dardistown LAP Period 2018 to 2024

Phase 2 (29.97Ha): The areas of this phase located to the north of the LAP lands will be more suited to logistics and warehousing uses. To the south of the Metro Depot, the development intensity will graduate the closer it gets to the principal internal movement axes, with the hub fully integrated and a high quality park and pedestrian spine running north/south of the hub and parkway running east/west, with higher density mixed used developments. Phase 2 development area may become a core area in itself as it is located more centrally within the overall LAP lands.

Phase 3 (23.87Ha): This phase of the development of the Dardistown Lands will see the further development of logistics and warehousing areas.

Phase 3 - Dardistown LAP Period 2024+

Phase 3 Metro (10.49Ha): These areas surround the proposed Metro North, Metro West and Metro Depot sites, with the areas within the Inner Public Safety Zone suitable for logistics and warehousing development, commercial car parks and transport depot(s) and those within the Outer Public Safety Zone suitable for commercial, higher density use

Opportunity Sites (Not Phase Specific)

Opportunity Sites 1 & 2 (8.10Ha): Two areas are identified as opportunity sites fronting the M50 road and at the intersection of the Ballymun Interchange and Naul Road. These are strategic sites that will be reserved for commercial development types that are strategic in their own right. These sites may be developed at any stage of the lifetime of the LAP subject to the suitability of the development proposals that may be brought forward and necessary infrastructure being in place.

Metro Opportunity Site (4.75 Ha): This opportunity site is located adjacent to the high intensity core and development can including high density commercial development.

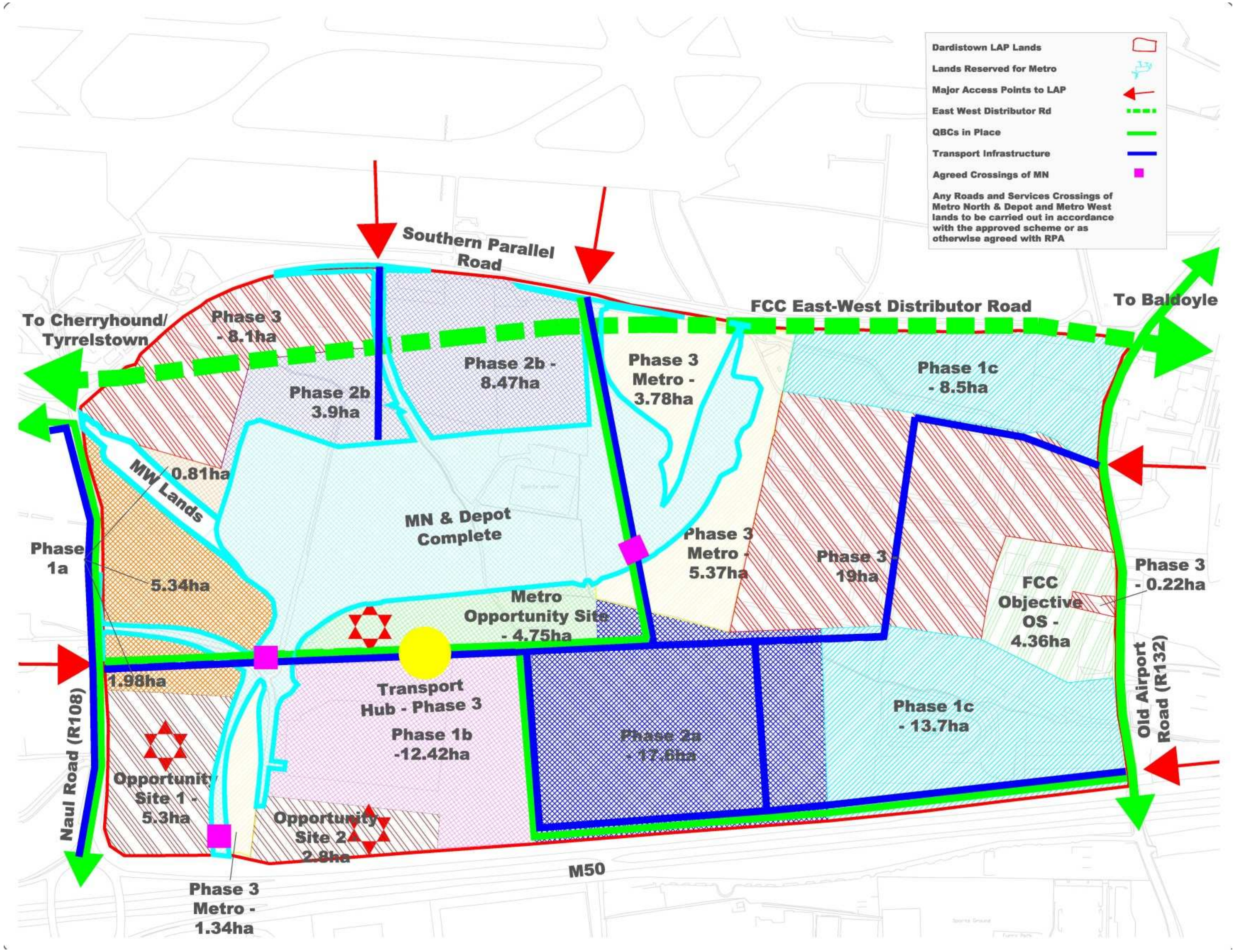


Figure 1.2 – Proposed Development Phasing

1.2. Best Practice

The Water Framework Directive (WFD) 2000/60/EC establishes a framework for community action in the field of water policy and was transposed into Irish Law in 2003. The Directive aims to maintain and improve the aquatic environment in European Communities. The overall objective of the Directive is to prevent deterioration in the status of any waters and achieve at least 'good status' for all surface waters by 2015. Dardistown is located in the Eastern River Basin District (ERBD), one of eight river basin districts established in Ireland arising out of the legal requirements of the WFD.

The Greater Dublin Strategic Drainage Study (GDSDS) identifies the policies, strategies and projects for developing a sustainable drainage system for the Greater Dublin Region. The long-term strategic drainage proposals are based on providing the infrastructure required for the anticipated sustainable development of the region and has been prepared in line with the Water Framework Directive. The Regional Drainage Policies of the Greater Dublin Strategic Drainage Study emphasise that the requirements of the WFD cannot be met unless sustainable drainage strategies and a commitment to best practice and continued improvements are implemented.

Any development of the lands will have regard to the standards set in current legislation, EU Directives and National Regulations including the Water Framework Directive 2000/60/EC. The proposed development will be in line with the Greater Dublin Strategic Drainage Study (GDSDS) and will require attenuation to Greenfields standards and the implementation of this SuDS strategy by replicating, as closely as possible, the natural drainage from the lands before development.

1.3. SuDS Strategy Report

Sustainable drainage can only be effectively implemented at a site if it is incorporated in a developer's plans at the earliest possible stage. This SuDS Strategy Report has been prepared to ensure a sustainable approach is adopted for dealing with the surface water runoff from all development within the LAP lands. This document must be considered and targets adhered to when designing and constructing the surface water drainage system for individual developments and phases in the subject lands. The targets of this SuDS strategy are based on the three key elements of any SuDS system i.e.

Water Quality Control – Protecting and improving the quality of water in the receiving watercourses and groundwater, thereby minimising ecological and physical impacts on receiving waters

Water Quantity Control – Managing runoff rates to ensure those prior to development are maintained, protecting the site from flooding of the drainage system and minimising the risk of flooding during extreme events

Amenity Value – Provision of environmental habitats e.g. ponds and wetlands, which also enhance the aesthetics of the area and providing recreational benefits.

The site conditions and the SuDS features available for the subject lands are reviewed, with those SuDS features most suited for use on these lands being identified.

This SuDS Strategy is based on the recommendations of the Greater Dublin Strategic Drainage Study (GDSDS), on CIRIA reports C687, C697, C521, C522, C523, and C609 and the DEFRA draft National Standards for Sustainable Drainage Systems - designing, constructing, operating and maintaining drainage for surface runoff (2011).

2. SuDS OVERVIEW

2.1. Background to SuDS

Sustainable urban Drainage Systems (SuDS) are intended to minimise the impacts of development on the quantity and quality of runoff and maximise amenity and biodiversity opportunities. The philosophy of this system is to replicate, as closely as possible, the natural drainage from the lands prior to development, thereby minimising the impact of the development on water quality in the receiving waters and quantity of runoff in the area. SuDS drainage should be designed to treat runoff and return it to the environment as close to the source as possible and in as many locations as possible, thus spreading the impact on receiving waters.

Conventional drainage systems are designed for quantity, to collect surface water and prevent flooding locally by conveying water away as quickly as possible, disposing of it through underground drains and sewers. However, this can lead to problems elsewhere in the catchment area due to excessive volumes of run-off discharging at uncontrolled rates into the receiving waters, resulting in flooding of areas further downstream and upstream of the development. More recently, water quality issues have also come to the fore as pollutants from urban areas are washed into the receiving waters or infiltrate and contaminate the groundwater.

SuDS systems are more sustainable than conventional drainage methods as they:

- Manage runoff volumes and flowrates, reducing the impact of urbanisation on flooding
- Protect or enhance water quality by filtering our pollutants
- Are sympathetic to the environmental setting and the needs of the local community
- Provide a habitat for wildlife in urban watercourses
- Encourage natural groundwater recharge (where appropriate).

This is achieved by:

- storing runoff and releasing it slowly (attenuation)
- allowing water to soak into the ground (infiltration)
- Slowly transporting (conveying) water on the surface
- allowing sediments to settle out by controlling the flow of the water.

Through effective control of runoff at source the need for larger flow attenuation and flow control structures should be minimised.

2.2. SuDS Benefits

Urban drainage is moving away from the conventional thinking of designing for flooding to balancing the impact of urban drainage on flood control, water quality management and amenity.

Sustainable drainage takes account of the quantity and quality of runoff, and the amenity and aesthetic value of surface water in the urban environment.

2.2.1. Water Quality

With SuDS techniques, protecting and improving the water quality in receiving watercourses and groundwater is achieved by removing sediment and contaminants from runoff either through settlement/filtration or biological breakdown of pollutants i.e. Biodegradation. Some systems are primarily designed to capture suspended material e.g. swales, detention basins, filter drains and grass filter strips. Infiltration systems provide filtration in the top layers of soil/subsoil, and assume sufficiently low levels of contamination by water soluble pollutants to rely on degradation and subsequent dilution and dispersion of these contaminants. Retention ponds and storm water wetlands have sufficient retention time to allow for the breakdown of many pollutants. They also provide significant storage for persistent pollutants adsorbed on deposited sediments. Biological degradation of pollutants deposited in the vegetation of swales and detention basins will also occur, but may only be a modest proportion of the influent load.

2.2.2. Water Quantity

The main aim of any SuDS system is to mimic the natural runoff characteristics of a site prior to development taking place by focusing on disconnecting roofs, roads and paved areas from conventional drainage systems and conveying runoff to relevant SuDS components. SuDS systems strive to prevent the generation of runoff by reducing the impervious cover within an area, thereby reducing the quantity of surface water entering the stormwater network, particularly during storm events. Permeable sub-bases are used to attenuate or store surface water in the ground, e.g. permeable pavements, vegetated open spaces, bioretention areas, and allow runoff volumes and flowrates to be managed to avoid flooding. Infiltration techniques further reduce the amount of runoff in the stormwater system by enabling surface water to infiltrate permeable soils e.g. soakaways, infiltration trenches, infiltration basin.

2.2.3. Amenity

There is increasing pressure on planners and developers to deliver green infrastructure. SuDS can improve a development by creating habitats that encourage biodiversity and simultaneously provide open space. Incorporating particular SuDS components in a development can enhance the ecology and biodiversity of an area by providing wildlife habitats, while also presenting recreational benefits e.g. stormwater wetlands or retention ponds. Amenities can also be an additional benefit of using SuDS, providing opportunities for multi-functional areas e.g. play areas or sports pitches in detention basins.

2.3. SuDS Techniques

The SuDS treatment train uses a logical sequence of SuDS facilities in series thus allowing runoff to pass through several different SuDS before reaching the receiving watercourse or waterbodies. By using the treatment train approach, runoff will encounter different passive treatment processes that are active in different types of facilities. The treatment train comprises four main categories as follows:

Prevention - of runoff and pollution to runoff
Source Control – treatment of runoff close to the source, within the curtilage of properties
Site Control – runoff is managed in a network across the site or local areas with a reduction in volume and rate of surface runoff and some treatment provided
Regional Control – downstream management of runoff for a whole site/catchment.

SuDS components should be located as close as possible to where the rainwater falls, providing attenuation for the runoff. In addition to piped systems, other methods of conveyance of drainage flow can also be considered in SUDS schemes.

A menu of SUDS components is presented at Table 2.1 below

Management Train	Range of Use	Component	Suitability
Prevention	↑ ↓	Land Use Planning Reduction of Paved Surfaces	Planners to take account
Source Control	↑	Green Roofs Rainwater Harvesting Geocellular Modular Systems Permeable Paving	Large Buildings Individual Buildings No Amenity Value Driveways and carparks
Site Control	↓ ↑	Channels and Rills Soakaways Bioretention Rain Gardens	In curtilage of buildings/open space In sands and gravels- not clays In curtilage or open space In curtilage and open spaces
Conveyance	↑ ↓ ↓	Infiltration Trench Filter Strips/Drains Swales Trench Troughs	Beside roads (in sands and gravels) Next to roads and carparks Next to roads and carparks In open space
Regional Control	↑ ↓	Detention Basins Wetlands Retention Ponds	In open space In open space/parkland In open space/parkland

Table 2.1 Menu of SUDS Components

2.3.1. Prevention

The initial runoff from a site or catchment following a dry spell is known as the 'first flush'. As this runoff travels over a catchment, particularly over impervious areas, it will pick up or dissolve contaminants such as dust, oil, litter and organic matter. The "first flush" portion of the flow is generally the most contaminated as a result especially in vehicular and industrial hardstanding areas. By intercepting this 'first flush', a significant amount of contamination can be prevented from entering the storm water management train.

Site Maintenance

Pollutants can be prevented from entering the surface water drainage system, especially during the 'first flush' of rainfall, by employing a planned maintenance regime for all impermeable surfaces on the site e.g. sweeping to remove dust and debris off roofs and hardstanding areas. This can prevent blockages in the SuDS system which prevents them from working efficiently.

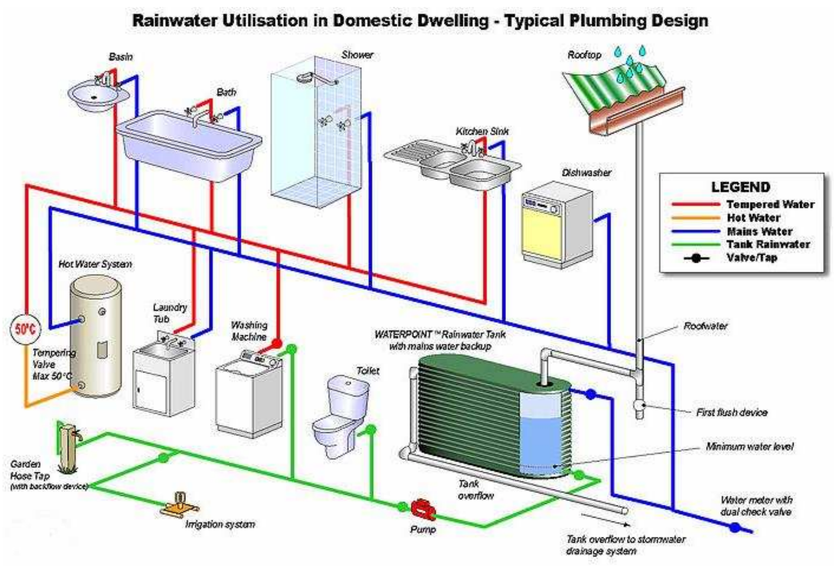
Rainwater Butts

A rainwater butt is a receptacle or tank which is connected to a downpipe and provides offline attenuation of runoff from roofs. Pollutant removal improves if used in conjunction with 'first flush devices', to divert the first 2mm of roof rainfall run-off, and screens to filter out leaves and insects.

Typical Rainwater Butt

Rainwater Harvesting

With this technique, roof runoff is collected in rainwater tanks and stored for future use. The rainwater is generally pumped/piped back into residential, industrial or commercial development to be used for general domestic use, irrigation and landscaping uses. This system is installed to allow the mains to provide water supply in times of dry weather. An overflow pipe will run from the rainwater tank to the storm water management train.



Rainwater Harvesting Schematic

Note: Rainwater Filter to be located at inlet to rainwater tank.

2.3.2. Source Control

An important element of source control is the integration of the street network with SuDS features. The road network presents a potential source of contaminated surface water runoff. During periods of low rainfall following periods of dry weather, the initial runoff, or 'first flush', from a site, particularly road surfaces, contains a high level of contaminants and should be intercepted and treated before it reaches the surface water drainage system, where possible. Locating grass swales, filter strips, infiltration trenches and filter drains adjacent to the road network is an effective method of retaining pollutants that are washed off the road surfaces.

Green Roofs

Green roofs are a multi-layered system that covers the roof of a building or podium structure with vegetation over a drainage layer. The use of vegetation improves the quality and reduces flowrates of rainwater runoff by providing retention, attenuation and provides treatment of rainwater, while also increasing the amenity and biodiversity value of the location. There are two types of systems used; (i) Extensive systems: these require little or no maintenance and are developed primarily for their environmental benefits. They normally consist of thin soils and hardy vegetation applied to the roof areas and (ii) Intensive Systems: these require high levels of maintenance and are developed primarily for their aesthetic enjoyment, but are generally the more expensive option.

Extensive Green Roof System

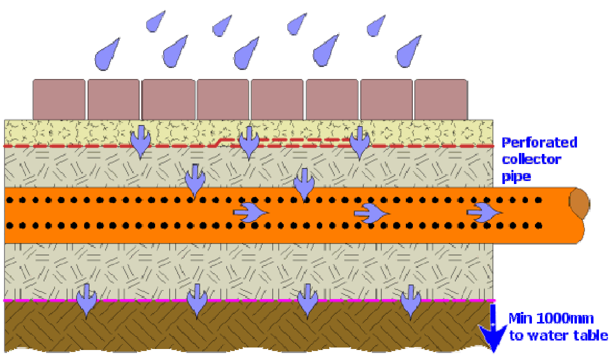
Intensive Green Roof System

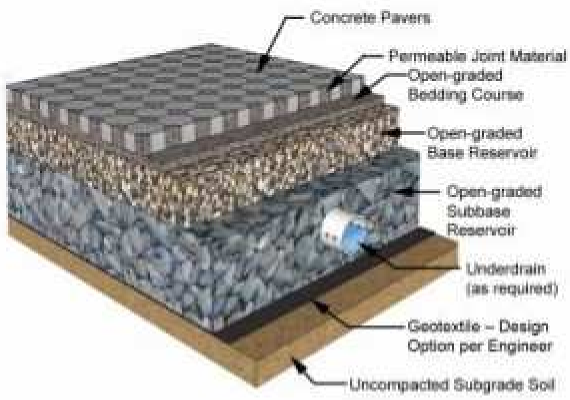
Green Walls

Green walls can be free-standing or part of a building and are partially or completely covered with vegetation. In some cases, soil or an inorganic growing medium is also incorporated. There are two types of green wall (i) green facades and (ii) living walls. Green facades consist of climbing plants either growing directly on a wall or, more recently, specially designed supporting structure. Here, their plant shoot system grows up the side of the building while being rooted in the ground. With a living wall, the modular panels are often made of geotextiles, irrigation systems, a growing medium and vegetation. The three types of growth media used in living walls are (i) loose media, (ii) matt media and (iii) structural media. Green walls are found most often in urban environments where the plants reduce overall temperatures of the building. Living walls may also be a means for water reuse.

Permeable Pavements

Permeable pavements are an alternative to conventional paving and are designed to reduce impervious areas and minimize surface run-off by allowing water to filter through the paved structure rather than running off it. These paved surfaces can vary in type from porous asphalt or concrete to modular paving. Modular paving is suitable only in lightly trafficked areas. Run-off infiltrates to an underlying stone reservoir which is capable of removing pollutants, before discharge in a controlled manner into the storm water management train. High voids-ratio plastic media can be used in lieu of the underlying stone. If this system is used in permeable ground, infiltration directly to the subsoil can occur, thereby reducing the volume of runoff into the stormwater system. If groundwater contamination is an issue, the underlying reservoir can be lined with an impermeable liner. If a system is designed for infiltration only, then an overflow pipe will be required to cope with excess runoff in extended wet periods.



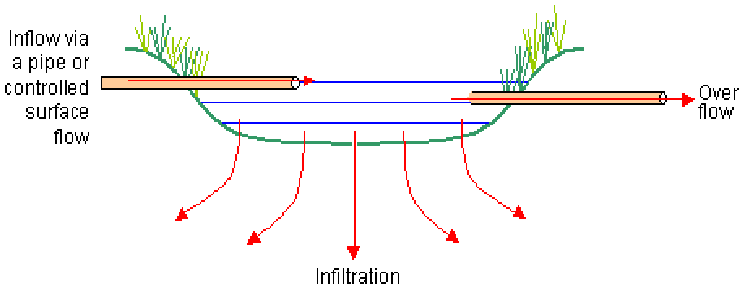


Permeable Pavement Details

Infiltration Basin

An infiltration basin is a shallow depression created permeable ground conditions, designed to promote the infiltration of surface water to the ground. The use of infiltration basins facilitates recharge of groundwater resources and replenishment of surface water baseflows. They have the added benefit of significantly removing pollutants and suspended solids through the process of filtration through underlying unsaturated soils. However, a 6 to 12 inch layer of filter material e.g. coarse sand is recommended to prevent the build-up of impervious deposits on the soil surface. This layer can be replaced when it becomes clogged. They require a large accessible area which is relatively flat and highly pervious and can be integrated into a site's landscaping or open space. Their design should provide for a minimum of 1.5m of unsaturated soils beneath the base of the device to provide for efficient infiltration to the soil and should not be used in areas where groundwater contamination could be an issue.

Infiltration Basin

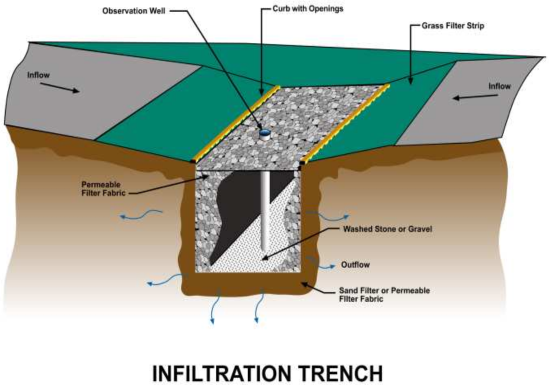


Infiltration Basin Details

Infiltration Trench

This is a gravel or rock–filled trench designed to control and treat run-off by removing pollutants and reduce volume of water discharged to the stormwater management train through infiltration and storage of run-off. Soils underlying the site should be permeable and a pre-treatment devices, such as a swale or filter strip, are recommended upstream of the trench to reduce incoming velocities and the presence of coarser sediments. The run-off is stored in the voids between the gravel or rock and is allowed to slowly infiltrate through the bottom of the trench and into the soil matrix, thereby reducing the volume of water that is discharged into the stormwater management train and reducing some of the impacts caused by excess flow and pollutants. The stone should be wrapped in a geotextile, to prevent soil piping, which should have a greater permeability than the subsoils it drains to.

Infiltration trenches are best used on sites without significant slopes and located adjacent to hardstanding areas, as close to where the rainfall lands as possible. The water table seasonal highs should be at least 1.5m below the invert of the trench to provide for an adequate infiltration rate and treatment in the unsaturated soils and possible contamination of groundwater should be avoided. Sweeping of the draining area to the trench is regularly required to minimise clogging of the system.



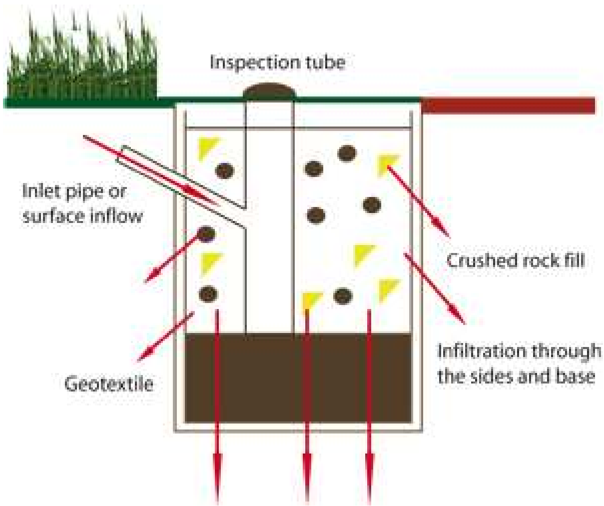
Infiltration Trench Details

Infiltration Trench

Soakaways

A soakaway is a subsurface structure into which surface water is conveyed and allowed to infiltrate into the surrounding permeable ground. The principles of soakaways are similar to that of infiltration trenches, whereby the excavation is backfilled with granular material, but they are then enclosed with pre-cast concrete, polyethylene rings or perforated storage structures and are generally of deeper construction. The construction is effectively a ‘reverse well’ i.e. a ‘hole-in-the-ground’ which loses water rather than collecting water.

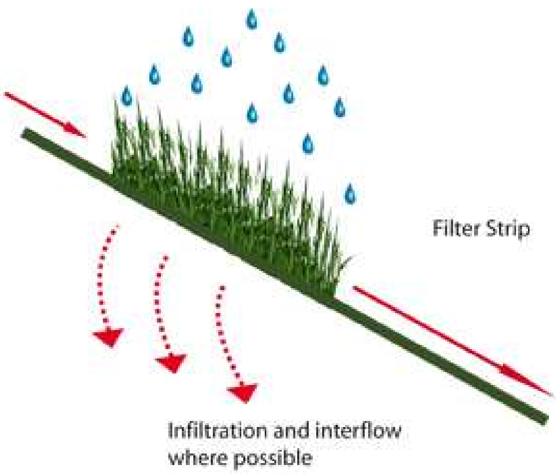
As with all infiltration techniques, the highest water table level should be at least 1.5m below the bottom of the soakaway and possible groundwater contamination should be avoided. Soakaways should be located at a lower level than the area it is draining and at least 5m from surrounding buildings to avoid undermining any existing foundations. A soakaway shouldn't require any maintenance, but it is recommended to lift the cover and check the structure every few months or so to check for silting or contamination.



Cross Section through a traditional soakaway

Filter Strips

A Filter Strip is a gently sloping area of vegetated ground designed to drain water evenly off impermeable areas and filter out silt and other material before entering another SuDS component or watercourse. In order to be effective they should be 5-15m wide and may adopt any natural vegetated form, from grassy meadow to small wood. Filter strips are most effective when located adjacent to hardstanding areas, reducing pollutants and controlling runoff rates from these areas. Filter strips are not designed to attenuate peak stormwater flows, but can be an effective water quality measure, with some infiltration occurring in suitable soil conditions. A dense vegetative cover, long flow length, and low gradient provide the most efficient pollutant removal rates.

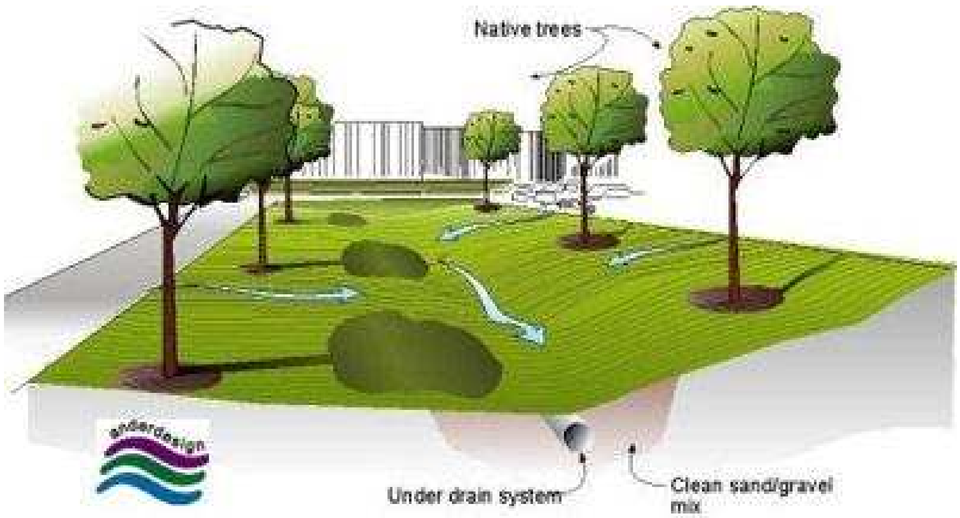


Typical Filter strip detail

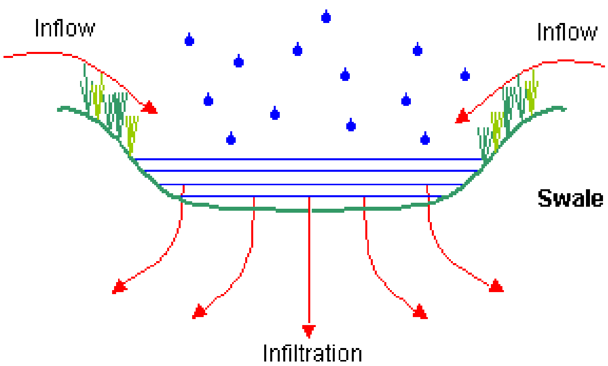
Filter strip

Swales

Swales are long shallow, narrow vegetated channels used to convey run-off whilst removing pollutants by filtering run-off down the side slopes and into the base of the swale. Where located in impermeable soil conditions, the swale channel can be formed using a sand/gravel mix with an underlying drain system. If situated in permeable soil conditions, some or all of the runoff can be infiltrated through the sub-soil matrix. Run-off is then transported in a controlled manner to another SuDS component or to a stream or river downstream though the underdrain system. Due to their linear nature, swales are particularly suitable for controlling run-off from small residential developments, parking areas and roads and are usually used in conjunction with filter strips to provide pre-treatment of the run-off. Swales should be designed to empty within 24 hours of a storm and can be used to link up with other types of SuDS creating green wildlife corridors, providing aesthetic and habitat value to the area.



Schematic of Swale area in public open space along/between roads (Impermeable soil conditions)



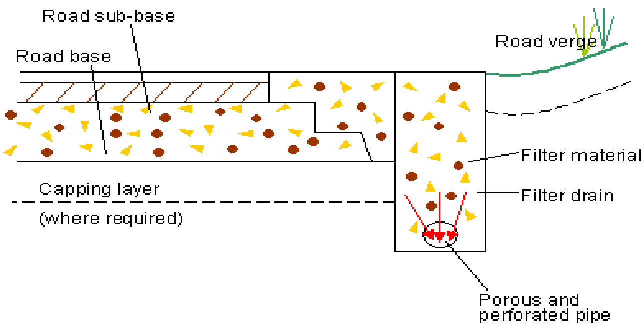
Typical Swale detail in Permeable Soil Conditions

Swale

Filter Drains

Filter Drains are gravel filled trenches, generally with a perforated pipe at the base, linear in feature and designed to run parallel to the surface they are draining. Run-off flows slowly through the granular material, trapping sediments, organic matter and oil residues that can be broken down by bacterial action through time. The runoff rate is reduced, providing attenuation and storage. Flow is then directed to the perforated pipe, which conveys run-off to the stormwater management train. The perforated pipe is not required along the entire length of the drain, only near the end of the component. Filter drains are mainly used to drain roads and carpark surfaces and are situated on the roadside verge or median strip. They can also be used at the base of swale to provide additional attenuation and treatment. Ideally, filter drains should be used in conjunction with filter strips or other pre-treatment device to remove sediment from the run-off and increase the longevity of the system and can be lined with geotextile to prevent the ingress of soil and other material into the system. Excess flows during extreme rainfall events may be dealt with by overland flooding passing to swales or by an overflow pipe which connects to swales or other parts of the stormwater management system.

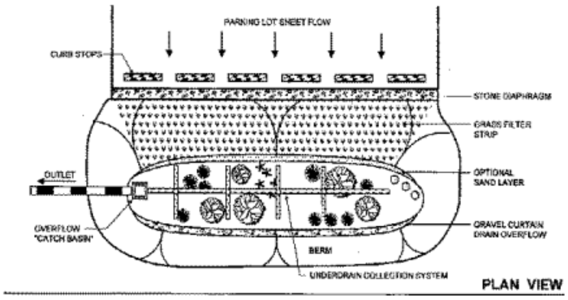
Filter Drain



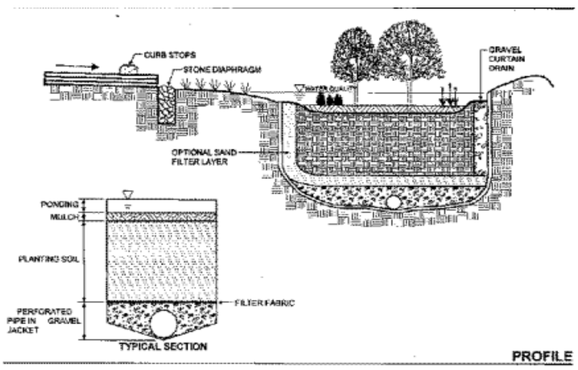
Typical Filter Drain Detail

Bioretention

Bioretention devices are landscaped features adapted to control and treat run-off, close to its source, on the development site. They are designed as depressions and backfilled with a sand/soil mixture, with an upper mulch layer, and planted with native vegetation. Filter strips should be located adjacent to the area to provide pre-treatment of the run-off and increase the longevity of the system. Stormwater runoff collected in the upper layer of the system and passes through a surface vegetation, mulch layer and pervious soil layer, providing filtration and settlement in addition to allowing for possible infiltration, depending on the soil conditions. Bio-retention facilities are typically under-drained and the filtered run-off is conveyed to the stormwater management train. An overflow system should be incorporate into the design to allow larger storm flows to by-pass the system. They are most commonly used in high density urban areas in car parks, traffic islands or within small pockets in residential areas and increase the aesthetic value of an area.



Typical Bioretention Plan Area



Typical Bioretention Cross Section

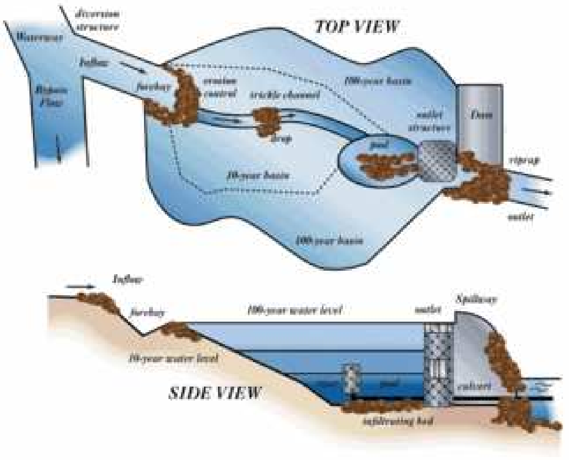
Bioretention Area

2.3.3. Site Control

Detention Basins

These are vegetated depressions designed to store run-off during large storms and provide controlled release of the detained run-off. Detention basins mainly provide runoff rate control as opposed to water quality control and are therefore best used as part of an overall stormwater treatment train approach. However, a limited amount of treatment is provided through settlement of suspended solids and the provision of a sediment forebay will assist with sediment removal. Basins should be designed to empty within 24 hours of a storm event and should, therefore, not have a permanent pool of water. However, the outlet device should be designed so that the facility temporarily impounds runoff in the basin during large storms. An overflow or spillway should also be included in the basin design, to prevent the water levels from over topping the embankment. Depending on the soil type, infiltration to the ground can occur. However, the invert level of the basin should be a minimum of 1.5m above the highest groundwater level and impermeable liners should be incorporated where there is significant potential for seepage of pollutants to the groundwater e.g. in industrial developments. Their design should be for a range of return periods of up to 100 years and they can be used as a regional flood control facility to reduce the 10 and 100 year run-off volumes, depending on their location and the site conditions. In certain instances, these areas can be integrated into green space areas or used as parks, playgrounds or sports fields to enhance the amenity of the area.

Detention Basin



Typical Detention Basin Detail

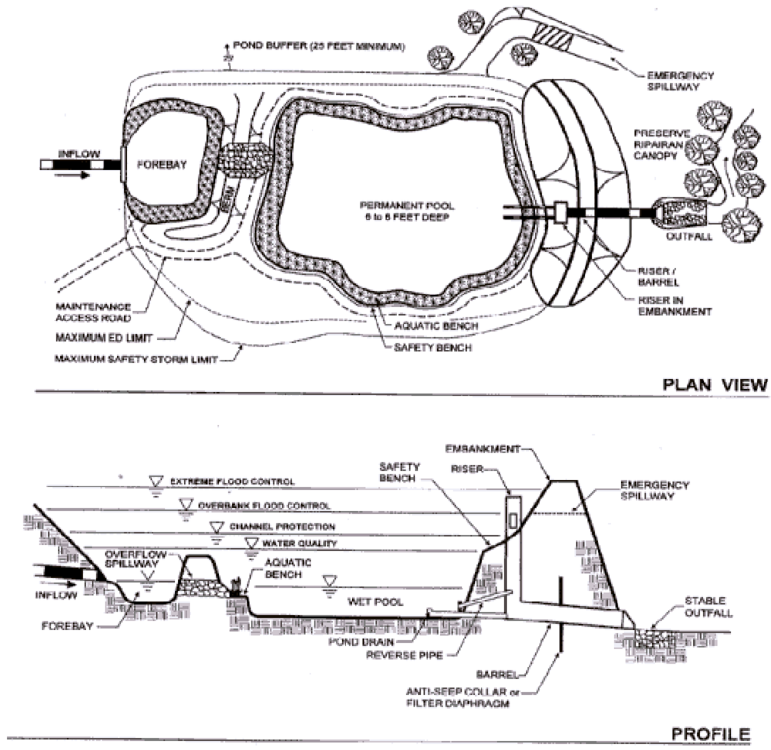
2.3.4. Regional Control

Retention Ponds

Retention ponds are artificial ponds with an open water area and marginal wetland around the edge and incorporate a stilling/settlement area at the inlet to allow for some treatment and calming of storm flows. They are regional controls which serve large scale developments, such as industrial estates or large housing developments, and are one of the most effective water management installations for removing run-off pollutants and improving water quantity and quality while enhancing the amenity and biodiversity value of the area. The ponds store water for up to 3 weeks and release it slowly, allowing sediment to settle in the pond. Nutrients are removed in the open water by photosynthesis and by bacteria attached to the wetland vegetation. As retention ponds have the capability of removing soluble pollutants, they are suitable for sites where nutrient loadings are expected to be high. By designing the ponds to allow fluctuations in water level above the permanent pool of water, they also provide flood control for the area.

Typically the ponds are comprised of the sediment forebay, where coarse particles are trapped and pre-treatment is achieved, and the permanent pond, with wetland and aquatic vegetation planted mainly around a shallow benched edge. The inlet should be designed to minimise the velocity of flow entering the system and should not be fully submerged at normal pool elevation. The inlet and outlet structures should be placed to maximize the flow through the pond, with other features e.g. baffles, islands, and pond shaping, helping to increase the flow path and improve the sedimentation and treatment process. A liner may be required in certain circumstances, e.g. to retain the permanent pool in permeable soil conditions, where pollution to groundwater is possible or where the groundwater levels are high. Multiple retention ponds can be used in sequence to further improve the quality of run-off.

Only specially constructed wetlands should be used to treat surface water. It is not normally an acceptable practice to lead surface water into an existing natural wetland area.



Typical Retention Pond Details

Retention Pond ***Retention Pond***

Stormwater Wetlands

Stormwater Wetlands are retention ponds with more emergent aquatic vegetation and a smaller open water area. They are shallow pools that create growing conditions suitable for marsh plants and typically have less bio-diversity than natural wetlands. They are designed to detain runoff for up to 2 weeks and release it slowly, removing pollutants through biological treatment and settlement and providing habitat and aesthetic benefits. Stormwater Wetlands are the most effective type of SuDS component in terms of pollutant removal and can be integrated into developments as a community water feature, increasing the amenity value of an area. A typical stormwater wetland consists of the following elements:

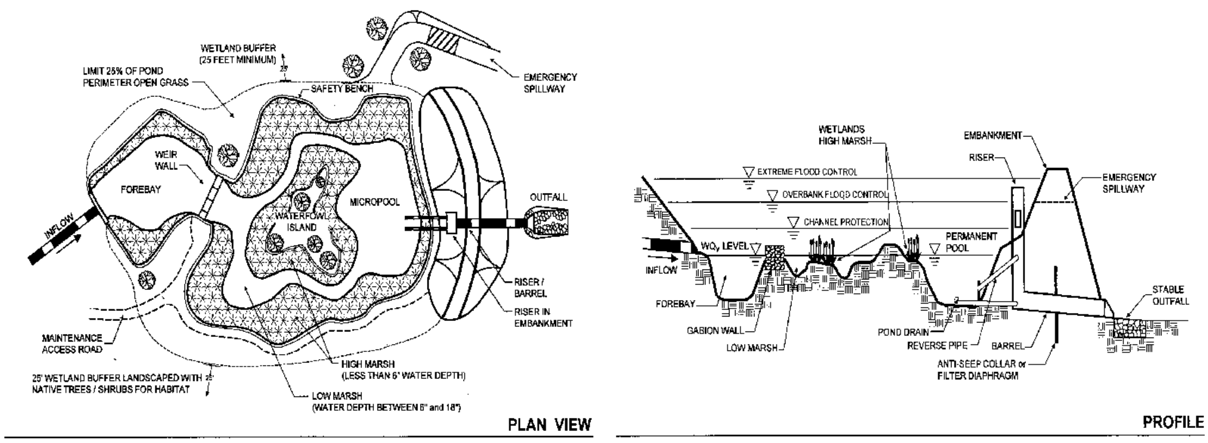
Sediment forebay: this is recommended to decrease the velocity of the inflow and trap coarse sediment and is constructed as a separate cell. Maintenance is performed in this smaller pool eliminating the need to dredge the entire wetland. As an alternative, a detention basin could be located before the wetland to remove settleable solids and protect the wetlands from extreme fluctuations in water levels during large storms.

Shallow vegetated areas of varying depths: wetlands should have zones of both shallow and moderately shallow depths using underwater berms to create the zones. This provides a longer flowpath through the wetland which encourages settlement and plant diversity and discourages undesirable plant monocultures.

Permanent pool or micropool: Wetlands can be designed for flood control by providing flood storage of up to 2m above the level of the permanent pool.

Small depth range overlying the permanent pool, in which runoff volumes are stored: wetlands can be designed for flood control above the level of the permanent pool.

Overflow or emergency spillway: The use of islands and peninsulas ensures that the flowpath between inlet and outlet is maximized. A liner may be required in certain circumstances, e.g. to retain the permanent pool in permeable soil conditions, where pollution to groundwater is possible or where the groundwater levels are high.



Typical Wetlands Details

Typical Wetlands

2.4. SuDS Maintenance

Like all drainage systems, SuDS components should be designed for inspection and future maintenance. This ensures efficient operation and prevents failure. A commitment to the long term maintenance of the drainage system should be established at the early stages in the planning process by involving the owner of the proposed drainage system in the design process.

Usually, SuDS components are on or near the surface and most can be managed using landscape maintenance techniques. For below-ground SuDS, such as permeable paving and modular geocellular storage, the manufacturer or designer should provide maintenance advice. This should include routine and long-term actions that can be incorporated into a maintenance plan.

The tables below indicate typical operation and maintenance requirements for typical SuDS components along with the recommended frequency of completing each type of activity:

O&M Activity	SUDS Component												
	Pond	Wetland	Detention Basin	Infiltration Basin	Soakaway	Infiltration Trench	Filter Trench	Modular Storage	Pervious Pavement	Swale/Bioretention/	Filter Strip	Sand Filter	Pre-Treatment
Regular Maintenance													
Inspection	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Litter/debris	Y	Y	Y	Y	M	Y	Y	M	Y	Y	Y	Y	Y
Grass Cutting	Y	Y	Y	Y	M	Y	Y	M	M	Y	Y	M	M
Weed/invasive Plant Control	M	M	M	M		M	M		M	M	M	M	M
Shrub Management	M	M	M	M					M	M	M		M
Shoreline Vegetation Management	Y	Y	M										M
Aquatic Vegetation Management	Y	Y	M										M
Occasional Maintenance													
Sediment Management *	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Vegetation/Plant Replacement	M	M	M	M						M	M		M
Vacuum Sweeping and Brushing									Y				
Remedial Maintenance													
Structure Rehabilitation/Repair	M	M	M	M	M	M	M	M	M	M	M	M	M
Infiltration Surface Reconditioning				M	M	M	M		M	M	M	M	

Table 2.2 - Typical key SUDS components Operation and Maintenance Activities (CIRIA C697 – SUDS Manual)

Y – Will be required
M – May be required
* Sediment should be collected and managed in pre-treatment systems, upstream of the main device.

Activity	Indicative frequency
Routine/regular maintenance	Monthly (for normal care of SuDS)
Occasional maintenance	Annually (dependent on the design)
Remedial maintenance	As required (tasks to repair problems due to damage or vandalism)

Table 2.3– Typical Operation and Maintenance Requirements

A commitment to the long term maintenance of the drainage system should be established at the early stages in the planning process by involving the owner of the proposed drainage system in the design process.

2.5. SuDS during Construction

For many SuDS, the final construction should take place towards the end of the development programme, unless adequate provision can be made to protect the component. The contractor and all relevant operatives should have an understanding of the mechanism and purpose of the SuDS components to ensure appropriate construction practice and protection is carried out.

Traditional car parking and other paved areas are usually partially constructed during the initial stages of development to provide storage and access on the site. However, if pervious pavements and infiltration are proposed for these areas, the construction process needs to be modified to prevent sediments from clogging the structure or the soil base e.g. it is more effective to lay the permeable paving system late in the construction process, thus avoiding the time where contamination by silts is a higher risk. If deemed necessary, jet-washing of the blocks can be undertaken to clear debris in joints. Immediately following this operation the joints should be refilled with an appropriate sand / grit.

The construction of swales, basins and ponds at an early stage in the construction will assist in managing runoff and help settle out the high volumes of sediments created during construction. Temporary SuDS systems can be provided, comprising a filtration system to trap debris and allow settlement and collection of silt. However, complete reinstatement of these components will be required once construction is finished.

3. DARDISTOWN EXISTING SITE CHARACTERISTICS

3.1. Topography and Watercourses

The topography of the LAP lands is generally flat, rising gently from the south-east to the north-west and from the south-east to the south-west of the site. There are a few existing paths and hedgerows from the north to the south of the site, and a number of watercourses crossing from west to east. There is a verge of dense vegetation along the M50.

The subject lands lie within the catchment of the Turnapin stream which rises in the north west of the site and traverses the LAP from northwest to south east and is an open ditch for most of its length. The surface water in this area drains to this stream, which flows into the Mayne River. This Mayne River in turn discharges to Portmarnock Estuary at Mayne Bridge. This estuary is a designated SPA, SAC and pNHA site under the EU Habitats Directive.

The existing stream/river system which drains the LAP lands is indicated in Figure 3.1.

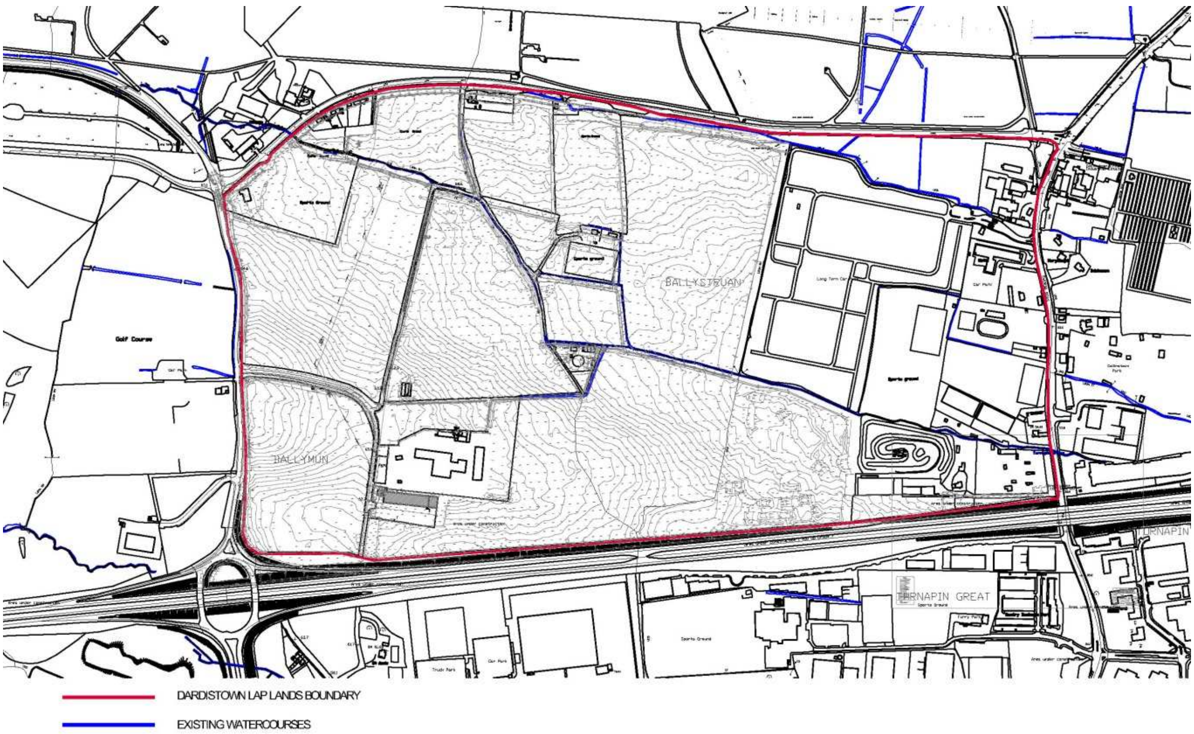


Figure 3.1 Existing Watercourses and Site Topography

3.2. Soils, Geology and Groundwater

The dominant soil type of the Local Area Plan is a firm grey-brown sandy gravelly clay, or boulder clay, of glacial origin overlying carboniferous limestone bedrock. The boulder clay is over-consolidated and is relatively incompressible, resulting in a low permeability.

A review of the Bedrock Geology Map from GSI established the bedrock geological features of the site as being part of the Tober Colleen formation which is classified as dark grey, calcareous, commonly bioturbated mudstones and subordinate thin micritic limestones. Fossils are generally scarce, but a goniatite fauna occurs towards the top. The Tober Colleen formation can also exhibit transported blocks of Waulsortian and locally derived limestones as can be seen north of Portmarnock Strand. This material reflects the tectonic event that also produced the Rush Conglomerate and the Boulder Conglomerate at Navan.

A site investigation was carried out by B. J. Murphy and Associates for Hugo Byrne's lands between November 2000 and May 2001 and included a desk study, a walkover study and geophysical survey. Based on the results of these surveys, a trial pit investigation was carried out at a number of selected locations. Laboratory testing was also carried out to determine the geotechnical parameters of the materials identified. The depths of the pits varied from 2.5m to 3.3m below ground level and indicate that the ground conditions are generally consistent throughout the site. A layer of topsoil, ranging from 0.3m to 0.5m in thickness, was encountered over a layer of firm to stiff, brown, sandy gravelly CLAY with cobbles and boulders (Dublin Brown Boulder Clay) at depths of 0.3m to 2.7m below ground level and varying in thickness from 1.4m to 2.4m. Underlying this layer is very stiff, dark grey, sandy gravelly CLAY with cobbles and boulders (Dublin Black Boulder Clay) at depths of at least 1.7m below ground level. A soft to stiff, sandy fine to medium gravelly CLAY (possibly Post-glacial deposits) was encountered in localised areas. Bedrock was not encountered within the depth of the excavations.

The boulder clay material has low permeability and percolation rates, protecting underlying bedrock aquifers, restricting recharge and, where sufficiently thick, confining them. In terms of groundwater, the majority of the site is within the designation Pi i.e. poor aquifer generally unproductive except for local zones The south-east corner of the site is designated Li i.e. locally important moderately productive aquifer. Groundwater was encountered infrequently as local seepages or dampness in the firm brown clay during excavation of the trial pits The Carboniferous bedrock has a low permeability and is generally unproductive with some higher permeability horizons occurring within the calp. Groundwater flow through the Calp limestone is dominated by fissure permeability. During excavation it is considered that pumping will adequately deal with the amount of water ingress that may occur locally. The area is unsuitable for infiltration and soakaway construction.

No visible indication of contamination of the site was apparent during excavation of the trial pits and no contaminants were encountered during laboratory testing of the trial pit spoil material.

A copy of the site investigations carried out by B. J. Murphy and Associates are included in Appendix A.

3.3. Environment

3.3.1. SPA, pNHA and SACs

The LAP will be required to achieve and maintain required standards for ecological, biological and chemical water quality of existing rivers and streams. It will be important to ensure no pollution and/or contamination of ground water sources occurs as a result of runoff infiltration.

Portmarnock Estuary is identified as an SPA, pNHA and SAC under the EU Habitats Directive. It is therefore imperative that the quality of the Turnapin stream and Mayne River is maintained and that all future developments consider surface water issues and apply the principles of SuDS as part of the development strategy of the lands.

3.3.2. Proximity to Airport Lands

The proximity of Dublin Airport to the subject lands means that birdstrikes (i.e. aircraft collisions with large and flocking birds) pose a significant risk to aircraft. Consultation with the Dublin Airport Authority is required to ensure the proposed SuDS techniques do not increase the risk of birdstrikes to any aircraft using the Airport facilities. The recommendations of Section 20.3.5 of the SuDS Manual (CIRIA C697, 2007) shall be implemented in the detailed landscaping design for SuDS components within the LAP lands

3.4. Flood Records

Fingal County Council is currently carrying out the Fingal East Meath Flood Risk Assessment and Management Study (FEM FRAMS), in conjunction with Meath County Council and the Office of Public Works. This is a catchment-based flood risk assessment and management study of rivers and streams within the county area. The Mayne River catchment is located in the FEM FRAMS area and the current draft flood extent maps for the Turnapin stream produced for this study indicate there are two prominent flooding locations just downstream of the subject lands. Although there is no history of flooding on the subject lands, based on the Fingal East Meath Flood Risk Assessment and Management Study (FEM FRAMS) flood extent maps for the Turnapin stream, there are a number of areas within the proposed development which are at risk of flooding. There are also extensive flooding locations downstream of the subject lands. These areas should be protected against flooding from a design event return period of at least once in 100 years. This would reduce the risk of flooding to existing development to less than a 1% chance in 100 years which is the standard set down in the OPW/DoEHLG 'Planning Guidelines for the Planning System and Flood Risk Management' (Nov 2009). The impact of any surface water proposals and channel improvements will have to be considered in terms of changes to flood risks on the lands. In this regards, this SuDS Strategy has been undertaken for the LAP lands.

A Site Specific Flood Risk Assessment will be completed in accordance with 'The Planning System and Flood Risk Management, Guidelines for Planning Authorities' (2009) for the subject lands, incorporating flood risk assessment into the process of making decisions on planning applications and planning appeals.

The relevant draft FEM FRAMS flood extent maps are included in Appendix B.

3.5. Survey Data – 3rd Party Surveys

As previously discussed, a site investigation was carried out by B. J. Murphy and Associates for Hugo Byrne's lands between November 2000 and May 2001 which included a desk study, a walkover study and geophysical survey. The objectives of the initial desk study, walkover and geophysical surveys were to:

- estimate the overburden thickness
- map changes in overburden type and thickness, areas of soft ground and areas of made ground or disposal pits across the site
- determine depth to bedrock, bedrock quality and excavatability
- select trial pit locations based on the results of these studies

The methods used to complete the above were

- EM31 conductivity surveying to map variations in overburden type and thickness and outline areas of soft ground, made ground and disposal pits across the site
- 2-D Resistivity profiles to estimate the overburden thickness and variation in rock type with depth
- Seismic refraction to estimate the overburden stiffness and to map the rock profile and rock quality.

The desk study examined data from the following sources:

- GSI 1:10560 six inch scale filed mapping sheets
- McConnell, B., Philcox, M.E., MacDermot, C. V., and Sleeman, A. G. 1995 *Bedrock Geology 1:100,000 Map Series, Sheet 16, Kildare-Wicklow* (with geological description)
- Geological Survey of Ireland Karst Database
- GSI geotechnical database for the area, comprising a site investigation report from a nearby site including 4 no. borehole information
- GSI Groundwater Section well records
- GSI 1979 Aquifer Protection Map for Dublin County
- Map Sheets c. 1912, 1997, 2000.

Based on the results of these studies, the location of fifteen trial pits were chosen and opened and laboratory testing carried out to determine geotechnical parameters of the material identified. The depths of the trial pits ranged from 2.5m to 3.3m below ground level. The pits indicated that ground conditions are generally consistent throughout the site, comprising topsoil over firm to stiff, brown, sandy gravelly clay with cobbles and boulders underlain by very stiff, dark grey, sandy gravelly clay with cobbles and boulders. The depth to the very stiff clay varied between 1.40m and 2.40m below ground level across the site. Bedrock was not encountered within the excavated depths.

No visible indication of contamination of the site was apparent during excavation of the trial pits. Groundwater was encountered infrequently a local seepages or dampness in the firm brown clay. The interpretation of the trial pit data is summarised in the following table:

LAYER	THICKNESS	DESCRIPTION	INTERPRETATION
1	0.3-0.5	Topsoil	
2	0.3-1.0 (present locally only)	Soft to stiff sandy fine to medium gravelly silt or clay	Post-Glacial Deposits
3	1.4-2.4	Firm to stiff brown gravelly clay with cobbles and boulders	Weathered Till (Dublin Brown Boulder Clay)
4	> 0.6	Very stiff dark grey gravelly clay with cobbles and boulders	Unweathered Till (Dublin Black Boulder Clay)

Table 3.1 Trial Pit Data Summary

Samples of soil were taken from the trial pits during the fieldwork. Laboratory testing was carried out on these samples to test for a range of geotechnical parameters. The tests carried out included Moisture Content, Sulphate pH, Sieve analysis (wet sieve), Sieve analysis (hydrometer), Atterberg Limits Tests, Organic Content and Soil Compaction/CBR tests.

A number of site investigations were completed for proposed developments on other landholdings within the LAP lands, including the proposed Collinstown Road Car Park for Gatland Properties in 2008, the Quickpark Car Park for Gerard Gannon and the proposed Metro North Dardistown Depot site for the RPA. The ground conditions encountered in these site investigations were consistent with those encountered by B. J. Murphy and Associates.

The references for the previous reports, completed by B. J. Murphy & Associates, is included in Appendix A.

4. FUTURE PROJECTIONS

4.1. Proposed Development

The total area of the LAP lands is 156.34Ha, with the proposed Metro North, Metro West and Metro depot area covering 28.6Ha of this area. The proposed development consists of low density logistics and warehousing, and low density and high density commercial development, in addition to the proposed Metro North Depot and three opportunity sites.

As discussed, in Section 1, it is proposed that the development on the LAP lands will occur in a phased manner. The proposal allows for appropriate densities of development to proceed immediately in appropriate locations, while reserving later phases until public transport has been significantly upgraded. The phasing also identifies opportunity sites which will be reserved for major landmark developments. Figure 1.2 provides an overview of the proposed development phasing and areas as follows:

Phase 1 - Dardistown LAP Period 2012 to 2018

Phase 1A (8.29Ha): The area within this phase will be suitable for commercial and logistics & warehousing uses. This phase can benefit from road access to the Naul Road and from the Quality Bus Corridor to be developed along this route, providing links with the Airport, Ballymun and the city centre. Development should be focused on the north western section of the site where access to the external road network is good and conflict with the construction of Metro North would be avoided.

Phase 1B (12.42Ha): Development in this phase can become more focused around the high intensity core of the site, including higher density commercial, office, leisure, hotel, conference and retail developments, graduating in intensity as it moves closer to the transport interchange. A high quality park is proposed with a pedestrian spine running north/south of the area and parkways running east/west with new buildings framing these green/open spaces. This phase can proceed independent of the Metro based on the excellent bus based potential of the Dardistown Development site.

Phase 1C (22.20Ha): This area contains a number of established commercial, leisure and amenity uses, with the majority of the lands falling both within the Inner and Outer Public Safety Zones. Uses will be appropriate to these designations and the zoning of the lands as General Employment and could potentially include low intensity/density uses such as logistics, warehousing, commercial car parks and transport depot(s).

Open Spaces/Sports (4.36Ha): These areas to the east of the LAP lands are to be retained for open space and sports uses.

Phase 2 - Dardistown LAP Period 2018 to 2024

Phase 2 (29.97Ha): The areas of this phase located to the north of the LAP lands will be more suited to logistics and warehousing uses. To the south of the Metro Depot, the development intensity will graduate the closer it gets to the principal internal movement axes, with the hub fully integrated and a high quality park and pedestrian spine running north/south of the hub and parkway running east/west, with higher density mixed used developments. Phase 2 development area may become a core area in itself as it is located more centrally within the overall LAP lands.

Phase 3 (23.87Ha): This phase of the development of the Dardistown Lands will see the further development of logistics and warehousing areas.

Phase 3 - Dardistown LAP Period 2024+

Phase 3 Metro (10.49Ha): These areas surround the proposed Metro North, Metro West and Metro Depot sites, with the areas within the Inner Public Safety Zone suitable for logistics and warehousing development, commercial car parks and transport depot(s) and those within the Outer Public Safety Zone suitable for commercial, higher density use

Opportunity Sites (Not Phase Specific)

Opportunity Sites 1 & 2 (8.10Ha): Two areas are identified as opportunity sites fronting the M50 road and at the intersection of the Ballymun Interchange and Naul Road. These are strategic sites that will be reserved for commercial development types that are strategic in their own right. These sites may be developed at any stage of the lifetime of the LAP subject to the suitability of the development proposals that may be brought forward and necessary infrastructure being in place.

Metro Opportunity Site (4.75 Ha): This opportunity site is located adjacent to the high intensity core and development can including high density commercial development.

4.2. Development Densities

The proposed development densities are indicated in Table 4.1 below. These development densities will be used in the determination of impermeable contributing areas in the design of the SUDS scheme.

Note: The development densities for the proposed Metro North, Metro South and Metro Depot development area are not accounted for in this report. For details of the SuDS strategy for this area, refer to Metro North Dardistown Depot EIS.

Phasing Ref.	Land Use	Gross Extent of Plot (ha)	Net Extent of Plot (ha)	Zoning	Indicative Plot Ratio Low	Indicative Plot Ratio High	Indicative Floorspace (sqm) Low	Indicative Floorspace (sqm) High
Dardistown LAP Period 2012 to 2018 (Phase 1)								
1A	Commercial	1.98	1.49	HT	1.5	2	22275	29700
	Commercial	3.70	2.78	HT	1.5	2	41625	55500
	Logistics and Warehousing	1.80	1.35	GE	0.3	0.75	4050	10125
	Logistics and Warehousing	0.81	0.61	GE	0.3	0.75	1823	4556
	Metro Land Take	28.60	21.45	GE	0	0	0	0
1B	Commercial	12.42	9.32	HT	1.5	2	139725	186300
1C*	Logistics and Warehousing	20.50	15.38	GE	0.3	0.75	46125	115313
Retain	Open Space / Sports	4.36	0.00	OS	0	0	0	0
Sub-Totals		74.17	52.36				255623	401494
2nd Dardistown LAP Period 2018 to 2024 (Phase 2)								
2	Commercial	17.60	13.20	HT	1.5	2	198000	264000
2	Logistics	3.90	2.93	GE	0.3	0.75	8775	21938
	Logistics	8.47	6.35	GE	0.3	0.75	19058	47644
Sub-Totals		29.97	22.48				225833	333581
3*	Logistics and Warehousing	0.22	0.17	GE	0.3	0.75	495	1238
3*	Logistics and Warehousing	2.70	2.03	GE	0.3	0.75	6075	15188
3*	Logistics and Warehousing	12.85	9.64	GE	0.3	0.75	23130	72281
3*	Logistics and Warehousing	8.10	6.08	GE	0.3	0.75	14580	45563
Sub-Totals		23.87	17.90				53708	134269
3rd Dardistown LAP Period 2024+ (Phase 3)								
3 - metro	Logistics and Warehousing	3.10	2.33	GE	0.3	0.75	6975	17438
3 - metro	Logistics and Warehousing	3.80	2.85	GE	0.3	0.75	8550	21375
3 - metro	Commercial	1.34	1.01	HT	1.5	2	15075	20100
3 - metro	Commercial	1.50	1.13	HT	1.5	2	16875	22500
Sub-Totals		9.74	7.31				47475	81413
Opportunity Sites (Not Phase Specific)								
OS-1	Commercial	5.30	3.98	HT	1.5	3	59625	119250
OS-2	Commercial	2.80	2.10	HT	1.5	2	31500	42000
Sub-Totals		8.10	6.08				91125	161250
Metro Opportunity Site (Proceed upon confirmation of Metro North delivery)								
Metro OS	Commercial	4.75	3.56	HT	1.5	2.5	53438	89063
Sub-Totals		4.75	3.56				53438	89063
Developable Site Area and Totals		150.60	109.68				727200	1201069
Inner PSZ Total lands		6.00		In PSZ	0.00	0.00	0	0

Note 1: *Development may take place in subsequent Phases*
Note 2: *All indicative development quantums based on net site area which allows for a 25% reduction in site area to accommodate roads, ancillary spaces, etc.*
Note 3: *Above Quantums discount approx. 6.0ha of land within Inner PSZ (Cone)*

Table 4.1 Proposed Development Densities

4.3. Impermeable Areas

A detailed architectural layout has not been received for the subject lands and runoff coefficients based on the land uses and densities for the LAP lands form the basis for the calculation of the impermeable area. Table 4.2 below sets out the percentage impermeable areas for the range of development types and densities envisaged for the subject lands.

Development Type	% Impermeable Area Low	% Impermeable Area High
Logistics and Warehousing	75	80
Commercial	75	80

Table 4.2 – Impermeable Areas

These impermeable area percentages will be used as the impermeable contributing areas in the design of the SUDS scheme.

4.4. Design Review

4.4.1. Greenfield Runoff Rates

The Turnapin Stream flows through the subject lands and collects the existing runoff from the LAP lands. The Greenfield runoff rates from the catchment can be calculated using the equation for ***Qbar*** given in Volume 2 of the Greater Dublin Strategic Drainage Study (GDSDS) and developed by the Institute of Hydrology Report No. 124 "*Flood Estimation for Small Catchments*" 1194. It allows Greenfield runoff rates, based on site conditions for small catchments, to be estimated as follows:

$$Qbar = 0.00108\ (AREA^{0.89})\ (SAAR^{1.17})\ (SOIL^{2.17})$$

where:

Qbar = the mean annual flood flow from a catchment in m^3/s for a return period of 2.3 years.

Area = Site Area in km^2

SAAR = Standard Average Annual Rainfall in mm

SOIL = Runoff Constant

This equation is referred to as the IAH124 equation for mean annual flow and should not be applied to areas less than 50 hectares ($0.5km^2$). As all phases of the proposed development are less than 50 Ha in size, *Qbar* is calculated for 50 hectares and flow rates are then linearly interpolated for smaller areas.

The nearest rainfall station to the site is Dublin Airport, for which the SAAR is 733mm.

Table 6.7 of Volume 2 of the GDSDS indicates % runoff rates or SOIL values for different soil types. For the subject lands soil type of 4 (CLAY), the value for SOIL = 0.47

For an area of 50ha:

$$Qbar = 0.00108\,(0.5^{0.89})\,(733^{1.17})\,(0.47^{2.17})$$

$$\Rightarrow \quad Qbar = 254.8 \text{ l/s}$$

According to the GDSDS, a minimum value of 2l/s/ha is recommended for *Qbar* in order to prevent excessive costs for smaller discharge rates. The value of *Qbar* calculated above for 50ha is equivalent to 5.1 l/s/ha, and is in excess of the proposed minimum value.

Using linear interpolation for *Qbar* for an area of 50 ha, Table 4.3 below gives values of *Qbar* for each of the proposed phases of the development.

	Area (ha)	Q_{bar} (l/s)
Phase 1A	8.29	42.25
Phase 1B	12.42	63.29
Phase 1C	13.7	69.82
	8.5	43.32
Phase 2	17.6	89.69
	8.47	43.16
	3.9	19.87
Phase 3	15.55	79.31
	8.1	41.28
	0.22	1.12
Phase 3 - Metro	5.37	27.37
	3.78	19.26
	1.34	6.83
Opp. Site 1	5.3	27.00
Opp. Site 2	2.8	14.27
Metro Opp. Site	4.75	24.21

Table 4.3 Greenfield Runoff Rates

According to CIRIA SUDS Manual, Table 4.2, FSSR 14 (IH, 1993) regional growth curve factors should be used to calculate Greenfield peak flow rates for 1-, 30- and 100-year return periods. The GDSDS states that *Qbar* can be factored using the Flood Studies Report regional growth curve for Ireland to produce peak flows for these return periods.

Using the recommended FSR Growth Curve from Figure C2, Vol. 2 of the GDSDS gives the following factors:

Return period T years	25	100
Q/Qbar	2.05	2.58

Table 4.4 Q/Qbar values for Return Period of T years

Interpolation of the growth curves in Table 4.4 for a 30 year return period gives

$\Rightarrow \quad Q_{30}/Q_{BAR} = 2.09$

$\Rightarrow \quad \mathbf{Q_{30}} = Qbar \times 2.09$

Also

$\Rightarrow \quad Q_{100}/Q_{BAR} = 2.58$

$\Rightarrow \quad \mathbf{Q_{100}} = Qbar \times 2.58$

From Table 6.6 of the GDSDS, the interim growth curve factor for a return period of 1 year is 0.85.

$\Rightarrow \quad \mathbf{Q_{1}} = Qbar \times 0.85$

The various Greenfield runoff rates for the proposed development phases are summarised in Table 4.5 below.

		Q_1 (l/s)	Q_{bar} (l/s)	Q_{30} (l/s)	Q_{100} (l/s)
Phase 1A		35.91	42.25	88.30	109.00
Phase 1B		53.80	63.29	69.82	43.32
Phase 1C	13.7ha	59.35	69.82	145.93	180.14
	8.5ha	36.82	43.32	90.54	111.77
Phase 2	17.6ha	76.24	89.69	187.45	231.40
	8.47ha	36.69	43.16	90.20	111.35
	3.9ha	16.89	19.87	41.53	51.27
Phase 3	15.55ha	67.41	79.31	165.75	204.61
	8.1ha	35.09	41.28	86.28	106.50
	0.22ha	0.95	1.12	2.34	2.89
Phase 3 - Metro	5.37ha	23.27	27.37	57.20	70.62
	3.78ha	16.37	19.26	40.25	49.69
	1.34ha	5.81	6.83	14.28	17.62
Opp. Site 1		22.95	27.00	56.43	69.66
Opp. Site 2		12.13	14.27	29.82	36.82
Metro Opp. Site		20.58	24.21	50.60	62.46

Table 4.5 Summary of Greenfield runoff rates

Development is likely to commence along the Naul Road frontage, with Phases 1A and 1B benefiting from road access to the Naul Road and from the Quality Bus Corridor to be developed along this route. Similarly, Phase 1C to the east is accessible from the Swords Road and can be accessed from the existing infrastructure located along this route. Phase 2 would build out the area around the proposed Metro North and Metro West interchange and may become a core area in itself as it is located more centrally within the overall LAP lands. Phase 3 will see the full build out of the lands in the LAP area.

Opportunity Sites 1 & 2 and the Metro Opportunity Site are strategic sites and are not phase specific. These sites may be developed at any stage during the lifetime of the LAP subject to the suitability of the development proposals that may be brought forward and the necessary infrastructure being in place.

Surface runoff from these phases will not outfall to a single location. Topographical and other constraints determine that a number of outfalls will be required. The proposed outfall locations are indicated on Figure 4.1 below and are described as follows:

Outfall A - Phase 1A: Surface Water from Phase 1A areas can discharge northwards to the Turnapin Stream via a corridor retained between the proposed Maintenance depot and the Ballymun Kickham GAA pitch.

Outfall B - Phase 1B, Phase 3 Metro (1.34ha), Opportunity Sites 1& 2 and Metro Opportunity Site: Surface Water Runoff from these phases can discharge north eastwards to the Turnapin stream.

Outfall C - Phase 1C – 8.5ha: Surface water from this phase, located in the north east corner of the site, can discharge to the existing watercourse which flows along the LAP site boundary adjacent to this phase.

Outfalls D-L: As the remaining phases all have frontage along the Turnapin stream, surface water from these phases can discharge directly into the Turnapin stream.

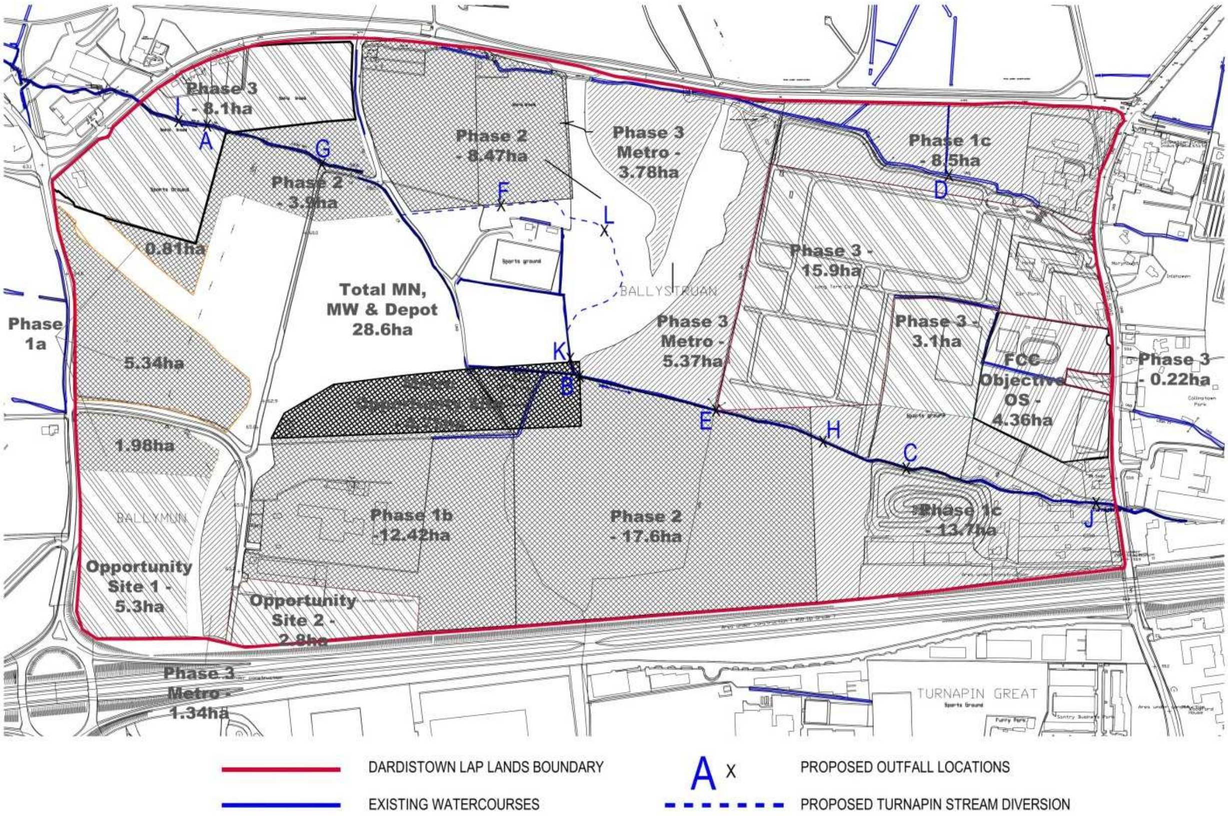


Figure 4.1 Proposed Outfall Locations

Each of the proposed outfalls will be designed for the Greenfield runoff rates indicated in Table 4.6 below, which will be used in the design of the SUDS scheme for the development:

		Outfall Reference	Q_{bar} (l/s)
Phase 1A		A	42.25
Phase 1B		B	135.60
Phase 1C	13.7ha	D	69.82
	8.5ha	C	43.32
Phase 2	17.6ha	E	89.69
	8.47ha	F	43.16
	3.9ha	G	19.87
Phase 3	19.0ha	H	107.6
	8.1ha	I	41.28
	0.22ha	J	1.12
Phase 3 - Metro	5.37ha	K	27.37
	3.78ha	L	19.26
	1.34ha	B	135.60
Opp. Site 1		B	135.60
Opp. Site 2		B	135.60
Metro Opp. Site		B	135.60

Table 4.6 Summary of Outfalls and Greenfield Runoff Rates

4.4.2. Treatment Volume

The water quality treatment volume, V_t aims to retain and treat the most polluted water from the rainfall runoff from all events, and to retain the full volume from 90 per cent of all rainfall events. It is linked to the rainfall depth for the area, as defined by M5-60, i.e. a 5-year return period, 60 minute duration storm depth.

To determine the required storage or water quality treatment volume, V_t for SUDS components, the following formula is used:

$$V_t\ (m^3/ha) = 9 \times D(SOIL/2 + (1 – SOIL/2 \times I)$$

where:

V_t = Water Quality Treatment Volume in m^3/ha
D = M5-60 rainfall depth (5 year return, 60 minute duration)
SOIL = Soil Classification
I = % of the area which is impervious

From Table 6.8 of the GDSDS, we note that the equivalent rainfall depth, *D*, for North Dublin for an M5-60 event is 15mm.

SOIL = 0.47, as previously noted.

The value of *I* varies depending on the proposed use of each phase of the development and are based on the values indicated in Section 4.3 above. For the purposes of these calculations, the lower value of 75% impervious area will be used for all phases.

Table 6.2 of the GDSDS indicates climate change factors to be applied to drainage design. A 10% increase in rainfall depth is to be incorporated into the design of the drainage elements i.e. all rainfall intensities should be increased by a factor of 1.1.

Therefore, the value of $V_t m^3/ha$ for the proposed development can be calculated as

$$V_t = 9 \times (1.1 \times 15)\ (0.47/2 + (1 - 0.47/2) \times 0.75)$$

$\Rightarrow$ $\mathbf{V_t}$ = 120.10 m^3/ha

The values for V_t for the proposed development phases are summarised in Table 4.7 below.

	Area (ha)	V_t (m^3)
Phase 1A	8.29	996
Phase 1B	12.42	1,493
Phase 1C	13.7	1,645
	8.5	1,021
Phase 2	17.6	2,114
	8.47	1,017
	3.9	468
Phase 3	15.55	1,868
	8.1	973
	0.22	27
Phase 3 - Metro	5.37	645
	3.78	454
	1.34	161
Opp. Site 1	5.3	637
Opp. Site 2	2.8	336
Metro Opp. Site	4.75	571

Table 4.7 Summary of V_t values

4.4.3. Attenuation Volumes

Current design criteria require that no flooding occurs up to a 30-year return period. To minimise flood nuisance to the community and ensure that no flooding of the site, except where it has been specifically planned for, occurs, a 30-year return period event is used to determine the attenuation storage volumes required for a site.

From Section 4.4.1above, the values for Q_{30} for the various development phases are as follows:

		Q_{30} (l/s)
Phase 1A		88.30
Phase 1B		69.82
Phase 1C	13.7ha	145.93
	8.5ha	90.54
Phase 2	17.6ha	187.45
	8.47ha	90.20
	3.9ha	41.53
Phase 3	15.55ha	165.75
	8.1ha	86.28
	0.22ha	2.34
Phase 3 - Metro	5.37ha	57.20
	3.78ha	40.29
	1.34ha	14.28
Opp. Site 1		56.43
Opp. Site 2		29.82
Metro Opp. Site		50.60

Table 4.8 Summary of Q30 values

A detailed drainage model of the proposed system is required to analyse the volumes to satisfy this criterion.

4.4.4. Long-term Storage Volumes

Given the low infiltration rates associated with the subject land soils, it is recommended that stormwater infiltration to the ground is not seen as a solution for regional stormwater control or storage. 'Long term storage' will be required to ensure sufficient runoff is retained on site during extreme events, thereby not exacerbating flooding in the receiving waters, and maintaining Greenfield runoff rates.

In accordance with the GDSDS, a 100-year return period is applied for the protection of flooding within properties, in adjacent urban areas and for river flood protection. The estimation of the 'long term' storage is a simple calculation of finding the difference between the runoff volume generated by the development site and that for the Greenfield site using the 100 year 6 hour event. As infiltration is not a technique suitable for the proposed development site, Figure 6.4 of Volume 2 of the GDSDS can be used to determine Vol_{xs}, i.e. the 'long-term' storage volume, for the various phases of the development.

Using Soil Type 4 and the lower *I* value of 75%, described in Section 4.3, the volume in m^3/ha for 1mm of rainfall depth is:

Vol_{xs} (m^3/ha.mm) = 2.5

Table 6.8 of the GDSDS describes the rainfall depth for North Dublin as 58.7mm. This results in a 'long-term' storage volume for the North Dublin Area of:

Vol_{xs} (m^3/ha) = 146.75

Table 4.9 below indicates the total 'long-term' storage volumes required for each Phase of the proposed development.

	Area (ha)	Vol_{xs} (m^3)
Phase 1A	8.29	1,217
Phase 1B	12.42	1,823
Phase 1C	13.7	2,010
	8.5	1,247
Phase 2	17.6	2,583
	8.47	1,243
	3.9	572
Phase 3	15.55	2,282
	8.1	1,189
	0.22	33
Phase 3 - Metro	5.37	788
	3.78	545
	1.34	197
Opp. Site 1	5.3	778
Opp. Site 2	2.8	411
Metro Opp. Site	4.75	697

Table 4.9 Summary of Vol_{xs} values

4.5. Roads Hierarchy

A defined road network for the LAP lands has been developed and is illustrated in Figure 4.2. An internal circulatory road was designed to provide adequate access, connectivity and permeability to all parcels of land within the LAP boundary while eliminating the need for all traffic to travel through the centre of the site, where the majority of pedestrian activity is likely to take place around the urban core and Metro station.

The provision of this internal road network will minimise traffic on the external road network by allowing vehicles to access the proposed development on either side of the Metro Rail Line in the most efficient manner possible. A number of different road layout types may be adopted with this internal grid pattern depending on its position within the road hierarchy as follows:

- Access Distributor Road
- Main Distributor Road
- Main Distributor Road with Bus/Cycle Lane.

The existing five access points to the LAP lands are to be maintained, two of which are located on the Southern Parallel Road, to the North of the site, one from the Naul Road to the west of the site and one from the Old Swords Road to the east of the site. The locations of these access points are also illustrated on Figure 4.2.

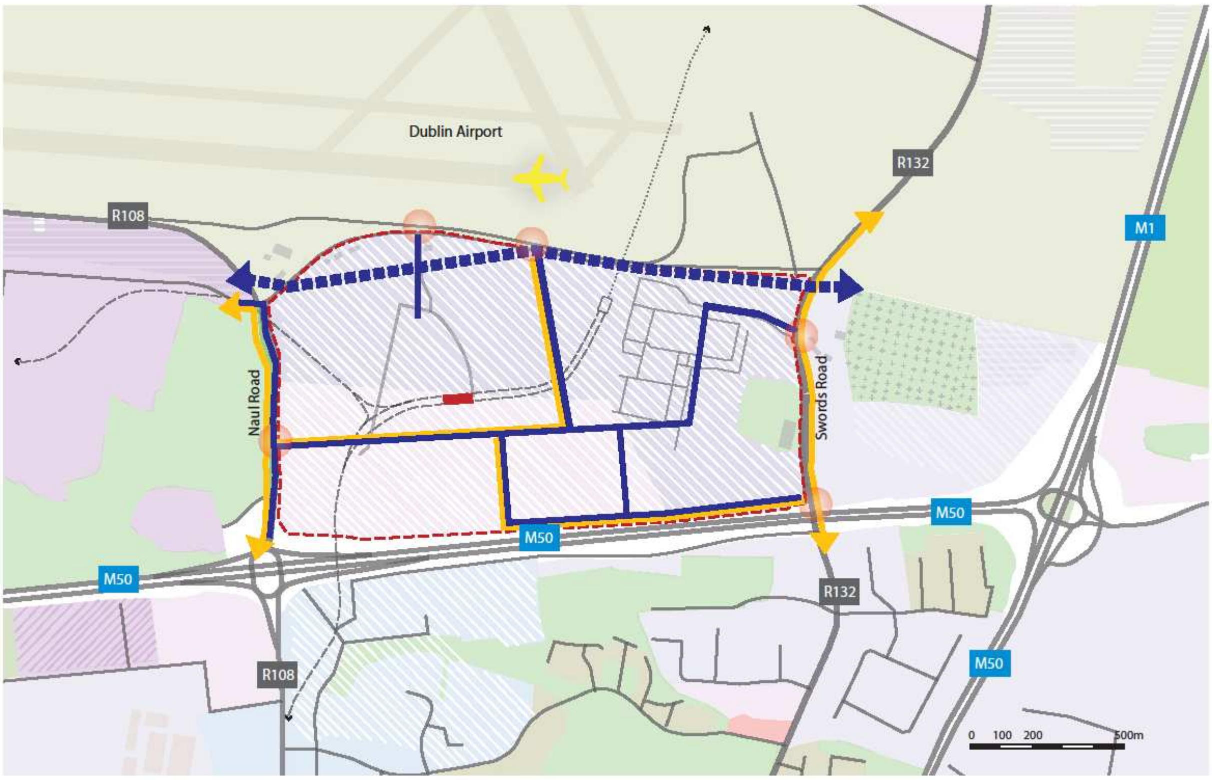


Figure 4.2 Proposed Road Network

4.6. Parks and Green links

The proposed overall structure for the LAP lands includes the provision of a green spine of open space through the site. The landscape of the site sets up a grid of perpendicular axes with the watercourses defining an east-west rhythm to the site and the existing roads and hedgerows establishing the north-south connections. These will be adapted to provide for a green network of spaces within the lands and environs, using the natural environment to assist with drainage and the preservation of the existing flora and fauna, where possible. Within built-up areas public spaces and green links should be located to coincide with the existing depressions in the topography, allowing for stormwater retention and/or attenuation areas within these green spaces. It is proposed that pedestrian and cycling networks will occur along the proposed green networks.

The landscape strategy is illustrated in Figure 4.3. Large open bodies of water shall be avoided given the proximity to the Airport.

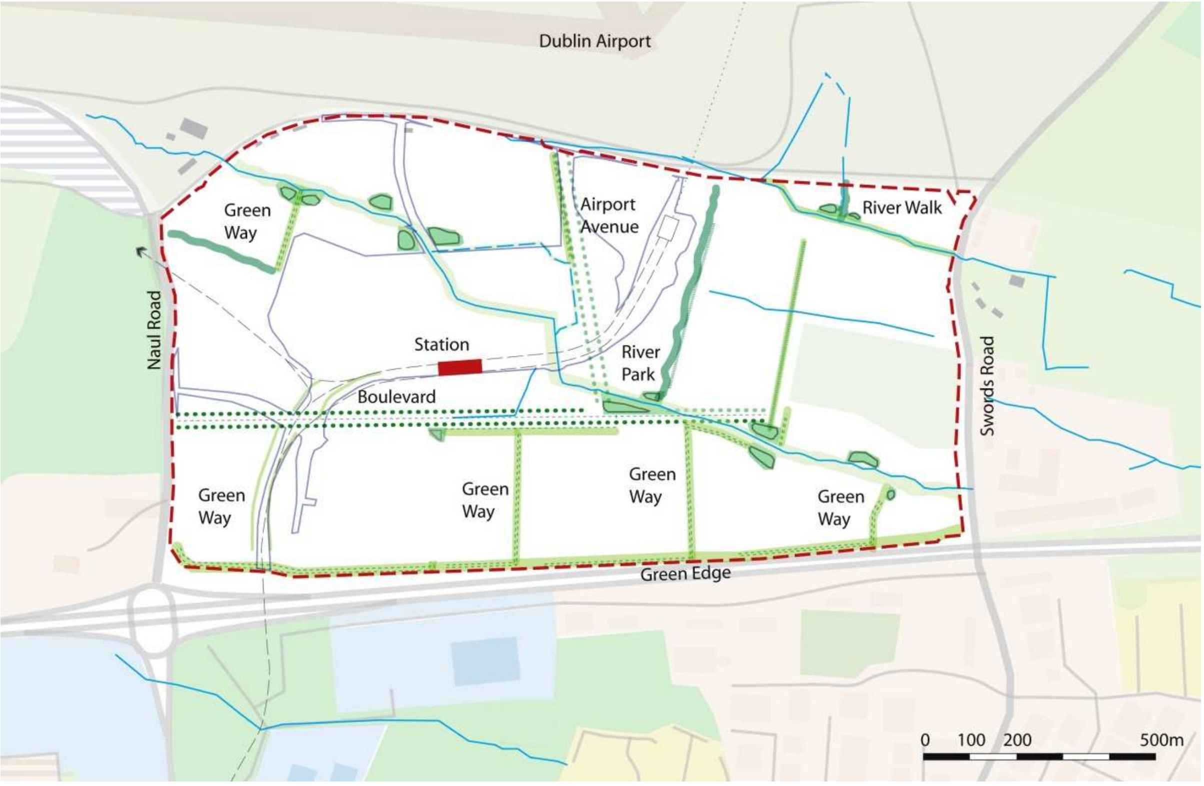


Figure 4.3 Proposed Landscape Strategy

5. SuDS SELECTION & STRATEGY

The SuDS Strategy for the LAP lands will incorporate a hierarchy of solutions based on the principle of treatment at source, where practical. Any surface water runoff from the proposed development will be restricted to the Greenfield discharge rates, as detailed in Section 4.4.1, and as per the requirements of GDSDS, by the combination of extensive use of SuDS and installing surface water attenuation systems. A surface water management train approach is to be adopted in the design of the proposed surface water drainage scheme for the subject lands by utilising suitable SuDS mechanisms in providing Source, Site and Regional Control. All surface water design for the LAP lands will be based on this SuDS Strategy, incorporating an integrated approach to the management of runoff from each phase of the development and the LAP lands as a whole.

The following is a list of site specific characteristics which have an influence on the type of SuDS components best suited to the proposed development.

5.1. Design Criteria

Design criteria for the Dardistown SUDS scheme must provide an objective framework for designing the system to drain the subject lands effectively, while protecting the environment and ensuring public health and safety is not compromised.

The objectives of a SuDS scheme are to:

- Store or safely pass the runoff from extreme storm events, without putting public property at risk
- Reduce if possible, or at least not increase, the pre-development risk of flooding associated with the receiving watercourse
- Prevent downstream stream bank and channel erosion
- Reduce urban runoff pollutants and improve stormwater quality before discharge
- Provide amenity and ecological benefits, wherever practicable
- Avoid negative impacts on nearby airport

It is not possible to design for all events and there will always be instances where the design criteria are exceeded. The design process should therefore consider the consequences of events larger than the design event of risk and physical, economic, social and environmental impacts. Such impacts should be managed through appropriate site design as far as possible.

Project specific design criteria are considered in more detail below with a view to establishing runoff design specifications to be met by individual developments within the LAP lands. Hydraulic, water quality, amenity and ecological/environmental design criteria are considered and established.

5.1.1. Hydraulic Design Criteria

As stated above, the basic hydraulic principle for the design of the Dardistown SuDS scheme is that the rate at which runoff enters the local watercourse from the proposed development does not exceed the corresponding rate prior to the commencement of the new development (year storm events up to 1 in 100 year frequency).

The OPW and DoEHLG have established Guidelines for Planning Authorities as set out in their Guidance Document "The Planning System and Flood Risk Management". The Guidance document states that flood plains have a valuable function both in attenuating and storing flood water through their ability to convey flood water in a relatively controlled and safe way. It is important to identify and safeguard identified flood plain areas against development in both urban and rural areas.

The Fingal East Meath Flood Risk Management Assessment and Management Study (FEM FRAMS) has being undertaken on behalf of Fingal and Meath County Councils and the OPW. Draft flood extent mapping has been published for nineteen rivers and streams in the Fingal-East Meath area and include the Turnapin/Mayne River. These flood extent maps present information on flood extent, depth, velocity and hazard and are included, for the Mayne River, in Appendix B. These maps are the copyright of the OPW and are in draft format at present. Their use in respect of the Dardistown SuDS scheme is subject to the qualification that the Office of Public Works makes no representations, warranties or undertakings about any of the information provided on these maps including, without limitation, their accuracy, their completeness or their quality or fitness for any particular purpose. However, they indicate the likely extent of Flood Zones A and B along the Turnapin/Mayne river.

The Local Area Plan for Dardistown is being developed based on the maintenance of a riparian corridor along the Turnapin Stream and Mayne River and no development is proposed within the floodplain of these watercourses. Therefore, adherence to the Planning and Flood Risk guidelines will ensure that there is adequate protection against flooding from the watercourse.

5.1.2. Water Quality Design Criteria

The key principle in respect of water quality is that an appropriate management train of SuDS components should be implemented to effectively mitigate the pollution risks associated with different site users/activities. The first flush of surface runoff from paved areas generally contains higher concentrations of pollutants as a result of the build-up of solids and pollutants on the urban surfaces during the preceding dry weather. To remove the major proportion of the pollution it is necessary to capture and treat runoff from frequent small event and capture and treat a small proportion of the initial runoff (first flush) from larger and rarer events. Runoff from impermeable surfaces should be managed at source where possible and provision of a multi-component treatment train will maximise the treatment efficiency of a wide range of pollutants. This in turn will provide protection to the final stages of the treatment train so as to maximise potential amenity and wildlife benefits.

Therefore, a stormwater management train with a minimum of two components is required. This conforms to the recommendations of the SuDS Manual. The design of the SuDS components will need to consider erosion control and sedimentation for both the construction and operation phases.

5.1.3. Amenity

The key design considerations for amenity are Health & Safety, visual impact and amenity benefit. There is a fundamental requirement that SuDS components should be designed to eliminate actual or perceived health and safety risks. Basins should be designed with shallow side slopes, shallow shelving edges and strategically placed vegetation. Limiting the side slope and depth of swales will ensure that they do not present an undue risk to vehicles that may leave the adjacent road in an accident. Maintenance access should be considered form the outset. The risk of falls should be identified and either eliminated or mitigated.

High quality visual impact is essential to ensure public acceptability and maximise amenity benefits. This can be achieved by appropriate use of vegetation and landscaping techniques to maximise aesthetic appeal. Open water areas should be linked to recreation sites and the size of such permanent areas should be kept to a minimum in order to avoid negative impact on the operation of the nearby airport. An appropriate landscaping scheme and maintenance programme should be established which will ensure that the areas within and around SuDS components are visually attractive throughout the year. The public should be informed (and in particular local homeowners) concerning the role played by the SuDS systems in draining the site and protecting the environment. Public information signage or leafleting may achieve this.

5.1.4. Environmental Performance Requirements

The Turnapin Stream and Mayne River discharge to Portmarnock Estuary at Mayne Bridge. This estuary is a designated Special Protection Area, Special Area of Conservation and a proposed National Heritage Area under the EU Habitats Directive. There is, therefore, a need to maintain habitat quality and the conservation status of this area by preventing pollution to the area. As any potential development on the subject lands could impact on this designated site, it is imperative that the quality of the Turnapin stream and Mayne River is maintained and that all future developments consider surface water issues, applying the principles of SuDS as part of the development strategy of the lands.

The LAP will be required to achieve and maintain required standards for ecological, biological and chemical water quality of existing rivers and streams. It will be important to ensure no pollution and contamination of ground water sources as a result of runoff infiltration and that all future developments consider surface water issues and apply the principles of SuDS as part of the development strategy of the lands.

Ecological diversity shall be maximised through the consideration of the following:

- The use of native planting.

- The use of appropriate source control or pre-treatment techniques before discharge of runoff to open water bodies.
- Locating SuDS in or near non-intensively managed landscapes where possible, e.g. close to natural pond or wetland habitats
- Retaining and enhancing the natural drainage system
- Creating a range of habitat types
- Including a shallow aquatic bench in pond designs
- Implementing an appropriate maintenance and management plan.

However, due to the proximity of the airport to the development, it is recommended that the creation of additional bird habitats is avoided to eliminate the threat and danger of 'bird strikes' to the aircraft using Dublin Airport. The following is a list of particular hazards related to landscaping features and, as such, must be avoided in the proposed development:

- Dense vegetation cover that may provide roosting or nesting habitats for starlings, rooks, woodpigeon and other aviation-hazard bird species
- Fruit or berry bearing plants that provide winter food supplies to starlings, fieldfares, redwings etc.
- Open water or watercourses that attract gulls and other large waterfowl and cause increased bird movement between existing waters and the new site, over and around the airport
- Open grasslands close to water which attract Canada geese and Greylag geese.

SUDS landscapes for the subject lands shall be designed to support non-hazardous species such as passerines (song birds) rather than larger flocking birds. Large open water areas shall be avoided with smaller mosaics of ponds more acceptable, although even these may have to be netted in some cases. Islands that provide safe nesting locations shall not be included within designs and ease of access by birds between the water and land shall be constrained. Grass shall be kept long (>200mm) and managed as a meadow to deter birds.

5.2. Proposed Development

The proposed development consists of low density logistics and warehousing, low density and high density mixed use, e.g. office, retail and leisure, and outdoor areas for entertainment, recreation and public events, in addition to the proposed Metro North Depot and a number of opportunity sites. A network of main distributor roads are, where possible, located on or beside the main natural drainage routes of the lands. It is anticipated that development of the Dardistown LAP lands will be phased as tenants are secured for each of the areas. Development should be focused initially on the western and eastern section of the site where access to the external road network is good and conflict with the construction of Metro North would be avoided.

Due to the benefit from road access to the Naul Road and from the Quality Bus Corridor to be developed along this route, providing links with the Airport, Ballymun and the city centre, it is expected that the Phase 1A will initially be developed with Phases 1B and 1C to follow.

A surface water management train approach shall be adopted in the design of the proposed surface water drainage scheme for the subject lands by utilising suitable SuDS mechanisms in providing Source, Site and Regional Control. It is recommended that areas greater than 2 ha do not drain to a single component, but that the catchment is split into sub-catchments and several smaller features are included that drain to a final site control. In this respect, the SuDS strategy for the subject lands will consist of a multi-point discharge as illustrated in Figure 4.1.

Attenuation and SuDS measures can be provided within the respective development phase areas.

All development proposals will be required to take into consideration the threat of pollution from surface water runoff and mitigate appropriately. Distribution and access roads and other circulation routes and public realm areas will require treatment and attenuation of runoff. Swales, infiltration basins, retention ponds and stormwater wetlands should be considered, where practical, as a first solution for surface runoff from such areas. Retentions of riparian corridors as significant landscape features, free from development, will facilitate the routing of flood flows.

It is not considered appropriate that all of the SuDS provision be provided within the primary infrastructure, i.e. the distributor roads network and associated services provision. The requirement for the area draining to a single SuDS component not to exceed 2hA approximately, taken in conjunction with the principle of source control, will dictate that a significant proportion of the SuDS components will be located within these phased areas. The precise form and detailed layout of these areas may vary from that prepared for the Local Area Plan. Therefore it is not yet proposed to prepare a detailed scheme specifying precisely the SuDS components to be provided within all of these areas.

Given the likely overlap in terms of responsibility for delivery of primary infrastructure and the individual phases, it is proposed that 60% of the surface attenuation provision/volume reduction for developed site should be provided within or adjacent to the individual phases. The balance of the surface attenuation provision/volume reduction must be accommodated within the SUDS scheme accompanying the distributor roads network and associated services provision.

5.3. SuDS Suitability /Selection Criteria

There are many different SuDS components that can be used on a site, with each type having certain limitations depending on a number of site specific characteristics and proposed development design criteria e.g. water quality treatment is critical for low flows, and stormwater attenuation and volume control is critical for high flows. The options chosen for any particular SuDS Strategy will depend on a variety of factors relating to that particular development i.e. soil type, proposed land use, site constraints, future management and the needs of local people. The ideal solution to SuDS design will comprise a number of SuDS components linked together to form a SuDS management train for the site.

The following details the suitability of particular SuDS techniques for the Dardistown LAP lands based on various specific characteristics.

5.3.1. Land Use

The majority of the LAP lands to be developed are currently in agricultural use, with a small proportion of the land used for industrial purposes. The M50 motorway runs along the southern boundary of the lands.

The original Greenfield Runoff Rates from Section 4.4.1 must be maintained after the proposed development is completed. As agriculture is currently the main land use, it will be required to maintain a low percentage of impermeable surface area, where possible, for the new development. Permeable pavements, filter strip, swales and green roof techniques can all contribute to reducing the impermeable area of the development.

5.3.2. Site Characteristics

Table 5.1 below, from CIRIA Report C697 – SUDS Manual, details a site characteristics selection matrix for particular SuDS Components:

Suds Group	Technique	Soils		Area draining to single SuDS component		Minimum depth to water table		Site Slope		Available Head		Available Space	
		Impermeable	Permeable	0 - 2ha	> 2 ha	0 – 1m	> 1m	0 – 5%	> 5%	0 – 1m	1 – 2m	Low	High
Retention	Retention pond	Y	Y[1]	Y	Y[5]	Y	Y	Y	Y	Y	Y	N	Y
	Subsurface storage	Y	Y	Y	Y[5]	Y	Y	Y	Y	Y	Y	Y	Y
Wetland	Shallow wetland	Y[2]	Y[4]	Y[4]	Y[6]	Y[2]	Y[2]	Y	N	Y	Y	N	Y
	Extended detention wetland	Y[2]	Y[4]	Y[4]	Y[6]	Y[2]	Y[2]	Y	N	Y	Y	N	Y
	Pond/wetland	Y[2]	Y[4]	Y[4]	Y[6]	Y[2]	Y[2]	Y	N	Y	Y	N	Y
	Pocket wetland	Y[2]	Y[4]	Y[4]	N	Y[2]	Y[2]	Y	N	Y	Y	Y	Y
	Submerged gravel wetland	Y[2]	Y[4]	Y[4]	Y[6]	Y[2]	Y[2]	Y	N	Y	Y	N	Y
	Wetland channel	Y[2]	Y[4]	Y[4]	Y[6]	Y[2]	Y[2]	Y	N	Y	Y	N	Y
Infiltration	Infiltration trench	N	Y	Y	N	N	Y	Y	Y	Y	N	Y	Y
	Infiltration basin	N	Y	Y	Y[5]	N	Y	Y	Y	Y	N	N	Y
	Soakaway	N	Y	Y	N	N	Y	Y	Y	Y	N	Y	Y
Filtration	Surface sand filter	Y	Y	Y	Y[5]	N	Y	Y	N	N	Y	N	Y
	Sub-surface sand filter	Y	Y	Y	N	N	Y	Y	N	N	Y	Y	Y
	Perimeter sand filter	Y	Y	Y	N	N	Y	Y	N	Y	Y	Y	Y
	Bioretention/filter strips	Y	Y	Y	N	N	Y	Y	N	Y	Y	N	Y
	Filter trench	Y	Y[1]	Y	N	N	Y	Y	N	Y	Y	Y	Y
Detention	Detention basin	Y	Y[1]	Y	Y[5]	N	Y	Y	Y	N	Y	N	Y
Open channels	Conveyance swale	Y	Y	Y	N	N	Y	Y	N[3]	Y	N	N	Y
	Enhanced dry swale	Y	Y	Y	N	N	Y	Y	N[3]	Y	N	N	Y
	Enhanced wet swale	Y[2]	Y[4]	Y	N	Y	Y	Y	N[3]	Y	N	N	Y
Source Control	Green roof	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y
	Rain water harvesting	Y	Y	Y	N	Y	Y	Y	Y	Y			
	Permeable Pavement	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y

Table 5.1 Site Characteristics Selection Matrix

= Y: Yes N:No

[1] with liner *[2] with surface baseflow*

[3] unless follows contours *[4] with liner and constant surface baseflow, or high groundwater table*

[5] possible, but not recommended (implies appropriate management train not in place)

[6] where high flows are diverted around SuDS component

The following is noted based on the above matrix:

- Infiltration SuDS techniques are unsuitable for sites with impermeable soils
- The available head needs to be considered when selecting the locations of open channels, detention basins and sand filter techniques, noting that the site slopes gently in a west to east direction
- The available space will be a determining factor for the selection of most SuDS techniques

The gentling sloping site should not restrict the choice of SuDS techniques to be incorporated into the development.

Soils at Dardistown generally comprise post-glacial deposits over Dublin brown/black boulder clay. The boulder clay material is over-consolidated, is relatively incompressible and, as a result, has low permeability and percolation rates. It protects underlying bedrock aquifers, restricting recharge and, where sufficiently thick, confining them. Overburden depths are generally shallow ranging from 0.3m to 0.5m. Due to the low permeability of the boulder clay and shallow depths of overburden, infiltration solutions are not considered suitable over the greater part of the LAP area. However, although any basins or swales will not need to be lined in order to retain a permanent depth of water, large bodies of water are not permitted due to the proximity to the Airport.

During site investigations, groundwater was encountered infrequently as local seepages or dampness in the boulder clay and no soil contaminants were found. The choice of SuDS techniques, therefore, will not be affected by issues with groundwater quality or a high water table.

The overall site area is in excess of 125hA. A treatment train with several components will be required with the site broken up into sub-catchments with separate outfalls. Proposals for the sub-division of the site into sub-catchments and their proposed outfall locations are presented at Figure 4.1 and discussed in Section 4.4.1. Attenuation and SuDS measures can be provided within the respective development phase areas.

5.3.3. Catchment Characteristics

The site drains naturally to the Turnapin stream which rises in the north west of the site and traverses the proposed development from northwest to south east and is an open ditch for most of its length.

Although there is no history of flooding on the subject lands, based on the Fingal East Meath Flood Risk Assessment and Management Study (FEM FRAMS) flood extent maps for the Turnapin stream, there are a number of areas within the proposed development which are at risk of flooding. There are also extensive flooding locations downstream of the subject lands. These areas should be protected against flooding from a design event return period of at least once in 100 years. This would reduce the risk of flooding to existing development to less than a 1% chance in 100 years which is the standard set down in the OPW/DoEHLG 'Planning Guidelines for the Planning System and Flood Risk Management' (Nov 2009). This can be achieved by locating attenuation components adjacent to floodplain areas, thereby utilising areas not suitable for development e.g. stormwater wetlands.

The riparian corridor of the Turnapin stream, illustrated in Figure 4.3, can be maintained free from development and incorporated within the SuDS management train for the LAP lands, maintaining the original catchment drainage route.

5.3.4. Quantity and Quality Performance

The Turnapin stream flows into the Mayne River which in turn discharges to Portmarnock Estuary at Mayne Bridge. Portmarnock Estuary is identified as an SPA, pNHA and SAC under the EU Habitats Directive. There is therefore a need to maintain habitat quality and the conservation status of this area by preventing pollution to the area. As any potential development on the LAP lands could impact on the Natura 2000 site, it is imperative that the quality of the Turnapin stream is maintained and that all future developments consider any surface water issues, applying the principle of SuDS as part of the development strategy of the lands.

Table 5.2 below, reproduced from CIRIA Report C697 – SUDS Manual, details a quantity and quality performance selection matrix for SuDS Components.

Suds Group	Technique	Water Quality Treatment Potential					Hydraulic Control			
		Total Suspended Solids Removal	Heavy Metals Removal	Nutrient (phosphorous, nitrogen) removal	Bacteria Removal (^{x})	Capacity to treat fine suspended sediments and dissolved pollutants	Runoff Volume Reduction	Suitability for flow rate control (probability)		
								0.5 (1/2 yr)	0.1–0.3 (10/30 yr)	0.01 (100 yr)
Retention	Retention pond	H	M	M	M	H	L	H	H	H
	Subsurface storage	L	L	L	L	L	L	H	H	H
Wetland	Shallow wetland	H	M	H	M	H	L	H	M	L
	Extended detention wetland	H	M	H	M	H	L	H	M	L
	Pond/wetland	H	M	H	M	H	L	H	M	L
	Pocket wetland	H	M	H	M	H	L	H	M	L
	Submerged gravel wetland	H	M	H	M	H	L	H	M	L
	Wetland channel	H	M	H	M	H	L	H	M	L
Infiltration	Infiltration trench	H	H	H	M	H	H	H	H	L
	Infiltration basin	H	H	H	M	H	H	H	H	H
	Soakaway	H	H	H	M	H	H	H	H	L
Filtration	Surface sand filter	H	H	H	M	H	L	H	M	L
	Sub-surface sand filter	H	H	H	M	H	L	H	M	L
	Perimeter sand filter	H	H	H	M	H	L	H	M	L
	Bioretention/filter strips	H	H	H	M	H	L	H	M	L
	Filter trench	H	H	H	M	H	L	H	H	L
Detention	Detention basin	M	M	L	L	L	L	H	H	H
Open channels	Conveyance swale	H	M	M	M	H	M	H	H	H
	Enhanced dry swale	H	H	H	M	H	M	H	H	H
	Enhanced wet swale	H	H	M	H	H	L	H	H	H
Source Control	Green roof	n/a	n/a	n/a	n/a	H	H	H	H	L
	Rain water harvesting	M	L	L	L	n/a	M	M	H	L
	Permeable Pavement	H	H	H	H	H	H	H	H	L

Table 5.2 Quantity and Quality Performance Selection Matrix

[X] Limited data available
[*] There may be some public safety concerns associated with open water that require addressing at design stage
n/a: non-applicable
H = High Potential
M = Medium Potential
L = Low Potential

The following should be noted in respect of the matrix at Table 5.2:

- Wetlands, filtration and open channels provide the most effective means of water quality treatment potential
- Source control methods provide the most effective available means of runoff volume reduction.
- Due to the location of an identified SPA, pNHA and SAC, Portmarnock Estuary, downstream of the proposed development, the quality of the Turnapin stream must be maintained. SuDS techniques which provide high quality water treatment potential should be used e.g. wetlands, filtration and open channel techniques.

The SUDS techniques being considered for the SUDS strategy for Dardistown include the following:

Source Control - permeable pavements will be considered within residential developments and pedestrian and low trafficked areas, with the option of rainwater harvesting and green roofs and walls for larger institutional and commercial buildings. Permeable pavements perform well in terms of water quality treatment potential and in terms of both runoff volume reduction and suitability for flow rate control across the range design return periods (1 year to 100 year). It is important to note that silt traps and petrol interceptors, although not specifically SuDS techniques, do need to be incorporated into the treatment train as a form of pollution prevention for surface runoff in car parking or trafficked areas. The incorporation of these elements will improve the quality of the runoff into the SuDS treatment train. Swales and filter strips can be incorporated in roadside verges/margins between footpath and road, providing medium to high potential for water quality treatment. With the exception of enhanced wet swales, swales have medium potential for runoff volume reduction. All swale types have high potential for flow rate control across the range design return periods (1 year to 100 year). Bioretention areas can provide additional runoff control and treatment if sufficient space is available. If possible, runoff from roofs and hardstanding areas can be directed to vegetated areas.

Site Control - Detention Basins have medium potential for removal of heavy metals and total suspended solids but low potential for nutrient and bacteria removal and are of little benefit in treating fine suspended sediments or dissolved pollutants. Although they have low potential for runoff volume reduction they have high potential for flow rate control across the range design return periods (1 year to 100 year). Detention basins in Dardistown will be used in conjunction with swales and therefore the combination of the two will adequately address any categories of low potential. However, restrictions on the availability of land, and therefore their size, may reduce their effectiveness.

Regional Control - Constructed wetlands and wetland channels have high potential for total suspended solids and nutrient removal. However they are not as efficient in respect of heavy metals or bacteria. These reservations should not disqualify them from consideration in the LAP lands. They are not very effective for runoff volume reduction but have high potential for flow rate control although this reduces with increasing return period. They can be located at the end of the treatment train in floodplain areas, in conjunction with detention basins, allowing the use of undevelopable areas. Retention ponds, used as an end of line control, offer high potential for total solids removal but are less effective at nutrient or heavy metals removal. However, retention ponds do have a high capacity to remove fine suspended sediments and dissolved pollutants. They do not offer any significant potential in terms of runoff volume reduction but have high potential for flow rate control across the range design return periods (1 year to 100 year). The use of retention ponds is restricted in order to avoid the threat and danger of ‘bird strikes’ to the aircraft using Dublin Airport.

5.3.5. Community Environmental and Amenity Performance

Table 5.3 below, reproduced from CIRIA Report C697 – SUDS Manual, details a community and environmental factors performance selection matrix for SuDS Components.

Suds Group	Technique	Maintenance	Community Acceptability	Cost	Habitat Creation Potential
Retention Wetland	Retention pond	M	H*	M	H
	Subsurface storage	L	H	M	L
	Shallow wetland	H	H*	H	H
	Extended detention wetland	H	H*	H	H
	Pond/wetland	H	H*	H	H
	Pocket wetland	H	M	H	H
	Submerged gravel wetland	M	L	H	M
	Wetland channel	H	H*	H	H
Infiltration	Infiltration trench	L	M	L	L
	Infiltration basin	M	H*	L	M
	Soakaway	L	M	M	L
Filtration	Surface sand filter	M	L	H	M
	Sub-surface sand filter	M	L	H	L
	Perimeter sand filter	M	L	H	L
	Bioretention /filter strips	H	H	M	H
	Filter trench	M	M	M	L
Detention	Detention basin	L	H*	L	M
Open channels	Conveyance swale	L	M	L	M
	Enhanced dry swale	L	M	M	M
	Enhanced wet swale	M	M	M	H
Source Control	Green roof	H	H	H	H
	Rain water harvesting	H	M	H	L
	Permeable Pavement	M	M	M	L

Table 5.3 Community and Environmental Factors Selection Matrix

X Limited data available

* There may be some public safety concerns associated with open water that require addressing at design stage

H = High Potential

M = Medium Potential
L = Low Potential

It should be noted in respect of the matrix at Table 5.3 that, in addition to providing greater habitat creation potential and community acceptability, open channels and detention basins are the most cost effective and low maintenance SuDS options available, with a high longevity for flow rate control.

As noted in Section 5.1.4, it is recommended that the creation of additional bird habitats is avoided to eliminate the threat and danger of ‘bird strikes’ to the aircraft using Dublin Airport. SUDS landscapes for the subject lands shall be designed to support non-hazardous species such as passerines (song birds) rather than larger flocking birds with large open water areas avoided. Islands that provide safe nesting locations shall not be included within designs and grass should be kept long and managed as a meadow to deter birds.

In terms of amenity services for the development, a number of public open spaces and pedestrian areas are proposed and it is proposed that the Suds components be integrated with the Landscaping strategy and coordinated with the open space provision to ensure that the SuDS components contribute to the amenity aspect of the open space provision

There are a range of factors that need to be considered in respect of whether the proposed SUDS components meet all of the community and environmental requirements of the site. The primary community and environmental issues of concern, as cited in Designing for SUDS, are reviewed below.

Source Control - permeable pavements within residential developments and pedestrian and low trafficked areas have a medium requirement for maintenance, are generally acceptable in close proximity to property, but have low habitat creation potential. Permeable pavements represent a medium cost solution. Rainwater harvesting and green roofs and walls, which may be considered for larger institutional and commercial buildings, have high maintenance requirements and represent high cost SUDS solutions. However, they have medium to high community acceptability and green roofs and walls offer high potential for habitat creation. Understandably rainwater harvesting has low potential in this regard. Swales and filter strips, incorporated in roadside verges/margins, (in all their forms) have low potential maintenance requirements together with low construction costs (medium cost for enhanced swales). Swales are likely to have reasonable community acceptability. They have good potential for habitat and amenity creation particularly if delivered as part of an integrated landscaping scheme which is the intention in this scheme.

Site Control - Detention Basins have low maintenance requirements coupled with low initial cost. They have good community acceptability subject to the reservation that there may be concerns associated with open water in proximity to housing which is not a consideration in this scheme.

Detention basins in Dardistown can be provided in conjunction with swales and will be delivered in conjunction with a comprehensive landscaping and planting scheme. They have medium potential for habitat creation but could be of significant amenity benefit if delivered in a manner which provides improved visual amenity integrated within public open space. However, restrictions on the availability of land, and therefore their size, may reduce their effectiveness.

Regional Control - Constructed wetlands and wetland channels have high initial construction costs and high maintenance requirements. Wetlands and wetlands channels have high community acceptability and high potential for habitat creation. Retention ponds have medium initial construction costs and maintenance requirements. Retention ponds have high community acceptability, subject to the reservation that there may be concerns associated with open water in proximity to housing. They have high potential for habitat creation and could be of significant amenity benefit if delivered in a manner which provides improved visual impact integrated within public open space. However, the use of retention ponds is restricted in order to avoid the threat and danger of 'bird strikes' to the aircraft using Dublin Airport.

5.3.6. Proposed Development

All SUDS Techniques are permissible for Commercial (including shops, schools and offices) developments, although this may require three treatment train stages depending on receiving water sensitivity.

All SUDS Techniques are permissible for Local Roads, with the exception of source control. Runoff from roads may require two treatment train stages depending on type and intensity of road use and receiving water sensitivity.

The SUDS techniques being considered for the SUDS strategy for Dardistown include the following:

Source Control - Surface water from the various phases of the development can discharge to the Turnapin stream via SuDS techniques located along distribution and access roads and other circulation routes. Swales and filter strips can be incorporated in roadside verges/margins between footpath and road, providing an effective source control technique. Bioretention areas can be incorporated into the road network if sufficient space is available. Permeable pavements can be located in pedestrian and low trafficked areas e.g. public transport zones. Green roofs may be constructed on building roof areas. It may be possible to direct runoff from roofs and hardstanding areas to vegetated areas. Rainwater harvesting and rainwater butts can be incorporated into commercial, industrial and residential development drainage.

Site Control - Surface Water from public open spaces can be treated and attenuation provided through various SuDS techniques, e.g. small retention ponds. These will also enhance the amenity of these areas.

5.3.7. Treatment Train

Taking into account the scale of the Dardistown LAP and its likely phased delivery, it is recommended that areas greater than 2 ha do not drain to a single SuDS component, but that the catchment is split into sub-catchments and several smaller features are included that drain to a final site control.

Given the sensitivity of the receiving waters in relation to Portmarnock Estuary, a stormwater management train with a minimum of two components is required. The combination of components will vary depending on location within the drainage network and will be influenced by site characteristics and soil conditions.

Table 5.4 below, taken from the Greater Strategic Drainage Study (GDSDS), identifies the overall ranking for various SuDS techniques based on a variety of factors, including water quality, water quantity, operation and maintenance requirements, applicability to land use and robustness. The overall scores indicate that, taking all influencing factors into consideration, the provision of Detention Basins and Wetlands and minimising directly connected impervious areas are the most effective SuDS techniques.

Table 5.4: Usability of Different Types of SuDS

							Applicability for Given Land Use			Robustness				
SuDS Option	**Water Quality Improvement**	**Flow Rate Control**	**Runoff Volume Reduction**	**O & M Needs [1]**	**Sensitivity to Site Conditions**	**Failure Potential**	**Low to Medium Density Residential**	**High Density Residential or Medium Density Commercial**	**High Density Commercial or Industrial**	**Hydrologic & Hydraulic**	**Water Quality**	**Potential for Groundwater Contamination**	**Average Score**	**Rank Order of Average Scores**
Minimised Directly Connected Impervious Area [2]	9	10	10	3	3	3	10	9	5	9	9	3	6.9	**2**
Extended Detention Basin	9	10	6	3	3	3	9	9	8	9	9	3	7.0	**1**
Retention Pond	10	10	6	3	2	4	8	9	8	9	9	3	6.8	**3**
Stormwater Wetland	10	10	7	2	1	4	9	8	8	9	8	3	6.6	**4**
Permeable Pavement [2]	9	8	9	2	3	3	8	8	8	8	8	3	6.4	**5**
Infiltration Basin [2]	9	10	10	1	0	1	7	6	5	8	8	1	5.5	**10**
Infiltration Trench [2]	8	9	9	0	0	1	9	7	5	8	9	1	5.5	**9**
Swale [2]	8	8	8	3	3	3	10	8	6	8	6	3	6.2	**6**
Filter Strip	8	7	7	3	3	3	10	8	5	7	5	3	5.8	**8**
Bioretention[2]	9	7	6	2	4	2	9	9	5	6	8	3	5.8	**7**

Notes: [1] Routine or rehabilitative maintenance, or both [2] When site conditions permit

As a result of the above selection assessment a number of SUDS techniques have been considered to be unsuitable or inappropriate for the Dardistown development. These include the following:

- Infiltration trench;
- Infiltration basin;
- Soakaway;
- Sub-surface storage;

Sub-surface storage has been excluded from consideration on the basis that such measures have no significant water quality or habitat creation benefit. They purely serve to reduce peak runoff volumes. Because they are out of sight below ground, ensuring that they are properly maintained can be an issue. There have been occasions where the design storage volume could not be mobilised in a storm event due to blockage of the outlet control.

Sand filters are expensive, have low community acceptance and amenity benefit and as such are not being proposed. Green roofs and walls and rainwater harvesting will be considered as source control techniques for larger commercial and/or institutional buildings. Enhanced swales, filter trenches and detention basins will exhibit some degree of recharge.

As discussed in Section 5.1.4, the use of retention ponds will be restricted to avoid the creation of additional bird habitats, which pose a threat and danger of 'bird strikes' to the aircraft using Dublin Airport.

Therefore, the menu of SUDS components that will be considered for inclusion in the Dardistown SUDS Scheme are as follows:

- Permeable Paving
- Rainwater harvesting/ green roofs and walls (for larger institutional/commercial buildings only)
- Filter Drains
- Open channels i.e. swales, enhanced wet swales, enhanced dry swales
- Detention basins
- Bioretention
- Filter strips
- Retention Ponds (with restrictions)
- Stormwater Wetlands

As discussed in Section 5.4.3, silt traps and petrol interceptors are to be incorporated into the treatment train as a form of pollution prevention for surface runoff in car parking or trafficked areas.

5.4. SuDS Strategy

A surface water management train approach is to be adopted in the design of the proposed surface water drainage scheme for the subject lands by utilising suitable SuDS mechanisms in preventing runoff and pollution and providing Source, Site and Regional Control.

This Dardistown Sustainable Urban Drainage Scheme Strategy Report has been prepared to ensure a sustainable approach is adopted for dealing with the surface water runoff from all development within the LAP lands. This document must be considered and objectives adhered to when designing and constructing the surface water drainage system for individual developments and phases in the subject lands. The objectives of this SuDS strategy are based on the three key elements of any SuDS system i.e.

Water Quality Control: Protecting and improving the quality of water in the receiving watercourses and groundwater, thereby minimising ecological and physical impacts on receiving waters

Water Quantity Control: Managing runoff rates to ensure those prior to development are maintained, protecting the site from flooding of the drainage system and minimising the risk of flooding during extreme events

Amenity Value: Provision of environmental habitats e.g. ponds and wetlands, which also enhance the aesthetics of the area and providing recreational benefits.

The site conditions and the SuDS features available for the subject lands have been reviewed, with those SuDS features most suited for use on the LAP lands identified. Taking into consideration the information reviewed in previous sections, Figure 5.1 indicates the proposed SuDS strategy for the Dardistown LAP lands, with the following SuDS features recommended for inclusion in the SuDS management train:

5.4.1. Prevention

Good housekeeping: an effective maintenance regime should be put in place once the development is completed and in use to ensure dust and debris, which can cause blockages to the SuDS management train components, is minimised or eliminated.

Rainwater Butts and Rainwater harvesting: suitable for commercial and industrial developments. It is recommended that all structures with large roof catchment areas and having a suitable demand for harvested water within the LAP lands should incorporate rainwater harvesting. For residential buildings, it should be reviewed on a case by case basis during detailed design.

5.4.2. Source Control

Green Roofs and Walls and roof gardens should be incorporated to the maximum extent possible.

Directing runoff from roof and hardstanding areas to vegetated areas is seen as a significant and positive strategy in dealing with surface water runoff across suitable areas of hardstanding and all structure within the subject lands.

Permeable Pavements are recommended for use in pedestrian areas and low trafficked zones. Outlets will be required due to restrictions on infiltration.

Filter Strips are a desirable method of treating surface water runoff from roads in particular and are recommended in the high density areas within the LAP lands.

Swales are recommended to treat surface runoff from access roads and distributor roads serving the proposed development.

Filter Drains are recommended for use, in conjunction with swales, to treat surface runoff from access roads and distributer roads serving the proposed development.

Bioretention methods are recommended, locating them as a source control where feasible

An important element of source control is the integration of the street network with SuDS features. The road network presents a potential source of contaminated surface water runoff. During periods of low rainfall following periods of dry weather, the initial runoff, or 'first flush', from a site, particularly road surfaces, contains a high level of contaminants and should be intercepted and treated before it reaches the surface water drainage system, where possible. Locating grass swales, filter strips, infiltration trenches and filter drains adjacent to the road network is an effective method of retaining pollutants that are washed off the road surfaces, with no run-off to pass directly into the receiving watercourse for rainfall depths of up to 5mm and up to 10mm if possible.

5.4.3. Site Control

Existing stream corridor will be retained, as much as possible, to convey run-off from the development to the SuDS management train, providing treatment, filtration and attenuation while mimicking the natural catchment behaviour.

Detention Basins should be used extensively across the proposed development locations.

5.4.4. Regional Control

Stormwater Wetlands are recommended for use within floodplain locations for the Turnapin Stream/Mayne River towards the end of the SuDS management train.

Retention Ponds are restricted due to threat and danger of ‘bird strikes’ to the aircraft using Dublin Airport, but the use of smaller ponds may be acceptable.

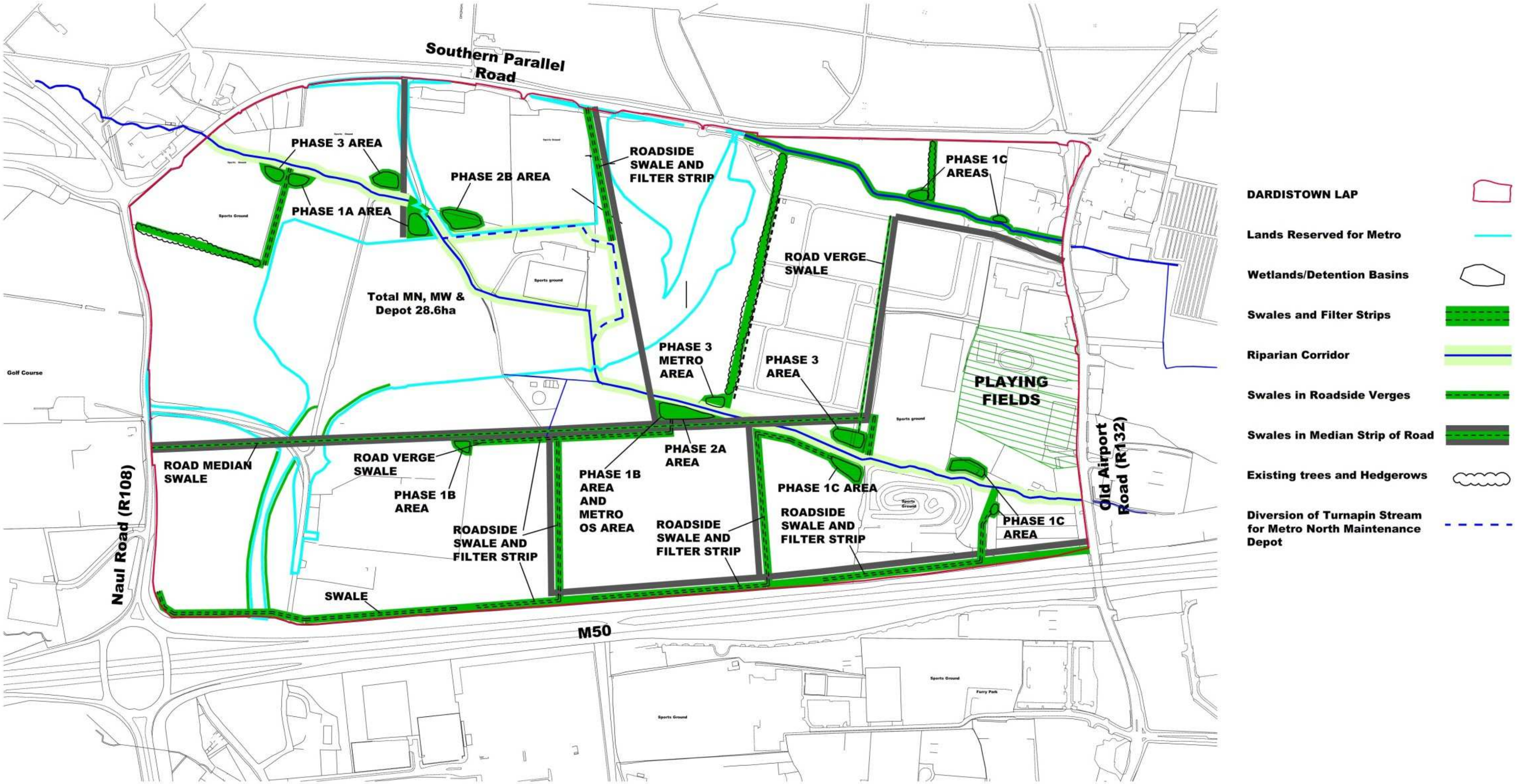


Figure 5.1 Proposed SuDS Strategy

APPENDIX A

- **B. J. Murphy & Associates Desk study, Walkover and Geophysical Survey of Hugo Byrne's Land at Ballymun, Co. Dublin**

- **B. J. Murphy & Associates Trial Pit Investigation of Hugo Byrne's Land at Ballymun, Co. Dublin**

APPENDIX B

- **Draft FEM FRAMS Flood Extent Map**