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1. EXECUTIVE SUMMARY

1.1 Introduction

The economic success of the Greater Dublin Region since the 1990s has led to very significant growth in Dublin city and the surrounding counties. The foul and stormwater drainage infrastructure is stretched to keep pace with the increased demand for new serviced land for housing, commercial developments and industry.

Overloading of the existing systems is evident from marked deterioration in water quality, increased risks of flooding and concerns that the drainage system and wastewater treatment plants have insufficient capacity to cater for future development.

In 2000 the Department of the Environment, Heritage and Local Government supported the proposal by the Dublin Region Local Authorities to proceed with the Greater Dublin Strategic Drainage Study (GDSDS) to examine these issues and to identify solutions. The Study was funded under the National Development Plan 2000-2006 and Dublin City Council was appointed as the contracting authority for the Study.

The GDSDS was commissioned in June 2001 to carry out a strategic analysis of the existing foul and surface water systems in the local authority areas of Dublin City, Fingal, South Dublin, Dun Laoghaire-Rathdown and the adjacent catchments in Counties Meath, Kildare and Wicklow.

The objectives of the Study were to identify policies, strategies and projects for the development of a sustainable drainage system for the Greater Dublin Region.

The Study was carried out by the Dublin Drainage Consultancy, a joint venture between Hyder Consulting and Dublin based firms PH McCarthy Consulting Engineers and RPS-MCOS (in association with HR Wallingford). The Consultancy included specialists from Wallingford Software for GIS advice, University of East Anglia for Climate Change aspects, University College Dublin for coastal water quality modelling and Dublin based town planners Brady Shipman Martin.

The Study area comprises over 50 foul and stormwater catchments varying from dense city centre development to suburban streams and rivers. As in most cities, foul drainage is a mixture of separate and combined systems with storm overflows to watercourses. The storm systems include separate stormwater drains, local watercourses and larger rivers.

1.2 Study Objectives

The Study objectives are set out in the Consultancy brief and are summarised as follows:

- To develop an environmentally sustainable drainage strategy for the Region consistent with the EU Water Framework Directive. This strategy should outline the requirements for foul and stormwater drainage capable of meeting the demands of the Region in the context of current Development Plans, the Regional Planning Guidelines and the longer term development potential of the region;

- To provide a consistent policy framework and standards which will apply throughout the Region, and promote the requirements of environmental legislation and the recommendations of the GDSDS itself;

- To develop tools for the effective management of the drainage systems including Geographical Information Systems (GIS), network models and digital mapping; and

- To develop the optimum drainage solution from a range of alternative scenarios having regard to whole-life cost and environmental performance, the solution to be broken down into a set of implementation projects which can be prioritised and put in place.
1.3 Regional Drainage Policies

The Consultancy undertook a review of local authority drainage practices in five key areas:

- New Development
- Environmental Management
- Climate Change
- Inflow/Infiltration and Exfiltration
- Basements

New policies have been drawn up in all of these areas and incorporated into the Development Plans of the local authorities. A set of detailed technical documents has been prepared to support the implementation of these policies. The policies seek to optimise the performance of drainage assets and to mitigate drainage impacts on the environment. Implementation of the policies is vital to ensuring the ongoing sustainable development of the Greater Dublin Region.

1.4 Population and Land Use

In defining the existing and future drainage requirements of the Region, the Study used three planning scenarios: years 2002, 2011 and 2031. The 2002 scenario represented the existing situation, incorporating the 2002 Census results. The 2011 scenario corresponds to the planning horizon of the Regional Planning Guidelines, which have been reflected by local authorities in their current Development Plans. The 2031 scenario is a long-term horizon reflecting regional planning policy and drivers. This latter scenario is appropriate for the planning of major long lead-time strategic infrastructure and has regard to likely demands for the foreseeable future. The development intentions for the Regions are challenging, as demonstrated by Table 1.1 for residential population.

<table>
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<tr>
<th></th>
<th>2002</th>
<th>2011</th>
<th>2031</th>
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<tbody>
<tr>
<td>Population</td>
<td>1,225,545</td>
<td>1,489,962</td>
<td>2,054,401</td>
</tr>
<tr>
<td>Compared with 2002</td>
<td>+ 22%</td>
<td>+ 68%</td>
<td></td>
</tr>
<tr>
<td>Household Size</td>
<td>2.92</td>
<td>2.46</td>
<td>2.18</td>
</tr>
<tr>
<td>Compared with 2002</td>
<td>- 16%</td>
<td>- 25%</td>
<td></td>
</tr>
<tr>
<td>Housing Units</td>
<td>420,130</td>
<td>605,667</td>
<td>943,627</td>
</tr>
<tr>
<td>Compared with 2002</td>
<td>+ 44%</td>
<td>+ 125%</td>
<td></td>
</tr>
</tbody>
</table>

Table 1.1 Residential Population Statistics (GDSDS Study Area)

The combination of increasing population and decreasing household size gives rise to a significant increase in numbers of household units. Within the existing urbanised areas (such as City Centre, Docklands, Rathmines and Pembroke, North Dublin and Grand Canal) this is being achieved by infill development of open spaces, or by intensification of redevelopment sites. Increased population in these areas places greater pressure on the city’s drainage and treatment systems. For the outer areas and commuter towns surrounding Dublin, development is occupying new development lands. The large areas being occupied and attendant large flows being discharged to the city networks are producing flows greater than available system conveyance and treatment capacity. Therefore, the current practice of bringing such external flows into the City’s systems for treatment is no longer sustainable.
1.5 Data Collection, Processing and Hydraulic Modelling

The first step in the Study was to collect and review the validity of existing data. This included all paper and digital records as well as available hydraulic models.

To supplement this data four short-term flow and rainfall survey contracts, three asset survey contracts, three topographical survey contracts and one CCTV survey contract were awarded.

A study Geographical Information System (GIS) was established. This involved the digitising of existing paper records and the merging of existing digital databases. A major data management exercise was required to develop an integrated asset inventory.

To enable the hydraulic performance of the existing drainage systems to be replicated and to assess existing and future deficiencies hydraulic models were prepared for 37 separate catchments. The specified modelling software was InfoWorks CS from Wallingford Software.

Reports provided for each catchment included

- Phase 1 – Initial Planning
- Phase 2 – Existing System Performance Assessment Report
- Phase 3 – Needs, Options and Strategy Report

A short summary report on each catchment is contained in Chapter 7 and Chapter 9 of this Final Strategy Report.

1.6 Sewerage Systems

The capability of the existing foul/combined systems to serve existing and future development is summarised below.

- Grand Canal System – This system, which includes the 9B Branch from Lucan/Clondalkin and the 9C Branch from Blanchardstown, is the backbone of the City's drainage network. The foul cell of the Grand Canal Sewer has capacity for the original catchment only. The capacity of both the 9B and 9C Branches are exceeded with current development.

- Dodder Valley Sewer – This sewer serving South Dublin is currently at capacity with the risk of local flooding.

- North Dublin Sewers – The new trunk sewers in place in the North Fringe area have the capacity for future foreseeable development. Local overflows and flooding risk issues have been identified in the older catchment sewers.

- City Centre and Docklands – The capacity of the system is exceeded with excessive spills at combined sewer overflows causing pollution of the Liffey. There is a risk of flooding in some areas.

- Rathmines and Pembroke – The capacity of the combined system is exceeded with high flood risk areas needing relief.

- Dun Laoghaire – The pass forward flows are limited to the capacity of the pipeline to Ringsend. Storage systems will be required to cater for future development.

- Shanganagh Bray – The systems require upgrading to cater for future development.

- Osberstown and Leixlip – These Kildare systems require upgrading to cater for future developments.

In summary, there is very limited capacity in the existing systems for development beyond the existing zoned areas especially to the west and southwest of the city.
1.7 Wastewater Treatment Works

The existing wastewater treatment works in the study area were assessed in relation to their currently planned expansion, the ultimate design load and receiving water and existing site constraints. This review is included in Chapter 8 of the Final Strategy Report and can be summarised as follows.

- Ringsend – The existing plant is at capacity and needs immediate expansion for short term needs to meet the requirements of the Nitrogen Discharge Standards for Dublin Bay as set out in the Urban Wastewater Regulations. This expansion is included in the DEHLG capital investment programme 2004-2006.

- Local Plants – The Shanganagh, Osberstown, Leixlip and Fingal Coastal plants can meet future needs with the current planned upgrading. Some such as Osberstown, Leixlip, Swords and Malahide may be marginal at the 2031 design horizon.

1.8 River and Stormwater Systems

The Study area is split into 33 river and stormwater catchments. Detailed reports were prepared for each of these catchments and a summary of the report findings are included in Chapter 9 of the Final Strategy Report.

In general, local flood risk areas have been identified and there are increased risks of flooding from the impacts of new development and climate change.

Pollution levels are elevated in urban watercourses. This is linked to pollution load from the stormwater drainage system and in particular the impacts of spills at combined sewer overflows (CSOs).

1.9 Criteria, Standards and Influences on Strategy

The strategy is based on appropriate (best practise) criteria, standards and influences which can be summarised as follows.

- Standards relating to continuous discharges to receiving waters would be based on detailed studies of the receiving waters in the context of all relevant statutory requirements including the Water Framework Directive.

- Load management to reduce non-domestic loads at source would be undertaken in conjunction with the extension of the treatment works at Ringsend to meet the short-term needs.

- Operational standards of intermittent discharges from CSOs would be based on best practise environmental standards, retention of “first flush” and controlled spill frequency.

- The wastewater treatment strategy would be based on the optimisation and maximisation of the existing facilities to meet identified needs. Developments beyond those currently zoned will require additional capacity.

- The foul sewer strategy would allow the capacity of the existing systems, principally the Grand Canal system to be consolidated for existing development.

- Stormwater drainage strategy would be developed on a catchment-by-catchment basis taking account of flood risk, the impact of climate change and the systematic use of Sustainable Drainage Systems (SuDs) for new developments.

1.10 Strategy Scenarios and Resulting Options

Eight different strategy scenarios were identified. Six of these scenarios, on evaluation, were considered unfeasible due to technical, social, economic or environmental constraints. Medium to long-term needs, therefore, would require either of the following two options:

Option 2B – Wastewater Treatment in South Dublin for new development south and west of Clondalkin and discharge via the Grand Canal Tunnel Sewer to the Liffey Estuary combined with the development of a new Regional Treatment Works at Portrane and diversion of North Dublin flows to it. The ultimate
development of an orbital sewer to Portrane serving the West of Dublin would provide for the long-term needs of the region beyond the current design horizon. This twin plant option has a number of disadvantages. The principal disadvantage is uncertainty as regards the treated effluent criteria which would apply to the Liffey estuary in the future.

**Option 2C – Regional Wastewater Treatment at Portrane, with development of an orbital sewer to serve the Northern and Western environs of the city and with a pumped connection from South Dublin beyond 2011, and from Leixlip prior to 2031.** While this scheme has the potential to provide an integrated and comprehensive scheme to meet the requirements of the region for the 2031 design horizon and well beyond, it does require that the orbital sewer between Blanchardstown and Portrane be provided in the medium term to meet the development needs of South Dublin and West Fingal beyond those areas currently zoned.

### 1.11 Proposed Works and Cost Estimate

Capital and Whole Life Costs of Option 2B and 2C proposals were prepared and a comparison of the costs is summarised in Table 1.2 below.

The costs include strategic option costs, all foul and storm catchment network upgrading costs, wastewater treatment works costs, and includes contingencies, overheads, planning and VAT.

<table>
<thead>
<tr>
<th>Description</th>
<th>Option 2B</th>
<th>Option 2C</th>
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<tr>
<td>Capital Costs</td>
<td>2,193</td>
<td>2,361</td>
</tr>
<tr>
<td>Operational Whole Life Costs</td>
<td>240</td>
<td>224</td>
</tr>
<tr>
<td>Comparative Total</td>
<td>2,433m</td>
<td>2,585m</td>
</tr>
</tbody>
</table>

*Table 1.2 Strategic Options 2B and 2C Comparison*

The estimated capital cost difference between Options 2B and 2C is calculated at €168m in favour of Option 2B (inclusive of overheads and VAT). This figure is reduced to the order of €152m when relative operating costs are accounted for in the NPV calculation. This represents a 6% difference in favour of Option 2B. Given the sensitivity to changes in quantities and the unit rates used in estimation of costs at strategy stage, this difference cannot be regarded as significant. Furthermore, the level of risk associated with the Option 2C estimates is considered to be lower than for Option 2B, given that a larger proportion of the works can be accommodated in green-field sites.

### 1.12 Recommended Strategy

The recommended strategy for the long term drainage requirements for the Greater Dublin Region are those set out in Option 2C;

- New Regional Wastewater Treatment Plant at Portrane
- Orbital sewer to Blanchardstown
- Pumped connection from South Dublin to orbital sewer
- Pumped connection from Leixlip to orbital sewer
- Pumped connection from Meath to orbital sewer
- Redirecting excess flows from Swords and Malahide
- Maintain Ringsend Wastewater Treatment Plant for existing catchments
- Upgrade existing treatment works to their ultimate design capacity
- Upgrade local sewerage networks
The recommended strategy offers:

- The least environmental risk in the context of receiving water standards and community impacts, and

- The most robust and secure operational regime, relying largely on proven technologies and with lower community impact where the bulk of the works can be constructed outside of existing developed areas.

- A future proofing of the strategy for growth beyond the 2031 horizon.

In whole life costs the difference between the two feasible options is marginal when the risk factor is considered.

The orbital sewer to Blanchardstown is required for the long-term drainage needs of the region. This will be provided as part of Option 2C but not as part of Option 2B. If Option 2B were chosen now, the orbital sewer would have to be provided as an additional item, post 2031. This means that over a 40 year time frame the recommended strategy would show a positive NPV over option 2B.

Implementation of this recommendation will require an agreed regional approach between the Local Authorities and the Department of the Environment, Heritage and Local Government in support of the successful planning, funding arrangements and procurement strategies for implementation according to the required timescales.

1.13 Implementation of the Strategic Plan

The timetable for implementation of the major infrastructure would be spread over the period 2005 to 2031. However, a significant proportion of the plan needs to be implemented over the period 2006-2013 to ensure that capacity is available for planned development. This will require up front expenditure of some €1,560m. A critical element of the plan is the immediate extension of the Ringsend Wastewater Treatment Works.

The implementation of the policy elements of the strategy are crucial to delivery of a sustainable drainage system. Formal adoption of the policies should be followed by active implementation across the region.

1.14 Summary and Conclusions

The strategy recommendations in this report should be adopted in principle to achieve the stated objectives, namely:

- To relieve overloading at Ringsend Wastewater Treatment Works while catering for committed development to 2011 of zoned lands and resolving pollution and flooding risks within the existing networks.

- To provide for necessary ongoing development in the Greater Dublin Region, while ensuring that existing networks, Ringsend and other local WwTWs can accommodate the needs of the existing catchments to 2031.

This will require approval to a major programme of works and funding needs of €2,585 million in parallel with systematic implementation of policies and operational recommendations. A strong coordinated regional approach will be required to deliver successfully on these recommendations.
2. INTRODUCTION

2.1 Objectives of the Study

The Greater Dublin Strategic Drainage Study (GDSDS) was commissioned in recognition of the need to have a regional understanding of sewerage and sewage treatment infrastructure. The extent and pace of recent development, resulting from strong economic growth, has increased pressure on the existing drainage system and rivers. Additional drainage loads could lead to more frequent and more extensive flooding and deterioration in water quality. Quantification of future system loads is required to permit development of a regional strategy for drainage and sewage treatment.

As such, the brief calls for a regional approach to drainage planning, designed to achieve:-

- An environmentally sustainable drainage strategy consistent with the EU Water Framework Directive;
- A blueprint for foul and stormwater drainage capable of meeting the demands of the Region in the context of current development plans, the strategic planning guidelines and the longer term development potential of the region;
- To provide a consistent policy framework and standards which will apply throughout the Region, covering development requirements, stormwater management, infiltration and ex-filtration, drainage with respect to basements in older properties, consideration of the effects of climate change and a coherent environmental policy, consistent with water quality objectives of the river systems and of Dublin Bay;
- To develop tools for the effective management of the drainage systems including GIS, network models and digital mapping; and
- To develop the optimum drainage solution from a range of alternative scenarios having regard to whole-life cost and environmental performance, the solution to be broken down into a set of implementation projects which can be prioritised and put in place.

One of the major objectives of the GDSDS is the drainage strategy for the Study Area up to 2031 and beyond. In general terms, creation of this strategy involves:

- defining, to an appropriate level of accuracy, the future development scenarios for the area;
- comparing the drainage requirements to service these scenarios with existing and currently planned drainage infrastructure;
- identifying the feasible options for optimising known drainage infrastructure and future drainage requirements to meet any shortfalls in service;
- selecting the preferred option and identifying how it will be implemented, in terms of projects, programmes, financing and procurement.

The Study covers the seven local authorities that make up the Greater Dublin Area, which are:

- Dublin City Council, the lead Client Council;
- South Dublin County Council;
- Dun Laoghaire County Council;
- Fingal County Council;
- Kildare County Council;
- Meath County Council, and;
Wicklow County Council

The boundaries of the Study and the seven Client Councils are shown in Figure 2.1.

Figure 2.1 Study Area

2.2 Background to the Study

2.2.1 History of the Study Area

The history of Dublin’s formal sewerage goes back to 1800, with the construction of sewers in the principal streets to drain foul flows and rainwater into the River Liffey. Major system construction started in 1881 serving the Rathmines and Pembroke areas. The Centre City Main Drainage Scheme followed around 1900 with the City Quays sewers, being interceptor sewers laid either side of the River Liffey, gravitating flows eastwards to the Main Lift Pumping Station and Primary Treatment Plant at Ringsend in Dublin Bay. The North Dublin system followed in the late 1950’s to serve the then rapidly developing area north of the City. Again this system directed sewage in an easterly direction to a sea outfall off the Nose of Howth.

The southern suburbs were serviced by the Dodder Valley sewer in the early 1970’s, still directing sewage eastwards to the Ringsend Treatment Plant via a submarine pipeline. The Dun Laoghaire catchment was connected to Ringsend in the early 1990’s by a submarine pipeline. Two most recent major sewerage schemes are: the Grand Canal system, built in the 1980’s to serve the new industrial development areas to the west of the City, and relieve the overloaded south city; and the North Fringe Interceptor, (completed in 2003) directing foul flows, originally to the Howth outfall, and lately to the Ringsend Wastewater Treatment Works.

The layout of the existing sewerage systems in Dublin is shown in Figure 2.2.
The Ringsend Treatment Plant and Main Lift Pumping Station were upgraded in late 2003, from a treatment capacity of 950,000 population up to 1.64 million, with sewage flows from North Dublin also transferred to the Plant via the Dublin Bay submarine pipeline (Sutton to Ringsend).

Stormwater drainage systems are sparse in the older central areas, such as City Centre, Docklands and Dun Laoghaire, which are served by foul/combined or partially separate sewerage. Most stormwater systems have been constructed as part of the separate systems serving post 1960’s developments.

### Need for the Study

For the past decade the Irish economy has expanded rapidly, resulting in very large increases in population, inevitably concentrating on the Dublin Region. Many high-tech companies have set up, such as Intel and Hewlett Packard, supported by returning Irish and incoming foreign workers. The inevitable consequence has been intense pressure on development, one symptom being the rapid rise in house prices.

Faced with economic and political pressure to approve widespread development, the Councils needed the tools to fully understand the capability of their sewage collection and treatment systems. The last major review had been in the 1970’s, and some individual studies had been done, but the widespread concern was that the system was nearing capacity. Modelling and GIS technology had greatly improved in recent years, so it was therefore timely to review the whole Region and set the strategy for the next 30 years, up to 2031 and beyond.

### Overview of the Study

The Study was carried out by the Dublin Drainage Consultancy, a joint venture between Hyder Consulting, and Dublin based firms, PH McCarthy Consulting Engineers and RPS-MCOS (in association with HR Wallingford). The Consultancy includes specialists from Wallingford Software for GIS advice, University of East Anglia for Climate Change aspects, University College Dublin for coastal water quality modelling and Dublin-based town planners, Brady Shipman Martin.

The Consultancy Team totalled over 90 staff, comprising managers, specialists, modellers, and technicians and survey supervisors, with around 50% of the team being modellers.

The Client’s Team was 6 permanent staff, comprising Study Manager, drainage engineers, GIS and survey staff from Dublin City Council, and 6 part-time representatives from the other Councils. As well as monitoring the Study, their input was pivotal in data collection, comments, reviews and approvals of reports and participation in Study workshops.
The Study area comprises over 50 foul and storm catchments, varying from dense city centre development to rural streams and rivers. As in most cities, foul drainage is a mixture of separate and combined systems with overflows to watercourses. The storm systems include separate drains, watercourses and major rivers. Foul, combined and storm systems are all represented by InfoWorks models, the detail of the models depending on the availability of asset information and their importance to future development.

The hydraulic models were built from existing SUS25 databases, with further assets being digitised from record drawings. Asset surveys by specialist contractors provided information on ancillary structures and pumping stations. Information on the main rivers was provided by topographical surveys of the channels, combined with LIDAR aerial survey of the flood plains.

The Consultancy arranged and supervised site surveys to the value of €3.5 million, involving 12 contracts. The specialist surveys included installation of over 480 flow monitors and 270 rain gauges, survey of over 4100 assets and topographical survey of some 74 km of rivers and streams.

All modelling and survey information was held in the Study Geographical Information System (GIS), incorporating digital mapping, ortho-rectified aerial photography, digital terrain mapping, and system information. Reporting and drawing production was also based on the GIS using MapInfo software.

2.3 Scope of the Study

The Study scope is defined in the Client Brief (Revision 2 of 26 October 2000) which required the following:

2.3.1 Recommendation of Policies

The policy recommendations should be consistent across all Client Councils, as far as possible. The policy areas suggested were new development, stormwater management, infiltration and ex-filtration, climate change, environmental matters and basements. The work should comprise the review of existing policies, and the incorporation of best national and international practice.

2.3.2 Capture and Analysis of All Data

All information necessary for the completion of the Study was to be collected, supported by site survey. The Study was to include the scoping, procurement, management and site supervision of all necessary surveys. Asset information was to be entered into a GIS (called the Study GIS) in a format compatible with the Irish National Grid and other GIS and CAD packages. Recommendations for a Regional Drainage GIS were also to be made.

2.3.3 Construction and Verification of Models of Existing Systems

Computerised hydraulic models of foul, combined, stormwater, rivers and streams were required to be built, using the InfoWorks software package. The hydraulic models were to be verified against the results of short-term flow surveys. The verified models were then to be used to assess the performance of the existing systems, to identify current inadequacies. Training of the Client staff in the use of the hydraulic models was to be provided.

2.3.4 Definition of System Loads

Close liaison was to be maintained with planning departments to define future development information, which was to be compared with system capacity to accept flows generated. Options for upgrading the systems, or restricting development to produce sustainable solutions were to be prepared.
2.3.5 Examination of Implementation Options

The options for upgrading the existing drainage systems were to be examined against three design scenarios, being:

- Scenario 1 – year-end 2002, being existing development
- Scenario 2 – year-end 2011, being medium-term development, as represented by Development Plans and foreseeable development;
- Scenario 3 – year-end 2031, being long-term development, anticipated and/or assumed as likely to occur.

Options to address the requirements of each design scenario were to be prepared, with main features, costs and major impacts, threats and opportunities. Options were to be ranked to produce the preferred option, with associated implementation strategies.

2.3.6 Assessment of Treatment Capacities

The effects of the design scenarios on the Wastewater Treatment Works were to be reviewed, with similar recommendations for upgrading of existing Works and/or construction of new Works.

2.3.7 Grand Canal Sewer

An initial review of the Grand Canal Sewer system was to be carried out early in the Study period to assess the capacities of the existing sewerage and treatment facilities to address planned development. The review was to include a possible scenario for dealing with any deficiencies found.

2.3.8 Agreed Scope for the Study

The Client Brief provided a well-written and comprehensive scope for the Study. However during the detailed discussions between Client and Consultant it was agreed that some aspects would be too complex, time-consuming and expensive to be practically addressed by the Study. These were:

- Limitation of the study of Water Quality and Urban Pollution Management (UPM) aspects to the volumes and frequencies of spills as predicted by the hydraulic models
- Impermeable Area Surveys were too detailed to be carried out under the Study. Such studies were more appropriately carried out as follow-up activities where inflow and infiltration were found to be problematic
- Modelling of rivers and stormwater catchments was to be prioritised, as described in Chapter 6 of this Report.

2.4 Methodology of the Study

Development of the future drainage strategy was undertaken at two levels, namely:

- Strategic level, where the regional infrastructure for future drainage was developed having regard to existing and future land use requirements, the capacity and limitations of the existing networks, treatment systems and receiving waters and consideration of the options to provide for future development over and above the existing capacities.
- Within existing systems, for which improvement or rehabilitation works and network strengthening have been identified to resolve existing deficiencies and/or cater for new development. These aspects of the strategy have been contingent on the modelling studies.

The Consultant's Technical Proposal envisaged that the strategic work, with the exception of definition of future development scenarios, would be carried out late in the Study period, at the end of the
hydraulic modelling. However it became apparent that much of this work could in fact be carried out earlier in the Study period, with resultant advantages of early definition of possibilities for Strategy and obtaining initial Client involvement and feedback. The overall methodology for the Study is shown in Figure 2.3.

Figure 2.3 Flow Diagram of Study Methodology

The Study used the conventional approach to hydraulic modelling of initial planning, followed by hydraulic modelling, and optioneering, all supporting the overall strategy. These phases were:

- Phase 1 Initial Planning, comprising review of catchment maps, drainage systems, operational information – producing Client comments for inclusion in later modelling
- Phase 2 Modelling for Foul/Combined Catchments, comprising model build, verification and hydraulic assessment of existing performance
- Phase 2 Modelling for Stormwater Catchments, including river and storm system aspects of model build, verification and assessment, such as channel and flood plain modelling under InfoWorks CS, and model application for flood plain mapping.
- Phase 3 Optioneering, comprising upgrading to address future development scenarios, and influences from climate change and stormwater runoff management.

Reflecting the importance of development as a driver for the Study, the Brief required that a short-term study of the Grand Canal system be carried out, to obtain an initial review of capacity availability for this main system serving the ongoing development areas to the west and northwest of the City. This study was completed in September 2002, and confirmed that the existing system was performing adequately, but that both trunk sewers feeding the Grand Canal tunnel were suffering from significant inflow and infiltration. The overall system would be at capacity around the future timeframe of 2011.

The Consultancy initiated the concept of an Initial Strategy Review, bringing together the members’ widespread knowledge of the sewerage and treatment systems with the results of the Grand Canal study. This initial review of possible strategy options was issued in April 2003, and provoked many useful comments and concepts.

Development of the final strategy followed on from the initial strategy review, when the Phase 2 models for the major foul catchments (Grand Canal, City Centre/Docklands, Rathmines and Pembroke, etc, were available in late November 2003.

From November 2003 to March 2004, regular strategy meetings were held involving both Client and Consultant to discuss drainage and treatment issues, and give co-ordinated and agreed direction to the hydraulic modellers. Thus the development of strategy for the Study has been a joint process, ensuring that Client and Consultant knowledge, ideas and understanding are shared and fully transparent.
2.5 Catchment Definition

Boundaries have been delineated separately for foul/combined, stormwater and river catchments. For the foul/combined and stormwater catchments the boundaries were the extents of the existing and foreseeable drainage system. For the rivers, the boundaries were the edges of the drainage basins.

Foul/combined catchments are shown on Figure 2.4, and comprise 19 single or grouped catchments. The river and stormwater catchments are shown on Figure 2.5 and comprise 33 single or grouped catchments. Large-scale maps of foul/combined and stormwater catchments are contained in Appendix A. Plans of the individual catchments accompany the catchment details in Chapters 7 and 9.

2.6 Report Format

Following Chapter 1, the Executive Summary, the document is structured as follows:

Chapter 2 Introduction

This chapter explains the objectives of the Study, and outlines of the Brief. The scope and methodology of the Study are also explained.

Chapter 3 Regional Drainage Policies

This chapter opens with the background to the policies and their relationship with each other and the overall Study. The key issues and recommendations for each policy are summarised.

Chapter 4 Population and Land Use

The basis for existing information and future projections are outlined, with summary information provided for the three development scenarios.

Chapter 5 Data Collection and Processing

This chapter summarises the methods and results of collection of existing information from many sources, as well as the extensive surveys carried out during the Study.

Chapter 6 Hydraulic Modelling

The methodology for hydraulic modelling of foul/combined, stormwater and river systems is summarised, together with the phased approach taken for modelling at catchment level.

Chapter 7 Sewerage Systems

This chapter summarises the modelling and reporting activities and results for the foul/combined catchments.

Chapter 8 Wastewater Treatment Works

This chapter assesses the implications of future flows and loads for the existing Works. The effects on the coastal waters of Dublin Bay and the Irish Sea are also summarised.

Chapter 9 River and Stormwater Systems

This chapter explains how the river and stormwater catchments were prioritised, and summarises the modelling and reporting activities and results.
Chapter 10 Strategy Criteria and Standards

The criteria for development of drainage strategy, in particular environmental requirements are reviewed, with particular emphasis on the effects of continuous and intermittent discharges on receiving waters.

Chapter 11 Strategic Drainage Plan

This chapter applies the general strategy criteria to produce the overall approach for deriving strategic options for wastewater treatment, foul sewerage and stormwater drainage. The detailed options are presented and evaluated.

Chapter 12 Proposed Works and Cost Estimates

This chapter summarises the works and associated cost estimates proposed at catchment and strategic level, based on the detailed information contained in Appendix B.

Chapter 13 Implementation of the Strategy Plan

The steps required to realise the Study proposals are explained, with particular emphasis on Public Private Partnership (PPP). The timetable for implementation is also suggested.

Chapter 14 Summary and Conclusions

The results and recommendations of the Study are summarised.

Appendix A Catchment Maps

Catchment maps which are too large to be included with the main text.

Appendix B Cost Estimates

Details of costs of proposed upgrading works at catchment and strategic level to support Chapter 12: Proposed Works and Cost Estimates

Appendix C Population and Land Use Maps

Maps providing large scale information to support Chapter 4: Population and Land Use

Appendix D Flows for Development Scenarios

Detailed flow figures to support the strategic options contained in Chapter 11: Strategic Drainage Plan

Appendix E Assessment of Existing Wastewater Treatment Works

Further information on individual Works to support Chapter 8: Wastewater Treatment Works

Appendix F Constraints Maps

Large scale maps showing the constraints to strategy

Appendix G Strategy Details

Large scale maps showing the options for the Strategy Plan
3. **THE REGIONAL DRAINAGE POLICIES**

The Greater Dublin Strategic Drainage Study (GDSDS) requires the recommendation of policies for the future provision and management of drainage services in the Greater Dublin Region (GDR). These drainage policies are to assist Local Authorities in complying with their legal responsibilities, their planning and development objectives and are to, in so far as practicable, conform to good international practice. A particular requirement from the Study is that Drainage Policies adopted across the Region should facilitate a uniform and consistent approach to urban drainage infrastructure planning, design, construction and operation. The drainage policies should also result in improved customer service.

The Client Brief identified policies to address specific problem areas with the GDR’s drainage, but acknowledged that other policies could be required. Hence the overall needs for policies were investigated early in the Study period, and reported in November 2001 in the Working Paper on Development of Regional Policies (Ref: GDSDS/NE02057/025). This report was discussed at a Policy Workshop held in December 2001, following which the policies documents to be produced were agreed as:

- Volume 1 – Overall Policy
- Volume 2 - New Development
- Volume 3 - Environmental Management
- Volume 4 - Inflow, Infiltration and Exfiltration
- Volume 5 - Climate Change
- Volume 6 – Basements

Consultation documents for each policy were produced and circulated for comment. Comments were consolidated and discussed at a series of Workshops, attended by all Council stakeholders, to agree the final contents. The consultation documents were then finalised as Technical Documents, containing the agreed recommendations for each regional policy.

The reference for each detailed policy Technical Document is contained at the end of each following policy section. Copies of all policy documents are held by the seven local authorities constituting the Client for the GDSDS.

### 3.1 Overall Policy

The major existing drainage infrastructure is interconnected, with the greater part of the foul sewer network catering for Dublin City, South Dublin and parts of Fingal, Meath, and Dun Laoghaire Rathdown, draining to Ringsend WwTW for treatment. The management of this interconnected system requires each Local Authority (LA) to have consideration of the needs and drainage requirements of the other local authorities. Most of the other treatment plants cater for discrete catchments covering one or two LA’s.

The rivers and streams in the region cross LA administrative boundaries, and thus discharges to watercourses in one area will impact on areas downstream.

It is therefore a necessity that the future management of all drainage in the GDR is integrated across the seven local authorities in the region and across the various disciplines within those authorities, in order to bring conformity of approach in drainage matters to Councils across the region.

The policies are intrinsically linked and cover a number of key areas, including:

- Existing Drainage Infrastructure; or how to best utilize the existing assets and minimize their impact on the regions watercourses;
- New Development; or how to minimize the impact of future development on the environment, particularly its watercourses;
• Basements; or how to protect basements from sewer flooding;
• Climate Change; or what, if anything, should be done to prepare for higher sea levels and greater rainfall intensities - the predicted outcome of climate change.

Figure 3.1 depicts the interrelationship of these key areas.

![Diagram](image)

**Figure 3.1 Relationship between the Regional Drainage Policies**

New development produces increased levels of urbanization, potentially leading to:

• decline in the quality of our surface, ground, estuarine and coastal waters;
• loss of biological diversity, amenity and habitat;
• accelerated run-off response leading to higher flood levels and loss of ground water re-charge.

The impacts of climate change will reduce the level of service of drainage systems, due to increased rainfall intensity and sea level. The presence of substantial inflow, infiltration and exfiltration flows will continue to compromise the capacity of sewerage and treatment systems to service future development. Any work undertaken on the existing drainage network and all future development should consider the potential impact on basements at risk from sewer flooding.

### 3.2 New Development Policy

The Local Authorities currently have different practices in place as to how new development is managed. These practices have developed over recent years, but are now proving inadequate to address the rapid growth of development in the Dublin Region, and the need for control of the resulting pollution of the environment.

The adverse effects of current practices include:

• Building in floodplains, with increased risk of flooding of developments;
• Discharge of high flows and pollution to watercourses from stormwater runoff;
• Presence of substantial amounts of inflow and infiltration in the foul system;
• Inefficient record keeping of drainage asset information
The Local Authorities also have different requirements for the design, construction and taking-in-charge of drainage facilities associated with those developments. The New Development Policy provides uniform approaches, in accordance with best local and international practice, and supporting environmental legislation, such as the Water Framework Directive and the proposed New Water Services Bill.

Among the issues addressed are:

- Legal requirements regarding new development, in particular the Planning and Development Act, 2000;
- Existing drainage regulations, in particular the Local Government (Sanitary Services) Acts 1878 to 1964 and the Building Regulations, 1997;
- Liaison between Council Departments to promote similar approaches;
- Procedures for drainage aspects of new development, involving Council Departments and developers;
- Design, materials and construction specifications to promote similar standards.

The departments principally involved in the new development process are the Planning Department, Drainage Department, Building Control, and Roads Department. The Parks Department will be involved in stormwater management, using Sustainable Drainage Systems (SuDS). The level of co-ordination needed depends on the size of the Authority, and will vary from the largest, Dublin City Council, to the smallest, Bray Urban District Council. However the principles and procedures constituting the policy should be uniform across the region, and independent of size of Council.

The policies must be practical, capable of support, and compatible with the objectives of the other Regional Drainage Policies, in particular the policy for Environmental Management.

3.2.1 Objectives of New Development Policy

The policy objectives are to meet the requirements of efficient management of the process of planning, construction and Taking-in-charge, and also to provide best practice in minimising environmental impact of development. The detailed objectives include:

- Emphasis on the role of drainage management in addressing environmental legislation, such as the Water Framework Directive, and systems set up to promote that role;
- Emphasis to developers and the public at large that sustainable drainage systems are mandatory, as a corner-stone for achieving environmental improvement of the region’s watercourses;
- Implementation of new design approaches to support SuDS and stormwater control;
- Liaison between Council Planning and Drainage Departments ensuring that drainage infrastructure for new developments will be co-ordinated;
- Management of planning applications, and that drainage involvement will be co-ordinated;
- Ensuring that planning approvals will only be given to sustainable developments, avoiding floodplains, overloaded drainage systems and the like;
- Taking in charge procedures and requirements will be consistent;
- Taking in charge requirements for sustainable urban drainage systems will be consistent;
- Specifications and practices for design, materials and construction will be consistent;
- Drainage construction quality will be improved, thus reducing the current high occurrence of illegitimate flows in the drainage system;
• Drainage standards and practices will be periodically reviewed to take account of changes in technology, industry practices and local requirements;

• Promoting electronic management of drainage matters, such as planning applications and taking-in-charge, to improve efficiency within the Council departments, and provide better service to the public;

• Promoting drainage systems as assets to be understood, protected and preserved for the environment and future generations

3.2.2 Planning Implications

The principle of sustainable development required in the Planning and Development Act, 2000 is to remain. The Regional Policies seek to fully support this principle, and the Act’s requirement that drainage considerations be included in the planning process.

The Act also seeks to systemise the planning application process, which these Policies support. The objectives of the policy are thus to:

• Ensure that the Planning Department maintains control of the planning process, and manages developments through use of a planning database;

• Ensure that proposed development is compatible with existing and proposed drainage infrastructure;

• Ensure that the Drainage Department agrees the requirements for the new development;

• Ensure that the Planning Department understands any constraints imposed by the Drainage Department on new development, especially development in or near floodplains;

• Ensure that the Planning Department imposes any requirements specified by the Drainage Department related to new development;

• Ensure that the Developer understands any requirements for the design, construction and taking-in-charge of new development;

• Ensure that all drainage construction complies with satisfactory design and construction standards;

• Ensure that all records of new development are satisfactorily managed

The Policy includes four procedures, corresponding to the phases in the life of a typical development.

The first procedure for Development Plan Liaison deals with the involvement of the Drainage Department (and other utility departments) in the production of the Council’s Development Plan.

The second procedure for Planning Application Procedures and Approvals covers the selection and review of planning applications by the Drainage Department, and the approval by the Local Authority of the Developer’s Planning Application.

The third procedure for Drainage Construction and Connection is concerned with the checking and approval of site work, the making of connections to the public system and associated certification.

The fourth procedure for Taking in Charge deals with the taking over of drainage from the developer, the final inspections and completion of agreements.

The purpose of the procedures, and their linkage to the proposed Regional Drainage GIS, is to systemise the flow of information relating to planning decisions. The management of information will allow drainage engineers to reach decisions in the shortest period, and with the greatest confidence in the correctness of their advice.
3.2.3 Drainage Design

Drainage best practice has undergone a dramatic shift in emphasis in the last decade in Europe. This is generally termed BMPs (Best Management Practices) or SuDS (Sustainable Drainage Systems), the latter being the term applied in UK. It has been recognised for some time that separation of drainage systems (foul and surface water systems), although dealing with much of the drainage needs of the urban environment, have some significant limitations. The primary issues are:

- Surface water runoff is very rapid and tends to pass rainfall-runoff downstream, exacerbating flooding from networks or rivers;
- The diffuse pollution of rivers and streams caused by surface water runoff is now recognised as being a significant problem, which will prevent the effective implementation of the Water Framework Directive.

To address these problems a range of drainage methods, which involves emphasis on retention and infiltration at source, has been developed which will both reduce runoff volumes, slow runoff rates and partially treat the effluent. These SuDS methods are summarised in the New Development policy, and are detailed more fully in the Environmental Management policy.

Due to the fact that these systems have been developed relatively recently, there are two issues that are important to recognise, being:

- New design criteria are needed to ensure that consistent design of the systems is achieved;
- Lack of experience in both construction and management of these systems means that there is some uncertainty and therefore some concern over their long term performance and maintenance needs

These aspects have both been addressed, with design criteria defined with an illustration to assist drainage engineers. SuDS is mandatory for all new developments, except where the developer can demonstrate that its inclusion is impractical due to site circumstances. Where SuDS cannot be provided, the developer must provide alternative means of dealing with pollutants.

3.2.4 Specific Recommendations

Acceptance of new policies for urban drainage across the region will require implementation at various levels, as follows:

**Drainage Departments**: Council departments to raise their profiles in planning and management of drainage infrastructure, including flood risk assessment and stormwater management;

**Drainage Involvement in Planning**: Council Departments should adopt the policies and procedures to co-ordinate drainage infrastructure with new development;

**Development Plans**: should make allowance for drainage aspects, including provision of drainage infrastructure, risk of flooding and isolation of basements;

**Council Liaison**: Liaison Committee to be maintained to implement Study recommendations with the ongoing role of agreeing future drainage matters for the region;

**Public Liaison**: The application of Sustainable Drainage Systems (SuDS) is mandatory for all new development, and will be promoted by the setting up of a Regional Working Party of all stakeholders;

**Design**: Design standards and Codes of Practice to be co-ordinated, to ensure co-ordinated and consistent implementation of drainage systems;

**Construction**: requires that appropriate specifications be developed for the construction of drainage systems to satisfactory quality standards, including testing/acceptance procedures and standards of completion;
**Drainage Department Management:** Most critical of all will be the effect on the Local Authority Drainage Departments of the policies on monitoring of construction, requiring additional staff resources or the use of agencies. The setting up of a Drainage Inspectorate on a Regional basis should be considered.

### 3.2.5 Further Information

The Regional Drainage Policy Volume 2 - New Development Technical Document (Ref: GDSDS/NE02057/28-02) contains supporting information, in particular the procedure flow diagrams, design parameters and methodology for foul and stormwater system design, and specifications.

### 3.3 Environmental Management Policy

The requirement for a new drainage policy for Environmental Management relates to the prime functions of a local authority and the belief that the existing practices are not effective. This new policy requires a regional application because of the interconnection / interdependency of the existing drainage infrastructure.

A Local Authority fulfils many prime functions, including those of Planning Authority and Sanitary Authority. The first function is responsible for Planning and Policies and the second function is responsible for Drainage Policies and their Implementation.

As Planning Authority, the Local Authority has a duty to promote, encourage and facilitate future development. In promoting future development the Local Authority has already enshrined in the most recent Development Plans a commitment to “sustainable” future development and a commitment to protect and enhance the built and natural environment.

As Sanitary Authority, the Local Authority has a duty to facilitate future development through the provision of drainage infrastructure. However, there are concerns over the adequacy of the existing drainage infrastructure to cater for existing flows and loads, never mind the flows and loads from future development. There is also concern over the deteriorating quality of the water bodies in the region and the impact that drainage discharges have in this deterioration. In providing solutions for these concerns there is a desire to introduce best national and international management practice (BMP) to drainage undertakings.

#### 3.3.1 General Principles

The environmental management policy focuses on the commitment to protect, maintain, improve and enhance the natural environment and to make features in the natural environment, such as watercourses, to be focal points of future development. The key focus is the development of Integrated Water Management Planning across the region and the implementation of best management practice in all aspects of sustainable drainage, addressing water quantity and water quality objectives on a catchment/river basin scale. These policies generally fall into the medium to long-term objective category. Specific policy recommendations that relate to natural amenities and recreation are given below.

#### 3.3.2 Specific Recommendations

**Natural Amenities and Recreation**

Policies in the area of Natural Amenities and Recreation include:

- the development of Integrated Water Management Plans across the Region, looking at water quantity and quality issues at the Catchment /River Basin level in order to effectively manage, in a sustainable manner the entire life cycle of water in the region;

- promoting the implementation of Water Quality Management Plans for ground, surface, coastal and estuarine waters in the county as part of the implementation of the EU Water Framework Directive;

- establishing a working group to oversee the preparation of a guide on Irish river rehabilitation and a public education programme.
• However, in order to achieve these objectives it will be necessary to implement the following actions in the short to medium term:

• to pilot the development and implementation of Integrated Water Management Plans in priority catchments in order to facilitate the development of Policy relating to integrated water management across the Region;

• to promote access, walkways and other recreational uses of public open space associated with watercourses, subject to a defined strategy of nature conservation and flood protection;

• to establish, where feasible, riparian corridors, free from development, along all significant watercourses;

• to restrict, where feasible, the use of culverts on watercourses;

• to evaluate all watercourses in the region for rehabilitation potential, particularly in conjunction with sustainable drainage measures;

• to seek the continued improvement of water quality, bathing facilities and other recreational opportunities in the coastal, estuarine and surface waters in the Region;

• to minimise the number and frequency of storm overflows of sewage to watercourses and to establish a consistent approach to the design, improvement and management of these intermittent discharges to ensure that the needs of the region's receiving waters are met in a cost effective manner;

• to improve the licensing of discharges to surface waters, through a central body, involving review of existing licenses, and imposition of discharge standards on all large sources of non-domestic pollution;

• to support the mandatory use of sustainable drainage systems which balance the impact of urban drainage through the achievement of control of run-off quantity, control of run-off quality and amenity / habitat enhancement;

• to impose effective control of development, especially in or near the natural flood plain of watercourses;

• to minimise the impact of development on watercourses by requiring flood impact assessments to be undertaken and sediment and water pollution control plans to be in place prior to the commencement of any development.

3.3.3 Further Information

The Regional Drainage Policy Volume 3 – Environmental Management Technical Document and Executive Report (Ref: GDSDS/NE02057/28-03) contain further information on this policy.

3.4 Inflow, Infiltration and Exfiltration Policy

Inflow and Infiltration both cause increases in the legitimate flows in the sewerage system. Inflow is where surface waters enter the foul sewerage system directly, and Infiltration is where the increased flows are due to groundwater entering the foul system through faults in the pipework, manholes and chambers. Inflow and Infiltration cause reduced capacity for legitimate sewage flows, increase pressure on treatment capacity and encourage structural deterioration and damage. The most significant effect for the Dublin Region is that the capacity of the foul system and treatment facilities is compromised, resulting in restrictions in their ability to service new developments.

Exfiltration causes reduced flows in the foul system, due to leaks and outflows from faults and openings in the pipework, manholes and chambers. Exfiltration of foul flows results in contamination of the surrounding soils and possible pollution of groundwater.
Since both Infiltration and Exfiltration involve flows passing through physical defects in the sewerage fabric, they often occur together in conjunction with fluctuating groundwater levels. This continuing flow mechanism can result in erosion of surrounds and foundations to pipes and manholes. In serious cases failure of the asset or ground subsidence has resulted.

### 3.4.1 Evidence of Inflow and Infiltration

The Drainage Departments in the Dublin Region have long suspected that there are substantial quantities of inflow and infiltration in the sewerage systems of the Region. These suspicions have been confirmed by verification of the hydraulic models under the GDSDS.

Existing approximate infiltration flows for the Ringsend WwTW catchments are:

<table>
<thead>
<tr>
<th>Catchment</th>
<th>Infiltration Flows in l/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grand Canal System</td>
<td>615</td>
</tr>
<tr>
<td>City Centre/ Docklands</td>
<td>558</td>
</tr>
<tr>
<td>Dun Laoghaire</td>
<td>338</td>
</tr>
<tr>
<td>Rathmines &amp; Pembroke High Level</td>
<td>500</td>
</tr>
<tr>
<td>Total Infiltration Flow</td>
<td>2011 l/s</td>
</tr>
</tbody>
</table>

The flow to full treatment at Ringsend WwTW is 11m$^3$/s; 2011 l/s comprises 18% of this flow. At a daily sewage discharge per household of 650 litres, 2011 l/s corresponds to 267,300 households.

### 3.4.2 Overall Approach Needed

At around 2011 l/s, infiltration in the Ringsend WwTW catchments is approximately 50% of dry weather flow. Comparing the above figures with those included in the 1996 CIRIA survey of UK catchments would place the Ringsend system in the worst 9% of catchments of the 1646 examples studied. The Ringsend system could therefore be classified as being on the high end of the range of infiltration commonly found.

Information on achievement of reductions in Inflow, Infiltration and Exfiltration (I/I/E) is limited, with the USA providing the most examples. Reductions of 50% to over 80% have been achieved by thorough rehabilitation programmes. However the cost-effectiveness of such programmes is less clear, and we would predict that a cost-effective level of reduction for Dublin would be considerably lower, say around 25%.

The Local Authorities should conduct a pilot study into I/I/E reduction to establish the cost-effectiveness of such reduction programmes in the Dublin area. This pilot scheme should concentrate on the areas with various levels of I/I/E as identified by the GDSDS. The objective would be to establish typical rates of reduction actually achieved, together with the associated costs. Such information would then be used to manage the I/I/E reduction programme for the Region.

It must be recognised that I/I/E is difficult and expensive to identify, locate and reduce. It is therefore far more cost-effective to minimise its occurrence in the first place. The overall approach must therefore include measures to improve the quality of drainage construction and maintain its condition for as long as possible. This approach is one of the cornerstones of the Regional Drainage Policy for New Development.

### 3.4.3 General Principles

Most I/I/E occurs in relatively small quantities throughout the extent of the sewerage system, and is hence difficult, time-consuming and expensive to identify. For that reason the recommended policy is for reiterative reduction of flows based on homing-in from the general area to particular significant sources. The largest sources would be tackled first, then progressing to smaller sources. Where flows are small, or the sources are diffuse through the system, it may be more cost-effective to discontinue
the process. This approach is similar in principle to that carried out successfully for reducing leakage in the water supply system in the Dublin Region (Water Conservation Project).

The most cost-effective policy is to minimise I/I/E in the first place. This can best be done by strictly controlling the quality of new and renovated sewerage installations, and by ensuring that best quality materials and construction techniques are used, to provide a long-lasting leak-free system. Connections must also be correctly made, and private drains and abandoned sewers managed to minimise the risk of leakage. Rigorous monitoring by Council Inspectors will ensure that sewerage construction will achieve its maximum life without defects.

Since private drainage systems can cause similar or worse problems due to lack of maintenance, the policy is recommended to apply to both public and private drainage.

3.4.4 Specific Recommendations

**New Water Industry Specification** for Ireland, covering materials, installations, construction, testing and inspection to improve the standard of drainage assets.

**Strengthened Drainage Inspectorate** to ensure that the highest practical standards of drainage assets are achieved. Their remit would include inspection of both public and private drainage systems.

**Inflow/Infiltration/Exfiltration Procedure** to be adopted to reduce non-legitimate flows in the most cost-effective manner, including strengthening of the current misconnections programme.

**Drainage Operation and Maintenance Practices** to include particular emphasis on minimising opportunities for non-legitimate flows to enter and leave the systems, such as through missing manhole covers and faulty flap valves.

**Maintenance of Hydraulic Models and Databases** to support the above procedures by providing geographically based asset and performance information for the identification of non-legitimate flows.

**Register of Water Source Boreholes** to enable the interface between water sources and drainage systems to be established and hence allow management of risks of cross-contamination.

**Survey and Renovation of Private Drains**, as a condition of sale.

The Regional Drainage Policy for New Development has similar objectives in improving the quality of drainage construction, such as new specifications and strengthened inspectorate, so both policies are mutually supportive.

3.4.5 Further Information

The Regional Drainage Policy Volume 4 – Inflow, Infiltration and Exfiltration Technical Document (Ref: GDSDS/NE02057/028-04) contains further information on this policy.

3.5 Climate Change Policy

Climate change is of considerable concern to all engineering professionals whatever their discipline, as well as being a popular topic for general discussion. It is acknowledged by nearly all scientists that climate change is already taking place, and that the chief culprit is emission of gases related to man’s activities. Although Ireland is taking measures to achieve reductions of “greenhouse gases”, such emissions are a global problem. Ireland will therefore inevitably experience the changed conditions being forecast for increasing global temperatures and possible significant changes in rainfall over the next 100 years. Changes in rainfall require consideration by drainage engineers and appropriate actions must be taken now to ensure satisfactory management of drainage systems in the future.

The forecast for Ireland is for drier summers, wetter winters and warmer average temperatures throughout the year. Although rainfall events are predicted to become heavier, the uncertainty of the quantification of these predictions is such that care should be taken in making any dramatic changes in current drainage policy, whilst ensuring that appropriate changes are made to minimise the risk of
severe consequences occurring in due course. Emphasis is therefore to be placed on deriving policies that are effective in mitigating and adapting to possible changes in rainfall characteristics.

3.5.1 Climate Change Policy in Ireland

Ireland has recognised the reality of this situation, through its involvement in the Kyoto Protocol to control emissions on greenhouse gases, and the establishment of the National Climate Change Strategy (NCCS) to manage the process.

The current debate relates to the accuracy of predictions and their implications. There are quite a number of climate change models and each is run with a number of scenarios, resulting in a wide scatter of predictions. However this situation helps draw attention to the level of uncertainty and the need to take a precautionary and flexible response to the impending changes.

Apart from the NCCS, the Climatology Department of the National University of Ireland, Maynooth (NUIM) has also carried out work on climate change and it is understood that the Met Office is also carrying out work in this area. Currently the emphasis on climate change policy is on the wider issues relating to the occurrence of climate change and in particular the issue of addressing greenhouse gas emissions. To date there have been no firm policy decisions relating to the effects of climate change on drainage design criteria for use in Ireland.

3.6 Climate Change Model Predictions for Sea Level and Rainfall

There are quite a number of GCM (General Circulation Models) of the world climate. The Hadley model and their RCM3 model results, based on the Medium – High scenario, have been used by the University of East Anglia, who are part of the GDSDS team. These results were reviewed by the NUIM.

The projected increase in temperature over the next century will cause expansion of the water column and result in an increase in sea level. The change in storm conditions will also affect surge and wave heights, the latter also being affected by the increase in water depth.

By the end of the century, the predicted rise in sea level in the UKCIP02 model, taking into account surge, is in the order of 300mm to 400mm with an additional 30mm due to the relative land movement. Due to the very slow process of expansion of the oceans, it should be noted that this trend will continue for up to 1000 years resulting in sea level changes of between 1m to 3m depending on a range of assumptions. Work carried out by NUIM, which looked at eight GCM models, predicts a sea level rise change of 480mm by the end of the century. In spite of these differences, it is acknowledged that sea level rise is predicted with much greater certainty than rainfall change due to climate change.

Daily rainfall data from the Hadley RCM3 model for the Dublin region has been analysed suggesting that the 2 year return period event has an increase in depth of around 10 percent, rising to nearly 25 percent for the 100 year event. However the findings by NUIM are less extreme, with little increase in rainfall on the East coast. Drainage engineers are more interested in hourly rainfall, but at this stage information at this resolution is unavailable.

The rise in sea level and increase in rainfall will result in the future in periods of much greater flood risk in some low-lying areas. This leads to much greater importance in understanding the level of risk for combinations of both activities occurring. At present it is not known what the level of dependency is in the Dublin region between the joint occurrence of significant tide and rainfall events.

3.6.1 Policy Recommendations

The EPA sponsored project carried out by NUIM is involved in reviewing policy on climate change. Their findings have been considered and taken into account in this policy.

Climate Change Policy covers all the principal effects of climate change on the Greater Dublin Area (GDA), in terms of the main factors affecting drainage, particularly sea level and rainfall. The Policy contains modification factors for drainage engineers to apply to their usual design parameters.

A periodic review of the GDSDS Climate Change Policy, in particular the modification factors, should be made following any reviews carried out by NCCS, NUIM and such bodies involved in climate change in Ireland.
3.6.2 **Specific Recommendations**

The following recommendations are proposed for drainage criteria to be applied in the Dublin region.

1. The results of the Hadley Centre models are to be used for climate change policy for the Dublin region. In particular, the UKCIP02 Medium – High (A2) SRES scenario should be used for climate change policy until further work is carried out;

2. The projections for 2080 – 2100 should be applied to all infrastructure design unless design lives are considered to be short (30 years or less). Linear interpolation of the recommendations might then be applied.

3. Sea level rise for 2080 in the Dublin region will be assumed as being between 400mm to 480mm.

4. The 200-year return period should be used for coastal flooding design and this level is 3.4m Malin AOD. Strategic very long term Dublin area planning and highly sensitive areas to use 4.0m Malin AOD.

5. The design sea levels refer to the Dublin Port gauge, and higher levels will occur up river estuaries;

6. A pragmatic approach to joint probability analysis for combinations of events can be taken initially, but more detailed joint probability analysis should be applied where costs are significant or other reasons require greater accuracy in assessing performance or flood risk. The following event combinations are proposed, based on providing combined return periods greater than 100 years for river flooding affected areas and 30 years for flooding from sewerage systems affected by river or tidal levels.

   **River flooding evaluation (100 years):**
   - MHWS tide with 100 year river;
   - 1 year tide with 5 year river;
   - 5 year tide with 1 year river.

   **Sewer system flooding evaluation, with tides (30 years):**
   - MHWS tide with 30 year drainage;
   - 1 year tide with 1 year drainage;
   - 5 year tide with 0.25 year drainage.

   **Sewer system flooding evaluation, with rivers (30 years):**
   - 0.25 river with 30 year drainage;
   - 1 year river with 5 year drainage;
   - 5 year river with 1 year drainage.

7. In cases where there is a potential for life-threatening situations to develop from rapid inundation due to breach of sea or river defences, then a standard of protection greater then the 1:200 year event should be considered. This may be as high as 1:500 or more depending on the level of risk involved.

8. River flow changes in the future should be determined individually for catchment planning. However for the purposes of CSO drainage system performance evaluation, the following precautionary position should be taken:
• River baseflows could reduce by as much as 40%.
• River flood flows are likely to increase by around 20%

9. Present day design rainfall depths for all durations and return periods are to be increased and factored by 1.1.

10. A new time series rainfall should be produced which represents future rainfall conditions

11. Present day time series rainfall are to be modified separately for summer and winter series
• Summer rainfall intensities to be factored by 0.9, except for the top 5 events
• The number of summer rainfall events is to be reduced by 40%
• Winter rainfall intensities to be factored by 1.10

12. It is recommended that a future stochastic rainfall time series should be produced in the medium term to properly reflect the projected change in seasonal rainfall pattern across the Dublin region.

13. New drainage schemes should be evaluated using these recommended criteria, but should also carry out risk and cost – benefit analysis. The consequence of “failure” should specifically be considered and may well influence scheme selection due to this uncertainty. However major rehabilitation or modification of the networks should still be based on evidence of need rather than the predicted reduction in level of service.

14. Explicit advice is not provided on issues relating to changes in infiltration, and other secondary effects that are likely to occur due to climate change. All these issues should be considered and allowed for, if thought appropriate, when designing drainage schemes.

15. Ireland should decide whether to rely upon the UKCIP (or other modelling) work in the future, or carry out work on climate change modelling to support its policies dealing with future change.

16. Rivers and their quality are a very important issue for Ireland. The uncertainty with regard to river flows has far reaching implications for Ireland (water resources, fisheries, tourism) and although this document is focused on drainage issues, it is suggested that a climate change evaluation and policy is needed to address these issues.

17. The dependency for joint probability analysis between tide, river and rainfall events should be evaluated to enable a better understanding of the level of service being provided. This is important, as tide levels will have an increasing influence on drainage for large areas of the Dublin region.

3.6.3 Further Information

The Regional Drainage Policy Volume 5 - Climate Change Technical Document (Ref: GDSDS/NE02057/028-05) contains further information on this policy.

3.7 Basements Policy

Many older properties in the study area have basements with connections from basement level to old sewers and culverts. These can be prone to flooding at times of high flow and sewer surcharge. New developments or modification to the existing drainage networks could result in existing basements being exposed to a higher risk of flooding.

Basements flooding incidents could increase due to the impacts of climate change where both increased rainfall intensities and sea level rise are predicted.
3.7.1 Why Basements Flood

When flows to the sewer exceed the capacity of the system, flows are released at the first opportunity. As basement drains are frequently constructed below the surcharge levels in the public sewer, sewage will often discharge into basements before overflowing at manholes. Basement flooding can be caused by a variety or combination of problems with the external sewer system, or with private drains where there are localised deterioration problems or poorly designed and constructed drainage.

3.7.2 Basement Locations

There is no asset database showing the location and use of basements throughout the Dublin Region. Dublin City Council has prepared a database of properties with basements in the city centre area between the canals. Bord Gais have a database of basements limited to streets that were serviced by old cast iron gas mains.

Using this information the number of basements identified in the study area is 16,200. Given the limited data available the total number of basements is expected to greatly exceed this figure.

Without knowledge of the location and drainage of the basements, the risk of flooding cannot be fully assessed when designing modifications to the drainage system, or approving upstream developments.

3.7.3 General Principles

The most cost-effective method of protecting basements from flooding is known as surcharge management. Basements can be protected from backflows from surcharged sewers through the installation of small pumping stations or Anti Flooding Devices (AFDs) on the basement drainage system before it connects to the public sewer.

Surcharge management measures can be conditioned on new developments subject to the Planning and Development Act 2000. On existing basements the owners are often unaware of the risk of flooding. It is the responsibility of the basement owner to provide protection against flooding. By installing pumping stations or AFDs, owners can provide protection against flooding at relatively low costs.

3.7.4 Specific Recommendations

The following policy recommendations are proposed:

- Establish a database of basements and flooding incidents.
- Use the Planning and Development Act to condition developers to provide protection against basement and underground car park flooding in all new developments.
- Incorporate basement protection requirements into the Building Regulations.
- The installation of pumps is recommended in preference to Anti Flooding Devices (AFDs) to protect basements.
- Embark on a public awareness campaign to inform homeowners of the causes of flooding and the methods of protection. The insurance industry should be approached to assist with the campaign.

3.7.5 Further Information

The Regional Drainage Policy Volume 6 - Basements Technical Document (Ref: GDSDS/NE02057/028-06) contains further information on this policy.
3.8 Implementation of Policies

The overall policy principles have been adopted by the Councils, and included in their current Development Plans.

The arrangements to implement the detail of the Policies are shown in Figure 3.2.

**Figure 3.2 Flow Chart for Implementation of Regional Drainage Policies**

The individual policy documents contain further information on the composition, objectives and methodology for the various bodies needed to take the policies forward. The general principles are:

- The liaison group established during the GDSDS should be maintained to drive the implementation of policies;
- The implementation must be adequately resourced and financed;
- The policies must be publicised to all stakeholders, especially those beyond the Council departments, including developers and the general public.
4. POPULATION AND LAND USE

4.1 Background

The GDSDS requires that land usage and planning requirements be determined to assess the capability of existing systems and to prepare plans for the future. This has been done through consideration of three design scenarios: 2002, 2011 and 2031.

The first scenario (2002) represents the baseline, or existing, situation. The second (2011) corresponds to the planning horizon of the Strategic Planning Guidelines, which must be taken into account by Local Authorities when producing their Development Plans. The third (2031) is a long-term horizon, appropriate for the planning of major strategic infrastructure which has evolved from consideration of regional policies, notably the National Spatial Strategy, the Strategic Planning Guidelines and the Dublin Transport Office (DTO) Transport Strategy. This long-term estimate is critical to the strategy given the long lead-in time for major drainage infrastructure (10 years or more) and a design life of well over 50 years, generally.

The extent and nature of development at each design horizon needs to be understood in order to determine the loadings on the sewerage system and wastewater treatment works. Existing land use can be readily determined by reference to maps, aerial photography and record plans of recent developments. Existing water supply, industrial effluent discharges, sewer flows and WwTW flows can all be measured. An assessment of the existing situation can therefore be undertaken with a reasonable degree of accuracy.

For the 2011 and 2031 horizons, however, it is necessary to make assumptions, which involved:

- Agreeing overall projections of population growth and associated development for the Region, taking account wherever possible of agreed long-term national and regional frameworks;
- Reconciling development patterns in individual Local Authorities with medium-term planning policy for the Region;
- Providing outline indication from individual Local Authority planners of where future development might be located, beyond those areas defined in Council Development Plans.

Factors affecting accuracy of the estimates included:

- Population growth (influenced by economic growth, migration, fertility etc.)
- Spatial planning policy (at both national and regional levels)
- Household formation (average household size is continuing to decline, meaning that more housing units will be needed for the same size population)
- Housing density and building height, allowing greater densities in the city area, in particular
- Extent of redevelopment (e.g. along new rail/metro corridors)
- Industrial land use (amount and type e.g. ‘wet’ or ‘dry’ industry)
- Commercial land use (e.g. retail parks, high density office developments)
- Capacity of the construction industry.

To minimise the degree of uncertainty, and to give confidence that the assumptions are reasonable, a detailed and comprehensive “Population and Land Use” exercise has been undertaken. This exercise has involved liaison with, amongst others: planning personnel from each of the seven local authorities in the Greater Dublin Area (GDA); the Strategic Planning Guidelines team; the Spatial Planning Unit of the DoEHLG; the Dublin Transport Office (DTO), and; the Economic and Social Research Institute (ESRI). Outputs have been reviewed by specialist planning consultants Brady Shipman Martin and are listed in Table 4.1.
Output | Description
--- | ---

Population and Land Use Database plus accompanying guidance notes; June 2002 | A MapInfo database covering the GDSDS area. Contains details of commenced and planned development sites to year end 2002 and 2011.

2031 Drainage Design Scenario – Population and Land Use; Ref. GDSDS/NE02057/80; July 2002 | A discussion paper setting out a proposed methodology for estimating outline 2031 land use at a level appropriate for strategic drainage planning.

Population and Land Use – Final Report; Ref. GDSDS/NE02057/094v2, March 2003 | Report bringing together and updating previous reports and papers to present the basis upon which the GDSDS has been progressed at catchment and regional strategy level.

**Table 4.1  Population and Land Use – Key Outputs**

The Final Report on Population and Land Use (Ref: GDSDS/NE02057/094v2) issued in March 2003 is the record of the base data used to estimate future system loads. It must be emphasised that the work has been undertaken for the sole purpose of developing a drainage strategy. Given the long service life of drainage infrastructure and indeed the lengthy implementation timetable for new works, this long-term development perspective is essential to test the robustness of medium-term proposals.

Many different factors will influence the ultimate population level and pattern of land use at 2031. It is important to stress that, whilst the GDSDS has made the best use of all currently available forecasts, planning guidelines and strategies, these publications are regularly revised and updated. Any work following on from this Study should similarly take account of the best information available at that time. At the same time, the strategy is not dependent on a precise development scale – proposals can be varied in terms of scoping and timing to cater for actual needs.

**4.1.1 Population and Land Use Databases**

The planning information collected for 2002 and 2011 has been compiled in GIS form and a MapInfo database produced. The GIS format has several benefits, not least of which is the ease of interaction with hydraulic modelling software. The format also allows the GDSDS planning information to be readily transferred to other studies and used by planners and engineers in the future.

Zoning maps from the current County Development Plans were obtained in digital form as a starting point for the database. The locations of additional development areas, i.e. sites identified by local authority planners as being likely to be developed by 2011, were then added. Each site was given a unique reference based on the Local Authority and the type of development. Information such as site area, number of units, housing density, foul catchment, storm catchment, WwTW catchment etc. was then entered for each site. The number of residential units constructed and the amount of industrial area developed by 2002 was identified separately from that for 2011.

The database was designed to be used in conjunction with the set of Ordnance Survey digital mapping (1:1000 or 1:2500) available at June 2002. In areas of major growth, the actual extent of development at 2002 could differ significantly from that shown on the background mapping. The numbers in the database for 2002 provide an update on the extent of development shown on the mapping.
4.2 2002 (Existing) Development

The following data sources were used to establish the extent and nature of existing development, and to ensure correct representation in sewerage models:

- Ordnance Survey digital base maps;
- Ortho-rectified digital aerial photography;
- ‘Taking-in-Charge’ plans and ‘As-built’ plans of more recent developments;
- Records from meetings and site visits;
- GDSDS Population and Land Use Database – 2002 data;
- 2002 Census preliminary population data and ‘Geodirectory’ data;
- Industrial effluent data from Local Authority discharge licences;
- Database of metered water supply.

In addition, short-term flow surveys were carried out to measure actual sewage flows and permit verification of the models.

The Preliminary Report on the 2002 Census was published by the Central Statistics Office (CSO) on 25 July 2002. The data was limited to population figures and there was no information relating to numbers of households. The 2002 population for the Greater Dublin Area, being the full Council areas, was 1,535,250. This corresponds to an estimated GDSDS population of 1,225,545.

One of the key findings was the ‘unprecedented’ level of population movement into the commuter belt areas around Dublin. Figure 4.1 shows the CSOs map of population change between 1996 and 2002 on an Electoral Division level. The population decrease in a ‘ring’ of suburbs outside the city centre is notable and illustrates the effect of declining household size. The high growth of more outlying areas such as Lucan and Blanchardstown is also apparent, and continuing.

Table 4.2 presents a summary by County level of the 2002 population data and the changes since 1996. High growth in South Dublin, Fingal, Meath, Kildare and Wicklow contrasts with a much lower level of growth in Dublin City and Dun Laoghaire Rathdown.

Publication of the Census 2002 data also permitted an analysis of population by foul drainage catchment and by WwTW. As census data on households was not then available, an estimate of household numbers was made using county average household size. This is an approximate method but is considered acceptable for the initial review of drainage strategy. Table 4.3 shows 2002 data by foul catchment. Some catchments have been subdivided to provide additional information for the drainage strategy.

Table 4.3 also provides an analysis of 2002 census population by WwTW catchment. The eight catchments shown are either existing or are planned following completion of transfer schemes and/or construction of new treatment facilities. Population growth rates over the six year period since 1996, range from 1% for Malahide WwTW to 28% for Osberstown WwTW. The 6% growth for the Ringsend catchment (including North Dublin) equates to an average annual growth rate of 0.95%.

Information on trade flows and loads was much more difficult to obtain. Although most of the major industries have discharge licences that specify maximum discharge rates and loads, there is little information on actual discharges. Also the numerous commercial sources, such as pubs, shops and offices, are unlicensed. Thus the trade discharge licence information can only provide a very rough guide as to the commercial/industrial discharges actually occurring within a particular catchment.

The only available information for PE is from measurements taken at the inlets to the WwTWs, which vary throughout the year, and with the weather. For example, loads into Ringsend WwTW have been measured between September 2003 and January 2004, at 1.9m PE, and 1.75m PE respectively. The interpretation of these figures is that the total PE of the Ringsend WwTW catchment is 1.9m, and that
the reduction of 0.15m in wet weather is most likely due to loads being lost from the system due to CSO discharges with some load shedding by industry over the Christmas holiday period.

### 4.3 2011 Development

The principal source of data for establishing 2011 development is the GDSDS Population and Land Use Database. Production of the database followed issue of the Working Paper (January 2002) and involved extensive liaison with the 7 Local Authorities in the GDA. In particular, meetings were held with senior planning personnel in each Local Authority. Further meetings and data collection followed before the database could be completed.

In line with other infrastructure planning for the GDA, the Strategic Planning Guidelines (SPG) have been used as a guiding framework. The SPG April 2000 update provided population and household figures for the GDA as a whole. These figures were then distributed per county in the same proportion as set out in the original report (Tables 9.2 and 9.3, SPG, 1999). This gave ‘target’ figures for household numbers in each county. For Meath, Kildare and Wicklow, the figures were adjusted because the GDSDS area includes only parts of these counties.

The database was populated initially with details of land zoned for new development in the County Development Plans, with additional information from Local Plans. The current set of County Development Plans covers five-year periods from their date of adoption, i.e. up to 2004, 2005 or 2006. The housing capacity of zoned land was then compared with the SPG figures. Where there was a shortfall, additional lands with potential for development by 2011 were allowed for in conjunction with Local Authority planning staff, and these were added to the database.

Table 4.3.1 compares the SPG-derived figures with those in the GDSDS database. For all counties except Wicklow, the database figures are marginally higher than the SPG forecast. This is considered desirable, as it provide an element of flexibility in the resulting drainage strategy. For Wicklow, the database figure is considered more realistic than that derived from the SPG (the latter was derived using an assumed percentage share for the GDSDS part of Wicklow, whereas the former was built up from detailed information on individual sites).

<table>
<thead>
<tr>
<th>Local Authority</th>
<th>Households (2011) derived from SPG figures</th>
<th>Households (2011) based on GDSDS Population and Land Use Database</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dublin City</td>
<td>225,301</td>
<td>234,994</td>
</tr>
<tr>
<td>Dun-Laoghaire Rathdown</td>
<td>87,558</td>
<td>88,360</td>
</tr>
<tr>
<td>South Dublin</td>
<td>106,778</td>
<td>112,572</td>
</tr>
<tr>
<td>Fingal</td>
<td>104,642</td>
<td>116,847</td>
</tr>
<tr>
<td>Meath (GDSDS Part)</td>
<td>12,173</td>
<td>17,876</td>
</tr>
<tr>
<td>Kildare (GDSDS Part)</td>
<td>55,097</td>
<td>56,086</td>
</tr>
<tr>
<td>Wicklow (GDSDS Part)</td>
<td>15,536</td>
<td>11,555</td>
</tr>
<tr>
<td>Total GDSDS Area</td>
<td>607,084</td>
<td>638,290</td>
</tr>
</tbody>
</table>

**Table 4.3.1  2011 households**

The totals in Table 4.2 differ slightly from those in Table 4.3, since the estimates were built up in different ways. Table 4.2 is based on household completions whereas Table 4.3 uses preliminary Census 2002 population data, converted to household numbers using assumed household sizes.

The database was also populated with data for non-residential sites. These were allocated in three categories: industrial, science and technology, and commercial. Again, this was based primarily on current zonings but with additional data on specific sites. In particular, Dublin City Council provided detailed information on a number of mixed use (residential and commercial) developments. Not all Local Authorities use the ‘Science and Technology’ zoning category in their Development Plans. In
addition, it was advised that some sites zoned as ‘Industrial’ could be used for high-density office developments, with implications for the potential future flows and loads generated.

Overall, it is considered that the total land area included in the database for 2011 under these non-residential categories is high, i.e. it is unlikely that all land will be developed by 2011. However, it would be unwise to try and reduce the land area or attempt to select which areas might not become developed by 2011. It is particularly difficult to predict future flows and loads from industrial land areas - a single major heavy water user could have a significant impact.

Whilst existing flows and loads can be measured, estimation of future values requires assumptions to be made. A “Guidance note on generation of flows” was issued in conjunction with the Population and Land Use Database. This note is included in the Final Report on Population and Land Use. Estimation of future treatment loads, i.e. in terms of population equivalent, is difficult for industrial areas when all that is known is a gross site area in hectares. Whilst controls may be imposed on industrial dischargers, e.g. maximum permissible BOD 500mg/l, application of a maximum value such as this to all sites would result in unrealistically high total loads.

For estimating non-domestic loads, the following assumptions have been made:

- ‘Industrial’ land – 100 PE (population equivalent) per ha.
- ‘Science and Technology’ land – 150 PE per ha (likely to include a higher density of staff, e.g. in office-type developments)
- ‘Commercial’ sites – 0.025 PE per m² (based on 20m² floor space and 0.5 PE per employee)

Due to long distance commuting, some catchments may ‘import’ load during the working day whilst in others it may be ‘exported’. By applying loadings to all employment land, there may be some over-estimate of total catchment loads but this is considered preferable to an under-estimate.

Table 4.3 contains details of housing units and industrial land area for 2011 at foul catchment level, which were then combined to give a breakdown by WwTW catchment.

4.4 2031 Development

An approximate estimate of 2031 land use, on a foul catchment basis, has been made for strategic planning purposes. The discussion paper – 2031 Drainage Design Scenario – explains the difficulty of this task and the many factors that could influence the estimates over such a long timescale. Essentially, the only published data for 2031 are population estimates and these vary from 1.9m to 2.6m for the GDA. The discussion paper describes the steps leading from national population figures to estimates of household numbers at a county level. The paper was circulated to each of the seven Local Authorities, the Strategic Planning Guidelines office and the Spatial Planning Unit of the DoEHLG. Comments received by the required date were taken into account in the subsequent work.

The county figures, set out in the discussion paper, were then distributed within the counties to a sufficient degree for strategic drainage planning. In Wicklow, Dun Laoghaire Rathdown, South Dublin and the southern part of Fingal, this was achieved by progressively identifying indicative development areas around the principal drainage network nodes in the existing system. The Population and Land Use MapInfo database was amended and used for this task. Gross housing density figures were used to convert household numbers to gross land areas, i.e. to allow for non-residential land use such as main roads, retail, employment and open space.

For the discrete towns in Meath, Kildare and Fingal (north of Swords), assumptions were made to initially distribute the county figures between towns. Adjustments were then made, based on guidance from Local Authority planning staff and known constraints. In Dublin City, the total households figure was distributed between foul catchments, based on guidance provided by DCC planners as to potential development and re-development sites beyond 2011.

In addition to the general planning principles set out in the SPG, the exercise took account of restrictions such as altitude (Wicklow, Dun Laoghaire Rathdown and South Dublin), airport zones (Dublin Airport and Baldonnel Aerodrome), conservation designations (Natural Heritage Areas, Special Areas of Conservation, etc.), amenity land classifications and any other issues communicated by Local Authority planning staff.
The drainage strategy does not “over-size” the future network for development needs. However, given the uncertainty of spatial definition and scale of long-term development, a reasonable degree of flexibility is essential. If all drainage areas are summed up, therefore, an upper bound estimate would result. The figures selected allow scenarios to be tested which highlight limiting capacities of existing plant and the indicative nature of new works. Exact siting and timing of new works will depend on the out-turn development realised.

For all Local Authorities except DCC, industrial land area was based on the assumption of 20% of the gross land area will be allocated for industrial development. Industrial load was then calculated assuming 100 PE per hectare. Although this is extremely simplistic, the general uncertainties involved in forecasts for this design horizon mean that a more detailed approach is not justified.

Table 4.3 provides details of housing units and industrial land area for 2031 at foul catchment level, which were then combined to give a breakdown by WwTW catchment.

### 4.5 Summary Information

Indicative population, household and industrial data per catchment for 2002, 2011 and 2031 are listed in Table 4.3. Table 4.4 shows the figures for the GDSDS area as a whole.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population 2002</td>
<td>Nr</td>
<td>1,225,545</td>
</tr>
<tr>
<td>Housing Units 2002</td>
<td>Nr</td>
<td>420,130</td>
</tr>
<tr>
<td>Housing Units 2011</td>
<td>Nr</td>
<td>605,667</td>
</tr>
<tr>
<td>Population 2011</td>
<td>Nr</td>
<td>1,489,962</td>
</tr>
<tr>
<td>Housing Units 2031</td>
<td>Nr</td>
<td>943,627</td>
</tr>
<tr>
<td>Population 2031</td>
<td>Nr</td>
<td>2,054,401</td>
</tr>
<tr>
<td>Commercial floor space from 2002 to 2011</td>
<td>m²</td>
<td>2,799,759</td>
</tr>
<tr>
<td>Industrial land from 2002 to 2011</td>
<td>ha</td>
<td>1,878</td>
</tr>
<tr>
<td>Sci/Tech land from 2002 to 2011</td>
<td>ha</td>
<td>1,316</td>
</tr>
<tr>
<td>Industrial land from 2011 to 2031</td>
<td>ha</td>
<td>1,636</td>
</tr>
</tbody>
</table>

**Table 4.4 Summary data for 2002, 2011 and 2031**

Large-scale maps are contained in Appendix C. Figure C1 shows the GDSDS foul/combined catchments. Estimated population figures for 2002, 2011 and 2031 are shown, as are population equivalent (PE) estimates of trade load. Figure C2 shows population and trade PE estimates for 2002, 2011 and 2031 at a WwTW catchment level for the purposes of assessing capacity and need at each of the horizon years.
5. DATA COLLECTION AND PROCESSING

5.1 Existing Information

The first step in the Study was the collection of existing data, in conjunction with its review to establish its validity, what information was missing, and the feasibility of obtaining further information. Most existing information was obtained from Governmental and Council sources, in particular the Drainage and Planning Departments of the Councils. This included drainage data, development data, background mapping and relevant legislation.

The drainage data included available SUS 25 asset data, existing Wallrus, HydroWorks and InfoWorks hydraulic models, paper drainage records and “Taken-in-Charge” drawings. All paper records were digitised as part of the Study. Digitising was carried out using the InfoWorks model tool and converted to SUS 25 using conversion software developed specifically for the Study.

Development data assembled included the National Development Plan, Strategic Planning Guidelines, National Spatial Strategy Documents, the DTO Transportation Plan, DoEHLG and ESRI Socio Economic Forecasts and the Development Plans and Strategic Area Plans prepared by the local authorities.

Ordnance survey mapping in digital format and aerial photography was collected to cover the Study Area along with the An Post/OS geodirectory.

Relevant European and National environmental legislation relating to the Study was assembled to develop a legislative framework within which future water resources management policies including urban drainage policy must be accommodated. These generally related to catchment water quality.

Natural Heritage Areas (NHAs) and sites of community interest (SACs and SPAs) within the GDSDS area were identified, as a number of these would place physical and spatial constraints on the final strategy development.

5.2 Study Surveys

To supplement existing data and provide the required information for InfoWorks model build and verification, flow and rainfall, topographical, asset and CCTV surveys were implemented.

EU Restricted Tendering Procedures were adopted in appointment of survey contractors. Advertisements were placed in the national press and the Official Journal of the European Communities. Following prequalification submissions a select list of survey contractors was invited to tender for the works.

Each of the surveys was divided into a number of contracts to ensure that they could be implemented to meet the Study programme. Advance contracts were placed for flow and rainfall and asset surveys for the Grand Canal Trunk Sewer (GCTS). These surveys were advanced to prepare a skeleton model of the GCTS early in the Study programme.

The Tolka River was added to the Study as a variation to the Client Brief. A separate topographical survey contract was awarded for this river system. In addition, a number of asset survey contracts had been let by Dublin City Council, and it was agreed that the data from these surveys would be used in the Study.
5.2.1 Flow and Rainfall Surveys

The short-term rainfall survey contracts were:

<table>
<thead>
<tr>
<th>Contract</th>
<th>Contractor</th>
<th>Commenced</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grand Canal Sewer (GCTS)</td>
<td>On Site Ltd.</td>
<td>20 November 2001</td>
<td>04 February 2002</td>
</tr>
<tr>
<td>FR 2</td>
<td>On Site Ltd.</td>
<td>29 May 2002</td>
<td>17 January 2003</td>
</tr>
<tr>
<td>FR 3</td>
<td>On Site Ltd.</td>
<td>29 May 2002</td>
<td>30 October 2003</td>
</tr>
<tr>
<td>FR 4</td>
<td>Precision Industrial Services Ltd.</td>
<td>12 June 2002</td>
<td>12 December 2002</td>
</tr>
</tbody>
</table>

Table 5.1 Flow and Rainfall Survey Contracts

Following pre-survey inspections with each contractor, suitable flow monitor and rain gauge sites were selected. In small diameter sewers standard flow monitors were used. In the large diameter pipework ADS monitors were installed. All flow monitor and rain gauge sites were routinely visited during the survey period to download survey information and carry out checks on the equipment.

5.2.2 Asset Surveys

Three asset survey contracts were awarded. The surveys were limited to critical assets for which no data was available and to check on assets of high hydraulic significance. They included major CSO’s and pumping stations. Drawdown tests were carried out on all major pumping installations. The contracts awarded were:

<table>
<thead>
<tr>
<th>Contract</th>
<th>Contractor</th>
<th>Commenced</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grand Canal Sewer (GCS)</td>
<td>EDS Ltd.</td>
<td>10 June 2002</td>
<td>19 April 2002</td>
</tr>
<tr>
<td>A1</td>
<td>USA Ltd.</td>
<td>10 June 2002</td>
<td>26 October 2002</td>
</tr>
<tr>
<td>A2</td>
<td>EDS Ltd.</td>
<td>10 June 2002</td>
<td>14 June 2003</td>
</tr>
</tbody>
</table>

Table 5.2 Asset Survey Contracts

Final asset databases were provided in SUS 25 format, which following conversion were imported directly into the InfoWorks models.
5.2.3 Topographical Surveys

Three topographical survey contracts were awarded to cover the nine river systems included in the GDSDS.

<table>
<thead>
<tr>
<th>Contract</th>
<th>Contractor</th>
<th>Commenced</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>Atkins</td>
<td>10 June 2002</td>
<td>15 October 2002</td>
</tr>
<tr>
<td>T2</td>
<td>On Site Ltd.</td>
<td>10 June 2002</td>
<td>20 August 2002</td>
</tr>
<tr>
<td>Tolka</td>
<td>BKS/ Longdin &amp; Browning</td>
<td>15 July 2002</td>
<td>11 October 2002</td>
</tr>
</tbody>
</table>

*Table 5.3 Topographical Survey Contracts*

The surveys were used to obtain cross-sectional information on the river systems to be modelled. They included details of all control structures and pipe systems (>225mm dia) discharging to the watercourse. On the smaller river systems, the sections were extended to cover the flood plain. In the case of the larger river systems a Lidar survey was commissioned to obtain full topographical information on the flood plains and the topographical survey was extended to tie in with the Lidar control points. For all survey cross sections, longitudinal data was provided digitally for direct importation into InfoWorks.

5.2.4 CCTV and Main Entry Surveys

A one-year term contract was awarded to McAllister Brothers Ltd. to carry out CCTV and Man Entry surveys of sewers. These surveys were carried out during InfoWorks model build and verification to confirm sewer connectivity and any abnormalities in the system.

5.2.5 Mapping, Aerial Photography and DTM

In recognition of the heavy reliance on digital mapping and GIS, extensive investigations were also carried out into availability and format of digital mapping, and any complementary mapping information. The result was that ortho-rectified photography and Digital Terrain Mapping (DTM) were incorporated into the Study mapping system. Both information sources proved invaluable to the modellers in interpretation of existing land uses and contours.

Further information can be found in the Report on Mapping, Aerial Photography and DTM (Ref. GDSDS/NE02057/049 of October 2002). The DTM for selected river catchments was obtained through the use of airborne laser scanning survey (LIDAR), for which further information can be found in Report on LIDAR Surveys (Ref. GDSDS/074512001 of April 2003).

5.3 Data Review and Processing

The availability and importance of digital information dictated that the Study GIS be established early in the Study period, and detailed investigations were carried out into each Council’s existing systems, being SUS25 and Mapdrain. Support for SUS25 was agreed with the Client, and digitising of record drawings into the Study GIS databases was carried out by a specialist sub-contractor and the Consultant’s staff.

Further information can be found in Report on SUS25 Digitising Issues and Recommendations (Ref. GDSDS/NE02057/063 of May 2002).
6. HYDRAULIC MODELLING

6.1 Background

The Client Brief correctly identified that hydraulic modelling was the core of the Study, to enable the hydraulic performance of the existing drainage systems to be replicated, and allow any modifications required to address existing and future deficiencies to be tested.

The specified modelling software was InfoWorks CS from Wallingford Software, which is the latest version of software for the hydraulic modelling of drainage systems, and which has been in use since the 1980’s. InfoWorks is the industry standard software for Ireland and the UK, and is based on Jet Access databases and MapInfo GIS software. InfoWorks is familiar to both Client and Consultant, and is compatible with asset databases from other sources, such as SUS25 and STC25. SUS25 is the current asset database system in use by the Client Councils, and it was therefore important that the Study be compatible with this information.

Hydraulic modelling on computers is a very specialised field of sewerage and drainage engineering, and can be difficult to understand for those not involved ‘hands-on’ in the modelling process. Recent major improvements in computer hardware and software have rendered modelling much more ‘user-friendly’ in that system and performance information is map-based, and hence much easier for the non-modeller to appreciate.

Nevertheless the Study team recognised that the process is highly technical and computer intensive, and that it was vital that all modelling activities be capable of being understood and critically reviewed by non-modellers, being the Client and Consultant personnel responsible for the strategy. The overall principle adopted was that hydraulic modelling is a tool for understanding drainage system performance. Hydraulic modelling thus has a useful, and it could be said vital, role in supporting the Study strategy.

The Study therefore put in place a modelling, reviewing and reporting system for the hydraulic modelling work. This system comprised a series of Manuals containing standard specifications, information databases, drawing templates and report formats, covering every aspect of the modelling process, and these were agreed with the Client beforehand. These Manuals are:

Phase 1 Initial Planning Study Report (Ref. GDSDS/NE02057/019 of September 2001).


Phase 3 Needs, Options and Strategy Report (Ref. GDSDS/NE02057/P3 of October 2003).

The Manuals standardised the methodology and reporting procedures for all Study catchments and ensured that all modelling staff adopted a consistent approach, utilising latest industry best practice to maximise the benefits and cost effectiveness of the Study. This was seen as essential to allow the studies to be refined, developed and audited in the future with confidence and with a full understanding of all assumptions and limitations.

It was foreseen that the GDSDS would need to be extended in the future to address new environmental or level of service requirements, or concentrate on particular issues such as proposed development and the progression of detailed design. It would therefore be essential that all relevant information and documentation be available in a consistent format to facilitate this process.

6.2 Modelling Methodology

As shown in Figure 2.3, modelling of each foul/combined, stormwater and river catchment was carried out in three Phases. This approach was needed because of the impossibility of completely scoping a feasibility study at its starting point. Any feasibility study will develop and change as it progresses, with the most changes needed after the available data has been evaluated, allowing the scope and direction of the study to be better understood. Thus Phase 1 - Initial Planning sets out the scope for the following Phases.
Each Phase was reported separately, with synopses of the preceding Phase in the following Phase 2 and 3 reports, to provide continuity.

Three reports were produced for the majority of the catchments, the exceptions being where modelling work was being carried out under separate studies, or where the catchment did not warrant detailed work, as was the case with some of the rural stormwater catchments.

The modelling reports that have been issued are tabulated in Chapters 7 and 9.

6.2.1 Phase 1 – Initial Planning

The purpose of Phase 1 is to thoroughly understand the configuration, features and operation of the catchment using existing information, site visits and discussions with relevant Council staff. This understanding then allowed the following Study work, comprising both modelling and surveys, to be scoped.

Phase 1 started with the definition, description and maps of the catchment, its drainage system and its specific assets, such as overflows, pumping stations and wastewater treatment works. Any previous reports, models and databases were reviewed to establish their potential for reuse for the Study. Most of the hydraulic models proved to be too old and/or simplified to be of much use, and most of the model build work had to be repeated.

Survey requirements were scoped on the basis of need for information for model building and verification. Asset and topographical surveys were scoped to extend and confirm available record information, with the specific inclusion of hydraulically significant structures, such as overflows, bifurcations, weirs and bridges. Pump tests were carried out for all large stations, together with dimension checks. Flow monitor locations were defined from the configuration of the drainage systems.

As well as the individual catchment reports the outcome of Phase 1 was the Working Paper on Survey and Fee Requirements for agreement with the Client. (Ref. GDSDS/NE02057/024 of March 2002), which agreed the scope of the modelling and survey work for the remainder of the Study.

6.2.2 Foul/Combined Modelling

This modelling was carried out under Phases 2 and 3, in accordance with the relevant Manuals. Following agreement of Phase 1 scoping, the initial build of the belowground hydraulic models was carried out using the databases of drainage assets, and then the results of the site surveys. Particular attention was paid to ancillaries, being any physical structures that affect the operation of the system.

The above-ground model build, assigning contributing area, population and land use to model nodes, relied heavily on mapping and aerial photography to understand foul and storm flows into the model.

The hydraulic models were verified/calibrated for dry weather and storm events against the measurements taken by the flow monitors and rain gauges during the flow surveys, as shown in Figures 6.1 and 6.2.
The verified models were used to test the performance of the existing drainage systems under a range of design storms, varying from intensities of 1 year to 100 years and durations of 30 minutes to 180 minutes or longer. This series of simulations was than analysed to determine the resulting surcharge and flooding conditions. Spill settings for all significant overflows were also determined, based on Formula A, and a spill volume and frequency assessment carried out to assess the performance of Combined Sewer Overflows (CSOs) in the catchment.

A coarse infiltration assessment was also carried out to determine approximate flows and locations, with the results being thematically mapped.

Since the Study is primarily concerned with drainage strategy to serve future development, the existing models were modified for all known upgrading works, and tested with flows generated by the two future design scenarios, 2011 and 2031. This modelling work identified pressure points on the existing system and demonstrated if increasing the capacity is feasible in those areas where growth was expected to cause a problem.
In considering whether the system provided an adequate level of service, criteria were set for the performance of both the drainage network and the river system. The target criteria for these were 30 years and 100 years respectively. Although the strategy addressed significant failures to meet these criteria, each and every predicted deficiency has not been addressed. The estimated effects of climate change, agreed for the Study as 10% increased rainfall intensity and 150mm increase in tide level, were applied to the 2031 development scenario.

With the development of sustainable drainage systems (SuDS) the decision was made that developments up to 2011 and the resulting drainage responses would be largely unaffected by the move towards the use of SuDS systems. This was based on the slow level of acceptance and application of SuDS units due to the need to prove their reliability. However for developments beyond 2011 it has been assumed that there would be virtually no impact, due to the total imposition of SuDS for such new developments.

The models were used to test the effectiveness of upgrading works needed to service both 2011 and 2031 development scenarios. These works were defined in outline in terms of lengths and diameters of pipelines, and particular ancillaries, such as pumping stations and CSOs. The works were then grouped chronologically and geographically into packages needed to upgrade each particular catchment to meet the drainage demands of existing and future development.

### 6.2.3 Stormwater/River Modelling

Three types of stormwater drainage models have been used for this Study, being:

**Type 1** models consist of a fully integrated model of the river and urban piped stormwater drainage system. Data from a short-term flow survey was used to verify the major piped systems. Long-term river flow data (where available) and short-term flow survey data were also used to calibrate the river flows and depths. References were also made to any available records of historic flooding from both the piped network and the river to verify the model results.

**Type 2** models consist of the urban piped stormwater drainage system. If useful, a nominal representation of the river system was also included, but this was only used to join the piped system together. Data from a short-term flow survey was used to calibrate the major piped systems. Reference was also made to any available records of historic flooding from the piped network. The flows in the river were not considered.

**Type 3** models consist of the urban piped stormwater drainage system only and no verification of the model was carried out.

All models were constructed entirely in InfoWorks CS. Additional modelling issues and techniques, however, were required for the Type 1 (and to a lesser extent Type 2) models, being:

- Topographical representation of the river and its floodplain
- Representation of flow control structures in the river
- Representation of rural catchments draining into the river network
- Inclusion of baseflows in the river
- Consideration of tailwater conditions, both tidal and non-tidal

The roughness values for the river cross-sections were estimated using the photographs provided by the survey contractors and additional site visits by the modelling team. This was achieved by comparing the channel construction (e.g. earth, concrete, rock) and general condition (e.g. straight, uniform, clean, weedy, silted, etc.) with standard (published) roughness values. An example of the type of photographs used is given in Figure 6.3.
Additional nodes were often required to connect outfalls from the piped network into the river and subsequently additional river sections were added and were based on nearby surveyed sections. Additional links, nodes and controls were also added at culverts, bridges, screens, trash racks, weirs and any other structures along the river to represent the flow restriction. Where it was considered that under severe storm conditions, flows might follow another route around or above the structure, further links were added to represent this. In simple cases these took the form of a weir, whereas in more complicated cases an additional river section was added, with a cross-section to match the flow route. Occasionally, several routes through and around culverts and bridges were modelled.

The modelling of the urban areas, which are drained by piped networks, were carried out in the same manner as for the foul/combined models. However, for the river models it was also necessary to consider the baseflow in the river and contributing runoff from the rural areas, which tended to be the further upstream parts of the river catchment.

The following Figure 6.4 is an example of the type of comparative results used during the calibration exercise. This shows the recorded flows compared to the model predictions using two different combinations of soil, runoff and routing parameters.
Analysis of the performance of the piped networks was carried out in the same manner as for the foul/combined models, using 1-year to 100-year return period design storms to determine the frequencies of predicted surcharging and flooding throughout the modelled system.

Analysis of the performance of the river was based on the extent of predicted river flooding for the 100-year return period design storms of different duration. This was presented in the form of a flood outline. In order to produce the flood outline plan, the peak water levels at the modelled sections were converted into a water surface using GIS software. This surface was then compared with a ground surface, developed from ground level data (where available this was DTM data). The intersection of the two surfaces was used to produce the flood outline. This was then checked manually and smoothed where appropriate. Where the model predicted significant out-of-bank flooding, this was considered as a flooding problem. In a similar way to the piped network, whether a flooding problem was taken forward to optioneering would depend on the consequences of the flooding (i.e. whether properties or services were at risk) and whether there were any historic records of flooding in the area.
7. **SEWERAGE SYSTEMS**

7.1 **General**

This chapter summarises the Phase 1, 2 and 3 Reports produced for each catchment. Most catchments involved the complete modelling process, with production of a full set of reports. Where studies external to the GDSDS were being carried out, the modelling and optineering process was truncated after Phase 1 or Phase 2.

Further details of the individual catchments can be found in the relevant Phase 1, 2 and 3 reports, which have been issued throughout the Study period. The Phase 1, 2 and 3 reports that have been issued are listed in Table 7.1.

<table>
<thead>
<tr>
<th>Ref</th>
<th>Title</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>F001</td>
<td>City Centre/Docklands</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>F002</td>
<td>Grand Canal Stage 1</td>
<td>Yes</td>
<td>Yes</td>
<td>N/A</td>
<td>Initial study</td>
</tr>
<tr>
<td>F003</td>
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<td>F004</td>
<td>NDDS &amp; North Fringe Interceptor</td>
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<td>Yes</td>
<td>Yes</td>
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<td>F005</td>
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<td>Yes</td>
<td>Yes</td>
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</tr>
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<td>Yes</td>
<td>Yes</td>
<td>Phase 2 and 3 reports combined</td>
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<td>F007</td>
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Table 7.1 **Foul/Combined Catchment Reports**

For presentation purposes in this chapter, the foul/combined catchments have been prioritised in terms of their importance to the overall strategy of the Study. Strategically, the most important catchment is the Grand Canal system since it forms the backbone to the sewage collection and treatment system for the Dublin area. The Grand Canal system therefore has its own section.

The Other Strategic Sewerage Systems are those connected to the Grand Canal and Ringsend WwTW system.

Self-contained sewerage systems have been defined as Other Sewerage Systems.
7.2 The Grand Canal System F002 & F003

The Grand Canal Trunk Sewer (GCTS) system serves over a quarter of a million people, about a fifth of the population of the Greater Dublin area. Designed thirty years ago to cater primarily for the planned growth areas of Lucan, Clondalkin and Blanchardstown, the system now also receives flows from the Meath towns of Ashbourne, Ratoath and Dunboyne and also the South Dublin towns of Newcastle, Rathcoole and Saggart.

Two main trunk sewers run from Clondalkin (the 9B Sewer) and Blanchardstown (the 9C Sewer) to the city where they converge and continue as a large diameter tunnel beside the Grand Canal watercourse. Along its way, the tunnel intercepts sewers from Walkinstown, Drimnagh, Crumlin, Kimmage and Terenure. The 3.66m diameter Grand Canal Tunnel Sewer is divided into two segments: one for foul sewage comprising approximately one third of the cross-sectional area of the tunnel with the remainder for surface water flows. Foul flows drain to the Main Lift Pumping Station at Ringsend for delivery to the Ringsend Wastewater Treatment Works. The surface waterside of the tunnel currently discharges into the Grand Canal Dock and receives direct flows from Crumlin, excess flow from the River Poddle and spilled flow from combined sewer overflows in the Rathmines and Pembroke area.

The Grand Canal Sewer is of considerable strategic importance because its catchment area includes some of the fastest growing towns and suburbs in Dublin. In the six-year period between the 1996 and 2002 census surveys, the population within the catchment grew by 14%, compared to 9% for the Greater Dublin Area as a whole. In the same period, the 9C (Blanchardstown) Sewer catchment witnessed a population growth of over 30%. This high growth rate, together with the recent connection of the Meath towns, has resulted in the design population for the 9C Sewer being exceeded. By 2011, the estimated population in the 9C catchment will exceed the design allowance by 75%.

Population, however, is only one element of the design. Other aspects include: the amount of industrial land and the flows discharged from it; the extent of roof and paved areas misconnected into the separate foul drainage system; the amount of water entering the system from the ground through defects in the pipes or manholes, and the extent to which the trunk sewers are protected by overflows on the branch sewers.

Figures 7.2.1 and 7.2.2 show the extent of the Grand Canal Trunk Sewer Foul Catchment divided into South and North areas respectively.

7.2.1 The 9B Trunk Sewer Catchment

7.2.1.1 Description of Catchment

The 9B trunk sewer serves the towns of:

- Lucan, Ronanstown, Cherry Orchard and Clondalkin
- Fox and Geese, Bluebell and Walkinstown
- Newcastle, Rathcoole and Saggart

These areas are within South Dublin County Council’s boundary. In addition, a part of Drimnagh, in Dublin City Council’s area, connects to the 9B sewer.

The area in the Liffey Valley catchment is served by five significant pumping stations. All flows are delivered to the 9B trunk sewer. The exceptions are the combined flows from Lucan old village plus any spill flows from the overflow at Lucan Low Level pumping station which are passed through a siphon under the River Liffey to the Strawberry Beds sewer that drains to the City Centre catchment. Flows from Lucan, Quarryvale and Cherry Orchard in the Liffey catchment are pumped to a high level sewer serving Clondalkin and the remainder of the area, which lies in the Camac River catchment.

The west of Clondalkin gravitates to the 9B trunk sewer. Ballymount Industrial Estate and Kingswood connect into the trunk main at Naas Road with the recently developed areas of Cherry Orchard and Park West also discharging into the 9B trunk sewer network. The WwTWs at Newcastle and Saggart have recently been de-commissioned and flows are now transferred into the 9B sewer via the new Camac Valley trunk sewer whose head is at the old Saggart WwTW. A recent development at City
West also connects into the 9B trunk sewer at Clondalkin, via a new trunk sewer, which has been recently commissioned. The trunk sewer from Clondalkin follows the valley of the Camac River as far as Blackhorse Bridge and then along Davitt Road and Dolphin Road to the head of the GCTS at Herberton Bridge.

7.2.1.2 Hydraulic Performance

The 9B (Clondalkin) Sewer was designed as a separate system and sized to carry four times the average domestic flow plus peak industrial flow. To allow for future growth a high design population figure was used by the planning authority.

However, two factors have adversely affected the available future capacity of the system. Firstly, the connection of the catchments of Newcastle, Rathcoole and Saggart and the City West area, to the lower section of the 9B sewer, has increased population and trade flows significantly. Secondly there is significant inflow and infiltration in this catchment due to misconnections of surface water to the foul system (peak factors of up to 6 times dry weather flow have been measured). The base level of infiltration observed during the short-term flow survey was quite significant at 42% of dry weather flow. Rainfall induced infiltration was also shown to have a marked effect on the sewer system. After significant rainfall events it could be seen that the sewer system took more than 24 hours to return to normal dry weather flows. Inflows during this post-rainfall period were more than twice normal average dry weather flows. Overflows in this separately sewered catchment are few in number and generally limited to 'emergency' overflows at pumping stations.

The 9B trunk sewer is currently operating at flows in excess of its design capacity and there are local risks of flooding.

7.2.1.3 Future Needs

The development intentions for the 9B catchment are very extensive, with current residential population predicted to increase by 47% by 2011, and by 141% by 2031. Rapid development towards these figures is already ongoing and upgrading solutions for the 9B sewer are therefore necessary as a matter of urgency, and certainly prior to the 2011 horizon. Reduction of inflow by removing stormwater connections is unlikely to be feasible in the future. It would be difficult to target any one particular area where this could be carried out economically. By 2011 the existing sewer will be completely overloaded. Conveyance of the estimated 2031 flows from the 9B catchment to the Grand Canal Tunnel Sewer would require significant additional capacity along the length of the 9B sewer through Lansdowne Valley Park and along Davitt Road, areas in which there would be substantial construction difficulties.

More detailed information on the 9B catchment is contained in the later section on the Lucan/Clondalkin catchment F008.

7.2.2 The 9C Trunk Sewer Catchment

7.2.2.1 Description of Catchment

The 9C trunk sewer serves the following towns:

- Ratoath, Ashbourne, Kilbride, Dunboyne and Clonee in Meath CC
- Mulhuddart, Corduff, Clonsilla, Blanchardstown, Carpenterstown and Castleknock in Fingal CC.

Ratoath and Ashbourne lie at the northwestern extremity of the catchment. Much of the housing in both towns is recent and these areas are served by separate sewer systems, although the older centres of each town have some combined sewers. In 1996 the WwTWs in both towns were replaced by sewage pumping stations, which deliver flows to a gravity sewer in the village of Kilbride. The old WwTW complex at Ashbourne has retained some stormwater storage with an overflow arrangement. At Kilbride, another pumping station transfers flows to a gravity sewer at Mulhuddart, which drains to the head of the 9C trunk sewer. The WwTW at Dunboyne has also recently been abandoned. Flows have been transferred by gravity to Clonee, and from there to the 9C sewer at Blanchardstown.
The 9C trunk sewer serving Blanchardstown begins at Mulhuddart and is laid along the Tolka valley to Ashtown on the Navan Road, a distance of approximately 7km. The trunk sewer continues through Phoenix Park, under the River Liffey in twin siphons, through Memorial Park and Kilmainham and links with the 9B trunk sewer at Davitt Road on the south bank of the Grand Canal.

There are two pumping stations in Blanchardstown. Main Street PS transfers flow from the north of Blanchardstown (Mulhuddart) into the 9C sewer. A second, minor pumping station located at River Road serves a small local housing estate. The majority of the developed areas in the 9C catchment are served by separate sewer systems. There is one CSO and a number of emergency overflows located at the pumping stations. The CSO in the catchment is located on the 9C trunk sewer and is a flood relief “hole in the wall” type CSO, which was constructed in 2003 as a temporary measure to prevent flooding re-occurring on the N3 Blanchardstown Bypass. For all future scenarios the CSO is assumed to be abandoned.

### 7.2.2.2 Hydraulic Performance

The 9C trunk sewer catchment was designed as a separate system on the same basis as the 9B Sewer, although an additional allowance of some 200 l/s was made for stormwater. Surface water inflow is present in the trunk sewer (observed peak factors of up to 5 times dry weather flow, from flow survey data) but not quite as pronounced as in the 9B catchment. In common with the 9B trunk sewer, catchment flows in the 9C trunk sewer take more than 24 hours to return to normal dry weather flows after a significant rainfall event indicating significant infiltration problems. Infiltration in the 9C was measured typically at 43% of dry weather flow during the Phase 2 flow survey period, which equates to a value of 110 l/s.

The design population of the 9C Sewer has already been exceeded and development of zoned lands would lead to it being exceeded by 60,000 (or 75%) by 2011 using current predictions. Although this is only one element of the loading, it is indicative of the high growth in this catchment and the impact of having connected the Meath towns of Ashbourne, Ratoath and Dunboyne.

The Stage 2 analysis has shown that the 9C Sewer has become overloaded due to the combination of development, infiltration and inflows. There are large areas of land around Blanchardstown zoned for industrial or ‘science and technology’ development. Indeed, trade flows are predicted to have the biggest impact on future growth with current flows of just over 110 l/s increasing to over 900l/s by the year 2011. The modelling predicts that the future loadings for 2011 lead to extensive flooding along the line of the 9C sewer. The rate of development of these sites determines when the existing trunk sewer system needs to be upgraded.

The towns of Ratoath and Ashbourne will also experience significant development to the year 2011 and beyond. The effect of this development is to increase both predicted flooding and spills to the Broadwater Stream.

### 7.2.2.3 Future Needs

The sewage collection and forwarding system for Ashbourne and Ratoath is totally inadequate for the predicted development. Upgrading works are thus required by year 2011 in the Ratoath and Ashbourne catchments with the provision of a storage tank in each catchment to address emergency overflow discharge problems and localised flooding. Radical pump upgrading is required (or more likely replacement of the pumping stations) and replacement of the existing rising mains, which serve both the Ratoath and Ashbourne pumping, stations. Further works are required at Kilbride pumping station to increase the pump capacity to give a pass forward rate equal to Formula ‘A’. On-line storage is also required at Dunboyne to address local flooding, which is predicted to occur prior to 2011. A total of some 2500m³ of storage would be required.

Similar large increases in flows are predicted for the downstream Blanchardstown catchment with the result that the 9C trunk sewer is completely overwhelmed with significant flooding predicted at 2011. A duplicate trunk sewer, similar in size to the existing trunk sewer, is required from Mulhuddart Bridge to a point adjacent to the old Phoenix Park Race Course. This would comprise a sewer/tunnel 6.5km long varying in diameter from 1050 mm and 2100mm to provide both hydraulic conveyance and on-line storage. This system, with associated storage of 11000m³ at Castleknock CSO, will need to be in place by 2011. The Castleknock CSO storage would need to be increased to 27,350m³ for 2031 development.
Other upgrading works to relieve flooding in the 9c catchment include construction of on-line storage at Terenure Road (615m of 1050mm diameter tank sewer) and Harold Cross Road (392m of 1200mm tank sewer) together with modifications to existing CSOs. Flooding predicted for 2011 in the Dunboyne main sewer would need to be addressed by construction of 392m of 1500mm diameter sewer.

It is also important to note that an integral part of all of the future preferred strategic options discussed in detail in Chapter 11 is to maximise the pass forward flow to the GCTS from the 9C trunk sewer. To facilitate this, both the twin siphons on the 9C trunk sewer under the River Liffey must be fully operational. Currently, the sluice gate at the entry to one siphon is closed. The River Liffey siphons are a key feature of the 9C trunk sewer system, and are important in the development of the strategic options. These assets act as a natural throttle to the 9C trunk sewer, with a maximum modelled pass forward flow of 2.73m³/s.

Reduction of infiltration would only marginally affect future flows and is unlikely to be reduced cost effectively.

### 7.2.2.4 Summary of Major Upgrading Requirements

The upgrading works needed in the 9C system, now and in the near future are extensive, and are summarised in Table 7.2.

<table>
<thead>
<tr>
<th>Catchment</th>
<th>Works Up to 2011</th>
</tr>
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<tbody>
<tr>
<td>9C Ratoath PS</td>
<td>Upgrade pumping capacity from 32l/s to 84l/s</td>
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<tr>
<td></td>
<td>Provide new 835m³ storage tank</td>
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<tr>
<td>9C Ashbourne PS</td>
<td>Upsize 81m of 525mm sewer to 750mm</td>
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<td>Provide new 230m³ storage tank</td>
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<td>Replace or remove inlet screens</td>
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<td></td>
<td>Upgrade pumping capacity from 76l/s to 143l/s</td>
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<td>Replace rising main</td>
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<td>9C Kilbride PS</td>
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<td></td>
<td>Upgrade pumping capacity from 111l/s to 236l/s</td>
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<td></td>
<td>Divert rising main to development sewer</td>
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<tr>
<td>9C Dunboyne Main Sewer</td>
<td>Upsize 392m of 525mm sewer to 1500mm</td>
</tr>
<tr>
<td>9C Trunk Sewer</td>
<td>Upsize 1134m of 900mm sewer to 1050mm</td>
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<td></td>
<td>2 No. New CSO chambers at Clonee and Castleknock</td>
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<td>495m of new sewer at 1350mm</td>
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<td>1383m of new sewer at 1500mm</td>
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<td>855m of new sewer at 1899mm</td>
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<td>2646m of sewer tunnel at 2100mm</td>
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<td>11,000m³ storage at Castleknock</td>
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<td>9C HaroldsCross Road</td>
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<td></td>
<td>Construct new CSO</td>
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<td>9C Terenure Road CSO</td>
<td>615m of new sewer at 1050mm</td>
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<td>Modify existing CSO</td>
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**Table 7.2 Summary of Works in the 9C Trunk Sewer System**
7.2.3 The Grand Canal Tunnel Sewer (GCTS)

7.2.3.1 Description of Catchment

The GCTS starts at Dolphin Road (Manhole 15), follows the route of the Grand Canal to the Docks and then heads towards Ringsend, terminating at the Main Lift Pumping Station (MLPS). The tunnel consists of a 3.66m diameter section sewer and accommodates separated foul and storm segments from Dolphin Road to the Grand Canal Basin a distance of approximately 4.5km. The foul cell takes approximately a third of the cross-sectional area of the tunnel sewer. The remaining area forms the storm cell. At Manhole 1, on Grand Canal Street Upper, the foul and the storm sections separate into dedicated sewers. The outfall for the Grand Canal storm sewer is located at the Grand Canal Dock but proposed works, some of which have been completed, will transfer these storm flows directly to the River Liffey. The foul section (Contract 14 sewer) continues as a 2.75m internal diameter sewer along Grand Canal Street, Bath Avenue and Londonbridge Road and into a collection chamber at the MLPS, a distance of approximately 1.5 km. Flows from the Low Level R&P catchment connect to the Contract 14 sewer at Londonbridge Road. The City Centre and High Level R&P catchments both discharge to the MLPS directly. A number of CSOs based in the High Level R&P catchment discharge spill flows to the storm side of the GCTS.

7.2.3.2 Hydraulic Performance

Information available from the flow survey with respect to inflows and infiltration is somewhat misleading due to suspected monitor inaccuracies. However analysis of all available flow data shows infiltration flows of approximately 270 l/s. Approximately 210 l/s of this flow arrives from the 9C and 9B catchments as discussed above.

The indications from the Phase 2 modelling carried out for the GCTS catchment shows that there is capacity in the foul cell of the Grand Canal Tunnel to receive further flows. There is also significant available capacity in the storm cell. An observed event recorded during the flow survey has been approximated to a storm return period in the region of a 1 in 100 year event. During model simulations of this event, less than two thirds of the capacity of the foul cell was utilised and less than half of the storm sewer. The reason for the apparent under utilisation of the storm cell goes back to the original design. It was always intended to divert the River Poddle into the GCTS. However because of the number of CSOs in the City Centre catchment which discharge to the downstream reaches of the River Poddle, diverting the watercourse would mean spill flows would be undiluted. The Poddle subsequently was never diverted but an overflow was constructed (Greenmount overflow) which diverts high flows from the Poddle to the GCTS storm cell.

7.2.3.3 Future Needs

The catchments that drain directly to the GCTS have very little future development potential. These include all of the area to the immediate south of the Grand Canal Tunnel as well as the catchments of Bluebell, Crumlin and Kimmage. Future capacity in the GCTS is largely dictated by the development in the upstream catchments. The Phase 3 hydraulic assessment exercise indicates that the foul side of the Grand Canal Tunnel Sewer would not be able to continue to provide an adequate level of service under the 2011 design scenario. The design flow at the midpoint of the GCTS was 5 m³/s but the as-constructed capacity is generally above 6.6 m³/s, i.e. 30% higher. The foul cell of the GCTS has an approximate capacity of 9 m³/s under surcharged conditions, which ties in with the capacity of the downstream Contract 14 sewer. At 2011 the combined Formula A flows at the end of the GCTS, and upstream of Contract 14 are calculated at 12.4 m³/s. Clearly the GCTS would be unable to take these flows without some upstream restrictions, and with storage. By 2031 calculated Formula A flows would exceed 16 m³/s.

7.2.4 Main Lift Pumping Station (MLPS)

7.2.4.1 Description of Catchment

There are three major trunk sewers, which connect to the Main Lift Pumping Station. The Rathmines and Pembroke (R&P) high-level sewer discharges into Chamber 1 and the City Centre sewer combines with flows from the R&P at chamber 4. These flows then mix with the discharge from the Grand Canal Trunk Sewer (GCTS) at the main collection chamber. Flows from the East Road Pumping Station also connect into the system upstream of Chamber 2. Flows from the main collection chamber are then
routed through a screen chamber, which houses three automatically operated bar screens. After screening, flows travel to two sumps in the Main Lift Pumping Station, where, under normal conditions, there are a total of 6 operational pumps. The MLPS pumps flows to Ringsend Wastewater Treatment Works through twin siphon pipelines.

7.2.4.2 Hydraulic Performance

Each sump has three pumps, being one small capacity unit and two larger capacity units. The smaller capacity units are variable speed pumps and have a maximum pump rate of 2.5 m$^3$/s. These are used as the duty pumps. The four larger pumps each have a pump rate of 3.4 m$^3$/s and are used as storm pumps.

7.2.4.3 Future Needs

Because the wet-well sump is small compared to the high inflows, under normal circumstances one of the duty variable speed pumps operates virtually all day. The pumping station maximum pump rate is 18.6 m$^3$/s. However the siphons to which the pumps discharge cannot take these peak flows so the pumping station never operates above 16.1 m$^3$/s maximum pump rate, i.e., one duty pump and four storm pumps running simultaneously. Any future proposals to increase the pump rate at the pumping station would need to take account of the upgrading that would be required to the siphons.

The constraint on this option is the hydraulic capacity of the inlet works, and the storm water storage capacity at the Ringsend WwTW.

7.3 Other Strategic Sewerage Systems

7.3.1 City Centre / Docklands Sewerage F001

7.3.1.1 Description of Catchment

This highly urbanised catchment, which has a population of 152,000, straddles the Liffey River and extends 12km inland from the Docklands. Whilst the residential population is spread across the catchment, commercial activities are concentrated in central and eastern parts, with industrial areas at the Docklands. There are several large trade discharges - the largest being Guinness.

Some of the eastern parts of the catchment are low-lying - with large areas being below the MHWS tide level. These areas are particularly susceptible to flooding during storms and / or high tides.

Major elements of the drainage system include interceptor sewers from Parkgate Street to Eden Quay and Heuston Station to Burgh Quay, an inverted siphon between Eden Quay and Burgh Quay, and the trunk sewer from Burgh Quay to the MLPS at Ringsend. Other major sewers transfer flows from the west to Heuston Station, from central parts to the Quay sewers and from south of the Tolka River to Eden Quay. There are several pumping stations, particularly in the Docklands, with the largest at East Road. This pumps foul flows to the MLPS, with excess storm flows pumped to a culvert, for discharge to the River Liffey.

Much of the sewerage system is very complicated, with nearly 100 CSOs, most of which discharge to the River Liffey. Several discharge to the Camac River, the Poddle River or the Tolka River. There are also numerous bifurcations, resulting in complex looped systems.

Although the catchment is already well developed there are many future developments identified, including infill residential and commercial sites. There are proposals for extensive high-density residential and commercial developments in the Docklands areas.

Figure 7.3.1 shows the extent of the City Centre/Docklands Sewerage Foul Catchment.

7.3.1.2 Hydraulic Performance

During the September 2002 flow survey infiltration was assessed at more than 550l/s (57% of the DWF). Infiltration rates are high in low-lying areas and close to the rivers. Although outfalls are normally fitted with flap valves, inflows from the Liffey River were observed during high tides.
The model has been used to predict existing and future flooding and CSO deficiencies. There was predicted flooding at nearly 200 nodes, at 36 locations. Much of the predicted flooding is confirmed by historic records. Flooding is particularly bad in the following areas:

- Between Fassaugh Road and Cabra Road;
- Between the Tolka River and the Royal Canal - Hollybank and Lindsay Roads, near Croke Park, in Ballybough Road and at East Wall;
- In Seville Place, between Connolly Station and the Royal Canal;
- South of the Liffey River, in the Pearse Street / Erne Street area.

CSO performances were assessed against the Formula A criterion - currently 43 CSOs (45%) fail to pass Formula A. 11 are predicted to spill at least once a week and 37 once a month. CSOs that discharge frequently and spill large volumes include those in the following areas:

- East Road;
- House Quay / Cardiff Lane;
- Patrick Street / Dean Street;
- Ormond Quay Upper / Arran Quay East;
- Arran Quay / Lincoln Quay;
- Parkgate Street.

When the 2011 conditions were modelled flood volumes in many areas were little changed. However, in the Docklands and other areas particularly affected by developments there were significant predicted increases in flood volumes. The overall catchment Formula A increased from 5.0 m³/s to 6.3 m³/s.

When the 2031 conditions were modelled there were large increases in flood volumes, due to Climate Change. CSO Formula A values were greater, with the catchment Formula A increasing to 6.7 m³/s. CSO spill volumes and frequencies increased significantly. One more CSO failed to pass Formula A.

### 7.3.1.3 Future Needs

There are currently many areas with insufficient capacity. Frequent and widespread flooding occurs and many CSOs fail to pass forward sufficient flow. These existing problems need to be addressed.

It is estimated that the population will increase by 19% by 2011 and by 34% by 2031. Although a 25% reduction in infiltration has been assumed, this has marginal effect on future storm flows. Additional capacity is required to accommodate these flows.

Several of the failing CSOs are along the north and south Quays. One of the major needs is therefore to develop a scheme to reduce spills. The provision of storage or additional sewer capacity in such areas would be extremely difficult to achieve, so it is proposed to improve CSO performance by diverting a proportion of the flow away from the Quays, to release capacity in the Quay sewers. Under the overall study strategy it is proposed that a substantial proportion of the flows (2 m³/s) be diverted to the GCTS, via a pumping station at Heuston Station. Major new sewers are required to transfer flows from the north and west of the catchment, on both sides of the Liffey, to Heuston Station.

In the east of the catchment major improvements will be required to accommodate the Docklands developments, to reduce flooding in low-lying areas and to ensure that CSOs pass Formula A. The Docklands Drainage Area Study (DAS) is being carried out by Carl Bro, who are developing improvement options. Although these have been considered in this study there are also hydraulic deficiencies west of the Docklands area that are not addressed in the DAS.

Because of the large scale of the flooding and the low-lying nature of much of the land it will be necessary to carry out very extensive improvements in the Docklands area, both on the north and...
south of the Liffey River. Low ground levels mean that much of the foul flow will have to be pumped. It will also be necessary to pump much of the storm water, particularly during periods of high tide. Consequently, on the northern side of the Liffey River there will need to be many new major sewers transferring flows by gravity to a new pumping station in the Docklands – the proposed Spencer Dock Pumping Station. These will not only cover the Docklands area, but also have to be extended north and west, to Drumcondra. The Spencer Dock Pumping Station will discharge flows to the WwTW. On the southern side of the Liffey River improvements will be less extensive, transferring flows from the southern Docklands area to Ringsend MLPS, via the tunnel interceptor proposed by Carl Bro. New sewers will be needed to connect into this, in order to alleviate flooding problems.

Elsewhere it is proposed that most hydraulic problems will be overcome on a more local basis, by CSO improvements, local storage and up sizing of sewers.

7.3.2 NDDS & North Fringe Interceptor Sewerage F004

7.3.2.1 Description of Catchment

The North Dublin Foul Catchment broadly defined extends from Cappagh in the west to Howth and from the River Tolka in the south to the M50 Motorway and Dublin Airport in the north. It also includes the airport and the satellite area of Portmarnock. This is broadly broken into the three main sub-areas, based on sewer operational mode (gravity, pressure, pumped), which are then each divided into individual sub-catchments. There are 20 sub-catchments within the north Dublin catchment. The main areas and sub-catchments are:

- North-West Gravity Catchments - Primary routes 4-11;
- Southern Pumped Catchments - Routes 12 and 13;
- Central and Eastern Catchments to the NDDS pressure sewer - Routes 2, 3, 14 to 18 and 20

Each route drains to the NDDS sewer, which used to discharge to the sea 60m off the Nose of Howth. A 1400mm diameter submarine pipeline has been constructed and commissioned in 2003 as part of the Dublin Bay Project with a pumping station at Sutton, which has re-directed flows to the Ringsend WwTW. A North Fringe/Northern Interceptor Sewer was completed in 2003 approximately along the Fingal County Council/Dublin City Council boundary to collect the planned growth areas within Fingal County Council and to relieve the overloaded NDDS sewer.

The Northern Interceptor/North Fringe System comprises two parts:

**Northern Interceptor;** comprising a sewer along Glasnevin Avenue from Finglas to Ballymun, intercepting the northern parts of the existing Finglas, Ballygall and Glasnevin catchments and connecting new development in the North Road and Poppintree Area. This sewer terminates in a pumping station at Ballymun, which pumps to the head of the North Fringe Sewer.

**North Fringe Sewer;** is a gravity sewer commencing at Ballymun Road and laid generally in an easterly direction across the Santry Valley following the new Northern Cross Extension (N32) Road to Ballydowly as far as the Ballydowly Estuary shoreline and from there along the shoreline and under the DART railway line to the new Sutton Pumping Station. This sewer collects flows from the Airport zone and all new development in the North Fringe area. Branch sewers would also divert the bulk of the existing Santry Valley, North Fringe and Ballydowly/Portmarnock catchment flows to the North Fringe Sewer.

Figure 7.3.2 shows the extent of the NDDS and North Fringe Foul Catchment.

7.3.2.2 Hydraulic Performance

Flooding and surcharge of sewers was predicted at many locations in the following catchment areas:

- Raheny/Kilbarrack
- Dollymount
The model predicts significant hydraulic overloading of the trunk sewers, which is mainly attributable to the storm run-off from separate, and partially separate areas entering the foul sewers. Sometimes, the flooding is predicted at local low-lying areas as a direct result of backing up from the trunk sewers.

A number of CSOs present within the system spill to watercourses during the storm events. Consequently, the foul/combined sewer system in the vicinity of CSOs is not predicted to flood.

The SUS database showed sections of sewer network with flat or reverse gradients, which were confirmed by surcharge, predicted by simulation results at these locations.

The siphons at Finglas & Killester were of concern as the observed flow survey showed a presence of some form of flow restriction at these locations, which needs to be investigated. The observed flow survey also indicated the presence of a blockage in the sewer adjacent to the Finglas Road. A number of operational problems were also reported by the operations staff of DCC. These are detailed in the Phase 2 report.

### 7.3.2.3 Future Needs

The majority of developments identified in the NDDS and North Fringe Interceptor catchment fall within the Fingal County environs. The developments planned in the FCC for 2011 & 2031 are located on the South Fingal Fringe. The development planned for 2011 within the DCC area is mostly infill development.

Solutions within the catchment have generally been developed based on the concept of increasing capacity within the existing system or providing storm storage to resolve hydraulic deficiencies and increasing pass forward flows or utilising storage at CSOs to conform to Formula A requirements. It is considered appropriate that, prior to developing the improvement options in greater detail, further site investigation be carried out to obtain more detailed information on unsurveyed CSOs. It is also considered necessary to conduct impermeable area surveys in Kilbarrack/Dollymount catchment and to monitor flows in the 300mm diameter Kilbarrack road sewer before implementing any drainage development options in this area.

It should be noted that the hydraulic deficiencies located outside the GDSDS study area are addressed separately by a number of capital works contracts currently being implemented. The recently constructed North Fringe/Northern Interceptor Sewer between Finglas and Sutton intercepts at various points the existing flows in the North Dublin System, thus relieving overloading of the main NDDS Sewer. Hence, the Phase 2 hydraulic/CSO deficiencies identified within the north fringe area are resolved.

### 7.3.3 Rathmines and Pembroke Sewerage F005

#### 7.3.3.1 Description of Catchment

The Rathmines and Pembroke (R&P) High-Level Catchment extends from Harold’s Cross, in the west, to Ballsbridge, in the east, and includes the districts of Rathmines, Ranelagh, Rathgar, Milltown and Donnybrook. The Grand Canal to the north and the River Dodder to the south border the catchment.

The catchment area is 836 ha with a population of approximately 59,000. The catchment is predominantly urban with some parkland areas. The buildings within the catchment are mostly residential housing, interspersed with industrial, institutional, community and recreational areas.

The R&P High-Level Catchment is neighboured by the catchments of Kimmage to the west, Clonskeagh to the south and R&P Low-Level to the east. Both Kimmage and Clonskeagh Catchments contribute flows to the R&P High-Level sewerage system during storm events. However, the R&P Low-Level system has no interaction with the R&P High-Level system. The Kimmage Catchment lies within both the SDCC and DCC areas and has been modelled as part of the GCTS Catchment (F003), as it
drains directly to the GCTS. The Clonskeagh Catchment lies within the DLRCC area and includes the areas of Churchtown and Milltown. This catchment is part of the Dodder Valley (DLRCC) Catchment model (F006).

The R&P High-Level sewerage system is mostly combined, except for some areas in the vicinity of the River Dodder that are partially separate. The Swan Sewer, originally a small stream, drains combined flows from the western and northern parts of the R&P High-Level Catchment. This sewer is also referred to as the R&P Main No. 1. The southern part of the catchment is drained by the R&P Main No. 2. This runs parallel to the River Dodder. These trunk sewers join together at Ballsbridge, with the R&P Main No. 2 passing under the River Dodder via the Beatty’s Avenue siphons to meet the R&P Main No. 1. The R&P High-Level trunk sewer then continues alongside the River Dodder until Londonbridge Road, where it passes under the river via inverted siphons, before continuing to Ringsend.

The R&P High-Level Catchment does not directly connect into the GCTS. However, there are two major overflows along the R&P Main No. 1 (Swan Sewer) that spill into the storm section of the GCTS. These are at Mountpleasant Avenue and Sallymount Avenue. There is a smaller, less significant, overflow at Harold’s Cross, which combines with flows from the Kimmage Catchment, before discharging into the GCTS at Parnell Road. There is a further overflow at Parnell Road, where continuation flows discharge into the foul section of the GCTS and any flows that are spilt over the overflow discharge into the storm section.

There are CSOs along both the R&P Main No. 1 and No. 2, discharging to the River Dodder. Several of these discharge into the tidal reach of the river downstream of Ballsbridge.

Figure 7.3.3 shows the extent of Rathmines and Pembroke Sewerage Foul Catchment.

### 7.3.3.2 Hydraulic Performance

Phase 1 concluded that the subsequent phases for the catchment should not be carried out until completion of the R&P High-Level Catchment Drainage Area Plan (DAP), which has been carried out at the same time as the GDSDS. Subsequently, Phase 2 reviewed the results of the R&P High-Level Catchment DAP, in order to report the existing performance of the sewerage network and system deficiencies as identified by the DAP study. Due to the level of detail included in the DAP study, there was no need to carry out any further modelling work.

The following deficiencies in the current system performance were identified by the DAP study:

- Flooding is a problem throughout the catchment. The worst areas are Rathmines, Donnybrook and Ranelagh.

- Infiltration is a problem throughout the sewerage system, which is causing structural deterioration. The increased flows also have an impact on the operational and maintenance costs at the Main Lift Pumping Station and at the treatment works at Ringsend.

- There are 5 combined sewer overflows discharging into the River Dodder that fail to achieve Formula A and spill at least 50 times a year.

- There is a risk of water entering the sewerage system at Bath Avenue CSO during high tides, due to there being no flap valve on the outfall.

- There are 2 lengths of sewer with a structural grade of 5 (i.e. in a very poor condition) and a further 16 km of sewers with a structural grade of 4. A large proportion of these are critical sewers, which means that in the event of structural failure there would be significant disruption for the local community and potentially high costs for repair.

### 7.3.3.3 Future Needs

Phase 3 also consisted of a review of the results from the R&P High-Level DAP study. The DAP identified that there are a number of solutions available to solve the hydraulic and environmental problems in the catchment, but they generally fell into two categories: upsizing of existing sewers with off-line storage or upsizing of existing sewers with a new interceptor sewer. The latter would involve
tunnelling, but would significantly reduce the extent of the sewer upsizing required and, therefore, reduce the amount of disruption to the public.

As part of the GDSDS strategy, however, a further solution has been proposed, which transfers flows to the GCTS instead of a new interceptor sewer. It is proposed that flows up to Formula A would be discharged into the foul section of the tunnel sewer and flows above this would be spilt to the storm section of the tunnel. This solution has now been adopted as the preferred solution for the DAP study.

7.3.4 Dodder Valley Sewerage F006/F007

7.3.4.1 Description of Catchment

The Dodder Valley Foul Catchment generally lies in the Dodder River Valley with a trunk sewer laid generally parallel to the River Dodder draining the areas to the south of the river. The eastern portion includes Windy Arbour, Dundrum, Churchtown and Ballinteer, while the western section includes the suburbs of Tallaght, Firhouse, Greenhills, Ballyboden and Rathfarnham.

The trunk sewer begins in the western portion of the Dodder River catchment within SDCC administrative area. It crosses into DLRCC administrative area at Mount Carmel draining by gravity to the Belfield siphon house. The Belfield siphon house is within the DCC administrative area. The trunk sewer is then a twin siphon travelling to the Sandymount foreshore with a submarine portion from the foreshore until it enters the Ringsend WwTW.

Dodder SDCC Catchment

The Dodder Valley (SDCC) catchment drains the suburbs of Jobstown, Tallaght, Oldbawn, Firhouse, Greenhills, Kilnamanagh, Ballyboden and Rathfarnham.

The trunk sewer was laid in 1970 generally alongside the River Dodder with a diameter of 825mm in the upper reaches and a downstream diameter of 1500 mm at the intersection with the Dun Laoghaire Rathdown County border.

Dodder DLRCC

The Dun Laoghaire-Rathdown section of the Dodder Valley Foul Catchment is a suburban catchment lying in the Dodder River Valley with its southern extent rising into the Dublin Mountains. The catchment consists mostly of medium density residential housing estates interspersed with industrial, institutional, community and recreational areas and includes the suburbs of Windy Arbour, Dundrum, Sandyford, Churchtown and Ballinteer. The catchment is almost fully developed. Apart from some available areas in the south of the catchment, future development will mainly consist of infill housing estates on subdivided lands throughout the catchment.

The catchment area does not include contributing flows from coastal areas or areas of a large tourist potential and therefore would not be influenced by any significant annual variation in population.

Figure 7.3.4 shows the extent of the Dodder Valley foul catchment.

7.3.4.2 Hydraulic Performance

The overall population of the Dodder Valley Catchment is predicted to remain relatively stable for the period to 2031 (approx. 160,000), with smaller household occupancies counterbalancing the allowances for development. It has been assumed that the Churchtown and a large portion of the Clonskeagh catchment, currently draining to the City Centre, will be diverted to the Dodder Valley Catchment for the future scenarios. There are large-scale increases in development allowed for in the Catchment in particular in the Tallaght/Firhouse areas, and also in the Dundrum/Sandyford area, which cause an appreciable increase in the predicted levels of flooding. In addition new deficiencies have been identified due to the connection of future development areas to the model. Predicted levels of flooding are particularly severe in the Dundrum, Goatstown, Roebuck, Belfield and Firhouse areas. The DLRCC portion of the Catchment, being the downstream end is more acutely affected by flooding.

Infiltration is an issue in the Catchment, with the average estimated percentage of DWF being around 20%, based on observed data from the flow survey. The system is capable of accepting dry weather
flows for the catchment, with storm contribution principally causing flooding. There are a number of CSOs in the Catchment. These generally operate within acceptable limits with one exception at Millmount Grove.

There are operational and maintenance problems at the Milltown Diverter, Belfield Siphon House and Twin Siphons to Ringsend WwTW.

7.3.4.3 Future Needs

The sewerage infrastructure requirements to cater for future development were assessed for two design scenarios, 2011 and 2031. Ten Drainage Development Options have been proposed for the Catchment. For the SDCC portion of the Catchment upgrades for the 2011 scenario were those provided in the Dodder Valley Strategic Drainage Study, 2001 by RPS-MCOS. These solutions included new branch sewers, which would relieve pressure on the existing system and take future development flows. Flows would be restricted on the Dodder Valley Sewer at Firhouse to limit the pass forward flow to the capacity of the downstream pipe and to store the 5-year critical duration volume. This solution caters for the 2031 situation with an increase in storage required at Firhouse and duplication of the Dodder Valley Sewer required at Mount Carmel Hospital. Upgrades are furthermore required in the 2031 scenario to cater for future development at Edmondstown.

For the DLRCC portion of the catchment solutions proposed generally include upsizing and duplication of sewers in the Churchtown, Dundrum, Ballinteer, Goatstown and Roebuck areas to alleviate existing and future flooding.

Large-scale works would be required in the Dundrum Village/Sandyford Road/Dundrum Bypass and Taney Cross, where an offline storage tank is proposed.

Online storage is proposed on the Dodder Valley Sewer, at Belfield and on Beaumont Avenue. Large offline storage tanks are required for the 2011 and 2031 scenarios at Belfield with a small tank proposed at Roebuck to alleviate flooding.

Adjustment of the weir setting of the storage tank at Belfield would relieve predicted flooding problems upstream of the siphon house.

It is proposed that the Dodder Valley Catchment will continue to drain to Ringsend WwTW in the future with the flow restricted to its current maximum of 3.25 m³/s. Storage is required to contain flows in excess of 3.25 m³/s.

7.3.5 Lucan Clondalkin Sewerage F008

7.3.5.1 Description of Catchment

The Lucan Clondalkin drainage system, in the administrative area of South Dublin County Council has been designed as a predominantly separate foul system, with the exception of Lucan and Clondalkin villages, which are combined.

The catchment encompasses the suburbs of Lucan, Quarryvale, Ronanstown, Neilstown, Clondalkin, Knockmitten, Newlands Cross and Ballymount. The total area of the catchment is some 23,000 hectares, with an existing residential population of around 78,000. The catchment drains through both pumped and gravity flow into the Grand Canal Sewer System, and ultimately to the Ringsend WwTW. A total of five significant pumping stations are located throughout the study area. Flows from Lucan, Quarryvale and Cherry Orchard are pumped to a high-level sewer, serving north Clondalkin. The remainder of the sub-catchments drain by gravity to the Grand Canal Sewer on the Naas Road.

A number of significant commercial sites are located within the catchment, including the Liffey Valley Shopping Centre. Industrial estates include Ballymount, Western and Robinhood. Wyeth Ayerst Ltd. is currently constructing a large industrial plant in Grange Castle. Primary national routes (N4 and N7) adjoin the catchment and the M50 motorway passes through the catchment.

The recently completed Camac Valley and City West trunk sewers link the villages of Saggart, Rathcoole and Newcastle and developments in the Citywest area respectively to the Lucan Clondalkin Drainage Area. These sewers convey flows from these areas into the system at Cherrywood.
The residential population of the Lucan Clondalkin catchment, excluding the population from the recently connected Saggart, Rathcoole, Newcastle study area (F009), is projected to increase by some 47% at the design horizon of 2011 and by 141% at 2031. This corresponds to an increase in the catchment area to 3,912 ha in 2011 and 5,120 ha in 2031. Non-domestic inputs are estimated to increase by an additional 24,000 PE for 2011 and some 48,000 PE by the year 2031.

Figure 7.3.5 shows the extent of the Lucan/Clondalkin foul sewer catchment.

7.3.5.2 Hydraulic Performance

The 9B trunk sewer which links the catchment to the Grand Canal is currently operating at flows exceeding its design capacity and there are local risks of flooding.

The increases in development are dramatic with corresponding increases in sewage flows. Whilst the system generally has the capacity to convey predicted DWF through the system, significant inflow, infiltration and the recent connection of flows from Saggart, Rathcoole and Newcastle have rendered the forwarding of all future flows for treatment at Ringsend as impossible without major upgrading of both the catchment sewers and Grand Canal Tunnel Sewers.

The existing hydraulic deficiencies in the system are identified as both surface water runoff entering the system in significant volumes due to cross-connections (inflow) and infiltration as identified in the system.

The extent of infiltration observed during the short-term flow survey is significant, such that it accounts for over 30% of the DWF to the catchment system. Infiltration has been identified as greater than 50% of dry weather flow in Quarryvale, Rowlagh, Kilmahud, Yellow Meadows, Clondalkin Village, Ballymount, Walkinstown Park and Robinhood.

Whilst Clondalkin village and Lucan village are combined systems the majority of the system is separate. The extent of cross-connections is such that peak factors of up to 6 times dry weather flow have been recorded at the outlet of the catchment.

7.3.5.3 Future Needs

The needs for future development were assessed for two design scenarios, for 2011 and 2031. In the first instance the assumption was made that for these future design scenarios all flows from Lucan Clondalkin (in addition to flows from Saggart, Rathcoole and Newcastle) would be routed ultimately to Ringsend WwTW, via the existing Grand Canal System.

In order for the extended catchment to convey all flows to Ringsend for the design horizons of 2011 and 2031, extensive upgrading of the existing network was identified as being required. In total some 27 km of trunk sewers were identified as requiring upsizing; these included most trunk mains in Lucan, sewers downstream of the Esker pumping station rising main, the City West sewer, trunk sewers in Cherrywood, Clondalkin Village, all sewers along the Nangor Road and in Ballymount and Robinhood industrial estates. Significant upgrades and increases in storage would also be required for the Lucan Spa, Lucan Lower Level and Esker pumping stations. Lands are available at or adjacent to the stations to facilitate these improvements. Upgrades are based on the assumption that there is no reduction in inflows or infiltration to the existing system. This assumption has been adopted throughout the study as it is difficult to remove inflow in a cost-effective manner.

For the 2011 design scenario predicted peak flows range from 4.61 m³/s for the 5-year event to 6.19 m³/s for the 30-year event. For the 2031 design scenario peak flows range from 8.07 m³/s for the 5-year event to 10.92 m³/s for the 30-year event. This indicates the scale of flow increases over the GDSDS design horizon.

In light of assessments of the capabilities of the Grand Canal tunnel to accept these flows and Ringsend WwTW to treat these flows, a number of alternative design scenarios were developed. These scenarios incorporated overflowing to the stormwater system, on-line and off-line storage, and alternative routes to deliver flows to Ringsend and sewage treatment in locations other than Ringsend.

Due to the scale of increased flows to the system for the design horizon of 2031 five design scenarios have been developed. Each of these scenarios assumes that the proposed upgrade for 2011 has taken place.
It should be noted that whilst some residential development had previously been allocated to the Saggart, Rathcoole, Newcastle catchment (F009) for 2031, due to downstream constrictions these flows were redirected into the greater Lucan Clondalkin design scenarios.

The five scenarios can be summarised using references from Chapter 11: Strategic Drainage Plan as:

**Scenario 1A** - Flows from all proposed 2031 developments, are to be conveyed directly to the Grand Canal tunnel sewer (GCTS). For this scenario the foul and storm cells of the GCTS would be swapped over in order to provide the additional capacity required to convey these additional foul flows to treatment and extensive tunnelling works would be required to increase the capacity of the GCTS at its lower end.

This scenario would require a 9.5 km trunk sewer of 2,100 mm diameter to the GCTS.

**Scenario 1B** - Flows from all proposed 2031 developments plus all flows from Lucan, Adamstown and Quarryvale are to be conveyed directly to Ringsend WwTW in a trunk sewer along the River Liffey valley.

This option in effect eliminates the requirement for pumping from the three existing pumping stations in Lucan and the need for any further pumping stations in the study area. In total five discharge points to the trunk main are anticipated, with the diameter ranging from 1,500 mm to 2,100 mm. The total length of the main would be approximately 30 km.

**Scenario 2A** – Flows from all proposed 2031 developments, in the west of the catchment are to be treated at a new WwTW in the west of the catchment. Lands zoned as industrial would be suitable for the WwTW. Three additional pumping stations would be required at Weston, South Adamstown and Hazlehatch pumping flows to the treatment works.

Treatment standards are to be to a very high standard, with treated effluent discharged locally to the River Liffey. Up to 3DWF would be treated, with storage on site. The contributing residential population to the WwTW would be 175,815 and an industrial load of 409 litres/s.

**Scenario 2B** - Flows from all proposed 2031 developments, in the west of the catchment are to be treated at a new WwTW in the west of the study area. Treatment standards are to be storm standard, with treated flows passed to the storm section of the Grand Canal tunnel sewer (GCTS).

Lands zoned as industrial would be suitable for the WwTW, with lands in Grange Castle identified as a suitable location. Up to 3DWF would be treated with storage on site. The contributing residential population to the WwTW is 175,815 and an industrial load of 409 l/s. This scenario would require a 9.5 km trunk sewer of 1,500 mm diameter to link the WwTW with the storm section of the GCTS.

**Scenario 2C** - Flows from all proposed 2031 developments are to be intercepted by a proposed orbital sewer that travels from the Newcastle area around the limit of existing development in north Dublin, conveying flows to a new WwTW on the coast, preferably in the vicinity of Portrane.

The contribution from Lucan Clondalkin (F008) and Saggart Rathcoole Newcastle (F009) would be a residential population of 175,815 and an industrial load of 409 l/s, with 3DWF pumped to the proposed WwTW.

Due to the scale and consequences of these proposed scenarios, they are considered further under the strategy options in Chapter 11 entitled “Strategic Drainage Plan.”

The 2011 model incorporates flows from the existing 9B catchment, Saggart, Rathcoole and Newcastle and future development including the development of the Adamstown SDZ lands. The strategic drainage options discussed in Chapter 11 of this report are all based on the restriction of flows to Ringsend WwTW. Continuing the practice of sending all flows to Ringsend is unsustainable from a drainage viewpoint. It is also necessary to maintain capacity in the Grand Canal Tunnel Sewer (GCTS) to take flows from the City Centre and Rathmines and Pembroke catchments as this is the only strategic option for draining these catchments. It is therefore necessary to limit flows to the Grand Canal Sewer from the combined catchments of Lucan Clondalkin (F008) and Saggart, Rathcoole, and Newcastle (F009) to 2.0m³/s. Flow control would have to be placed on the sewers discharging from these catchments. The introduction of this control and the storage provisions in South Dublin would
have to be planned and integrated with the introduction of the City Centre flows and R&P flows into the GCT Foul Sewer Section.

Extensive upgrades to the existing drainage network are required to convey these predicted flows, of the order of 27 km of trunk mains. The existing pumping stations located at Lucan Spa, Lucan Lower Level and Esker would require upgrades to increase flows and additional storage on site. Further drainage infrastructure is required including pumping stations, storage tanks and a new trunk main to both convey flows and also satisfy downstream constraints. A major pumping station at Tobermaclugg will be required to pumps flows from the Adamstown lands into the 9B system, up to 3DWF will be pumped with the remainder to storage.

The proposed system for 2011 incorporates spilling all flows greater than Formula A to the storm section of the Grand Tunnel. Modelling has indicated that the storm cell has sufficient capacity to take these flows as well as flows from the City Centre and R&P catchments. The difference between 2.00 m$^3$/s and Formula A is some 1.18 m$^3$/s. Therefore, the difference between these two limits needs to be accommodated by storage in the system. For the 5-year return period event this equates to some 11,000 m$^3$ and for the 30 year event equates to 20,000 m$^3$. It is envisaged that this storage could be provided off-line or on-line at multiple locations using both public and private lands.

7.3.5.4 Summary of Major Upgrading Requirements

The upgrading works needed in the Lucan-Clondalkin system, now and in the near future are extensive, and are summarised below in Table 7.3.

<table>
<thead>
<tr>
<th>Catchment</th>
<th>Works up to 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>9B – Cherrywood Avenue.</td>
<td>Upgrade 708 metres of sewer of 750 mm dia to 1200 mm dia</td>
</tr>
<tr>
<td>9B – Clondalkin Village (Knockmeenagh Lane to Watery Lane)</td>
<td>Upgrade 10 metres of sewer from 150 mm dia to 225 mm dia. Upgrade 394 metres of sewer from 150 mm dia. to 525 mm dia. Upgrade 1,047 metres of sewer from 225 mm dia to 525 mm dia. Upgrade 62 metres of sewer from 300 mm dia to 375 mm dia. Upgrade 300 metres of sewer from 300 mm dia to 1,050 dia Upgrade 264 metres of sewer from 375 mm dia to 1,050 mm dia. Upgrade 671 metres of sewer from 375 mm to 1,200 mm dia</td>
</tr>
<tr>
<td>9B – Ballymount and Robinhood Industrial Estate</td>
<td>Upgrade 365 metres of sewer of 225 mm dia to 375 mm and 450 mm dia. Upgrade 187 metres of sewer of 300 mm to 375 mm, 450 mm and 525 mm dia. Upgrade 1,381 metres of sewer of 375 mm to 525 mm dia. Upgrade 160 metres of sewer of 450 mm to 600 mm diameter pipe; Upgrade 244 metres of 450 mm to 1,050 mm dia</td>
</tr>
<tr>
<td>9B – Grange Castle</td>
<td>626 metres of new 450 mm dia. sewer 749 metres of new 900 mm dia. sewer</td>
</tr>
<tr>
<td>9B – Cappagh</td>
<td>1,013 metres of new 525 mm dia. sewer</td>
</tr>
<tr>
<td>9B – Ballyowen Park</td>
<td>698 metres of new 525 mm dia. sewer</td>
</tr>
<tr>
<td>9B – Adamstown</td>
<td>348 metres of new 450 mm dia. sewer 67 metres of new 600 mm dia. sewer 427 metres of new 750 mm dia. sewer</td>
</tr>
<tr>
<td>9B – Tobermaclugg</td>
<td>A new pumping station pumping 88 l/s. 5.7 kilometres of rising main Storage of 1,100 m$^3$</td>
</tr>
<tr>
<td>9B – Spa Pumping Station</td>
<td>Upgrade pumping station from 48 litres / sec to 70 litres / sec.</td>
</tr>
<tr>
<td>Catchment</td>
<td>Works up to 2011</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>------------------------------------------------------</td>
</tr>
<tr>
<td>9B – Lucan Lower Level Pumping Station</td>
<td>Upgrade pumping station from 215 litres / sec to 400 litres / sec.</td>
</tr>
<tr>
<td>9B – Nangor Road / Naas Rd</td>
<td>Upgrade 2,374 metres of sewers to 2,325 mm dia.</td>
</tr>
<tr>
<td>9B – Fonthill Road / Ronanstown</td>
<td>Upgrade 289 metres of sewer of 900 mm to 1,350 mm dia. Upgrade 2,067 metres of 1,050 mm to 1,350 mm dia.</td>
</tr>
<tr>
<td>Dunawley (Nangor Road)</td>
<td>Upgrade 1,607 metres of sewer to 1,200 mm dia.</td>
</tr>
<tr>
<td>Nangor Road</td>
<td>Upgrade 45 metres of 750 mm sewer to 1,350 mm dia.    Upgrade 183 metres of 900 mm to 2,225 mm dia. Upgrade 324 metres of 1,219 mm to 1,500 mm dia. Upgrade 360 metres of 1,219 mm to 2,100 mm dia. Upgrade 552 metres of 1,219 mm to 2,225 mm dia. Upgrade 292 metres of 1,350 mm to 2,225 mm dia. Upgrade 406 metres of 1,372 mm to 2,225 mm dia.</td>
</tr>
<tr>
<td>CSO at Ballymount</td>
<td>To limit onward flows to Formula A (3.06 cumec), spill to GCTS Storm Cell</td>
</tr>
<tr>
<td>Storage Tank</td>
<td>11,000m³, possibly located at Ballymount.</td>
</tr>
<tr>
<td>Overflow Sewer to Storage Tank</td>
<td>1,460 metres of new sewer 1,500 mm dia.</td>
</tr>
<tr>
<td>Duplicate 9B Sewer Ballymount to Davitt Road</td>
<td>4,200 metres of new sewer 1,500 mm dia.</td>
</tr>
</tbody>
</table>

Table 7.3 Summary of Works in the Lucan Clondalkin Trunk Sewer System

7.3.6 Dun Laoghaire Sewerage F010/F011

7.3.6.1 Description of Catchment

The Dun Laoghaire Drainage System covers the catchments of West Pier West, West Pier East and Bullock. The system is combined and major infrastructure works were carried out between 1990 and the present to strengthen the drainage infrastructure in the area. Flows from the West Pier West and part of the West Pier East catchments discharge by gravity to a pumping station at West Pier. The remainder of the West Pier East catchment discharges to a pumping station at Bullock Harbour and from there flows are pumped to gravity sewers discharging at West Pier Pumping Station. All flows, with the exception of the small Coliemore outfall, are collected and transferred by trunk sewers, pumping stations and the 963 mm diameter cross-bay pipeline to Ringsend for treatment. Plans to connect a further 1000 PE from Coliemore are underway.

The catchments are highly developed with limited lands available for future development. Based on the population and land use predictions in the GDSDS, the population in the catchment will decrease from 74,912 in 2002 to 69,868 in 2011 and to 61,119 in 2031.

Figures 7.3.6 and 7.3.7 show the extent of the West Pier East and West foul sewer catchments.

7.3.6.2 Hydraulic Performance

The scheme was designed in 1990 to include discharges from a projected 2011 population of 80,000.

The existing pumping station at West Pier has the capacity to pump 1 m³/s across Dublin Bay for treatment. This equates to approximately 5 DWF at the above design population. Storage is provided in the system to limit overflows at West Pier and Bullock Harbour to three spills per bathing season to ensure compliance with the Bathing Water Regulations.
The existing system is thus capable of meeting the current and future projected populations in the catchment up to the 2031 design horizon.

7.3.6.3 Future Needs

There are some localised flooding problems and infiltration is known to be high in some parts of the catchment. Further increases in impermeable areas and connections of additional surface water flows to the system would lead to increased spills at the CSOs and water quality at the bathing beaches in the area would be compromised. These issues can be resolved through the planning and implementation of localised rehabilitation and drainage improvements that are outside the scope of this overall strategy for the Region.

7.4 Other Sewerage Systems

7.4.1 Newcastle/Rathcoole/Saggart Sewerage F009

7.4.1.1 Description of Catchment

Newcastle, Rathcoole and Saggart are suburban towns within the SDCC region, situated approximately 15km west of Dublin and adjoining the N7 National Primary Route to Dublin. The area has been identified for extensive residential and industrial developments which are either planned or currently underway. The existing catchment area is approximately 160 ha with a residential population of approximately 4,600. Under the design scenarios considered for the GDSDS the population is set to increase to approximately 20,292 by 2011 and 93,709 by 2031 with the catchment area increasing to approximately 215 ha at 2011 and 1,425 ha at 2031.

Flows from Newcastle are pumped to the Rathcoole and Saggart sewerage system, which drain to the site of the old Saggart WwTW, from where flows are transferred to the Lucan Clondalkin drainage system (F008) via the Camac Valley sewer. This discharges to the 9B sewer, the main trunk sewer within the Clondalkin area, with flows ultimately being treated at the Ringsend WwTW.

Figure 7.4.1 shows the extent of the Newcastle, Rathcoole and Saggart foul catchment.

7.4.1.2 Hydraulic Performance

Hydraulic deficiencies for both 2011 and 2031 scenarios are associated with the connection of development areas to the existing drainage system. Three deficiencies were also identified at CSOs within the catchment, which, due to the increased upstream populations at the 2031 development scenario, no longer passed forward Formula A flows.

7.4.1.3 Future Needs

The options developed at 2011 were based around the concept of increasing capacity within the sewerage system to resolve hydraulic deficiencies and increasing pass-forward flows at CSOs and pumping stations to achieve Formula A flow rates. For 2031 development scenario the options comprised the upsizing and duplication of existing sewers.

In addition to the policy of sewer upsizing and increased pass-forward flows to address deficiencies, more strategic options were also considered as part of the optioneering process. These included pumping development flows from the Rathcoole area to the Newcastle PS and then pumping these flows direct to the 9B sewer avoiding the need to increase capacity of the Camac Valley sewer. In addition flows from the Newcastle PS could be pumped for treatment within the Lower Liffey valley (F014) catchment where flows are currently treated at Leixlip WwTW.

7.4.2 Shanganagh & Bray Sewerage F012

7.4.2.1 Description of Catchment

The Shanganagh Foul Catchment is a suburban catchment lying in the southern section of the county of Dun Laoghaire-Rathdown. The catchment consists mostly of medium density residential housing estates interspersed with industrial, institutional, community and recreational areas and includes the
suburbs of Cabinteely, Carrickmines, Foxrock, Deans Grange, Killiney, Loughlinstown, Shankill and Ballybrack. Within areas of existing development there is little scope remaining for infill development. However there are significant areas of land zoned for development in the Stepaside, Ballyogan, Carrickmines and Cherrywood areas. Significant lands are also planned for development in the area between Shankill and Bray around Old Connaught, Ballyman and Woodbrook. This area will require a new trunk main system to connect to the Bray-Shanganagh transfer pipeline.

The Bray foul catchment consists of the urban area of Bray town with its surrounding suburbs largely consisting of medium density residential housing estates interspersed with some areas of industry. The north Wicklow village of Kilmacanogue is also connected to the Bray catchment. Future development in Bray will largely be confined to infill growth though a significant commercial and industrial development is planned to the west of Bray in the Fassaroe area.

The Shanganagh and Bray Main Drainage Scheme was commissioned in 1997, prior to the GDSDS. As part of the study it was recommended for all effluent from the Bray sewerage catchment to be transferred to an upgraded Shanganagh WwTW. The upgraded plant with a connecting transfer pipeline from Bray is due to be completed by 2007.

Figure 7.4.2 shows the extent of Shanganagh/Bray foul catchment.

7.4.2.2 Hydraulic Performance

The future modelled network system being provided under the Shanganagh and Bray Main Drainage Scheme has been designed for flows up to 2020. The addition of future development to the existing system results in flooding predictions in various areas particularly on the Deansgrange and Shankill trunk sewers. The system is capable of conveying dry weather flows and existing hydraulic deficiencies in the system are as a result of surface water runoff entering the system in significant volumes and to a lesser extent due to the infiltration identified in the system.

GDSDS population predictions for 2031 within the existing developed areas of Shanganagh and Bray are equal or less than predictions for 2020. Therefore to establish catchment performance for the 2031 scenario, modelling was required where it could be assumed that potential development areas beyond the 2020 horizon would avail of existing sewers. This involved the development of a 2031 hydraulic model for the Carrickmines catchment (part of Shanganagh Catchment) to include further area to the west of the DLRCC 1998 Development Plan development zoned areas at Carrickmines, Laughanstown and Cherrywood. For the 2031 design scenario, allowances for further expedient surface water connections would lead to flooding on the Carrickmines sewer. These issues can be resolved through the planning and implementation drainage improvements that are outside the scope of this overall strategy.

7.4.2.3 Future Needs

In Shanganagh various proposals for sewer system improvement are required, in particular, modifications to overflows on the Deansgrange trunk sewer, the construction of a diversion sewer from Foxrock Village to the Carrickmines Sewer and the construction of a new storm sewer at Church Road/Shanganagh Road to facilitate interception of a number of stormwater pipes currently discharging to the foul sewer. Elsewhere localised improvements to the existing networks at Stepaside, Kilbogget, Cherrywood and Kill Lane are necessary. Further monitoring, after comprehensive sewer cleaning and CCTV survey, is required at other key locations identified as potentially liable to flooding.

It is recommended that improved access be provided to the Deansgrange trunk sewer passing beneath the closed landfill site at Kilbogget Park, by constructing large diameter shafts to facilitate the pipeline’s maintenance and remediation. Prior to construction, detailed site investigations are required in the landfill area to establish waste composition, water levels, leachate strength and other Health & Safety issues, such as landfill gas strength.

To enable development of the Old Connaught, Ballyman and Woodbrook areas a new trunk sewer system will be required to connect to future Shanganagh WwTW, possibly via a connection to the future Bray to Shanganagh transfer pipeline. For the 2031 design scenario, allowances for further expedient surface water connections would lead to flooding on the Carrickmines sewer. These issues can be resolved through the planning and implementation drainage improvements that are outside the scope of this overall strategy.
In Bray a number of new sewers are recommended. These include Herbert Road – diversion and overflow sewers, Main Street – Stormwater separation and a new sewer to connect Meath Road to the Esplanade Sewer.

### 7.4.3 Upper Liffey Valley Osberstown Sewerage F013

#### 7.4.3.1 Description of Catchment

The Upper Liffey Valley Catchment comprises the towns of Naas, Newbridge, Clane, Sallins, Kill, Kilcullen, Johnstown, Athgarvan, Caragh, and Prosperous in mid-Kildare. The Catchment drains via a mixture of gravity and rising mains to the Osberstown WwTW, which is located at Osberstown, Naas. There are three main lines into the Osberstown WwTW, one serving Clane, Sallins and Prosperous to the north, which is pumped from Sallins Pumping Station, one serving Naas, Kill and Johnstown to the east which enters the plant via a 750 mm gravity line, and one serving Newbridge, Kilcullen and Athgarvan to the south, which is pumped from Tankardsgarden in Newbridge to a pumping station at Newhall and then on to Osberstown. The total connected catchment area is approximately 1,250 ha.

There are proposals to connect the remainder of Athgarvan and Blackrath, and the greater Curragh area (including Brownstown, the Curragh Camp, Maddenstown, Cut Bush, and Suncroft) to the WwTW at Osberstown.

The Catchment is predominantly residential with some food processing industries in Naas and large pharmaceutical and food processing in Newbridge.

The sewerage system is generally a separate system with the exception of the town centre of Naas and Newbridge and some older estates in all of the towns and villages, which have combined systems. There are some partially separate areas with roof drainage going to the foul/combined system.

Figures 7.4.3a and 7.4.3b show the extent of the Upper Liffey Valley/Osberstown foul catchment.

#### 7.4.3.2 Hydraulic Performance

There is very limited capacity available in the existing sewer system in Naas. Lack of sewer capacity and overflow problems at the old WwTW and in the main Naas 750 mm line would need to be addressed before any additional loads are connected to the existing Naas system.

There is a degree of capacity available in the existing sewer system in Kill and Johnstown. Future loads can generally be serviced by a combination of the existing sewers and by new sewers, depending on the area.

The main sewer systems in Newbridge are at capacity. Future flows should generally be serviced by new sewers. There is capacity in the new Kilcullen line but any significant future connections to this line will require detailed examination.

In Kilcullen, the only verified flooding location is at KDA Industrial Estate. There is a degree of capacity available in the existing sewer system in Kilcullen. Future loads can generally be serviced by a combination of the existing sewers and by new sewers, depending on the area.

Athgarvan does not have a dedicated sewer system except at recent new developments in the area, and would need new sewers and an upgraded pumping station to serve the area.

A significant degree of the existing sewer networks in the Prosperous, Clane, and Sallins areas are at capacity. There is also a degree of predicted sewer flooding that is verified (in the main) by KCC drainage staff.

There is a degree of capacity available in the existing sewer system in Prosperous. Future loads can generally be serviced by a combination of upgrading existing sewers and by new sewers.

There is little capacity available in the existing sewer system in Clane. Future loads can generally be serviced by a combination of upgrading existing sewers and by new sewers.
There is little capacity available in the existing sewer system in Sallins. Future loads would require upgrade of existing sewers, and new sewers.

**7.4.3.3 Future Needs**

Three stages of improvements are proposed for the Naas and Kill catchments, including an infiltration reduction programme, decommissioning of CSOs and construction of new interceptor sewers diverting flows away from the town centre.

Improvements for Newbridge involve upgrading of existing sewers and provision of new interceptor sewers and associated pumping stations. Major upgrade of both Tankardsgarden and Newhall Pumping Stations and new rising mains are required.

Kilcullen is recommended to be serviced mainly by new sewers directly to the pumping station, with a degree of connection to the existing sewer system with upgrades as required.

Virtually all sewer needs in Prosperous to service new development are either local connections to the existing sewer network or dedicated new sewers for individual developments, and all costs should therefore be borne by the developers.

The proposed works in the Clane catchment consist of upgrading existing sewers, new sewers, as well as upgrading the Clane and Sallins Pumping Stations with provision of storage.

**7.4.4 Lower Liffey Valley Sewerage F014**

**7.4.4.1 Description of Catchment**

The Lower Liffey Valley foul catchment area consists of the four towns of Kilcock, Maynooth, Celbridge and Leixlip, located in County Kildare to the west of Dublin. The entire catchment has a population of approximately 43,700 people.

Kilcock is the most westerly and the smallest of the towns included in the catchment with a population of approximately 3,000 in 2002. The town is mainly residential with some small commercial properties in the centre and the larger Leaf Chewing Gum Factory to the northwest of the town.

Maynooth is a vibrant university town with a busy main street that becomes congested in peak times. It has a population of approximately 10,700.

The opening of The Arrow Commuter rail service and completion of the M4 motorway in the 1990s have allowed both Kilcock and Maynooth to become commuter towns for Dublin.

Celbridge has a small town centre adjacent to the River Liffey. The town is mainly residential, with a current population of approximately 15,000.

Leixlip is a mainly residential town that has expanded considerably in the last 25 years and currently has a population of approximately 15,000. The town is located to the east of Maynooth and the northeast of Celbridge and is the closest of the four towns in the catchment area to Dublin. Given the excellent road and rail connections and attractive environment, the town has now become a commuter town to Dublin, which is just 15 km to the east.

At present, flows are pumped from Kilcock into the gravity system in Maynooth. The combined flows of the Maynooth system and Kilcock pumped flow are then pumped into the gravity system in Leixlip at the Intel Site. Celbridge flows are similarly pumped into the Leixlip gravity system in Celbridge Road. Flows from all four towns then gravitate in an easterly direction through the centre of Leixlip to the WwTW.

Extension of Leixlip WwTW to the ultimate design will be required to cope with 2011 development scenario. Beyond this, it is likely that excess flows will need to be diverted to an alternative treatment location such as Ringsend WwTW or the proposed Fingal Coastal Treatment Plant at Portrane. It may be possible to transfer the combined development flow from Lower Liffey and the adjacent Lucan & Clondalkin catchments to the alternative treatment facility.
The receiving watercourse for the treated flows from the Leixlip WwTW is the River Liffey, which has been designated as sensitive under the Urban Waste Water Treatment Regulations. In summer in particular the river has low flows and any increase in treated flows may compromise water quality.

Development flows for the 2011 scenario comprise an additional 10,238 population from the existing population of 43,689 and the development areas increase the total catchment area from 880 ha to 1317 ha. From 2011 to 2031, an additional 61,831 population and 1,060 ha area is forecast. This will also require a comprehensive approach of upsizing of sewers and upgrading of pumping stations.

Figure 7.4.4 shows the extent of the lower Liffey Valley foul catchment.

**7.4.4.2 Hydraulic Performance**

Options to resolve CSO and hydraulic deficiencies have been derived using an approach of passing forward increased flows to treatment by upsizing or uprating pumps. At pumping stations this approach was modified, as the pumped flows required in the 2031 scenario would be so large that it would be impractical to accommodate within the existing downstream gravity system. Therefore the increase in pump rate was moderated by also providing additional storage. In this way the pumping station CSO achieves Formula A equivalence.

**7.4.4.3 Future Needs**

The optioneering process has developed Drainage Development Options (DDOs) to resolve a total of 35 hydraulic deficiencies and 13 CSO deficiencies in the 2031 scenario. As a consequence of implementing the DDOs, a total of 3 operational deficiencies, 47 structural condition deficiencies and 2 general deficiencies will also be addressed as well as an infiltration reduction programme.

**7.4.5 Rush and Lusk Sewerage F015**

**7.4.5.1 Description of Catchment**

The towns of Rush & Lusk are situated 20 km north of Dublin in County Fingal on the northern side of the Rogerstown Estuary. Rush is located on the coast and Lusk is approximately 4 kilometres inland.

The drainage system is made up of two separate catchments, one for Rush and the other Lusk, with sewers in both towns primarily separate. The towns are not served by a wastewater treatment plant at present. Sewage from Rush discharges to the Irish Sea without treatment on the southern side of Rush Harbour. Flows from Lusk pass through a septic tank prior to discharge to the Rogerstown Estuary.

At present a new treatment facility to serve the requirements of the towns is at planning stage. This will either be located adjacent to Rush and Lusk, or alternatively flows will be pumped across the Rogerstown Estuary for treatment at an expanded plant at Portrane.

Figure 7.4.5 shows the extent of the Rush and Lusk foul/combined sewer catchment.

**7.4.5.2 Hydraulic Performance**

A separate study of the catchment is being carried out for Fingal County Council, as part of the Preliminary Report and Environmental Impact Assessment for the proposed wastewater treatment plant. This study will assess the potential development in the catchment as well as reviewing catchment capacity and future requirements.

**7.4.5.3 Future Needs**

The Phase 1 report for the GDSDS was issued in April 2002. The client subsequently instructed that no further work be undertaken for the catchment. Needs for Rush and Lusk are therefore not included in the GDSDS.
7.4.6 Malahide Sewerage F016

7.4.6.1 Description of Catchment

The Malahide foul/combined catchment is situated on the northeast of Dublin, to the south of the Broadmeadow estuary. The catchment occupies an area of 360 ha and has an existing population of 14,289. It is served with a wastewater treatment plant, which has recently been upgraded to serve a population equivalent of 20,000 PE.

The Malahide catchment boundary captures all areas that are drained by gravity and by pumping to the treatment works which is located to the north of Malahide between the railway line and the marina at Malahide Point. There is a high level of construction activity in Malahide at present, mostly development of new residential estates, which will be connected to the sewer system.

According to the Bathing Water Regulations (1996), the beach at Malahide is one of 124 bathing areas in Ireland for which detailed bathing water quality standards must be maintained.

The estuary is widely used for water-based activities such as sailing and windsurfing. Its waters have been identified as sensitive waters in the Urban Waste Water Treatment Regulations, 2001.

Figure 7.4.6 shows the extent of the Malahide foul sewer catchment.

7.4.6.2 Hydraulic Performance

Six hydraulic and three CSO deficiencies have been identified for consideration. Most of these deficiencies related to existing performance, but were exacerbated by the impact of developments being connected to the system. As well as the additional developments planned for the 2011 and 2031 development scenarios, account has also been taken for increase in sea level and rainfall intensity due to climate change.

7.4.6.3 Future Needs

Upgrading works involve upsizing of sewers and upgrade of the existing pumping station with provision of storage facility to accommodate increased flows.

Regular maintenance and removal of accumulated grease along critical sewers is recommended as it is required to prevent localised flooding incidents and maintain sewer capacity to convey flows to the treatment works. Investigation of the source of infiltration identified during the flow and rainfall survey is recommended.

7.4.7 Balbriggan & Skerries Sewerage F017

7.4.7.1 Description of Catchment

Balbriggan is the most northerly town in County Fingal and lies on the coast with a number of popular bathing beaches. Balrothery is a small village to the south west of Balbriggan and between the two settlements an industrial estate has been developed off the N1. The Balbriggan catchment is approximately 220 ha in size and has an estimated population of 10,341 people. The sewerage system comprises two catchments, both of which incorporate CSOs discharging to the sea. Frequent combined sewage overflows are reported to occur to the harbour and coastal waters during rainfall. Sewage is macerated before discharge to the coastal waters.

Skerries town is to the south of Balbriggan. The Skerries catchment has an area of approximately 196 ha and an estimated population of 8,617. The sewerage system comprises three pumping station catchments, which discharged by pump to the gravity sea outfall on the seaward side of Shenick’s island.

Water Quality Results for 2001 suggest that the beaches in Balbriggan and Skerries achieved mandatory water quality standards but failed to meet guideline (EEC Bathing Beach Directive 76/160/EEC).

Figure 7.4.7 shows the extent of the Balbriggan and Skerries foul catchment.
7.4.7.2 **Hydraulic Performance**

Numerous hydraulic deficiencies exist within both towns, including foul flooding of properties. This situation was confirmed by the Phase 2 modelling work undertaken by the GDSDS. Wastewater treatment facilities are also needed to stop untreated sewage being discharged to coastal waters.

7.4.7.3 **Future Needs**

Projects are being implemented by Fingal County Council to address hydraulic deficiencies and provide adequate wastewater treatment facilities. The sewerage schemes involve new trunk sewerage, storm storage and pumping facilities.

A new WwTW serving both Balbriggan and Skerries, at Barnageeragh, is currently in the planning and design stages. The planned WwTW will be designed with a treatment capacity based on a design population of 30,000 PE.

The Phase 2 report for the GDSDS was issued in August 2003. The client subsequently instructed that no further work be undertaken for the catchment. Needs for Balbriggan and Skerries are therefore not included in the GDSDS.

7.4.8 **Swords Sewerage F018**

7.4.8.1 **Description of Catchment**

Swords is located on the Broadmeadow Estuary in Fingal to the north of Dublin. It is one of the fastest growing towns in Europe, with major new community, commercial and industrial developments either planned or underway. The sewerage catchment covers an area of some 880 ha and has a resident population of approximately 31,200.

The 2011 development scenario comprises approximately 231 ha of residential development and 220 ha for industry, corresponding to an increase of approximately 120% in PE over the 2002 development. The 2031 development scenario comprises approximately 353 ha of residential development and 88 ha of industrial area, representing an increase of 220% in PE over the 2002 development. The population of Swords catchment is set to increase by nearly 230% for the 2031 development scenario from approximately 31,000 to 70,700 PE.

The Swords catchment has an extensive separate sewerage system with some combined sewers serving the town centre. The combined sewer system in the centre of town generally drains by gravity to the Wastewater Treatment Works to the north of the catchment. The Swords WwTW improvement works have now been completed to cater for a PE of 60,000, with an ultimate capacity of 90,000 PE.

The Swords Development Plan, 1997, identifies the available capacity for foul effluent treatment as the most important constraint on development. There is also the need to protect the Special Protection Area of the Broadmeadow Estuary, into which final effluent from the WwTW at Swords discharges. The estuary is also extensively used for water sports. In the outer estuary, the beach at Malahide was designated as a bathing water area under the first schedule of the European Communities (Quality of Bathing Water) Regulations.

Figure 7.4.8 shows the extent of the Swords foul catchment.

7.4.8.2 **Hydraulic Performance**

With the 2011 or 2031 development scenarios, the present drainage system is not able to cope with the increased flows and requires significant remedial work.

Under the 2031 scenario, a significant amount of additional flow will be conveyed to the Swords WwTW creating general surcharge and flooding in the area surrounding the inlet works. The current Works capacity of 60,000 PE will be exceeded by the 2031 prediction of 109,600 PE. Thus, upgrading work or alternative treatment facilities would be required.
7.4.8.3  **Future Needs**

Needs can generally be attributed to dramatic increases in flows as a result of the large areas proposed for development at the 2011 and 2031 scenarios. The two options for the future scenarios were triggered by the Crowscastle development at the southeast and Mooretown development, west of the catchment. Upgrading works are extensive and involve new sewerage, uprating of pumping facilities and provision of storage.

Strategic options are also applicable to the Swords catchment. The Strategic Options for provision of treatment at existing WwTW sites and provision of a new inland WwTW Facility would entail upgrading of the Swords WwTW to the 2031 capacity or building of a new WwTW facility, and would not have a significant impact or interaction with the deficiencies options of the GDSDS. The Strategic Option for provision of a New Fingal Coast WwTW Facility would mean diverting parts of Swords sewage flows to this new wastewater treatment plant. The trunk sewer collector would run north of Swords towards Portrane and would therefore provide an opportunity to divert all or part of the additional flows from the 2031 developments from the Swords Works into the new collector. In this way, Swords WwTW would still operate at its full 2011 capacity under the 2031 scenario, without being overloaded by the 2031 development loads.

7.4.9  **Donabate / Portrane Sewerage F019**

7.4.9.1  **Description of Catchment**

The towns of Donabate and Portrane are located on the Fingal coast to the north of Dublin. To the north is the Rogerstown Estuary, part which has been designated a wetland of international importance under the Ramsar Convention. The nature reserve and Ramsar site (covering about 80% of the bay) lie to the east of the Rogerstown Viaduct (railway line) that bisects the estuary.

The WwTW catchment comprises an area of 535 ha and 1,642 houses in the 2002 scenario.

Donabate is a generally flat low-lying town, with the sewerage system, served by two pumping stations directing flows to the WwTW at Portrane.

In Portrane, the sewer system is also extensively pumped. The new estates in the centre of Portrane are served by separate surface water and foul sewers.

The existing WwTW serves both Donabate and Portrane and is located to the south of St. Ita’s hospital. Treated flows discharge directly to the Irish Sea. An extension to the WwTW to increase capacity is underway, with provision for flows from the towns of Rush and Lusk also being considered.

In the 2011 development scenario, there are 10 parcels of land earmarked for development making a total of 94 ha. Apart from 10 ha of land, which is set aside for a community and leisure centre, the majority of the 94 ha is intended for residential use with 1,765 houses being proposed. The majority of the future development is concentrated in Donabate apart from 5 ha in Portrane. It was confirmed during a site visit that new developments are presently being constructed in the proposed development area.

The 2031 development scenario envisages 80.1 ha of land, of which 64 ha is intended for residential development and 16 ha is intended for industrial usage. The residential capacity is 2,572 houses. It is likely that majority of the development would be concentrated in Donabate as at present.

Figure 7.4.9 shows the extent of the Donabate and Portrane foul catchment.

7.4.9.2  **Hydraulic Performance**

Whilst local operations staff report no known structural, environmental and operational deficiencies, there is one reported hydraulic deficiency of foul flooding in southwest Donabate adjacent to the railway line.
7.4.9.3 Future Needs

The GDSDS Phase 1 report was issued in February 2002. The client subsequently instructed that no further work was to be undertaken for the catchment. Needs for Donabate and Portrane are therefore not included in the GDSDS.
8. WASTEWATER TREATMENT WORKS

The Study has reviewed the existing Wastewater Treatment Works (WwTWs) in the GDSDS area and, based on estimated future loads, considers the impact of long-term treatment requirements on the overall drainage strategy. Existing levels of treatment range from preliminary only (e.g. Balbriggan, Skerries, Rush, Shanganagh-Bray) to secondary (Ringsend, Osberstown, Leixlip, Swords, Malahide and Portrane). Improvement schemes are at various stages (from initial planning through to construction) for all of these sites.

The primary legislation driving the current WwTW improvements is the Urban Waste Water Treatment Directive. However, other legislation (e.g. Bathing Waters and Phosphorus Regulations) and management plans (e.g. Dublin Bay Water Quality Management Plan) also affect the designs. The likelihood is that the Water Framework Directive (WFD) in classifying stresses on water bodies will identify the need for further improvements in effluent standards.

The current proposals include consolidation of treatment at eight WwTW sites in the GDSDS area: Ringsend, Shanganagh-Bray, Osberstown, Leixlip, Portrane (including Rush, Lusk and Donabate), Malahide, Balbriggan-Skerries and Swords. These sites and their catchment areas are shown in Figure 2.4. There are a number of other minor WwTWs where it is proposed that flows be transferred to one or other of these eight locations. The following analysis of WwTW designs and loads has been undertaken based on these eight major sites.

8.1 Existing Treatment and Designs

The review of the existing WwTWs included the current and ultimate design proposals, and is presented in Appendix E, “Assessment of Existing Wastewater Treatment Works”. The report covers existing treatment provision, discharge standards, design constraints, future loads and availability of land for expansion.

Flow and load surveys were not undertaken specifically for the Study, but available information has been reviewed. Even where sampling has been undertaken regularly by the local authority or operator and cross-referenced between sampling, as happens at Ringsend WwTW, the results have been variable. Quoted values of existing load, in terms of Population Equivalent (PE), should therefore be viewed with some caution.

For each of the eight WwTW sites, a ‘current design’ and an ‘ultimate design’ have been identified. As the WwTWs are all at different stages of planning, design or construction, the term ‘current design’, as used here, has a wide range of meaning. For some sites, the ‘current design’ may have been recently completed (e.g. Osberstown and Ringsend) whereas others may be still at the planning stage (e.g. Portrane).

The ‘ultimate designs’ generally represent a further stage of development. These have been identified by the planners, the designers and the Local Authorities’ Project Office teams to allow for longer-term development and/or to provide the maximum treatment capacity on a restricted site or the limit of a receiving water body.

A summary of the existing treatment provision, current and ultimate designs is given in Table 8.1.
<table>
<thead>
<tr>
<th>WwTW</th>
<th>Receiving water</th>
<th>Existing treatment provision</th>
<th>Existing PE</th>
<th>Current design PE</th>
<th>Ultimate design PE</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ringsend Liffey Estuary</td>
<td>Existing with UV</td>
<td>1,900,000</td>
<td>1,640,000</td>
<td>1,905,000</td>
<td>Current secondary treatment design is at commissioning stage under DBO contract. Ultimate design based on maximum capacity of available site area.</td>
<td></td>
</tr>
<tr>
<td>Shanganagh Bray Irish Sea Preliminary</td>
<td>106,930</td>
<td>167,400</td>
<td>200,000</td>
<td>Existing provision is preliminary treatment at separate Bray and Shanganagh sites. Consultant study has recommended DBO procurement for a secondary treatment plant at Shanganagh. Bray flows to be pumped to Shanganagh.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Osberstown River Liffey Secondary</td>
<td>57,533</td>
<td>80,000</td>
<td>130,000</td>
<td>Space available within boundary for extension to ultimate design. Ultimate Design (130,000PE) at Preliminary Report, awaiting Departmental approval. EIS completed and approved.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leixlip River Liffey Secondary</td>
<td>68,189</td>
<td>90,000</td>
<td>130,800</td>
<td>Current design provided by recent addition of ‘Intel’ treatment stream. Additional land required for extension to ultimate design.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Portrane Irish Sea Secondary</td>
<td>14,531</td>
<td>35,000</td>
<td>65,000</td>
<td>Existing provision is small plant serving only Donabate and Portrane. Current design is proposed Phase 1 of DBO contract for plant to also serve Rush and Lusk. Ultimate design is Phase 2 extension to cater for long-term development.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malahide Broadmeadow Estuary Secondary</td>
<td>16,089</td>
<td>20,000</td>
<td>25,000</td>
<td>Existing provision is secondary plant designed for 13,000 PE, i.e. less than existing load. Current design is under construction. Feasibility of providing ultimate design capacity is under investigation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Balbriggan Skernes Irish Sea Preliminary</td>
<td>19,008</td>
<td>30,000</td>
<td>70,000</td>
<td>Existing provision is preliminary treatment via separate sea outfalls. Current design is Phase 1 of proposed DB contract. Ultimate design is Phase 2 for longer-term growth.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Swords Broadmeadow Estuary Secondary</td>
<td>34,254</td>
<td>60,000</td>
<td>90,000</td>
<td>Existing secondary plant designed for 22,500 PE is currently being extended under DBO contract to provide ‘current design’ – Phase 1. Ultimate design is Phase 2 for longer-term growth.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td>2,122,400</td>
<td>2,615,800</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 8.1  Existing Treatment and Current/Ultimate Designs**
8.2 Loads

Population Equivalent (PE) loads have been estimated for each of the eight WwTW catchments and for each of the three design scenarios: Existing 2002/2003 and Future 2011 and 2031. The analysis was carried out on a foul catchment level, based on the development data presented in Chapter 4. Foul catchments were then combined to produce the estimated total loads for each WwTW site. A full table of loads per foul catchment is included as Table 4.3. A summary of loads per WwTW catchment is shown in Table 8.2.

<table>
<thead>
<tr>
<th>WwTW</th>
<th>Current Design PE</th>
<th>Ultimate Design PE</th>
<th>PE Load Existing</th>
<th>PE Load 2011</th>
<th>PE Load 2031</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ringsend</td>
<td>1,640,000</td>
<td>1,905,000</td>
<td>1,900,000</td>
<td>2,402,603</td>
<td>2,813,901</td>
</tr>
<tr>
<td>Shanganagh Bray</td>
<td>167,400</td>
<td>200,000</td>
<td>106,930</td>
<td>162,505</td>
<td>249,016</td>
</tr>
<tr>
<td>Osberstown</td>
<td>80,000</td>
<td>130,000</td>
<td>57,533</td>
<td>98,152</td>
<td>154,088</td>
</tr>
<tr>
<td>Leixlip</td>
<td>90,000</td>
<td>130,800</td>
<td>68,189</td>
<td>100,343</td>
<td>183,378</td>
</tr>
<tr>
<td>Portrane</td>
<td>35,000</td>
<td>65,000</td>
<td>14,531</td>
<td>30,249</td>
<td>45,650</td>
</tr>
<tr>
<td>Malahide</td>
<td>20,000</td>
<td>25,000</td>
<td>16,089</td>
<td>16,669</td>
<td>23,236</td>
</tr>
<tr>
<td>Balbriggan and Skerries</td>
<td>30,000</td>
<td>70,000</td>
<td>19,008</td>
<td>55,852</td>
<td>90,863</td>
</tr>
<tr>
<td>Swords</td>
<td>60,000</td>
<td>90,000</td>
<td>34,254</td>
<td>75,241</td>
<td>109,567</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>2,122,400</strong></td>
<td><strong>2,615,800</strong></td>
<td><strong>2,216,534</strong></td>
<td><strong>2,941,614</strong></td>
<td><strong>3,669,698</strong></td>
</tr>
</tbody>
</table>

*Table 8.2 Total PE Loads for each WwTW Catchment*

The values in Table 8.2 are presented as generated by the domestic and non-domestic PE calculations. Because these load estimates are built up from sub-catchment planning potential, they are likely to be conservative. In the case of Ringsend WwTW, flow and load measurements taken between September 2003 and February 2004 have confirmed that the actual load arriving at the WwTW varies between 1.75m and 1.9m PE, which significantly exceeds the current design capacity of 1.64m PE.
8.3 Design Life

The design life ranges for both current and ultimate designs for the eight WwTW sites are listed in Table 8.3. Figures 8.1 to 8.8 show the design lives for the individual WwTWs while Figure 8.9 shows the design lives for all WwTWs.

<table>
<thead>
<tr>
<th>WwTW</th>
<th>Current Design Limit</th>
<th>Ultimate Design Limit</th>
<th>2011 Design Scenario</th>
<th>2031 Design Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ringsend</td>
<td>2003 to 2004</td>
<td>2003 to 2004</td>
<td>Current design at capacity and needs to extend past ultimate design</td>
<td>Need capacity beyond ultimate design</td>
</tr>
<tr>
<td>Shanganagh Bray</td>
<td>2012 to 2021</td>
<td>2020 to 2031</td>
<td>Current design acceptable</td>
<td>May need capacity beyond ultimate design</td>
</tr>
<tr>
<td>Osberstown</td>
<td>2007 to 2012</td>
<td>2022 to &gt;2031</td>
<td>Likely to need extension to ultimate design</td>
<td>May need capacity beyond ultimate design</td>
</tr>
<tr>
<td>Leixlip</td>
<td>2008 to 2010</td>
<td>2019 to 2026</td>
<td>Likely to need extension to ultimate design</td>
<td>Likely to need capacity beyond ultimate design</td>
</tr>
<tr>
<td>Portrane</td>
<td>2017 to 2029</td>
<td>&gt;2031</td>
<td>Current design acceptable</td>
<td>Ultimate design acceptable</td>
</tr>
<tr>
<td>Malahide</td>
<td>2021 to &gt;2031</td>
<td>&gt;2031</td>
<td>Current design acceptable</td>
<td>Ultimate design acceptable</td>
</tr>
<tr>
<td>Balbriggan &amp; Skerries</td>
<td>2005 to 2008</td>
<td>2020 to &gt;2031</td>
<td>Likely to need extension to ultimate design</td>
<td>May need capacity beyond ultimate design</td>
</tr>
<tr>
<td>Swords</td>
<td>2008 to 2016</td>
<td>2019 to &gt;2031</td>
<td>Current design likely to be acceptable but may need to extend to ultimate design</td>
<td>May need capacity beyond ultimate design</td>
</tr>
</tbody>
</table>

Table 8.3 WwTW Design Life

8.4 Conclusions from Load Assessment

Ringsend WwTW has recently been commissioned to 2020 design, which is to treat 1.64m PE with nitrification/denitrification and UV treatment. Currently between 1.75m PE and 1.9m PE arrives at the Works. The lower value was experienced in January 2004 and is suspected to be due to a higher PE content in overflows from CSOs during periods of wet weather and an element of load shedding by the non-domestic sector over the Christmas period. The WwTW is managing to treat 1.9m PE biologically with current tank volumes. However, in current operating mode, it is unlikely to meet the future nitrogen discharge standards for Dublin Bay as set out in the Urban Wastewater Treatment Regulations 2001 SI 254 of 2001. Unless the plant is expanded it will be unable to meet its statutory requirements. The deadline for compliance with the nitrogen standard as set out in the Regulations is 31st May 2008. Increased loadings to the WwTW due to growth in the catchment will increase overloading of the plant, even in the short term before the 2011 horizon. Ringsend WwTW therefore needs to be extended now to the maximum treatment capacity of the site, thought to be approximately 2.16m PE. Under the Planning and Development Regulations 2001 a new Environmental Impact Statement (EIS) may be needed for this PE capacity, since the current EIS has been approved for 1.9m PE.

At the 2011 design horizon, the ‘current designs’ are sufficient to deal with the estimated loads at Bray, Shanganagh, Portrane and Malahide. The current design for Swords is likely to be sufficient but there is a chance that extension to the ultimate design capacity will be required. The current designs for Osberstown and Leixlip are unlikely to be sufficient under 2011 loadings. It should be noted, however, that the loading for Leixlip is based on the maximum discharge allowance from the Intel plant. Whilst it is prudent to allow for this, the magnitude of the allowance (24,500 PE) may distort the true picture and should be reviewed in light of Intel’s recent plans for expansion.
Overall, allowing for extensions to ultimate designs where necessary, treatment can be provided for the estimated 2011 loadings at seven of the named sites. In other words, wastewater treatment at these seven sites is not a constraint on the drainage strategy for 2011. The exception to this is the Ringsend site where expansion will be necessary above the ultimate design capacity limits. Since this is the major plant serving the region, it follows that the options in this catchment, in addition to its ultimate development are:

- Constrain development;
- Reduce non-domestic load;
- Divert loads to other plants.

At the 2031 design horizon, the ‘ultimate designs’ are sufficient for Portrane and Malahide. In fact, it is possible that even the current designs will remain sufficient at these sites. By 2031, Shanganagh Bray, Osberstown, Balbriggan, Skerries and Swords may need some additional capacity beyond the ultimate design. Current planning and EIS approvals will need to be revisited for these plants. The expanded ultimate designs for Ringsend and current ultimate design for Leixlip are unlikely to be sufficient by 2031.

This analysis represents a first stage in the development of strategy. The next stage is to assess the feasibility of treating the 2031 loads by extension of the ‘ultimate designs’. This requires further consideration of receiving waters and physical site constraints.

### 8.5 Receiving Waters

The Centre for Water Resources Research (CWRR) at University College Dublin (UCD) was appointed by the Dublin Drainage Consultancy to carry out water quality modelling of the coast between Bray in the south to Balbriggan in the north.

The objectives of this modelling were to predict the flow patterns and contaminant distributions in the coastal waters of the Dublin Region corresponding to the pollutant loads from projected discharges from future treatment works that may be constructed as part of the overall strategy for the Region.

The modelling was used to assess the water quality for an envelope of possible treatment options and projected point loads. The Report on Water Quality Modelling in Dublin from Bray to Balbriggan (Ref. GDSDS/75407/130 of May 2004) gives detailed results of the modelling exercise.

The modelling software used to simulate flows was TELEMAC. WQFLOW – 2D was used in association with the hydrodynamic results from TELEMAC to simulate mass transport decay and interaction of water quality variables and defined pollutants.

For modelling purposes the coastal waters were divided into two, the South Dublin Model embracing the coast from Howth to Bray and the North Dublin Model from Howth to Balbriggan.

The water quality determinands modelled were faecal coliforms and total nitrogen. The methodology was to compute for these two determinands the response to two tidal conditions, mean spring and mean neap for each loading condition. The impact of discharges from both existing and potential wastewater treatment plants into the coastal environment was assessed under a number of loading conditions. These included Ringsend, Shanganagh Bray, Malahide, Swords, Portrane and Balbriggan. Modelling also included discharges from a possible South Dublin WwTW discharging to the storm cell of the GCTS and hence to the Liffey estuary via the proposed extended GCTS storm outfall.

The results for the most extreme combination of loads are summarised in Table 8.4 below. The table summarises the point of discharge, the load modelled in terms of population equivalent and the level of treatment i.e. secondary, UV or nitrogen removal adopted. Where more than one source is discharging to the same receiving body in close proximity to another source, the PE of each source is identified. The point source discharge to the Liffey estuary relates to a possible new WwTW located in South Dublin discharging via the storm cell in the GCTS.
<table>
<thead>
<tr>
<th>Point Source</th>
<th>P.E.</th>
<th>Faecal Coliforms</th>
<th>Nitrogen</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ringsend Outfall</td>
<td>2.37m</td>
<td>&lt; 1000cfu / 100ml in Bay</td>
<td>&lt; 10 mg/l</td>
<td>UV disinfection nitrogen removal</td>
</tr>
<tr>
<td>Liffey Estuary</td>
<td>0.46m</td>
<td>High in estuary</td>
<td>Not significant</td>
<td>Secondary treatment</td>
</tr>
<tr>
<td>Shanganagh/Bray</td>
<td>0.25m</td>
<td>&lt; 1000cfu / 100ml</td>
<td>Not significant</td>
<td>Secondary treatment</td>
</tr>
<tr>
<td>Broadmeadow Estuary</td>
<td>0.128m</td>
<td>High in estuary</td>
<td>&lt; 0.2mg/l</td>
<td>Secondary treatment UV Malahide</td>
</tr>
<tr>
<td>Swords &amp; Malahide</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(107,000 PE + 21,000 PE)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irish Sea Portrane &amp; Balbriggan/Skerries</td>
<td>0.715m</td>
<td>&lt; 100cfu / 100ml</td>
<td>&lt; 0.08mg/l</td>
<td>Secondary treatment</td>
</tr>
<tr>
<td>(625,000 PE + 90,000 PE)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 8.4 Summary of Water Quality Results**

The model predicts that faecal coliforms at the designated bathing beaches would be in compliance with the Bathing Water Regulations. The nitrogen levels are either low or not significant and in the case of the Ringsend outfall are required to meet the standard of 10mg/l as set out in SI 254 of 2001.

There was no bathymetric, hydrodynamic or water quality data available for the Broadmeadow Estuary or of flows from the contributing streams. It is therefore difficult to predict with any confidence the response to increasing the load in this water body.

The bathymetry of the Liffey and Dodder rivers was not available. Therefore, the level of confidence in the model predictions, that indicate high faecal coliforms in the estuary under low river flow conditions due to a point source discharge to the estuary, needs further investigations as part of future studies.

The EPA report "An Assessment of the Trophic Status of Estuaries and Bays in Ireland" (2001) establishes eutrophication based on three criteria. One of these criteria is nutrients including nitrates and phosphates. The report classifies the Liffey Estuary as eutrophic and Dublin Bay as non-eutrophic.

In developing strategy options based on a discharge to the Liffey Estuary, appropriate treatment standards based on detailed modelling and receiving water quality should be adopted. The modelling carried out as part of the GDSDS adopted secondary treatment only prior to discharge to the estuary. It is considered prudent that any strategy options based on treated effluent discharges to the Liffey Estuary should include UV treatment, as well as providing for phosphate and nitrogen removal.

Two of the eight main WwTWs within the study area, Osberstown and Leixlip, discharge to the River Liffey. The assimilative capacity of these receiving waters under low flow conditions is a constraint on further development. With more stringent discharge consent standards, Osberstown can expand to 130,000 PE. Based on the current discharge consent standards, Leixlip WwTW can expand to treat approximately 130,800 PE. Should further expansion be required, the current discharge standards of BOD 8mg/l, SS 15mg/l, and NH₄-N 9mg/l would have to be tightened further. Ultimately, development in these catchments beyond this level cannot be served by the Osberstown and Leixlip plants based on limiting receiving water capacity.

There is a real risk that currently acceptable discharge standards based on the assimilative capacity of the River Liffey and Liffey Estuary will become more stringent in the future following the advent of the Water Framework Directive and the envisaged adverse impact of climate change on low flows in the river. Discharges directly to the Irish Sea, such as the Portrane option, offer the most secure solution against higher environmental standards in the future and provides for greater flexibility and optimisation in both treatment process and sea outfall design.
8.6 Site Constraints

An assessment of Existing Wastewater Treatment Works was carried out in July 2002 and is included in Appendix E of this report. The assessment considered site constraints relating to future expansion of the existing Works within the study area, and these are summarised in Table 8.5 below.

### Table 8.5 Site Constraints

<table>
<thead>
<tr>
<th>WwTW</th>
<th>Site Constraint</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ringsend</td>
<td>0.8 ha available</td>
<td>Land availability is a major constraint on future development.</td>
</tr>
<tr>
<td>Shanganagh Bray</td>
<td>1.08 ha available</td>
<td>Land available for ultimate design.</td>
</tr>
<tr>
<td>Osberstown</td>
<td>1.36 ha within existing site</td>
<td>Receiving water major constraint on future development.</td>
</tr>
<tr>
<td>Leixlip</td>
<td>Further land available</td>
<td>Receiving water major constraint on future development.</td>
</tr>
<tr>
<td>Portrane</td>
<td>Further land available</td>
<td>No further constraints identified.</td>
</tr>
<tr>
<td>Malahide</td>
<td>No land available</td>
<td>Limited scope for expansion.</td>
</tr>
<tr>
<td>Balbriggan and Skerries</td>
<td>Further land available</td>
<td>May need further land for extension to ultimate design depending on proposed process.</td>
</tr>
<tr>
<td>Swords</td>
<td>Limited land available.</td>
<td>Receiving water constraint on future development.</td>
</tr>
</tbody>
</table>

8.7 Summary

Based on the assessment of loads and consideration of the receiving waters and physical site constraints, an assessment has been made of the feasibility of treating the 2031 loads by extension of the current ultimate designs of the existing WwTWs. The results are summarised in Table 8.6. The assessment is based on the use of currently available and proven treatment technologies for the scale of WwTW proposed.

### Table 8.6 Extension of Ultimate Designs

<table>
<thead>
<tr>
<th>WwTW</th>
<th>PE 2031</th>
<th>Ultimate Design Limit PE</th>
<th>Extended Ultimate Design PE</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ringsend</td>
<td>2,813,901</td>
<td>1,905,000</td>
<td>2,160,000</td>
<td>Site constraint</td>
</tr>
<tr>
<td>Shanganagh Bray</td>
<td>249,016</td>
<td>200,000</td>
<td>240,000</td>
<td>Site constraint</td>
</tr>
<tr>
<td>Osberstown</td>
<td>154,088</td>
<td>130,000</td>
<td>130,000</td>
<td>Receiving waters constraints</td>
</tr>
<tr>
<td>Leixlip</td>
<td>183,378</td>
<td>130,800</td>
<td>130,800</td>
<td>Receiving waters constraints</td>
</tr>
<tr>
<td>Portrane</td>
<td>45,650</td>
<td>65,000</td>
<td>800,000</td>
<td>No known constraint</td>
</tr>
<tr>
<td>Malahide</td>
<td>23,236</td>
<td>25,000</td>
<td>25,000</td>
<td>Site constraint</td>
</tr>
<tr>
<td>Balbriggan/Skerries</td>
<td>90,863</td>
<td>70,000</td>
<td>90,000</td>
<td>Prudent use of available lands</td>
</tr>
<tr>
<td>Swords</td>
<td>109,567</td>
<td>90,000</td>
<td>90,000</td>
<td>Receiving water constraint</td>
</tr>
</tbody>
</table>
The Shanganagh/Bray, Portrane, Malahide and Balbriggan/ Skerries WwTWs can all be expanded to meet the projected 2031 loads from their respective drainage catchments. To extend the Ringsend WwTW to serve a projected 2031 PE of 2.81m or even a projected 2011 PE of 2.40m would require the acquisition of additional lands (which are not obviously available) or the adoption of treatment technologies yet to be developed and proven on plants of this scale.

The constraint on the further development of the Osberstown, Leixlip and Swords WwTWs is the assimilative capacity of the receiving waters. In the absence of proven treatment technologies to achieve higher than planned standards, loads above the current ultimate design at the Osberstown and Leixlip plants would have to be transferred to alternative treatment facilities, discharging to suitable receiving waters. At the Swords WwTW the option is available to enhance the level of treatment at the existing plant, or alternatively to transfer additional loads to a new WwTW discharging to a more suitable receiving environment such as the Irish Sea.
9. RIVER AND STORMWATER SYSTEMS

9.1 General

The GDSDS project area is split into 33 river and stormwater catchments. As explained in Chapter 6 entitled “Hydraulic Modelling”, three types of river and stormwater drainage models have been used for this study, being:

**Type 1** models consist of a fully integrated model of the river and urban piped stormwater drainage system. Data from a short-term flow survey was used to verify the major piped systems. Long-term river flow data (where available) and short-term flow survey data were also used to calibrate the river flows and depths. References were also made to any available records of historic flooding from both the piped network and the river to verify the model results.

**Type 2** models consist of the urban piped stormwater drainage system. If useful, a nominal representation of the river system was also included, but this was only used to join the piped system together. Data from a short-term flow survey was used to calibrate the major piped systems. Reference was also made to any available records of historic flooding from the piped network. The flows in the river were not considered.

**Type 3** models consist of the urban piped stormwater drainage system only and no verification of the model was carried out.

Most of the Type 1 and 2 catchments involved the full modelling process, with production of a full set of reports. Where studies external to the GDSDS were being carried out, the modelling and optioneering process was truncated after Phase 1 or Phase 2.

Further details of the individual catchments can be found in the relevant Phase 1, 2 and 3 reports, which have been issued throughout the Study period. The reports have been listed in Table 9.1.

This chapter summarises the Phase 1, 2 and 3 reports produced for each river and stormwater catchment. For presentation purposes, the river and storm catchments have been prioritised in accordance with their type.
<table>
<thead>
<tr>
<th>Ref</th>
<th>Title</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1001</td>
<td>Mayne River</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>S1002</td>
<td>Santry River</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>S1003</td>
<td>Finglas River</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>S1004</td>
<td>Camac River</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>S1005</td>
<td>Poddle River</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>S1006</td>
<td>Swan River</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Included in R&amp;P High Level (F005)</td>
</tr>
<tr>
<td>S1007</td>
<td>Deansgrange River</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>S1008</td>
<td>Carrickmines River</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

**Type 2 Catchments**

<table>
<thead>
<tr>
<th>Ref</th>
<th>Title</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>S2001</td>
<td>River Liffey Lyreen Ryewater</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>S2002A</td>
<td>Broadmeadow 1 Malahide</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>S2002B</td>
<td>Broadmeadow 1 Portmarnock</td>
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**Type 3 Catchments**

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Table 9.1 River and Stormwater Catchment Reports
9.2 River Systems

9.2.1 Mayne River S1001

9.2.1.1 Description of Catchment

The Mayne River catchment straddles the border of the DCC and the Fingal County Council (FCC) administrative areas, approximately 7 km north of Dublin City centre. The catchment is drained via three watercourses; the Mayne River (8.4 km in length) and its tributaries, the Cuckoo Stream and the Grange Stream. These rivers, together with the local piped network drain the urban and rural lands of the 2,031 ha catchment, to two ocean outfalls at the Baldoyle Estuary. Several flood relief schemes have been implemented in the catchment in recent years, most notably the diversion of the Baldoyle catchment, and the Mayne Bridge Culvert up-grade. Phase 2 flood alleviation works are currently under construction, consisting of a pumping station, flow diversion scheme through Seagrange Park, Willie Nolan culvert re-lining and Brookstone Road pipe up-grade.

Scope for future development within the Mayne Catchment is extensive with the existing developed area proposed to double from 20% to 40% by the year 2011. Proposed future development in the catchment is located primarily along the banks of the Mayne River and continues the existing urban sprawl northwards. Future residential development predominates in the DCC administrative area of the catchment, particularly in the area bounded by the M1 Motorway and the Dublin/Belfast railway line. Within the FCC administrative area there are two areas of future industrial proposed adjacent to the N32 and east of the Malahide Road. In addition a pocket of future science and technology is proposed adjacent to the M1 Motorway and the N32 interchange, with the remaining portion being zoned as either mixed use or agricultural/open space.

Figure 9.2.1 shows the extent of the Mayne River storm level 1 catchment.

9.2.1.2 Hydraulic Performance

The performance of the pipe network was reasonable with only 10 manholes (1.0% of the total) predicted to give flood volumes greater than 25 m³ for a 5 Year ARI critical storm event. The majority of these hydraulic performance (HP) deficiencies were located in the older minor pipe network in the eastern half of the study area. The defined core networks of the 8 sub-catchments in the study area performed reasonably well, being relatively free of surcharge and flooding. There were several areas where the model showed a concentration of surcharge and flooding within the pipe drainage network below the prescribed GDSDS performance criteria. Although no historic flooding apart from that in Baldoyle has been reported, there were several areas that warranted further investigation and/or implementation of flood alleviation measures. The areas included:

- Baldoyle Industrial Estate;
- Grangemore;
- Belcamp; and
- Donaghmede.

The hydraulic performance of the Mayne River and its tributaries was generally found to be reasonable with only 3 locations predicted as being at risk of flooding during a 100 year ARI critical storm event. Anecdotal evidence also indicates that flooding has previously occurred in these same 3 locations, being:

- Baldoyle residential area;
- Mayne Bridge; and
- The Hole in the Wall Road.

The performance of the river crossings showed that in general they were hydraulically inadequate. Many crossings of the rivers were only able to accommodate low flows and overtopped during higher flow events. The majority of these river crossings are for local access only. However there are two
main road crossings that performed below the prescribed standards, being the M1 Motorway crossing of the Cuckoo Stream, and the bridge over the Mayne River at The Hole in the Wall Road.

9.2.1.3 Future Needs

Needs assessment of the Mayne River involved the upgrade of the model to include two future design scenarios, being future development expected up to the year 2011 and future development and climate change expected up to the year 2031.

Generally, the overall performance of the pipe network was reasonable with the majority of problems located in the older minor pipe network in the eastern half of the study area. The defined core networks of the 8 sub-catchments in the study area performed well, being relatively free of surcharge and flooding for both the 2011 and 2031 design scenarios. The areas for improvement including potential flood alleviation works at Baldoyle Industrial Estate and Carndonagh.

Six locations were identified as being at risk of flooding during a 100 year ARI critical storm event. These are Mayne Bridge, Racecourse Lands, Grange Stream, the Dublin-Belfast Railway Line, the Hole in the Wall Road and the Malahide Road.

The hydraulic performance of the Mayne River and its tributaries was in general found to be able to accommodate the increase in runoff from future development and climate change due to the relatively undeveloped floodplain.

Analysis of the river network under the 2011 and 2031 design scenarios has highlighted the importance of the flood storage areas of both the Racecourse Lands and Seagrange Park. These areas are vital to maintaining and accommodating peak flood levels within the Mayne River and Grange Stream by enabling flows from the catchment to be stored during periods of tide locking. Both the Racecourse Lands and Seagrange Park areas if managed correctly are capable of maintaining the predicted peak flood flows to an acceptable level for both existing and future conditions.

9.2.2 Santry River S1002

9.2.2.1 Description of Catchment

The Santry River catchment, located in the north of Dublin City, extends from south of Dublin Airport, through the districts of Kilmore, Coolock and Raheny, to Bull Island, Dublin Bay. The catchment, which covers 1,300 ha, is approximately 11 km long and typically 1.5 km wide. It has two distinct parts, of similar length. The upper region, between the Airport and Swords Road, is mainly rural, whilst the downstream section, from Swords Road to Dublin Bay, is largely urbanised. Although it is mainly residential the urban part also includes commercial areas and several parks and recreational areas.

It is anticipated that there will be a large amount of new residential and industrial development in the western rural areas of the Santry River catchment. Whilst much of this may occur by 2011, further development is anticipated between 2011 and 2031.

Whilst the majority of the impermeable areas in the urban part of the catchment drains to the river via a network of storm sewers, in the older parts of the catchment – e.g. Raheny – a proportion of the roads and roofs are connected to the foul / combined system. That system, which forms part of the NDDS and North Fringe catchment (F004), has several overflows that discharge into the river or into the storm sewers.

Historically there has been flooding from the river in several locations, particularly in the downstream parts of the catchment. Flooding problems in the Swords Road area have been overcome by the recent construction of an attenuation / storage scheme, with a large storage pond upstream of Swords Road. There is a flow control structure at its downstream end, controlling flows into the Swords Road culvert, and thus downstream.

Figure 9.2.2 shows the extent of Santry River storm level 1 catchment.
9.2.2.2 Hydraulic Performance

There are a few locations of predicted flooding from the piped network. This flooding is local in nature, requiring local improvements – sewer upsizing, diversion of flows, etc. River flooding is predicted in several places, particularly in the lower parts of the catchment. Whilst some of the flooding is in recreational areas, elsewhere it will affect properties.

9.2.2.3 Future Needs

Proposals to alleviate flooding in Raheny include clearing the river channel - particularly at a silted up bridge. It is also proposed to restrict the river flow further upstream, at Harmonstown Road, with the provision of attenuation storage. Although the future developments and the effects of climate change mean that there is an increase in flow further upstream, the Swords Road pond has a major attenuation effect, such that increases in peak flow rates further downstream are relatively small.

9.2.3 Finglas River S1003

9.2.3.1 Description of Catchment

The Finglas River catchment, which is on the northern edge of Dublin, includes flat areas either side of the M50 and a more steeply sloping area, extending southwards to the River Tolka. Whilst the northern part of the catchment is rural and is in the Fingal County Council area the southern part is fully urbanised and is in the Dublin City Council administrative area. The catchment covers an area of 1,080 ha.

The northern part of the catchment drains southeastwards, in two main tributaries, which run in open channel in the rural areas and in culvert in the urban areas. The branches join near the N2 / St. Margaret’s Road roundabout, from where the river follows the route of the N2, Finglas Road, mainly in culvert. It discharges to the Tolka River near Glasnevin Woods. Many piped surface water systems drain to the urban part of the river. No historic flooding has been reported from the piped network or from the river system.

Although the majority of the existing development is residential there are also commercial areas, with industrial units mainly in the northern parts of the urban area. Virtually all remaining undeveloped areas south of the M50 are identified for future development – both industrial and residential. Much of the flatter area north of the M50 may also be developed - some parts prior to 2011 and some prior to 2031.

The foul / combined sewerage system in the area is part of the NDDS and North Fringe catchment (F004), which transfers foul flows eastwards. There is a significant storm response within some of the NDDS system, with five CSOs that can discharge to the surface water system.

Figure 9.2.3 shows the extent of the Finglas River storm level 1 catchment.

9.2.3.2 Hydraulic Performance

There are a few locations of predicted flooding from the piped network. This flooding is local in nature, requiring local improvements. River flooding is also predicted in a few locations, in areas upstream of the existing urban area. This is new flooding and is due to the effects of the modelled 2011 developments. The new problems also include surcharging of the western culvert under the M50 and flooding from the main culvert in Finglas Road, opposite Wellmount Road, at a location where there is a significant reduction in capacity. Predicted flooding also occurs in the St. Margaret’s Road area, where verification was not achieved and where some of the system data is poor. It is clear that if 2011 development runoff is unrestrained it will cause a major increase in flows in the system, with significant new flooding.

9.2.3.3 Future Needs

In order to try to minimise major capital works in the urban areas it is recommended that SuDS principles be strictly applied to all new developments in this catchment, even prior to 2011. These should be imposed rigorously, to restrict peak flows from the development sites to greenfield site levels.
The hydraulic performance of the main culvert in the Finglas Road/Wallmount Road area is critical to predicted flooding. Due to incomplete physical information about the culvert, it is recommended that further survey work be carried out, to confirm details. In addition, further survey work is also required to confirm the details of the drainage system in the St. Margaret’s Road area, and how nearby commercial areas are drained. This will enable this part of the model to be refined and the most appropriate improvements to be confirmed. It may also be necessary to upsize the most restricted section of culvert in Finglas Road over a length of 40 m.

9.2.4 Camac River S1004

9.2.4.1 Description of Catchment

The Camac rises in the Dublin Mountains at Mount Seskin and flows westerly before entering Brittas pond. The river exits Brittas pond and takes a generally north/north-westerly course through South West Dublin passing through Saggart, Clondalkin, Lansdowne Valley, Inchicore and Kilmainham before discharging to the Liffey through a newly relined culvert under Heuston Railway Station just downstream of the Liffey freshwater limit at Islandbridge weir.

The River Camac is approximately 24 km in length, with a total area of some 51 km² and a mean slope of 1.6% over its natural length. Rising at an elevation of 380 m MHD from Mount Seskin the river is fast flowing particularly in times of flood and conversely following any prolonged dry periods the river is subject to particularly low flows. Historically flooding in the catchment has posed a problem within the heavily urbanised areas causing damage to adjacent properties. However some flood alleviation measures have recently been undertaken on the main channel at Corkagh Park and in Clondalkin and along the Robinhood Stream.

Land-use characteristics vary significantly within the catchment over its run from source to the River Liffey. The first 13 km of river length between the source and Corkagh Park has a catchment and floodplains that can be classed as predominantly rural. The lower parts of this reach are however developing rapidly. The remaining catchment from Clondalkin to the outfall at the Liffey has existing major suburban areas, or consists of highly industrialised or older residential areas of Dublin with the river mostly channelised with walled banks.

The river drains large areas of residential and industrial lands and also two major roads, the Western Parkway Motorway (M50) and the N7, Naas Road.

Figure 9.2.4 shows the extent of the River Camac storm level 1 catchment.

9.2.4.2 Hydraulic Performance

In general the performance of the pipe network varies from poor to reasonable across the catchment with areas of poor performance concentrated in and around the DCC administrative area and in Clondalkin Village. Main trunk sewer performance in these regions is also quite poor, reflecting the age of the network combined with the new and higher design standards recommended in the GDSDS policy. Performance noticeably improves in the more recently developed areas on the outskirts of the urban catchment in SDCC with many of the main trunk sewers performing well.

Analysis of the hydraulic performance identified almost 30 individual sites in the urban catchment on which properties are at risk of flooding. Large reaches in the rural portion of the catchment are also at risk of overtopping of the riverbank, although in most of these cases properties are not at risk of inundation by floodwaters.

Further analysis showed that most of the sites identified to be at risk of flooding result from the under-performance of bridges and culverts in the catchment, many of which are overtopped in the 100 year ARI event.

The introduction of future development (2011) resulted in an average increase of 80 mm in peak flood water level in the river and its tributaries. For the 2031 development scenario an average increase of 150 mm in flood depth was predicted.
9.2.4.3 Future Needs

In general, areas which show the most network deficiencies are in older parts of the catchment. The following areas were considered for option development:

- Clondalkin Village: Solutions to flooding in this area generally involved upsizing of trunk sewers and the removal of throttles in the system;

- Old industrial areas, such as Bluebell, Ballymount and Cookstown Industrial Estate: where solutions generally involve upsizing of pipes;

- Walkinstown: Flooding in this area is unverified and it is therefore recommended that a detailed study be carried out, which includes SUS and CCTV surveys.

There were also many areas identified throughout the minor network of the catchment where non-critical flooding was predicted. This is addressed in a single drainage development option which proposes upsizing of smaller pipes across the network.

The following areas, found to be at risk of river flooding, were considered during option development in the catchment:

- Kilmainham: Approximately 8 areas along the southern banks of the river were found to be at risk of flooding. Defined flood extents are, in some areas, subject to the confirmation of wall heights along the riverbank.

- Kylmore Road/Bluebell Avenue: Predicted flooding on the River Camac and Galblack Stream in this area is due to the backwater effect from culvert Cam-CU08 under the Naas Road.

- Robinhood Industrial Estate: Flood risk in this area is not due to underperformance of structures on the rivers but due to construction along the riverbank with little or no flood protection and probably no recognition/acknowledgement of past floodplain boundaries.

- Nangor Road Industrial Area: Flood risk at Toyota Ireland, Parkwest, Oak Road Business Park and Riverview Business Centre, is due to the backwater effect from culvert Cam-CU10 under Killeen Road.

- Clondalkin: Residential areas along Watery Lane are at risk due to insufficient flood protection.

In general, the primary solution considered at each deficiency was the upgrade of structures on the river to reduce afflux and backwater effect. Where this was not possible, or where the effects would be minimal, it was recommended that flood protection walls and embankments be constructed to a height of the peak predicted water level + 300 mm freeboard. The solution for flooding upstream of culvert Cam-CU10 under Killeen Road included a recommendation for the addition of a further 200,000 m$^3$ of attenuation area in Corkagh Park. A more detailed study of the Camac River Catchment is recommended in order to confirm the ultimate feasibility of this option.

9.2.5 Poddle River S1005

9.2.5.1 Description of Catchment

The Poddle River is best described as a fully urbanised watercourse, which receives flows from an associated surface water system in the SDCC and DCC regions. The river is some 12 km in length with a catchment area of approximately 1400 ha.

The river rises in Tallaght in the SDCC region and travels through Tymon Park, Kimmage, Harolds Cross and Dublin City Centre before discharging to the River Liffey at Wellington Quay. Between Tallaght and Kimmage the river is almost entirely in open channel. This is the only area of the catchment where development is not in close proximity to the river channel, which results in the largest area of floodplain within the catchment.

At Kimmage the river enters fully developed residential areas and between here and Harolds Cross the river is a mixture of open channel and culverted sections with very little floodplain area. Flows are also
able to leave the catchment in this region via three overflow structures located within the river channel. These are known as the Lakelands overflow, the Stone Boat overflow and the Greenmount storm overflow which discharge to the River Dodder, the storm water drainage system which discharges to the GCTS at Dolphins Barn and direct to the GCTS at Harold's Cross respectively. The Poddle River catchment interacts with the Grand Canal catchment (F003), the Dodder Owendoher catchment (S2009) and the Rathmines and Pembroke High Level catchment (F005).

After the river passes under the Grand Canal in siphon the river is almost entirely culverted as it flows through the city centre. Here the river heavily interacts with the foul and combined system in this region which forms part of the City Centre catchment (F001), as there are 8 CSOs which discharge spill flows direct to the main Poddle culvert and a further 3 which spill to the culvert via the associated surface water system.

As the catchment is fully urbanised there is very little area available for development apart from intensification of the population through infill or redevelopment.

Figure 9.2.5 shows the extent of the Poddle River storm level 1 catchments.

### 9.2.5.2 Hydraulic Performance

Hydraulic deficiencies were identified in relation to flooding from the surface water sewerage system within the catchment area based on the agreed criteria for the GDSDS. From the river channel deficiencies were identified based on either reported flooding records from the council concerned or predicted flooding above bank level for the trigger level event.

Following assessment of the identified deficiencies within the catchment area 16 of the 37 were selected to be resolved as part of the options development process.

### 9.2.5.3 Future Needs

Upsizing of sewers to accommodate flows has been used to resolve hydraulic deficiencies associated with the surface water drainage system. Where flooding of the river channel has been identified the capacity of the channel has been increased in order to reduce peak depth to below bank level or to the peak level predicted during hydraulic assessment of the existing system.

### 9.2.6 Swan Stream S1006

The Swan stream is included in the Rathmines & Pembroke High Level catchment F005.

Figure 7.3.3 shows the extent of the Rathmines and Pembroke sewerage with the Swan Stream included.

### 9.2.7 Deansgrange River S1007

#### 9.2.7.1 Description of Catchment

The Deansgrange catchment, located in the south east of Dublin, runs from Stillorgan in the northwest to Ballybrack in the southeast, discharging into Killiney Bay. The catchment is fully urbanised – mainly residential - and lies within the Dun Laoghaire Rathdown County Council (DLRCC) administrative area. The catchment covers 840 ha.

The head of the open section of river is near the junction of Kill Lane and Clonkeen Road, Deansgrange. From here it flows south-east, through recreational land for much of its length. There are several bridges and culverts, including a 1.3 km long culvert from Kilbogget Park to Wyatville Road – part of which is under an old landfill site. East of Shanganagh Road, in the Seafield Court area, the river enters another long section of culvert. The final section of this, under the DART railway line, is particularly small, causing a significant hydraulic restriction.

The surface water system is extensive, with many branches draining to the river. In addition, there is an inflow at the head of the catchment, from the the neighbouring West Pier storm system. Inflows consist of all the flows from one part of the West Pier catchment, plus flows spilt at the Brewery Road stormwater overflow. Although there are no reports of flooding problems from the surface water
network, historic flooding from the river has been reported at locations near Johnstown Road, south-east of Wyattville Road, near Shanganagh Road, at Killiney Hill Road and in the Seafield Court area.

Because of the high proportion of urbanisation the scope for new developments is limited. Although some residential and commercial developments are proposed, particularly between Pottery Road and Rochestown Avenue, the overall scale of 2011 developments in the Deansgrange catchment is small.

The foul sewers within the storm catchment form part of the Shanganagh – Bray foul system (F012). Although there are three overflows from that system the majority of the impermeable areas drain to the storm network, so the impact of the CSOs on the river system, in terms of flow rates and volumes, is small.

Figure 9.2.7 shows the extent of the Deansgrange River storm level 1 catchment.

9.2.7.2 Hydraulic Performance

There are many locations of predicted flooding from the piped network. However, such flooding is local in nature, requiring local improvements.

River flooding was predicted in several places through the catchment. Whilst some of this flooding would be contained in recreational areas, it would affect properties in several places. The main area of flooding is between Shanganagh Road and the DART crossing – an area with reported historic flooding. Extremely high tides can also contribute to flooding, but only in the lowest parts of the system.

9.2.7.3 Future Needs

For the flooding in the upper parts of the catchment online storage was generally proposed, with some upsizing of sewers. For flooding further downstream it was generally proposed that sewers are upsized, to transfer flows to the open river, with little or no local storage.

Proposed river improvements included the duplication of inadequate culverts, enlarging river cross-sections, the provision of a bypass culvert around a small bridge, river bunds and the construction of a new culvert / outfall system under the DART line.

9.2.8 Carrickmines River S1008

9.2.8.1 Description of Catchment

This catchment comprises an area of Dun Laoghaire-Rathdown County from Sandyford and Deansgrange in the northwest to Shankill in the southeast. This catchment, with an area of 3,200 ha, is 9km west to east and 6 km north to south. Although much is rural, particularly in the south, there are also areas of development which are primarily residential.

Many additional residential developments are proposed, with the majority being in the west. Most are concentrated between the M50 and the Enniskerry Road. There are also some proposed industrial developments.

The river system is extensive, consisting of several watercourses flowing from west to east. The main branch in the south is the Shanganagh River / Bride’s Glen Stream, whilst the Carrickmines River / Ballyogan Stream is in the north. These two watercourses combine at Loughlinstown, from where they flow to the sea, at Killiney Bay. Several smaller branches join these rivers. Ground levels and gradients vary considerably across the catchment. Whilst downstream of the main confluence the river gradient is relatively flat, it is generally quite steep further upstream. Ground levels range from 530 m AD at Two Rock Mountain in the west to almost zero at the sea. Although the watercourses are generally open, some sections are culverted through developed areas.

The foul sewers in the catchment are part of the Shanganagh – Bray foul system (F012). Although there are currently several overflows from that system, their impact in terms of overall flows and volumes in the storm network is small. Improvements may be made, to reduce the number of CSOs. It is reported that there are no areas of regular flooding from the storm sewerage system – flooding would only normally occur locally if sewers become blocked.
Figure 9.2.8 shows the extent of the Carrickmines River storm level 1 catchment.

### 9.2.8.2 Hydraulic Performance

Although flooding is predicted in several areas in the existing piped network, these are local issues, with no records of flooding at these sites.

Flooding of the river system was also predicted at several locations, with confirmation of the flooding in many of these areas. Although much of the flooding is in rural areas it has also included internal property flooding, mainly near the downstream end of the catchment. For example, there is significant flooding predicted in the Loughlinstown area. The model results also indicate that the tide has only a small impact on the system, solely in the area downstream of the DART line.

The 2011 development scenario showed major increases in peak flow rates and water levels, mainly in the Carrickmines River. On average, peak river flow rates almost doubled – and in some places were 2.5 times the existing flow rates. Predicted water levels rose by an average of 365 mm, with a maximum of 1.2 m. There were further increases in flows and levels for the 2031 scenario - with Climate Change also considered.

### 9.2.8.3 Future Needs

Because of these major increases in peak flow rates and water levels, it was recommended that surface runoff from all developments be constrained to greenfield site conditions, to be instigated throughout the catchment immediately.

Recommendations for river improvements made in the SEM Catchment Study report are still considered valid, provided that surface runoff from future development flows are constrained to Greenfield site conditions. Proposals from the SEM Catchment Study included the provision of a bypass culvert in the Kilgobbin Road area and a range of improvements near the downstream end of the catchment, from the N11 to Commons Road. Proposals are currently being developed for the N11 crossing / Commons Road work, as part of the Shanganagh River Management project.

### 9.3 Major Stormwater Systems

#### 9.3.1 River Lyreen / Rye Water Stormwater S2001

##### 9.3.1.1 Description of Catchment

The Lyreen Rye Water catchment includes five discrete drainage catchments, which take in Dublin City Centre, Lucan-Palmerston-Ronanstown, Celbridge, Leixlip and Naas. The total catchment size of 4,876 ha contains a population of approximately 198,000. All catchments are located on or near to the River Liffey and storm water from all of these catchments ultimately flow to it. The catchment straddles three different local authority boundaries: Dublin City Council, South Dublin County Council and Kildare County Council. The individual catchment areas are:

##### 9.3.1.2 City Centre

The City Centre catchment covers an area of approximately 2,000 ha and contains a population in excess of 100,000. The sewerage system within the City Centre area is predominately combined so there are very few storm water outfalls discharging directly to the River Liffey. Those that exist serve a small number of properties close to the river, and none are of any significance for modelling.

##### 9.3.1.3 Lucan, Ronanstown and Palmerston

The River Griffeen tributary passes in a northerly direction through Lucan and discharges to the River Liffey at Lucan old village. Flooding in the River Griffeen was recently addressed in a study for SDCC entitled “The River Griffeen Flood Alleviation Scheme”. These urban settlements cover an area of approximately 1,700 ha and have a total population of approximately 58,000. Land use is mainly residential with the majority of buildings being served by a separate sewerage system with storm flows entering the Liffey. There is a very large proposed residential development southwest of Lucan. The Liffey Valley Shopping centre is a recent development located in the apex of the M50 motorway and the...
N4 and is a significant commercial centre. The old village centres of Lucan and Palmerston are served by local combined sewerage systems which discharge to the main trunk sewers.

9.3.1.4 **Leixlip and Celbridge**

The urban areas of Leixlip and Celbridge are situated upstream and west of Lucan and are located within the local government boundary of Kildare County Council. The towns cover an area of approximately 670 ha with a population of around 23,400. The Rye Water River enters the Leixlip catchment from the west and travels through the middle of the town in a southeasterly direction joining the River Liffey on the southern edge of the conurbation. Immediately to the south of Leixlip and east of Celbridge the River Liffey is impounded in a storage reservoir and is used as a major source for water abstraction and power generation.

Land use is mainly residential with small areas of commercial development. Immediately to the west of Leixlip is the Intel Collinstown Industrial Park. Both of the towns are served by a predominantly separate sewerage system.

9.3.1.5 **Naas**

Naas is the administrative town of County Kildare and lies approximately 30km south west of Dublin on the M7. The Naas catchment stands at 620 ha in size with a population of approximately 15,000. Naas is a large centre for commerce, industry, retail and housing and is home to Naas and Punchestown racecourses. The catchment is served by a predominately separate sewerage system drained under gravity. The Naas hydraulic model and study is being carried out as a separate study, and is therefore not included in the GDSDS.

There are several areas in the Lyreen / Rye Water catchment where provision has been made for future development by means of laying oversized pipes.

Figure 9.3.1 shows the extent of the Lower Liffey Lyreen Ryewater storm level 2 catchment with the above catchments included.

9.3.1.6 **Hydraulic Performance**

Numerous isolated deficiencies were identified during the study and include silt problems, flooding, and intrusion of tree roots. The most significant problem appears to be the large amount of flooding that occurred in November 2000 in Lucan and surrounding areas along the route of the River Griffeen.

9.3.1.7 **Future Needs**

The hydraulic deficiencies addressed in the catchment are predominantly concentrated in Leixlip, Palmerstown, Lucan and Celbridge. The predicted flooding is generally caused by the under-capacity of the local pipe network, compounded in the 2011 scenario by flows from new developments.

Solutions developed for the above deficiencies involve the provision of additional capacity within the catchments to pass forward flows away from the flooding locations.

9.3.2 **Malahide Stormwater S2002-A**

9.3.2.1 **Description of Catchment**

Malahide is a coastal town situated in the shelter of the lower estuary of the river Broadmeadow approximately 15 km to the northeast of Dublin City Centre. It is an established high amenity area. According to the Bathing Water Regulations (1996), the beach at Malahide is one of 124 bathing areas in Ireland for which bathing water quality standards must be achieved.

The estuary is widely used for water-based activities such as sailing and windsurfing.

The inner estuary is an area of high national and international environmental significance due to a population of Brent Geese. Its waters have been identified as a sensitive area in The Urban Waste Water Treatment Regulations, 2001.
The Broadmeadow Estuary is designated as one of 1250 proposed Natural Heritage Areas (NHAs), which are areas considered to be of special interest for their flora or fauna. The same area is designated as a Special Area of Conservation (SAC) under the Habitats Directive (92/43/EEC). SACs are natural habitats and habitats of species of European importance. All of the main habitats of an estuarine system are in place in the Broadmeadow Estuary, many of which are contained in lists of habitats of interest at Irish and European level. Under the terms of the Habitat Directive, where development is proposed within an SAC, account must be taken of the impact on the conservation status of the area. The Broadmeadow Estuary is also identified as a Special Protection Area (SPA), designated for the conservation of rare or vulnerable bird species under the Wild Birds Directive (79/409/EEC). The estuary contains a population of Brent Geese of international significance. There is also a salt marsh protected for its specific habitats.

All of the estuary area has been marked as an Area of Scientific Interest (ASI) in the Development Plan 1999, due to its ornithological, botanical and zoological features.

There are no surface water sewer record plans for the rural area south of Back Road. It is understood that this area is served by minor separate surface water systems discharging to local streams. This area is planned for development in future scenarios for 2011 and 2031.

The predominant land use within the catchment is residential.

The predominant soil type, derived from the Flood Studies Report maps, is Class 2. This indicates that the soil has high Winter Rain Acceptance Potential (WRAP). The ground in Malahide is considered to have good permeability and there are a number of soakaways serving the old part of the town. All developments built since the 1960s have separate sewer systems. The majority of pipes are of concrete 225 mm and 300 mm diameter. Trunk sewers in the larger subcatchments have diameters up to 900 mm.

There is an interaction with the Malahide foul/combined catchment study. There are emergency overflows from two foul/combined pumping stations (Castlefield Manor PS and Inbhír Ide PS) and one CSO at the junction of The Mall and New Street discharging to the storm system. The foul/combined sewerage in this area is covered by the Malahide Phase 1, Phase 2 and Phase 3 reports Ref F016.

All developments proposed for the 2011 development scenario are residential with 1246 proposed residential units. New developments are located mostly to the south of the existing development. All proposed 2031 development is located in the Feltrim and Broomfield area south of the Malahide Demesne comprising of some 92 hectares of residential and industrial area.

Figure 9.3.2 shows the extent of the Malahide storm sewer catchment.

### 9.3.2.2 Hydraulic Performance

16 hydraulic deficiencies were identified for the catchment. Seven deficiencies were identified for the existing system and nine were caused by connections of future developments into existing system and the impact of climate change.

### 9.3.2.3 Future Needs

14 hydraulic deficiencies have been identified for consideration under Phase 3 of the study. Five Drainage Development Options were proposed that involved upsizing of sewers to accommodate increased flows.

The model indicates that the connection of any new development to the existing system would require the upsizing of the existing trunk sewers. Alternatively the development could be serviced by the construction of new sewers to an existing watercourse.

This catchment does not impact on the strategic options under consideration for the entire study area and deficiencies identified can be resolved by upgrading options implemented within the catchment.
9.3.3 Portmarnock Stormwater S2002-B

9.3.3.1 Description of Catchment

The Portmarnock storm catchment occupies approximately 115 ha. It comprises 12 subcatchments with separate outfalls. Six outfalls discharge into the Sluice River and its tributary stream. The river flows into the Baldoyle Estuary. Three outfalls discharge into the Irish Sea and three directly into the Baldoyle Estuary. The majority of pipes are of 225 mm and 300 mm diameter. Trunk sewers in the two larger subcatchments have maximum diameters of 600 mm and 900 mm respectively.

Designated bathing beaches (EC Bathing Waters Directive 76/160/EEC) are situated in Portmarnock and at the entrance to the outer Broadmeadow Estuary on both sides of the shoreline at Malahide and Donabate. Accordingly the statutory bathing water standards must be maintained.

The Baldoyle Estuary is an important bird sanctuary and is a Special Protection Area under the EU Birds Directive as well as being a Statutory Nature Reserve. It is designated as a National Heritage Area and an area of Special Scientific Interest.

Both aesthetic and water quality issues are considered to be of high importance for the Portmarnock catchment.

The basic land use within the catchment is residential.

The development strategy envisaged for Portmarnock in the Fingal County Council Development Plan 1999-2004 is a consolidation of the existing urban form and retention of amenities.

The land available for new development within the existing catchment is limited and all future development would have to be outside the existing catchment boundary. Most future expansion of the area is planned outside and to the south of the drainage catchment in the area adjacent to Portmarnock railway station. There is also land available to the west of the catchment adjacent to Blackwood Lane. There is only one proposed development to connect to the existing system.

Figure 9.3.3 shows the extent of the Portmarnock storm sewer catchment.

9.3.3.2 Hydraulic Performance

There were five hydraulic deficiencies identified for this catchment. Three deficiencies related to the connection of the future 2011 development into the existing system. The model predicted that the existing sewers have insufficient capacity to accept increased flows due to future development.

9.3.3.3 Future Needs

One Drainage Development Option was proposed. It involved the upsizing of pipes to address hydraulic deficiencies. The model indicates that the existing stormwater system is surcharged during storms with low return periods due to the majority of pipes having insufficient capacity to cater for the predicted run-off. The connection of any new development to the existing system would require the upsizing of the existing trunk sewers. Alternatively the development could be serviced by the construction of new sewers to an existing watercourse.

This catchment does not impact on the strategic options under consideration for the entire study area and deficiencies identified can be resolved by upgrading options implemented within the catchment.

9.3.4 Swords Stormwater S2003

9.3.4.1 Description of Catchment

The Swords catchment has an extensive surface water system with some combined sewers serving the town centre. There are 14 discrete surface water sewer networks discharging to watercourses in the catchment.
The surface water system serving the town centre flows in a northerly direction to an outfall structure at the mouth of the Broadmeadow River. In the western part of the town, several outfalls serve small areas and discharge both directly to the River Ward and to smaller tributaries running through the town.

It is also worth noting that an important constraint on the Swords catchment is the need to protect the Special Protection Area of the Broadmeadow Estuary, into which final effluent from the WwTW at Swords also discharges. The estuary is also extensively used for water sports.

The Ward River runs through the town from the West and joins the Broadmeadow River just upstream of the Broadmeadow Estuary. In the outer estuary, the beach at Malahide was designated as a bathing water area under the first schedule of the European Communities (Quality of Bathing Water) Regulations.

There are 3 CSO discharges in the Swords catchment. The Glassmore Park South CSO discharges to surface water sewers. The Forest Road and Bridge Street CSOs discharge directly to watercourses in the Swords area.

Swords is one of the fastest growing towns in Europe, with development mainly located to the north and south of the catchment. The developments identified comprise approximately 231 hectares of residential development and 220 hectares of industrial area.

Figure 9.3.4 shows the extent of the Swords storm level 2 catchment.

9.3.4.2 Hydraulic Performance

Numerous deficiencies were identified in the existing drainage systems during the study. Fingal County Council also raised concerns about the capacity and conditions of streams and culverts in the catchment and their ability to cope with the flow resulting from future developments.

The main areas with a lack of capacity to accommodate new development are in the south part of the catchment. Surcharge occurs in the Rathingle Road and Rathbeale Road areas with the most significant problems being large amount of flooding along the N1 road and in the Mooretown area. Additional flows arising from the new developments in the south of the catchment will significantly exacerbate the lack of capacity of the system.

9.3.4.3 Future Needs

Solutions developed for the above deficiencies involve the provision of additional capacity within the catchments to pass forward flows away from the flooding locations. Due to the large size of the developments proposed, some significant areas of work are required.

9.3.5 Donabate / Portrane Stormwater S2004

9.3.5.1 Description of Catchment

This catchment consists of two settlements, totalling some 500ha in area, on the Fingal Coast approximately 17 km to the north of Dublin. The towns are predominantly residential with the combined 2002 population of approximately 5,385. The population is forecast to rise to approximately 8,551 by 2011, and to 13,130 by 2031.

Donabate consists of an older town centre adjacent to the railway station. In recent years there have been extensive new developments on the edges of the existing town, as well as many individual houses along the roads. The surface water sewer system in Donabate consists of several independent networks discharging either directly to the Rogerstown Estuary or to minor watercourses that flow into the estuary. One outfall is located at the Broadmeadow Estuary to the south. The sewerage system serving the town is partially separate with the extent of separation varying between different areas. A new surface water sewer was constructed recently from the centre of Donabate to the Rogerstown estuary to reduce current runoff to smaller watercourses and to provide capacity for future development.

Portrane is situated to the east of Donabate with the principal housing areas located near to the sea and on the Burrow (the peninsular which partially closes the mouth of the Rogerstown Estuary).
Concentrated developments occur near to the town centre, whereas the housing on the Burrow is a mixture of detached properties and static caravans. St Ita’s Hospital is situated to the south of the town.

The new estates in the centre of Portrane are served by separate surface and foul sewers, whereas the Burrow only has one small diameter road drain that discharges road runoff to the estuary. Surface water runoff from the Burrow, that does not soak away, must be served by the foul sewer and has therefore been excluded. The surface water drainage arrangements in St Ita’s Hospital are unknown.

Figure 9.3.5 shows the extent of the Donabate and Portrane storm level 2 catchment.

9.3.5.2 Hydraulic Performance

No deficiencies were reported in the existing scenario whilst three hydraulic deficiencies are reported in the 2011 scenario. There are no further deficiencies in the 2031 development scenario.

9.3.5.3 Future Needs

There is a large potential in the stormwater system to accommodate development growth particularly in Donabate where the new 1350 mm storm culvert has recently been constructed. Three separate sewerage schemes have been identified to accommodate all the future development and meet the required target hydraulic performance criteria.

9.3.6 Rush Stormwater S2005

The town of Rush is situated approximately 30 Kilometres north of Dublin in County Fingal on the northern side of the Rogerstown Estuary and is located in the coast. It is a small urban township and the location is an established amenity area.

The Rogerstown Estuary is designated as a Special Protection Area (SPA) and Special Area of Conservation (SAC) under the Birds and Habitats Directives. There is an EC designated bathing water at Rush, South Beach. This has achieved the mandatory bathing water standard consistently and the guideline standard in some years.

The older parts of the town, principally along Main Street, are served by combined sewers that discharged directly to the sea. The newer housing estate developments mainly to the north of Rush have all been drained on a separate basis.

The majority of sewers are concrete of 225 mm diameter with trunk sewers of 300mm to 750mm diameter. The storm system discharges through 17 outfalls of which seven are directly to the Irish Sea, one is to the Rogerstown Estuary and nine are to local streams which subsequently discharge to the sea and the estuary.

The Development Plan for Rush indicates consolidation of the existing urban form with retention of amenity. A detailed review of future developments and performance of the system has been carried out by PH McCarthy Consulting Engineers under a separate study.

Figure 9.3.6 shows the extent of the Ballyboghill 1 – Rush storm catchment.

9.3.6.1 Hydraulic Performance and Future Needs

The Phase 1 report for the GDSDS was issued in April 2002. The client subsequently instructed that no further work be undertaken for the catchment. Performance and needs for Rush are therefore not included in the GDSDS.
9.3.7  Balbriggan Stormwater S2006

9.3.7.1  Description of Catchment

Balbriggan lies on the north Fingal, with a catchment area of approximately 730 ha and an estimated population of approximately 11,230. The County Development Plan allocates two large areas on the outskirts of Balbriggan to new housing - one to the north west of the town centre and the other to the south of town alongside the R127. An area to the southwest of the town centre, just off the N1, is allocated for industrial development.

The surface water sewer system in the town centre is centred on the River Bracken, which discharges to the Harbour. Playing fields and roads to the southwest of the catchment such as Curran Park and Pump Lane drain towards the sea. The outfall sewer for this area passes under the railway and discharges on the beach to the south of the harbour.

To the north of the town above Bath Road the catchment generally drains to the culverted River Bremore, which flows in an easterly direction to the beach. This culvert serves housing estates to the north of Bath Road and new estates to the north west of Drogheda St. Other surface water sewers now flow to the beaches and the River Bremore.

Figure 9.3.7 shows the extent of the Ballyboghill – Balbriggan storm level 2 catchment.

9.3.7.2  Hydraulic Performance

There were no reported deficiencies in the storm catchment and generally the existing system provides a level of service greater than a return period of 5 years, with only one location predicted to flood more than 25 m$^3$. However considerable development is planned in the catchment, which will require storm water drainage and discharge locations.

9.3.7.3  Future Needs

The Phase 2 report for the GDSDS was issued in September 2003. The client subsequently instructed that no further work be undertaken for the catchment. Needs for Balbriggan are therefore not included in the GDSDS.

9.3.8  Tolka Blanchardstown Stormwater S2007

9.3.8.1  Description of Catchment

The Tolka Blanchardstown catchment lies to the north-west of the City of Dublin, and is divided by the River Tolka which flows through the north of Dublin City Centre to Fairview Park, where it discharges to Dublin Bay. The River Tolka is a relatively small river, which follows a rather flat and narrow course and is prone to flooding. The most recent serious flooding event occurred on the 14th and 15th November 2002 following a major 2 day rainfall event, which resulted in the river overtopping its banks and flooding significant areas of the catchment. A separate study concerning the River Tolka catchment itself, which is entitled “River Tolka Flood Study” has been produced as part of the GDSDS.

The altitude of the Tolka Blanchardstown catchment varies gradually between 70 m and 50 m above Ordnance Datum.

Within the last ten years there has been a significant expansion in development in the catchment such that the developed area has doubled since 1990. This increase in developed area and the resulting additional runoff is likely to have exacerbated the flooding from the River Tolka. There is significant pressure for further large-scale development within this catchment and questions have been raised concerning the capacity of the River Tolka and the 9C Blanchardstown Trunk Sewer to service this. The geography of the catchment has also been significantly altered in recent years by the construction of the Blanchardstown bypass, which links the N3 to the Western Parkway (M50) and the M50 motorway itself.

The majority of the separate sewers serving the area form dendritic storm water networks which discharge to the River Tolka by gravity. There are also several areas in the network where the storm system drains into the foul system. The developments to the south of Clonsilla are an exception –
these are served by a storm water drain which discharges to a tributary of the River Liffey. Despite this, it has been reported that there is a large storm flow response in the foul sewer network (draining to the 9C Blanchardstown Trunk sewer) that is estimated to fairly regularly reach 3-4 times dry weather flow.

Figure 9.3.8 shows the extent of the Tolka Blanchardstown storm level 2 catchment.

9.3.8.2 Hydraulic Performance

The deficiencies identified within the Tolka Blanchardstown catchment can generally be attributed to increases in flows as a result of proposed areas for development at the 2011 and 2031 scenarios and are therefore currently not supported by existing flooding records held by Fingal County Council. For the 2011 development scenario the present drainage system is generally able to cope with the increased flows.

9.3.8.3 Future Needs

As there are significant areas of increased development draining into the system, it is in these areas where hydraulic needs are arising. The upgrading works comprise upgrading of existing sewers, and provision of new sewers to reroute flows to the River Tolka and its tributaries. It is also recommended that areas of the catchment should be subjected to more detailed modelling before a final solution to potential flooding problems is developed.

9.3.9 Tolka NDDS and Kilbarrack & Blackbanks S2008A and S2008B

9.3.9.1 Description of Catchment

Tolka NDDS

The 1430 ha catchment for the Tolka NDDS study area is located in North Dublin and drains to the final 7 km length of the Tolka River which itself extends from the estuary at East Wall to the western most edge of Dublin City at Ashtown. The study area is bounded by the Finglas River catchment (the largest tributary of the Tolka) to the north, the Wad River catchment to the north and east and the Tolka River / Royal Canal / Navan Rd to the south.

Predominant land uses are medium-density residential estates, semi-detached housing developments, commercial / light industrial estates, institutional buildings and grounds, and sports grounds. The wedge shaped catchment areas of the Finglas River and Wad River Diversion also provide easily identifiable landmarks that allow the entire study area to be split into four distinct regions being:

Region 1: The largest area is the 536 ha eastern-most region bounded by the Wad River Diversion to the west, the Wad River catchment proper to the north and east, the Tolka River to the south and the river estuary to the south-east. This region drains from a maximum high point of about 48 m MHD near Dublin City University at the Collins Avenue watershed in the north to the Tolka River and estuary via several watercourses that have now all been culverted and often diverted from their original course. The most significant watercourses are the Marino Stream, Grace Park Stream, Drumcondra Rd Upper / Swords Rd drain and the Hampstead Stream, which all have relatively steep slopes of between 2.0 and 2.6%.

Residential development here is also the oldest in the catchment although it still retains large areas of undeveloped institutional lands and grassed playing fields.

Region 2: The second largest region is the 373 ha area to the south of the Tolka River, bounded approximately by Botanic Rd to the east, the Royal Canal / Carnlough Rd / Navan Rd to the south and Ashtown Rd to the west. It drains at a variable slope of between 1.7% and 2.7% from a maximum high point of about 52 m MHD on the Navan Road watershed in the south to the Tolka River. The Cemetery Drain that services Glasnevin (Prospect) Cemetery in Drumcondra is the only named watercourse in this region.

Land use is very mixed and includes the Botanic Gardens, Glasnevin Cemetery, light industrial areas in North Cabra, relatively new residential housing estates in Ashtown and open space areas leading down to the grassed Tolka Valley Park. Development has generally progressed from North Cabra in the east
to Ashtown in the west, and will ultimately encompass the largest contiguous area planned for residential development within the catchment, situated in the north of Ashtown between the Royal Canal and River Road.

**Region 3:** The third largest region is the 241 ha area in the centre of the catchment between the Wad River Diversion to the east and the Finglas River to the west. This drains to the Tolka from a maximum high point of about 68 m MHD at Finglas East predominantly via the culverted Claremont Stream and at a slope of 1.8 to 2.0%. This region comprises well-established urban areas mixed with a good proportion of institutional lands and sports fields in the middle to lower reaches.

**Region 4:** The smallest region within the Tolka NDDS catchment is the 235 ha area bounded by the Finglas River to the north and east, the Scribblestown Stream to the west and the Tolka River to the south. It drains across the steep sided Tolka Valley Park at an average slope of about 2.8% via the Finglaswood Stream, the Scribblestown Stream and numerous smaller piped systems in the lower reaches. Small housing estates have recently been completed in the northwest of the region but no further development westwards is expected.

There are very few open channel watercourses remaining in the catchment with most having been culverted progressively over the years, as development has spread generally from south to north. The Scribblestown Stream is the most significant open channel watercourse, together with short sections of the Claremont Stream and Hampstead Streams.

The quality of the water discharging from the catchment, especially during rainfall events, is known to be poor due to polluted urban runoff, foul water overflows and waste flow misconnections. Studies have indeed shown that the physical, chemical, biological parameters of the River Tolka are less satisfactory than those of the Liffey and Dodder Rivers.

Figure 9.3.9a shows the extent of the Tolka NDDS storm level 2 catchment.

**Kilbarrack & Blackbanks**

The 646 ha Kilbarrack & Blackbanks catchment is located in North Dublin and discharges to North Bull Lagoon via the culverted Kilbarrack Stream, Kilbarrack Rd drain, Blackbanks Stream and Fox Lane drain. The catchment extends in a funnel shape from the Kilbarrack foreshore in the southeast to North Kilmore and the M1 in the northwest, and is almost fully urbanised. Future development is now limited to small scale redevelopment of institutional lands. The entire network is piped and the estimated time of concentration for the 6.6 km long Kilbarrack Stream culvert is very short at just over one hour.

Figure 9.3.9b shows the extent of the Kilbarrack and Blackbanks River storm level 2 catchment.

**9.3.9.2 Hydraulic Performance**

**Tolka NDDS**

Significant and widespread flooding is predicted, particularly in the Tolka East and Tolka West catchments. This indicates that future development should employ the SuDS principles of no worsening of the development area’s existing discharge to the surface water system.

**Kilbarrack & Blackbanks**

The Kilbarrack & Blackbanks drainage system is considered to perform well throughout the catchment under all design scenarios. There were very few nodes that flooded significantly during the design runs. For the 2011 development scenario the only development zoned for the study area is 3.51 ha of small-scale industrial and residential development. These developments have been represented in the hydraulic model but have no impact on the existing identified hydraulic deficiencies. It was not considered necessary to include storm flows from 2031 developments in the hydraulic model, as the full implementation of SuDS is assumed for the 2031 development scenario. However, an increase in rainfall intensity of 10% was applied to assess the effect of climate change on the performance of the catchment. The existing hydraulic deficiencies were only slightly exacerbated by the increase in rainfall intensity.
9.3.9.3 Future Needs

Tolka NDDS

The analysis of flooding locations in the Tolka NDDS Catchment during Phase 3 indicated that in some cases flooding occurs at locations where there is a very large sub-catchment area allocated to a small diameter pipe. It is recommended that particular attention be given to impermeable area allocation prior to upgrading.

During Phase 3 of the study, the hydraulic model of the existing system was upgraded to include for future developments expected up to the year 2011. No new developments were proposed for this catchment for the 2031 scenario. For the 2031 development scenario the impacts of climate change have been applied. Deficiencies were then identified based on criteria agreed between the Dublin Drainage Consultancy and the Client.

Significant and widespread flooding is predicted, particularly in the Tolka East and Tolka West Catchments. This indicates that future development should employ the SuDS principle of not worsening the development area’s existing discharge to the surface water system.

Eighteen Hydraulic Deficiency groups have been identified. These deficiencies relate to sharp changes in pipe gradient, pipe constrictions, under-sized pipes for the contributing area, input of new development and shallow pipe depths. For the 2031 scenario increased flows and sea level rise due to climate change were applied to the 2011 model. All Hydraulic Deficiency locations have been addressed for the 2031 horizon with additional flood locations arising at 2031 being added to the original hydraulic deficiency groups where appropriate.

This catchment does not impact on the strategic options under consideration for the entire study area. Recommendations of the River Tolka Flood Study as they apply to the Tolka NDDS have been included in the Phase 3 report. Deficiencies identified can be resolved by upgrading options including pumping and flap valve installation implemented within the catchment.

Kilbarrack & Blackbanks

A total of 4 hydraulic deficiencies were identified across the catchment. However, as the impact of the flooding predicted was considered to be negligible, none of the identified hydraulic deficiencies were brought forward as needs.

9.3.10 Dodder Owendoher Stormwater S2009

9.3.10.1 Description of Catchment

The 248 ha Dodder Owendoher study area comprises the South Dublin suburbs of Edmondstown, Ballyboden, Willbrook and Rathfarnham that all drain predominantly via a pipe network to the lower 3 km of the Owendoher River. It represents some 20% of the overall Owendoher River catchment and 10% of the entire River Dodder catchment, by area.

The study area extends from the Dodder / Owendoher River confluence opposite Bushy Park, Rathfarnham in the north to Rathfarnham Golf Course, Newtown in the south, and is bounded by the Dodder Valley study area to the west and north and the Whitechurch Stream catchment to the east. The catchment boundary for the study area narrows at the Whitechurch Stream confluence (as the Whitechurch is being examined as a separate catchment in the GDSDS).

Land uses include medium-density residential estates, semi-detached housing developments and small sports grounds and parks. Development has generally spread from north to south, with the most recent residential development taking place in open space areas in Ballyboden and Edmondstown. Scope for future development within the Dodder / Owendoher Catchment is considerable, with the existing developed area proposed to increase from 43% to 51% by the year 2031. The main areas of proposed development within the Dodder Valley study area are located primarily on the southern fringes of existing urban development extending towards the foothills of the Dublin Mountains. The remainder will comprise infill development within existing urban areas.
The study area catchment boundary extends no more than 600 m perpendicularly from the Owendoher River and times of concentration are therefore expected to be relatively short. Unlike the Dodder Valley study area, future development zoned for the south of the study area will always occur in close proximity to the Owendoher to which it will drain directly via dedicated pipe outfalls. This suggests that there are likely to be comparatively fewer flooding problems associated with these new developments.

Figure 9.3.10 shows the extent of the Dodder Owendoher River storm level 2 catchment.

9.3.10.2 Hydraulic Performance

The overall performance of the pipe network was reasonable with the majority of the flooding nodes located in the older minor pipe network in the eastern half of the study area. The defined core networks of the 8 sub-catchments in the study area performed well, being relatively free of surcharge and flooding for both the 2011 and 2031 design scenarios.

9.3.10.3 Future Needs

Generally, the drainage improvement works related to upsizing of existing pipes to improve the hydraulic performance of the system. Storage will however be required to attenuate the increased runoff associated with some proposed development areas to reduce the requirements for up-grading significant portions of the trunk sewer network.

9.3.11 Dodder Whitechurch Stormwater S2010

9.3.11.1 Description of Catchment

The Dodder Whitechurch catchment is located on the southern edge of Dublin. The urban part of the catchment is in the north, whilst the majority of the catchment in the south is rural and very steep. The urban part of the catchment is in South Dublin County, with most of the rural parts in Dun Laoghaire-Rathdown County. Although the overall stream catchment covers 830 ha, only 75 ha of this is urbanised. The M50 and topographical considerations act as a major constraint to future development, so it is unlikely that the urban area will be extended any significant distance further south. This is supported by the fact that there are no specific areas of future development identified for 2011.

The catchment drains northwards, via the Whitechurch stream, to the Owendoher stream, which then discharges into the Dodder River. Within the urbanised area there is an extensive surface water network, with many small systems draining to the Whitechurch stream. There is also an extensive foul network. No historic flooding problems have been reported.

Figure 9.3.11 shows the extent of the Dodder Whitechurch Stormwater storm level 2 catchment.

9.3.11.2 Hydraulic Performance

The model confirmed that there are no significant flooding problems in the catchment.

9.3.11.3 Future Needs

There are no overall strategy issues to consider when developing system improvements. Since the existing system performs adequately for all development scenarios, no improvements to the storm drainage system are proposed.

9.3.12 Dundrum/Slang Stormwater 2011

9.3.12.1 Description of Catchment

The Dundrum Slang catchment is located on the southern edge of Dublin, draining from south to north. It is 7.5 km long and typically 3 km wide, and overall catchment size is 1,700 ha. Whilst the southern part of the catchment is steep and rural the northern section is flatter and almost fully urbanised – mainly residential, but with some commercial areas. Because of the steep ground in the south and the existing high proportion of urbanisation the scope for new developments is limited. There are proposals
for residential developments in several locations in the catchment, which are mainly infill sites rather than extensions to the urbanised area.

Two small rivers flow through the catchment - the Slang River in the east and the Little Dargle in the west. They are both about 7 km long, rising in the mountains and discharging to the Dodder River. Both rivers normally flow in open channels, but also have several culverted lengths. In the middle of the Slang River many piped / culverted sections have been constructed recently, as part of highway improvements and development projects.

The surface water systems that drain to the rivers are very extensive in the urbanised parts of the catchment. Although the majority of the impermeable areas connect to the storm systems there are parts where a significant area connects to the associated foul / combined system. Flooding from the rivers has been reported in the Willow Road area (the middle of the catchment) and from the lower lying areas of the Slang, closer to the Dodder River. Although there is also a history of flooding in Pye Lands this area is being redeveloped, involving changes to the river. No areas with regular flooding from the piped storm system have been reported.

Figure 9.3.12 shows the extent of the Dundrum/Slang Stormwater storm level 2 catchment.

### 9.3.12.2 Hydraulic Performance

Although flooding is predicted in many areas in the existing piped network, this may well be an over-prediction.

For the 2011 scenario no constraint was applied to development flows, and 40 hydraulic performance deficiencies were identified for 1 in 5 year return period storms, with 13 considered for improvements. Five river section deficiencies were identified, for 1 in 50 year events – this return period was adopted for this study, to be consistent with the SEM work. The 2011 predicted water levels in the Slang River would typically be 60 mm higher than for the existing situation, with individual increase of up to 0.43 m. There are further increases for the 2031 scenario (typical overall increase of 90 mm, with a maximum increase of 0.58 m).

An approximate flood outline of the existing situation has been produced. However, the lack of ground level data and insufficient data to accurately define the full extent of the modelled cross-sections mean that it is not possible to produce accurate flood outlines.

### 9.3.12.3 Future Needs

The proposed works include upsizing existing sewers and the provision of new pipes to divert flows. The improvements require further analysis, at Drainage Area Plan level, before implementation. Recommendations were also made in the Slang Report of the SEM Catchment Study, regarding improvements to the lower parts of the Slang River. These included local re-grading / widening of the river, and a maintenance programme to reduce overgrowth and to repair collapsed walls in the lower reaches of the stream.

The construction of new flood banks / walls should also be considered, to protect properties, along with the implementation of SuDS principles for all new developments, to limit increases in flows. Additional survey work is proposed to enable river details to be updated further, so the model can more accurately predict the extent of flooding from the river. As a storm type 2 catchment that drains to the Dodder River, with no interactions with other storm catchments, there were no overall strategy issues to consider when developing system improvements.

### 9.3.13 Naniken Stormwater S2012

#### 9.3.13.1 Description of Catchment

The Naniken River study area is located in North Dublin and discharges to Dublin Bay behind North Bull Island. The study area comprises medium-density residential estates, semi-detached housing developments and commercial / light industrial estates. The catchment became almost fully developed by the late 1960’s. No additional development was added to the Naniken hydraulic model for the 2011 or 2031 scenarios, as all future development in the catchment will involve redevelopment of brownfield areas.
sites. Development of brownfield sites will not increase runoff and hence will have no effect on catchment hydraulic performance.

Figure 9.3.13 shows the extent of the Neniken River storm level 2 catchment.

9.3.13.2 Hydraulic Performance

The most significant problems occur in the centre of the catchment, where the Naniken Culvert runs along the axis of the Ardlea Road. A mostly contiguous block of manholes along this axis fail, and flood in almost every design storm. This section is in the centre of a dense distribution of storm drains in the catchment and is topographically very complex also. Along this section, flow running down the steep slope from the Beaumont portion of the catchment encounters a throttle in the Naniken Culvert, which causes surcharging of flows. Directly over this throttle, the surface topography produces a natural depression, in which large volumes of floodwater gather. No reported flooding incidents are available to compare with the predicted frequency of flooding at this site.

A second bottleneck can be seen downstream at St. Brigid’s Crescent and Brookwood Avenue and also occurs at a point where there is a depression in the topography. The main channel is running surcharged at capacity for the full length of the section joining these flood zones and is the cause of many of the minor peripheral floods, as tributaries back up.

The poor hydraulic performance of the pipe network was only slightly exacerbated by the application of the 10% rainfall intensity increase for the 2031 design scenario. This uniformity in catchment performance across the 3 scenarios meant that only the most extreme scenario, i.e. 2031 scenario, was considered during the development of performance improvement options for the catchment.

9.3.13.3 Future Needs

A total of 34 hydraulic deficiencies were identified across the catchment, 20 of which were brought forward to be addressed during the development of needs. Deficiencies in all of these areas were caused by throttles in the network due to undersized pipes and therefore all solutions involved the upsizing of existing pipes to remove the throttles.

9.3.14 Dargle Stormwater S2013

9.3.14.1 Description of Catchment

The 1190 ha study area comprises the main urbanised area of Bray and includes those rural areas to the south that drain to the piped stormwater network. The study area is bounded by the Dargle to the west and north, the Irish Sea to the east and The Little Sugar Loaf and Bray Head to the south.

The rural area south of Bray consists mainly of agricultural land with natural and wooded areas spread throughout. Runoff travels down the Little Sugar Loaf in a northerly direction from a maximum height of 342 m MHD where it enters the stormwater network at Bray Business Park. Runoff from the east side of the Little Sugar Loaf drains at a slope of approximately 18% and feeds to a pond in the grounds of Kilruddery House, which is the source of the Swan Stream. Runoff from the smaller peak on Bray Head flows down the north face from a maximum height of 206 m MHD at a slope of 17% and enters the stormwater network directly at Newcourt. Runoff also travels from the other peak of Bray Head (240 m MHD) down the west slope and is collected by a stream, which rises at Kilruddery House and flows to the stormwater network in the southeast of Bray.

The core stormwater network is located in the south and southwest of Bray town and drains to the Dargle, mainly via the Swan Stream (often referred to as the Oldcourt River). The Swan flows north from Kilruddery, through Oldcourt and outfalls to the Dargle at Glenwood Estate. There is a large area to the west of Bray which outfalls directly to the Dargle via an outfall on the steep south bank of the river at Killarney Glen. The small stream that drains Bray Head flows in open channel as far as Vevay Road, where it is culverted to join with the piped stormwater network on Putland Road. This part of the network outfalls to the foreshore at the eastern end of Putland Road.

The predominant land uses in the urban part of the study area are medium density, urban residential estates, commercial / light industrial estates, concentrated in the south of Bray, and various park, civic, community and educational areas scattered throughout. Bray has expanded rapidly in recent years
due to its proximity to Dublin city and the availability of good transport links (i.e. the DART railway line and the M11 motorway). However most of the current new development comprises infill residential and industrial areas.

9.3.14.2 Hydraulic Performance

Generally, the overall performance of the network was very good with 17 nodes (1.6% of the total) predicted to give flood volumes greater than 25 m³ for a 5 Year return period critical storm event. The majority of these “flooding” nodes were concentrated in the middle section of the study area, reflecting the older design of the network in this area, and generally located on the minor pipe networks. The defined core networks of the 6 sub-catchments in the study area performed well, being relatively free of surcharge and flooding.

There were several areas where the model showed a concentration of HP nodes flooding in the 1 to 5 Year ARI event. These areas are generally where there has been historic flooding.

9.3.14.3 Future Needs

The mountains to the south and west and a green belt to the north of Bray restrict future development in the study area to pockets of land on the outskirts of the town and infill development within the town. There is a large area of industrial development zoned at Fassaroe to the west of the town, this however will drain direct to the River Dargle and therefore will have no adverse effect on the existing stormwater system of this area.

While future development within this catchment will have limited effect on the existing hydraulic performance of the stormwater system there are several areas where flooding is predicted and/or exacerbated by development in the 2011 scenario. Primarily, these areas are along the core network of Boghall Road, Newcourt Road, Southern Cross Road and Killarney Lane. Reducing the flooding to the required performance standards within these areas will require the upsizing of the core pipe network.

The application of a 10% increase in rainfall intensities to represent climate change in the 2031 scenario introduces some additional flooding in the core network predominately along Boghall Road. To the west of the outfall to the Swan Stream on Boghall Road, the pipe sizes and connectivity of the core network are at some locations assumed and it is therefore recommended that a CCTV/SUS survey be carried out to confirm details before developing options to eliminate flooding. To the east of the same outfall to the Swan Stream, flooding will also be solved by upsizing of pipes.

9.3.15 Dun Laoghaire West Pier West Stormwater S2014

9.3.15.1 Description of Catchment

Dun Laoghaire town is located on the south shore of the Dublin Bay, approximately 7 km south east of Dublin. The catchment extends to the south and west of Dun Laoghaire town, covering an area of approximately 1,700 ha, including the areas of Sandyford, Kilmacud, Stillorgan, Monkstown, Booterstown, Blackrock and Sallynoggin.

The West Pier West catchment has a separate foul / combined system which is being included as part of the strategic study. (Ref. F011).

The catchment is a highly developed urban and suburban catchment with limited green field sites available for further development. The predominant land use in the catchment is residential. Most of the proposed developments for 2011 development scenario are residential infill developments with 2,871 residential units covering some 52 hectares. No further development is predicted for 2031 scenario. For the 2031 development scenario the impacts of climate change have been applied.

The southern area of Dublin Bay is a high amenity area governed by the Dublin Bay Water Quality Management Plan and the Bathing Water Regulations 1996. The beach at Seapoint has frequently attained Blue Flag status since the construction of the West Pier Pumping Station in the early 1990’s. There is a bird sanctuary in Booterstown adjacent to the DART station, which is designated as a Natural Heritage Area (NHA). This is an area of high national and international significance.
The Dun Laoghaire West Pier West storm system consists of six main subcatchments. Four of these subcatchments include culverted and open channel streams that discharge to the sea. These open channels are known as the Trimleston, Priory, Maretimo and Monkstown / Sallynoggin streams. Another subcatchment is a piped system that discharges to the Deansgrange Stream. This stream while outside this catchment discharges to the sea at Killiney and has been modelled as part of this study (Ref. S1007).

A number of areas in the study area are subject to flooding. The majority of the flooding occurs as open stream over bank flooding, although there are some areas where the system floods from manholes. The most problematic area regarding historical flooding is at the Carysfort pond and immediately downstream of the pond in the Maretimo storm subcatchment.

There are nine CSOs discharging from the foul / combined system to the storm catchment. Three overflows are situated on the Rock Road. There are two overflows to the Priory stream and one overflow to each of the Maretimo, Monkstown and Trimelston streams. There is one overflow into the piped network in Kilmacud. All major stormwater systems discharging to the Dublin Bay have overflows from the foul/combined system. The storm system which discharges to the Deansgrange stream also has an overflow from the foul/combined system.

Figure 9.3.15 shows the extent of the West Pier West storm sewer catchments.

9.3.15.2 Hydraulic Performance

Due to the complex nature of the interaction between the West Pier West (Storm) and the West Pier West (Foul/Combined) one InfoWorks model including all foul/combined and storm networks has been produced. The model has predicted flooding in 13 areas of the catchment mostly due to the insufficient capacity of the system to accept flows. Flooding from the streams was ascertained for the 100-year event and was caused by Priory, Maretimo and Monkstown streams mostly due to insufficient downstream culvert capacity.

9.3.15.3 Future Needs

Four Drainage Development Options were proposed that involved upsizing of existing sewers and construction of new sewers to accommodate increased flows. It is considered appropriate that, prior to developing the improvements, further investigations be carried out to obtain more detailed information and to update the model as necessary. Major residential development is planned at Dun Laoghaire Golf Course occupying some 32 ha. It is recommended to apply stormwater management policy to this development and to restrict outflow to that from the greenfield site, prior to 2011. Otherwise the model indicates that the connection of new development proposed for the Dun Laoghaire Golf Course to the existing system would require the upsizing of the existing downstream trunk sewers.

Because of existing hydraulic constraints within the drainage system of the Deansgrange and Maretimo stream catchments, no alternations to the existing overflow level at Brewery Road have been proposed. Nevertheless this is a subject to Carysfort Maretimo Stream Improvement Scheme currently being undertaken on behalf of the Council.

It should be noted that this catchment does not impact on the strategic options under consideration for the entire study area and deficiencies identified can be resolved by upgrading options implemented within the catchment.

9.3.16 Clontarf Stormwater S2015

9.3.16.1 Description of Catchment

The Clontarf storm catchment, located on the eastern side of Dublin, north of the docks, is bounded by the DART line to the west and by Dublin Bay to the south and east. The northern boundary runs close to the southern edge of St Anne’s Park. The Naniken catchment (S2012) lies to the north and Wad River section of the Tolka NDDS catchment (S2008) to the west. The catchment, which has an area of 350ha, lies within the Dublin City Council administrative area. Virtually all of the catchment is urbanised, being primarily residential.
The storm network is extensive, with many small and medium sized sewer systems draining south / southeastwards, towards Clontarf Road. These discharge to Dublin Bay via a series of outfalls. The majority of the systems also link to a surface water storage culvert that runs along the foreshore (Clontarf Road), between St. Lawrence Road and Kincora Road. This is about 40 years old. This should alleviate surface water flooding in the area, by storing storm flows during high tide periods, and releasing them to the Bay as the tide drops. Many of the flap valves on the tidal outfalls are missing, so it is not currently operating as designed. Although there are known flooding problems in Clontarf Road during periods of very high tide, no other problems with the storm sewerage network have been reported.

There is a significant storm response in the associated foul / combined catchments (Route 12 catchment and NDDS & North Fringe – F1004).

Figure 9.3.16 shows the extent of the Clontarf Stormwater storm level 2 catchment.

9.3.16.2 Hydraulic Performance

Although flooding is predicted in several places, historic flooding has not been reported at any of these sites, and the predictions should be treated with some caution. A total of 5 hydraulic performance deficiencies were identified for consideration of improvements - all in or close to Seafield Road East

9.3.16.3 Future Needs

The proposed improvements included the upsizing of existing pipework and the diversion of flows to other branches. It was also recommended that new flap valves be fitted to the outfalls along the foreshore. Because of the uncertainties in the impermeable areas contributing to the model and in some of the details of the foreshore culvert system, it is appropriate that prior to developing the hydraulic improvements, some further site investigations be carried out. Any other improvements to the culvert will depend upon a more detailed hydraulic analysis, when the accuracy of the model in this area is improved.

As a storm type 2 catchment that drains to Dublin Bay, with no interactions with other storm catchments, there were no overall strategy issues to consider when developing system improvements.

9.4 Minor Stormwater Systems

9.4.1 Liffey Zoo Newbridge Stormwater S3001

9.4.1.1 Description of Catchment

Newbridge is located to the southwest of Dublin just off the M7 and approximately 6 miles from Naas in County Kildare. After a short period of decline, new industry started to emerge and the town is an important industrial centre for County Kildare. Today the town is a large and growing commercial and industrial centre with a population of approximately 15,000 people.

The River Liffey flows from south to north through Newbridge with most of the town lying to the west of the river. The River is wide and free flowing as it passes through the town and a system of tributaries, some of which have been culverted to facilitate development, flow through the town and into the river at various points.

The town has an extensive surface water sewer system that serves all the newer residential and commercial development outside the town centre. The older combined sewerage system receives the surface water from the historic town centre and there are two combined sewer overflows that discharge from the combined system into surface water sewers. The surface water sewer system is fragmented into 54 separate sewer networks and these outfall either to the network of tributaries feeding the River Liffey or direct to the river itself.

There are 3 known foul / combined discharges (2 CSOs and 1 suspected wrong connection) to the piped storm system in Newbridge. These overflows are discussed further under the Upper Liffey Valley – Osberstown catchment, Ref. (GDSDS/NE02057/F013).
There are several locations in the Newbridge catchment that are known to suffer from surface water flooding. Flooding has been reported in the road outside the Newbridge Shopping Centre and in estates to the north of the catchment. Also two surface water sewers are reported to be in poor structural condition. Foul flooding has also been reported near the surface water outfall from the Newbridge Industrial Park to the River Liffey. The culvert that runs under Newbridge Football Club, under the road and then discharges to an open ditch has been reported to be in very poor condition beneath the road. A second sewer, opposite the school on Morristown Biller Road, is reported to be broken and this causes infrequent flooding in the upstream estate.

The current Kildare County Development Plan allocates a number of areas in Newbridge due for future development; however, much of this land allocation has now been built upon. A new area has been zoned for residential development since publication of the development plan. This area is to the northwest of the College Farm Estate.

Figure 9.4.1 shows the extent of the Liffey Zoo Newbridge storm level 3 catchment.

### 9.4.1.2 Hydraulic Performance and Future Needs

The Liffey Zoo Newbridge catchment is classified as a Storm Type 3 catchment for the GDSDS, meaning the model construction consists of an urban catchment drainage model incorporating pipe network details and urban area contributions, without validation. Performance and needs for this catchment are therefore not included in the scope of the GDSDS.

### 9.4.2 Liffey Bradogue Kilcullen Stormwater S3002

Kilcullen is located to the south west of Dublin just east of the M9 and approximately 7 miles from Naas in County Kildare. The existing population is approximately 1,600. The town straddles the River Liffey with a bridge crossing the river in the town centre. On either side of the bridge the town rises up the river valley and new development is ongoing in the higher areas at either end of the town. The surface water sewers discharge both directly to the River Liffey and to smaller tributaries running alongside the town. In the southern part of the catchment, from Saint Brigids Avenue, surface water discharges to the River Liffey through the Pinkeen Stream running alongside the town. The storm sewers are generally small in size, the largest being 450 mm in diameter.

There are three foul / combined discharges to watercourses in the Kilcullen catchment. The discharges are discussed under the Upper Liffey Valley - Osberstown catchment study (Ref. GDSDS/NE02057/F013).

There are no reported hydraulic, structural, environmental or operational problems with the surface water sewerage in Kilcullen.

Figure 9.4.2 shows the extent of the Kilcullen storm level 3 catchment.

### 9.4.2.1 Hydraulic Performance and Future Needs

The Liffey Bradogue Kilcullen catchment is classified as a Storm Type 3 catchment for the GDSDS, meaning the model construction consists of an urban catchment drainage model incorporating pipe network details and urban area contributions, without validation. Performance and needs for this catchment are therefore not included in the scope of the GDSDS.

### 9.4.3 Liffey Creosote Ballymore Eustace Stormwater S3003

Ballymore Eustace is a small town in County Kildare with a population of approximately 700. The development plan shows that large areas to the southwest and northeast of the town are zoned for residential development. The River Liffey flows through the town and generally the town slopes towards the river. A network of storm drains serves the town, all discharging to the Liffey. These primarily drain the roads and in some cases the front of pitched roofs.

A meeting with Kildare County Council indicated that the population target for Ballymore Eustace is 1,500 by 2006, which is a substantial increase from the current population. The Council also indicated that a large development is planned for the outskirts of the town, to the south of the river. This development site has the potential for 800 houses.
There are no reported hydraulic, structural, environmental or operational problems associated with the surface water sewerage in the Ballymore Eustace catchment. The River Liffey flows through the village and all surface sewers flow either directly to the river or to a tributary thereof. The catchment is steep and therefore if the drains reach capacity floodwater is generally routed along roads to the river.

Liffey Creosote Ballymore Eustace is a Storm Type 3 catchment. It would normally require digitisation of sewer records and construction of a model of the network. However, the council did not have records of the storm sewer system and a full asset survey would have been required before model construction could commence. The GDSDS does not include new blanket sewer surveys for catchments where no asset records are currently held. On this basis, no modelling work was carried out for the Liffey Creosote Ballymore Eustace catchment under the GDSDS.

Figure 9.4.3 shows the extent of the Ballymore Eustace storm level 3 catchment.

9.4.3.1 Hydraulic Performance and Future Needs

Only the Phase 1 report was required for this catchment, and therefore performance and needs are not included in the scope of the GDSDS.

9.4.4 Liffey St Lawrence Maynooth Stormwater S3004

Maynooth is located to the west of Dublin in County Kildare and has a population of approximately 7,300. The Royal Canal and Lyreen River run through the town and it is bounded to the south by the M4 motorway. The town has a reasonably extensive road drainage system, which also takes water from the front of some pitched roofs. This system serves most of the main roads in the town and drains directly to watercourses flowing through the town. New estates are also drained by separate foul and surface water sewers and therefore only a relatively small amount of surface water is believed to enter the foul / combined sewerage system. Approximately 114 ha of land in Maynooth has been identified for development in the County Development Plan.

There are 3 foul / combined discharges in the Maynooth catchment, all of which discharge to the River Lyreen or tributaries thereof. These are discussed in detail under the Lower Liffey Valley foul catchment (F014). There are also approximately 13 surface water outfalls in the catchment.

Consultations with Kildare County Council have revealed that the River Lyreen has caused flooding at various locations in the catchment in recent years. This flooding is thought to be the result of development in the town and puts properties at risk, particularly in the Meadowbrook Estate. Flooding has been partly due to blocked trash screens. In other locations the stream capacity was exceeded or culverts have become partially blocked.

To the west of Maynooth, downstream of the confluence of the River Lyreen and River Ryewater, ground levels in the flood plain have been raised during development of land belonging to Maynooth College. This has pushed flooding upstream onto farmland that was previously outside the flood plain and has resulted in property flooding in this area.

There are no other reported deficiencies in the piped surface water sewer in Maynooth. However, there are reported flooding problems associated with the watercourses in Maynooth and with significant areas of zoned development land around the town, it is possible that such problems could increase.

Maynooth is a Storm Type 3 catchment. It would normally require digitisation of sewer records and construction of a model of the network. However, the council did not have records of the storm sewer system and a full asset survey would have been required before model construction could commence. The GDSDS does not include new blanket sewer surveys for catchments where no asset records are currently held. On this basis, no modelling work was carried out for the Maynooth catchment under this study.

Figure 9.4.4 shows the extent of the Maynooth storm level 3 catchment.
9.4.4.1 Hydraulic Performance and Future Needs

Only the Phase 1 report was required for this catchment, and therefore performance and needs are not included in the scope of the GDSDS.

9.4.5 Liffey Kilcock Stormwater S3005

Kilcock lies just off the M4 motorway in County Kildare to the west of Dublin. It is a small town with a population of approximately 1,700 people. The Royal Canal and railway to Dublin dissect the town, which has a small town centre between The Square and the Harbour. The Ryewater River bounds the town to the east, as does the M4 motorway to the south.

There is an existing Local Development Plan for Kilcock. A total of 122 ha of land in Kilcock was allocated for future development.

The sewer system serving the centre of the village is substantially combined, although surface water sewers do exist in Church St, Bridge St and Mill Lane. The surface water sewers drain the roads and in some cases the front of pitched roofs, whereas the remaining surface water finds its way to the combined sewer. Where new estates have been built, separate drainage has been provided with the surface systems draining directly to local watercourses.

Kildare County Council report that the 225 mm road drain in Church Street is hydraulically overloaded in wet weather and causes regular flooding to the highway. No other deficiencies were listed by the council.

There is only one combined discharge in the Kilcock catchment, which is the Emergency Overflow at Kilcock Pumping Station. This discharges directly to the Rye Water River and does not impact on the storm sewer system. The overflow is discussed in detail under the Lower Liffey Valley foul catchment (F014).

Liffey Kilcock is a Storm Type 3 catchment. It would normally require digitisation of sewer records and construction of a model of the network. However, the council did not have records of the storm sewer system and a full asset survey would have been required before model construction could commence. The GDSDS does not include new blanket sewer surveys for catchments where no asset records are currently held. On this basis, no modelling work was carried out in the Kilcock catchment under this study.

Figure 9.4.5 shows the extent of the Kilcock storm level 3 catchment.

9.4.5.1 Hydraulic Performance and Future Needs

Only the Phase 1 report was required for this catchment, and therefore performance and needs are not included in the scope of the GDSDS.

9.4.6 Ratoath Stormwater S3006

The village of Ratoath lies between the towns of Ashbourne and Dunshaughlin within the county of Meath and is 30 km to the north west of Dublin city centre. The area is served by a separate sewerage system, which drains to a surface water trunk sewer, which runs beneath the main street through the village. This, together with other surface water sewers drains to the Broadmeadow River, which runs to the south of the centre of the village.

Building use within the village is almost entirely residential with a few commercial properties on the main street in the centre of the village. The village covers an area of approximately 156 ha but is growing rapidly due to the proximity of the village to the Dublin area. Significant amounts of land have been set aside for development which has already seen the population of the village grow from 600 in 1991 to a figure around 2000 in 2002. Inspection of the catchment in late 2001 revealed that many areas identified for future development by 2011 were already under construction. Development of the remaining zoned areas would lead to an estimated population in excess of 3,500.
During data collection for the catchment it was established that no sewer records existed for the catchment area in relation to the surface water drainage system and the understanding of the surface water system was based on hand drawn schematics provided by Meath County Council (MCC).

Under the GDSDS the catchment was classified as a Storm Type 3. This stipulates that an InfoWorks model of the catchment would be constructed based on existing drainage records. As drainage records were not available for the surface water system a manhole survey of the catchment would need to be conducted in order to build a representation of the surface water drainage system within an InfoWorks model. Provision for a manhole survey for this catchment had not been allowed for and the decision was taken at the end of Phase 1 not to progress the catchment study any further due to the lack of existing data available.

Figure 9.4.6 shows the extent of the Ratoath storm level 3 catchment.

9.4.6.1 Hydraulic Performance and Future Needs

Only the Phase 1 report was required for this catchment, and therefore performance and needs are not included in the scope of the GDSDS.

9.4.7 Ashbourne Stormwater S3007

Ashbourne is designated as a major urban centre in the Dunshaughlin Development Area. The town is located on the N2 National Primary Route, 23 km from Dublin City Centre. The N2 runs through the centre of the town, which has grown either side of it and covers an area of 203 hectares.

The area is served by a surface water sewerage system with flows draining to the Broadmeadow River, which follows a west-east course through the town. Due to the development pressures on the Dublin area, Ashbourne has seen significant development over the past 5 years. In 1996 the population stood at just under 5,000. In 2002 this figure was nearer 8,000. Land use in the area is predominantly residential with a few commercial properties in the centre of the town. Industrial development has also taken place towards the north of the town.

A significant proportion of land has been set aside for future development within the Meath County Council Development Plan for 2001. Inspection of the catchment in early 2002 revealed that many of the areas identified by the development plan had already been developed.

The data collection exercise in the catchment revealed that surface water sewer records did not exist for the catchment area. Current understanding of the surface water drainage system was established from a network schematic produced by MCC. This schematic identified outfall locations from the surface water system to the Broadmeadow River but had very little detail in relation to the surface water system upstream of the outfall locations. For an InfoWorks model to be constructed a manhole survey would need to be conducted within the catchment area to gather further details. As the catchment was given the classification of a Storm Type 3, no allowance had been made for surveys in the catchment area. Due to the lack of existing details available the catchment study was not progressed past Phase 1 and no model was constructed for the catchment area.

Figure 9.4.7 shows the extent of the Ashbourne storm level 2 catchment.

9.4.7.1 Hydraulic Performance and Future Needs

Only the Phase 1 report was required for this catchment, and therefore performance and needs are not included in the scope of the GDSDS.

9.4.8 Lusk Stormwater S3008

The town of Lusk is situated approximately 30 Kilometres north of Dublin in County Fingal on the northern side of the Rogerstown Estuary, approximately 4 kilometres inland. It is a small urban township and the location is an established amenity area.

The Rogerstown Estuary is designated as a Special Protection Area (SPA) and Special Area of Conservation (SAC) under the Birds and Habitats Directives. There is an EC designated bathing water
at Rush, South Beach. This has achieved the mandatory bathing water standard consistently and the guideline standard in some years.

The older parts of the town are drained on a combined or partially combined basis depending on whether separate storm drainage has been provided for the roads. The newer housing estates including Orlynn Park, Kelly Park and Ministers Park are drained on a nominally separate basis.

The majority of sewers are concrete of 225 mm diameter with trunk sewers of 300 mm to 750 mm diameter. The storm system discharges to local streams, which subsequently drain to the Roperstown Estuary.

The Development Plan for Lusk indicates consolidation of the existing urban form with retention of amenity. A detailed review of future developments and performance of the system has been carried out by PH McCarthy Consulting Engineers under a separate study.

Figure 9.4.8 shows the extent of the Ballyboghill 1 – Lusk storm catchment.

9.4.8.1 Hydraulic Performance and Future Needs

Only the Phase 1 report was required for this catchment, and therefore performance and needs are not included in the scope of the GDSDS

9.4.9 Skerries Stormwater S3009

Skerries is a picturesque town on the coast of County Fingal to the north of Dublin with a population of approximately 11,000 people covering an area of approximately 340 ha. The main line railway runs through the west of the town and the N1 trunk road passes close to the town en route to Dublin. The catchment includes three areas of land that are outside the existing urban area as these are zoned for future development in the current Development Plan.

Skerries has been extensively developed in recent years and has more than doubled in size. The majority of the development has been housing estates served by separate sewage and storm drainage networks.

The Brook River collects flows from large rural areas to the west of the Dublin-Belfast railway, before passing under the railway, and cutting through the south of the town, alongside Millers Lane to discharge to the South Beach. The Brook River is in open channel between the railway and the coast, although it does pass under a number of roads, the largest of which is Holmpatrick.

The Skerries catchment consists of the old town centre, which is located along the coast around North Beach and South Beach. This area consisting of Strand Street, South Strand, Balbriggan Street and The Hoar Rock, was originally served by a mostly combined sewerage system. Storm water separation appears to have been carried out to by the provision of highway drains to collect a portion of the stormwater runoff from these areas. Large arched storm water culverts have been constructed in the old town centre and one is known to pass along Church Street to discharge on the North Beach. Much of the old town centre is relatively low lying and historically suffered from extensive flooding, especially during high storm tidal surges.

Flooding has also been reported in the following locations:

- South Strand Area (Foul and Storm Flooding)
- Millers Lane (Foul and Storm Flooding)
- Balbriggan Street (Storm Flooding)
- Strand Street (Foul or Storm Flooding)

Figure 9.4.9 shows the extent of the Skerries storm level 3 catchment.
9.4.9.1 Hydraulic Performance and Future Needs

The Ballyboghill 2 - Skerries catchment is classified as a Storm Type 3 catchment for the GDSDS, meaning the model construction of urban catchment drainage model incorporating pipe network details and urban area contribution, without validation.

Performance and needs are not included in the scope of the GDSDS.

9.4.10 Ward Kilbride Stormwater S3010

Kilbride is a small village in County Meath, approximately 14 km northwest of Dublin, close to the N2 roadway. The existing population is approximately 100. The catchment includes three roads, several residential properties and a school. The River Ward runs through the village and collects surface water runoff from roads and water from land drainage. A system of ditches also receives surface water runoff from the village. The draft Meath County Development Plan recently proposed that Kilbride be the site of a new town, with a future population of 5,000 people. However, later consultations between the Department of Environment and Meath County Council led to a change in this designation and in the final plan no significant development is proposed.

Discussions with Meath County Council have confirmed that the road drainage in Kilbride was designed on site and no records of the system are available. The most recent known changes to the network are new road drains installed in the main road through Kilbride in 2001.

There are no known discharges from the foul/combined system into the storm sewers and no reported hydraulic deficiencies in the Ward Kilbride catchment. The catchment is currently very small and the separate surface water drainage discharges either to open ditches or the River Ward.

The Ward Kilbride catchment is classified as a Storm Type 3 catchment for the GDSDS. It would normally require digitisation of sewer records and construction of a model. However, Meath County Council did not have record drawings of the storm sewer system and a full asset survey would have been required before model construction could commence. The GDSDS does not include new blanket sewer surveys for catchments where no asset records are currently held. On this basis, no modelling work was carried out for the Kilbride catchment under this study.

Figure 9.4.10 shows the extent of the Kilbridge storm level 3 catchments.

9.4.10.1 Hydraulic Performance and Future Needs

Only the Phase 1 report was required for this catchment, and therefore performance and needs are not included in the scope of the GDSDS.
10. CRITERIA, STANDARDS AND INFLUENCES ON STRATEGY

10.1 Introduction

This chapter examines the criteria, standards and influences on the development of the GDSDS strategy, including performance standards for continuous and intermittent discharges to the various categories of receiving waters and for the sewerage system itself. These standards are based on current understanding of receiving water quality conditions and discharge criteria. Because there is limited water quality modelling available, standards for discharges are interim minimum standards.

The regional policies relating to environmental management provide a framework of policies for foul and storm water drainage consistent with the Water Framework Directive, the Urban Wastewater Treatment Directive and other relevant Directives and Regulations currently in force. Following on from the strategy, further more detailed modelling would be required including local water quality modelling studies in order to define the appropriate standards suitable for local conditions. The overall objective is for high environmental standards consistent with achievement of “good” water quality, without entailing excessive cost (BATNEEC).

The Greater Dublin Strategic Drainage Study (GDSDS) has developed methodologies to evaluate capacities and operating conditions in the existing drainage infrastructure of the Region. These studies indicate that existing systems are at, or approaching, capacity and in some cases are not achieving required service levels. Given the scope for potential development going forward, it will be necessary to implement a development strategy based on:

- Application of Best Practice policies and operational procedures in the development and management of environmentally sustainable drainage systems;
- Support of planning policies and objectives in the Region, notably the Strategic Planning Guidelines since adopted as the Regional Planning Guidelines;
- Optimisation and upgrading (where practicable) of existing infrastructure in order to maximise its capacity potential and performance, including rectification of existing deficiencies and supporting Regional Planning Policies to maximise development potential in existing catchments;
- Development of new infrastructure to cater for future loads over and above those which can be reasonably catered for by the existing systems;
- General upgrading and rehabilitation of existing systems where they fail to satisfy current performance standards.

10.2 Continuous Discharges to Receiving Waters

Continuous discharges to receiving waters arise from wastewater treatment plants. Effluent standards for these discharges will be derived from detailed study of the receiving waters in the context of all relevant statutory requirements including:

- Water Framework Directive requiring the objective of “good” water quality status.
- Urban Wastewater Treatment Directive.
- Bathing Water Regulations.
- Shellfish Water Regulations.
- Dangerous Substances Regulations.
- Phosphorus Regulations.

For rivers, standards are determined from consideration of available dilutions (normally calculated on 95 percentile flows) and background parametric values for key parameters such as BOD, suspended solids, ammonia, and phosphate and nitrate levels. For coastal and transitional waters, diffusion and dispersion patterns are more complex, requiring mathematical models to determine the impact of effluent discharges on the individual parametric values. Of particular importance in coastal waters are...
bacterial concentrations where bathing or general recreational use criteria apply. Where coastal or transitional waters are classified as sensitive, limitations on phosphate and nitrate levels will apply, in addition to the general standards in the Urban Wastewater Treatment Directive.

For new wastewater treatment plants or where existing plants are to be upgraded, it is anticipated that an Environmental Impact Statement (EIS) would be required. This will invariably require the development of appropriate water quality models by means of which these criteria can be assessed.

The Urban Wastewater Treatment Directive defines the monitoring regime and compliance standards for treatment plants. In order to manage effluent standards within the required limits, the following general recommendations apply:

- Continuous flow monitoring is required on all effluent discharges to receiving waters. This flow monitoring should be linked by telemetry to a central control where the results can be analysed and reported.

- Facilities for composite sampling of all treated effluents should be provided in conjunction with flow monitoring facilities whereby comprehensive proportional sampling is facilitated.

It may be appropriate to increase the frequency of monitoring, over and above the minimum criteria of the Directive, in order to adequately monitor effluent loads and the performance of the treatment facilities.

10.3 Continuous Discharges to Sewers

Continuous discharges from industrial and commercial premises to sewers are subject to licence. For certain categories of industry, Integrated Pollution Control (IPC) Licences are required from the Environmental Protection Agency (EPA). In all other cases, the Local Authority is responsible for licensing effluents both to sewers and to receiving waters.

Since the commissioning of the Ringsend Wastewater Treatment Works commenced in 2003, it has become evident that up to 50% of the total organic load to the plant is from non-domestic sources, as shown in the 2002 column in Table 10.1. This level of non-domestic load has brought the total load on the plant (1.9m PE) above the current design capacity (1.64mPE). This situation means that valuable treatment capacity, required for future domestic and related development, is being allocated to the treatment of excess loads from existing non-domestic sources.

The fact that the existing PE load to Ringsend WwTW exceeds the design load means that discharge of sewage from ongoing current and future development will exceed plant capacity further. The options to address this situation are to extend the treatment capacity of the Works, or to reduce the load to the Works or a combination of both.

10.3.1 Load Management for Ringsend WwTW

To evaluate the impact of load management on the Ringsend WwTW catchment, three load scenarios have been considered, as shown in Table 10.1. The scenarios are:

- Scenario 1 Minimal Load Management: This scenario is based on maintaining existing non-domestic loads at 2002 levels, allowing for residential growth related to Regional Planning Guidelines, and for regulation of future non-domestic discharges to domestic strength.

- Scenario 2 Optimistic Load Management: This scenario is based on reducing 2002 non-domestic loads by 50%, and allowing for residential growth related to regional planning guidelines, and for regulation of future non-domestic discharges to domestic strength. This would require rigorous application of regulating and economic instruments to minimise loads to treatment from the non-domestic sector.

- Scenario 3 Realistic Load Management: This scenario is based on reducing 2002 non-domestic loads by 25%, and allowing for residential growth related to regional planning guidelines, and for regulation of future non-domestic discharges to domestic strength.
The following measures are recommended as essential components of an integrated management approach to non-domestic discharges to sewers:

- **Existing licences should be reviewed in respect of both flow and other load parameters.** This review should have regard to an integrated approach to licensing on a regional basis. A systematic survey of non-domestic loads is recommended including flow and concentration measurements to quantify all significant loads (> 1,000PE) to the system.

- **All licences should provide for continuous flow monitoring and for the monitoring of relevant load parameters (wherever considered practical and appropriate).** Consideration should be given to connecting flow monitoring of the larger discharges (being those exceeding 1000 PE) to the telemetry system.

- **In setting licence parameters, good practice load management at source should be a minimum requirement before discharge, encouraging recovery to the maximum extent possible at source.** This approach is consistent with the “Proximity Principle” and will contribute significantly to load reduction.

- **For new industrial discharges, this approach to waste minimisation should be combined with the requirement for flow balancing and, as a minimum, partial treatment to a standard appropriate to protect the sewerage infrastructure.** This standard is consistent with normal domestic sewage and maximum parametric levels are suggested along the following lines:
  - COD less than 600 mg/l.
  - BOD less than 200 mg/l.
  - Suspended solids less than 250 mg/l.
  - pH range to be 6-9.
  - Temperature to be less than 30°C.

- **All industrial and commercial outlets should be required to have appropriate grease traps to control discharge of oils, fats and grease to the sewer.** Bylaws are recommended to enforce this requirement in order to reduce the incidence of blocked drains and other operational problems in the system.

- **Bylaws are also recommended to ban waste macerators in apartment blocks and commercial outlets, which contribute to the pollution load discharge to sewers.**

This approach has been demonstrated to be successful in the Osberstown catchment in reducing the waste loads to treatment. That plant was experiencing severe shock loads, associated with a very large variation in industrial loads from day to day. In turn, this was causing significant operational problems in the plant. To address this, Kildare County Council instituted systematic licence review and a rigorous monitoring regime. This has resulted in a substantial overall reduction in load and a much-reduced variability of load, with the result that the plant is now operating well within its design capability. Treatment and disposal charges at full economic cost (for example, based on the Mogden Formula) are seen as key drivers in maintaining load reduction levels.

The option to “do nothing” in relation to current non-domestic load is not sustainable. However even the load reduction target of 25% for current non-domestic load (Realistic Load Management Scenario in Table 10.1) will prove difficult to deliver. It is estimated that some 600,000PE of the current non-domestic load to the Ringsend WwTW is attributable to identifiable non-domestic sources. The remaining non-domestic load of some 341,000PE can be attributed to long-distance commuters, tourism and non-licensed sources. Thus a reduction of 40% in the licensed non-domestic loads would be required to achieve an overall reduction in non-domestic load of 25%. Currently, these discharges are considered to be largely uncontrolled.

It will be appreciated that the planning, design, procurement and implementation of new regional wastewater treatment facilities is an extended process. Even an immediate expansion of the Ringsend WwTW would take some years to deliver through the planning and construction stages. While the future treatment strategies developed later in this report will be based on the Minimal Load Management Scenario, the only practical option to make capacity available for new development in the short term is to achieve a reduction in existing non-domestic loads through a systematic load
management programme. Given the cost of new wastewater treatment infrastructure, it is essential that a rigorous load management strategy be put in place, incorporating the recommendations listed above.

Should reductions in non-domestic loads not be achieved and given that increased loads cannot continue to be transferred to an already overloaded plant, development would have to be constrained or alternatively ad-hoc temporary treatment plants installed to meet the short-term needs of these developments. Neither of these options is considered desirable from both planning and environmental viewpoints.

In conclusion the current loading situation for the Ringsend WwTW dictates that load management should be undertaken in conjunction with the extension of its treatment capacity. This combined approach is essential to relieve overloading and to avoid short-term constraints on development. At the same time, it is considered prudent to plan for future treatment capacity assuming limited reduction of existing loads.

10.4 Intermittent Discharges

Performance criteria for the sewerage network require that street flooding should not occur in new sewers for storm events up to at least the one in 30 years return frequency. Furthermore, where risk of street flooding is predicted once in five years, this is a trigger for upgrading of the existing network. This can be achieved by providing new capacity or by removing storm flows from the system.

The strategy recommends that budgets be provided to facilitate disconnection of storm water discharges to foul and combined sewers where this is practical and for reduction in infiltration. However, this programme is expected to have only partial success in reducing capacity pressures on sewers. The detailed modelling studies, reported on in earlier chapters, demonstrate that foul and combined sewers are generally at capacity or will be at capacity when existing planned developments are connected. At the same time, foul sewer connections from new development must be allowed for in the system together with some element of storm water connection which is inevitable even with improved construction and taking in charge standards.

Environmental studies have demonstrated that Combined Sewer Overflows (CSOs) are contributing to pollution of receiving waters due to the frequency, volumes and characteristics of spills. Existing overflows permit spilling as soon as flows reach the overflow level, with no buffer storage to moderate either the spill frequency or the pollution load. As a result, the strategy must provide for upgrading of the sewer system to limit the polluting effect of these overflows. The Urban Wastewater Treatment Directive requires collecting systems to be provided to a standard based on best technical knowledge not entailing excessive costs. This must have regard to the volumes and characteristics of urban wastewater, the prevention of leaks and the limitation of pollution of receiving waters due to CSOs. In the absence of detailed water quality models of receiving waters and of the sewer networks, a number of criteria are adopted in the strategy in formulating a programme of works to upgrade CSOs. These are:

- CSOs are deemed unsatisfactory if they cause significant visual or aesthetic impact, adversely impact on the ecological status of receiving waters or significantly contribute to the failure of such waters to meet the requirements of Regulations and Water Quality Plans, or if they operate in dry weather.

- CSOs are required to contain foul flows up to a minimum threshold level in order to retain “first flush” flows following the onset of rainfall and to ensure maximum dilution of the contents by the receiving waters. As a minimum, spilling should not occur until a continuation flow equivalent to the UK “Formula A”, defined below, (typically 6-7 times DWF) standard is reached.

- CSO structures should be capable of containing debris to a screening standard of 6mm and to regulate the spill regime so that spilling does not commence below the threshold value.

- For discharges to fresh water rivers and streams, a further local assessment is required to determine if a higher standard of containment is necessary. This local assessment should commence with biological assessment of the watercourse biosystems to check for degradation associated with overflow outlets. Where this shows that a problem exists, a detailed Urban Pollution Management (UPM) study should then be carried out to establish the criteria for these local discharges having regard to local conditions.
For discharges to bathing beaches, spills should be limited to 2 to 3 spills in a bathing season.

For waters with extensive recreational use, spills should be limited to 7 spills per bathing season.

‘Formula A’ was derived by the UK Storm Overflow Committee (Report to the Technical Committee on Storm Overflows and the Disposal of Storm Sewage) and has been used traditionally in the UK as the design setting for CSOs. ‘Formula A’ is a measure of the nominal flow that is retained in the sewerage system at a CSO, prior to spill occurring. The value was derived to take into account dry weather flow (DWF) and the amount of storm flow to be retained in the sewer. ‘Formula A’ corresponds to the CSO setting at which the sewage to stormwater flow (dilution) is high enough to allow acceptable discharges to watercourses in suitable circumstances. The standard formula for the determination of ‘Formula A’ is:

\[
\text{Formula A} = DWF + 1.360P + 2E \text{ (m}^3/\text{day})
\]

Where:

\[
DWF = PG + I + E \text{ (m}^3/\text{day})
\]

\[
P = \text{Population (head)}
\]

\[
G = \text{Per capita daily contribution to sewer flow (m}^3/\text{hd/day)}
\]

\[
I = \text{Infiltration (m}^3/\text{day)}
\]

\[
E = \text{Trade effluent (m}^3/\text{day)}
\]

In some circumstances, it is necessary to permit overflows very infrequently from nominally separate foul sewers where there is significant storm water connection. Given limitations on downstream sewer and treatment capacity, such overflows, combined with storage as necessary, would restrict forward flows to the downstream system capacity, while limiting spills to a maximum of once in five years on average.

These operational standards should be kept under review in the context of better understanding of water quality conditions and pressures in the receiving waters and the results of detailed water quality modelling of river, transitional and coastal waters.

10.5 Overview of Current System Status

This section gives a brief overview of the current system status and establishes the drivers on which the strategy should be developed. The system status is summarised in Table 10.2 and the layout of the existing foul/combined sewers in the Ringsend catchment is shown on Figure 10.1.
<table>
<thead>
<tr>
<th>Element</th>
<th>Current Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wastewater Treatment</strong></td>
<td></td>
</tr>
<tr>
<td>Ringsend</td>
<td>Plant designed for 1.64 mPE exceeded with current loading of 1.75 to 1.9 mPE/day and with the non-domestic load element approaching 1.0m PE/day</td>
</tr>
<tr>
<td>Local Plants</td>
<td>Shanganagh, Osberstown, Leixlip and Fingal Coastal plants can meet medium-term needs with planned upgrading with some marginal at 2031</td>
</tr>
<tr>
<td><strong>Foul Networks</strong></td>
<td></td>
</tr>
<tr>
<td>GCTS</td>
<td>Foul Cell has capacity for original catchment only. Storm Cell has some spare capacity.</td>
</tr>
<tr>
<td>- 9B Branch</td>
<td>Capacity exceeded with current development due to excess storm inflows and planned level of development. Local flooding risk at present.</td>
</tr>
<tr>
<td>- 9C Branch</td>
<td>Capacity exceeded with current development due to storm inflows and increased catchment development (incl. Meath connections from Dunboyne / Clonee, Ashbourne and Ratoath).</td>
</tr>
<tr>
<td>Dodder Valley Sewer</td>
<td>Currently at capacity with local flooding risk – Needs relief measures to accommodate planned developments.</td>
</tr>
<tr>
<td>North Fringe Sewer/NDDS</td>
<td>Trunk sewers in place for foreseeable development in North Fringe area. Local CSO/flooding risk issues in NDDS catchment sewers.</td>
</tr>
<tr>
<td>City Centre &amp; Docklands</td>
<td>Capacity exceeded with excessive spill flows at CSOs causing Liffey pollution. Local flood risk areas. Infill development to be catered for, including high density Docklands redevelopment.</td>
</tr>
<tr>
<td>Rathmines &amp; Pembroke</td>
<td>Capacity of combined system exceeded with high-risk flood areas needing relief. New sewer outlets needed.</td>
</tr>
<tr>
<td>General Issues</td>
<td>Problems with CSOs and local flood risk, even on nominally separate sewers, with significant infiltration flows identified. Very limited capacity in existing systems for future development, especially to the west.</td>
</tr>
<tr>
<td><strong>Storm Systems</strong></td>
<td></td>
</tr>
<tr>
<td>Rivers and Streams</td>
<td>Local flood risk areas identified and potential risks from development, tidal risk and climate change.</td>
</tr>
<tr>
<td></td>
<td>Pollution levels elevated in urban watercourses, linked to stormwater drainage and CSO impacts.</td>
</tr>
<tr>
<td>Storm Sewers</td>
<td>Local flood risk areas identified, including potential back pounding from rivers and tidal waters during floods.</td>
</tr>
</tbody>
</table>
In formalising a future strategy, therefore, the following conclusions apply to the existing situation:

- The wastewater treatment facility at Ringsend, catering for the bulk of the catchment, is overloaded at present in terms of organic load (BOD) and needs immediate expansion. At the same time, the level of non-domestic organic load to the plant is unsustainable and has the potential to be reduced through monitoring, best practice minimisation and basic local treatment at source. Therefore, a load management strategy, as discussed in detail in Chapter 10.3.1, must be applied to non-domestic discharges as a priority in order to achieve significant reduction in the organic loading on the plant from this sector, and provide head room for future committed development and time for expansion of the existing plant. Notwithstanding this approach, the Ringsend plant has limited ultimate design capacity, which must be conserved for existing planned development in the catchment as a priority.

- The centre city trunk sewers cater for combined flows and they overflow regularly to the River Liffey and to the Estuary. These overflows are well outside appropriate environmental standards and are unacceptable. Measures are needed to reduce loads on the sewers and to reduce spill occurrences to acceptable levels.

- The Grand Canal Trunk Sewer (GCTS) provides the core conveyance system serving the developing areas west of the city centre. The foul cell has some spare capacity, which will be fully utilised by existing or currently planned development in the catchment and by allowing for resolution of under-capacity problems in the existing systems. The storm cell of the tunnel has spare capacity, which can be used to relieve excess flows from the Rathmines and Pembroke catchment and potentially some additional flows from the western environs. The two principal branch sewers feeding the GCTS (foul) to the northwest serving Mulhuddart and Blanchardstown (9C) and to the southwest serving Clondalkin and Lucan (9B) are operating at flows in excess of their design capacity with local flooding risk for existing and planned development. Both sewers receive considerable stormwater inputs, which are the main factors causing overloading and risk of local flooding. However, reductions in such inflows will provide only marginal relief, and both 9B and 9C trunk sewers require extensive upgrading prior to 2011.

- The other principal catchment foul sewers are all generally close to capacity. Ad-hoc overflows have been provided to relieve flood risk, resulting in local pollution of receiving waters. In North Dublin, the newly constructed North Fringe/Northern Interceptor Sewer has substantial capacity for development going forward and has relieved, to some degree, overloading of the original North Dublin/NDDS trunk sewer. The new sewer will cater for substantial development in the northern environs of the city, including the airport zone.

- Existing storm systems discharge to rivers and streams throughout the catchment. Flood risk areas have been identified associated with extreme rainfall events, combined in low-lying areas with tidal interaction. The strategies identify areas at risk and requiring protection going forward. Water quality in rivers and streams deteriorates significantly in the urban areas due to pollutants from urban drainage run-off and CSO spill impacts.

- Therefore, the Strategic Drainage Plan is required to resolve existing problems and to cater for new development. This plan must support planning policies, as well as address current capacity and environmental deficiencies. Given the current situation, failure to implement such a plan in the short-term would result in:
  - inability to service new development areas already zoned;
  - inability to permit new development zoning;
  - failure of hydraulic and treatment performance in the WwTWs;
  - failure of effluent standards from the WwTWs;
  - more frequent and larger spills from CSOs;
  - increased pollution of watercourses and coastal waters;
  - failure of pumping stations to deal with incoming flows;
  - increased scale and frequency of flooding of streets and properties.
10.6 **Strategy Principles and Drivers**

The Drainage Strategy has been prepared in the context of the following principal considerations:

- The drainage strategy should provide a blueprint for the development of a sustainable drainage infrastructure capable of supporting the anticipated development of the Dublin Region up to 2031, consistent with the planning policies of the Region.

- Wastewater treatment should satisfy current standards for discharges to the receiving waters and have some flexibility for more rigorous standards in the future, wherever practicable.

- It is an assumption of the strategy that a co-ordinated “Best Practice” approach will be taken in the management and operation of drainage services including:
  - Systematic monitoring and good practice management of non-domestic effluent discharges, both to ensure satisfactory operational performance of treatment systems and to avoid unnecessary capital expenditure on new treatment capacity. In addition, environmental sustainability requires load minimisation at source as a priority ahead of “end of pipe” treatment and disposal.

- Effective implementation of new development policies to limit stormwater inflows to foul sewers. Reasonable allowances for some continuing incidental stormwater connection to foul sewers are made, however, in line with international norms.

- Best Practice stormwater management systems, including Sustainable Drainage Systems (SuDS) will be employed for stormwater drainage from new development in order to mitigate adverse hydrological and water quality impacts on rivers and streams.

- Where existing sewers have limited capacity, this would be consolidated for existing and committed developments, including alleviating capacity shortcomings in existing systems, such as overflows requiring upgrading.

- In the absence of specific standards for effluents and discharges generally, a good practice approach is adopted based on minimum internationally accepted norms and the principle of “no detriment”. Where specific Regulations dictate discharge standards, for example, Bathing Water standards, these have been applied according to current Regulations. In the absence of prescribed water quality standards for receiving waters, reasonable standards are taken, balancing environmental protection and cost. The strategy criteria and standards are contained in this Chapter.

Indicative standards to be used, wherever practical, are summarised in Table 10.3. Detailed receiving water modelling is recommended, particularly, for the Liffey Estuarine waters, to fine-tune standards locally.
<table>
<thead>
<tr>
<th>Discharge</th>
<th>Receiving Water</th>
<th>Standards &amp; Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ringsend WwTW</td>
<td>Liffey Transitional Waters and Dublin Bay Coastal Waters</td>
<td>Secondary Treatment (25:35) with Nitrate/E Coli Reduction</td>
</tr>
<tr>
<td>Coastal WwTW’s</td>
<td>Irish Sea</td>
<td>Secondary Treatment (25:35)</td>
</tr>
<tr>
<td>(Shanganagh, Portrane)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inland WwTW</td>
<td>River Liffey</td>
<td>Based on Dilution and BATNEEC Phosphorus Standard</td>
</tr>
<tr>
<td></td>
<td>Liffey Transitional Waters</td>
<td>Secondary Treatment (25:35) with Nitrate/Phosphate/E. Coli Reduction</td>
</tr>
<tr>
<td>Combined Sewer</td>
<td>Liffey Transitional Waters (Tidal Reach)</td>
<td>Retain UK “Formula A” Flows &amp; Screening Standard to 6mm</td>
</tr>
<tr>
<td>Overflows</td>
<td>Liffey, Tolka, Dodder Fresh Water</td>
<td>Minimum “Formula A” &amp; Local Assessment (Biological indicators, aesthetic criteria, followed by UPM Studies where necessary)</td>
</tr>
<tr>
<td>Relief Overflows on</td>
<td>Liffey / Tolka Transitional Waters (Tidal Reaches),</td>
<td>“Formula A” and Limit Spill Frequency (say 12/year target) subject to Local Assessment</td>
</tr>
<tr>
<td>nominally “Separate” Foul Sewers</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fresh Water Rivers</td>
<td>1 Spill in 5 Years</td>
</tr>
</tbody>
</table>

Table 10.3  Discharge Standards Assumed

In general, the capacities of wastewater treatment plants and downstream trunk sewers could be seriously compromised by excess flows from upstream systems where stormwater and infiltration flows to foul sewers are excessive. In such situations, the strategy seeks to constrain forward flows, requiring the provision of storage and other measures to preserve downstream capacity. If this approach were not accepted, for example, it would be necessary to duplicate elements of the Grand Canal Trunk Sewers, Main Lift Pumping Station and the hydraulic capacity and stormwater treatment components of the Ringsend Wastewater Treatment Plant, at extremely high cost and with major social impacts. Since severe storm conditions apply infrequently and for short durations only, the preferred strategy of upstream containment is the only economically sustainable approach. In any case, the valuable downstream capacity is required for the needs of the city, as a priority.

10.7 Overall Integrated Approach to Strategy

The overall strategy for the GDSDS is based on conveyance of flows and their treatment and discharge to receiving waters. To that end hydraulic models have been produced for the majority of the foul and stormwater systems, including a number of receiving rivers. The coastal and estuarine waters of the seaboard of the study area have also been modelled for water quality.

Frequently, the hydraulic models have been combined to replicate the interaction of flows between systems, for example, overflows from the foul system at CSOs. Based on these systems, an integrated strategy has been evolved taking account of the inter-dependence between systems and catchments. The effects of discharge flows and locations have also been modelled to assess the water quality impacts of the various strategies.

This integrated approach primarily relates to the foul system, which crosses catchment boundaries, with the bulk of foul flows passing through the Grand Canal Tunnel System (GCTS), and terminating at the Ringsend WwTW. Capacities of storm sections of the GCTS have also been modelled to ensure that proposed overflow and flow diversion arrangements are feasible hydraulically.
River and stormwater drainage systems, however, are generally self-contained in their catchments, and operate by gravity, with individual drainage systems discharging to an outfall to the watercourse or seashore. For that reason, there is little opportunity for a strategic regional approach to stormwater drainage solutions apart from adoption of uniform standards, policies and techniques. Stormwater issues, therefore, are generally dealt with on a catchment-by-catchment basis.

10.8 Wastewater Treatment Strategy

The strategy for Wastewater treatment relies firstly on optimisation of existing facilities. The position for each plant is summarised in Table 10.4, giving present and future estimated loads and potential plant capacities. The figures in Table 10.4 assume that existing non-domestic loads require to be accommodated, i.e. no reduction achieved.

<table>
<thead>
<tr>
<th>WwTW</th>
<th>Current Design PE</th>
<th>Ultimate Design PE</th>
<th>PE Load Existing</th>
<th>PE Load 2011</th>
<th>PE Load 2031</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ringsend</td>
<td>1,640,000</td>
<td>1,905,000 to 2,160,000</td>
<td>1,750,000 to 1,900,000</td>
<td>2,402,603</td>
<td>2,813,901</td>
<td>Extend to 2.16m PE a.s.a.p.</td>
</tr>
<tr>
<td>Shanganagh Bray</td>
<td>167,400</td>
<td>200,000 to 240,000</td>
<td>106,930</td>
<td>162,505</td>
<td>249,016</td>
<td>Phase 1 to 180,000 PE. Extend after 2011</td>
</tr>
<tr>
<td>Osberstown</td>
<td>80,000</td>
<td>130,000</td>
<td>57,533</td>
<td>98,152</td>
<td>154,088</td>
<td>Extend towards 2011</td>
</tr>
<tr>
<td>Leixlip</td>
<td>90,000</td>
<td>130,800</td>
<td>68,189</td>
<td>100,343</td>
<td>183,378</td>
<td>Extend after 2011</td>
</tr>
<tr>
<td>Portrane</td>
<td>35,000</td>
<td>65,000</td>
<td>14,531</td>
<td>30,249</td>
<td>45,650</td>
<td>Extend towards 2011</td>
</tr>
<tr>
<td>Malahide</td>
<td>20,000</td>
<td>25,000</td>
<td>16,089</td>
<td>16,669</td>
<td>23,236</td>
<td>Extend after 2011</td>
</tr>
<tr>
<td>Balbriggan &amp; Skerries</td>
<td>30,000</td>
<td>70,000 to 90,000</td>
<td>19,008</td>
<td>55,852</td>
<td>90,863</td>
<td>Extend towards 2011</td>
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<td>Swords</td>
<td>60,000</td>
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<td>34,254</td>
<td>75,241</td>
<td>109,567</td>
<td>Extend towards 2011</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>2,122,400</strong></td>
<td><strong>2,615,800 to 2,930,800</strong></td>
<td><strong>2,066,534 to 2,216,534</strong></td>
<td><strong>2,941,614</strong></td>
<td><strong>3,669,698</strong></td>
<td></td>
</tr>
</tbody>
</table>

Table 10.4 Loads on Existing WwTWs

By comparing existing and design PE in Table 10.4 it can be seen that overall existing PE load exceeds design treatment capacity by up to 94,134PE. Loads on the Ringsend WwTW exceed design capacity by up to 260,000PE (16% of existing capacity). This is offset by the other WwTWs, which are currently operating below design capacity.

At 2011 the situation for the Ringsend WwTW worsens, in that loads exceed even the ultimate treatment capacity of 2.16mPE by over 242,600PE (11% of ultimate capacity). This is offset by the other WwTWs, which are currently operating below design capacity.

At 2031 the situation for the Ringsend WwTW worsens further, with loads exceeding the ultimate design capacity of 2.16mPE by over 653,900PE (30% of ultimate capacity). Loads on other WwTWs would also exceed their ultimate design capacities. These include Osberstown (18% of ultimate capacity), Leixlip (40% of ultimate capacity) and Swords (22% of ultimate capacity).
In this context, the strategy foresees:

- **Ringsend**: the existing plant needs to be developed to its ultimate design capacity and should include for the upgrading of effluent standards as required to satisfy receiving water criteria set out in the Urban Wastewater Treatment Regulations 2001. Based on currently available and proven treatment technologies and the currently available land at Ringsend, this ultimate design capacity has been assessed as 2.16mPE. To meet the projected 2011 and 2031 loads from the Ringsend catchment of 2.40mPE and 2.81mPE respectively, would require the acquisition of additional lands on the Ringsend peninsula, or the adoption of treatment technologies yet to be developed on plants of this scale. Accordingly the ability of the Ringsend WwTW to meet future short term needs will depend critically on the management of organic loads being discharged to the plant, until such time as the plant is expanded and an alternative wastewater treatment facility or facilities are constructed.

- **Shanganagh/Bray**: upgrading of existing facilities at Shanganagh would provide capacity to cater for medium and reasonable long term needs for current standards of discharges to the Irish Sea. There is an approved EIS for a phased development of full treatment for 160,000 PE in Stage 1, extending to 200,000 PE in the future. This could readily be increased to 240,000 PE to satisfy the projected catchment needs for 2031.

- **Upper Liffey/Osberstown**: this plant currently has capacity for 80,000PE, with some spare capacity for new development in the short-term. The proposal to expand this facility to 130,000PE, for which an EIS has been approved, would be likely to satisfy future needs towards 2031 with continued rigorous load management. Based on current treatment technologies, this would appear to be the practical limit of the Liffey at this point. Future expansion of the plant above 130,000 PE at its current location would be dependent on the development of new treatment technologies affording improved phosphate reduction. The alternative is the construction of a new plant discharging to the River Barrow toward the 2031 design horizon.

- **Lower Liffey/Leixlip**: upgrading of this facility to 130,800PE will cater for medium-term needs. However, should the development meet the projections set out in this strategy, the capacity of the plant would be exceeded approaching 2031. Future expansion of the plant above 130,800 PE at its current location would be dependent on the development of new treatment technologies affording improved phosphate reduction. The alternative is to redirect some of the Osberstown catchment to Leixlip for ultimate transfer of additional flows to the new treatment facility proposed in this strategy.

- **Fingal County Plants**: the coastal plants of Swords, Portrane, Malahide, Skerries and Balbriggan and other smaller plants can accommodate local needs with upgrading as necessary. These plants are undergoing extension or can be extended to meet medium-term development needs. Should the loads at Swords/Malahide exceed the capacity of the plant and receiving environment of Broadmeadow Estuary, it would be possible to combine flows from these conurbations with Portrane in a new large capacity plant at Portrane. There is little practical constraint on the capacity of a coastal plant discharging to the Irish Sea, with appropriate treatment. Hence, development along the coastal corridor can be safely accommodated from a drainage point of view.

The key strategic issue regarding future treatment, therefore, relates to the limiting capacity of Ringsend WwTW and the need for new regional wastewater treatment facilities to meet additional development needs. Predicted loads to Ringsend, corresponding to various strategies for management of non-domestic loads, have been summarised in Table 10.1. The level of success in implementing non-domestic load management and achieving the targets will not impact on the ultimate strategy adopted. However, it would impact on the timeframe for the phasing of the planned infrastructure development. In the short/medium term, it should be regarded as a vital component of a sustainable drainage system.

Given the timeframe for planning and implementation of wastewater treatment facilities, it follows that the only option to cater for wastewater loads from the Ringsend catchment up to 2011 is at the Ringsend WwTW. Accordingly, the immediate strategy for wastewater treatment requires:

- **Expansion of the plant to its full ultimate capacity, which is nominally 2.16 million PE.**

- **Implementation of a systematic monitoring and management approach to non-domestic discharges, including review of license conditions and charging policy, which would be likely to produce a significant reduction in load levels. Should reductions in non-domestic loads not be**
achieved and given that increased loads cannot continue to be transferred to an already overloaded plant, development would have to be constrained or alternatively temporary treatment plants installed to meet the short-term needs of these developments.

- Control of future commercial and industrial discharges through monitoring and licensing regimes to ensure effluent standards which minimise both volume and organic load according to best practice management. To protect sewerage infrastructure, discharge strengths should not exceed the characteristics of domestic effluent.

- In the hydraulic design of the plant, provide for the maximum potential inflows from the City Centre, Grand Canal, North Dublin, Dodder Valley, Dun Laoghaire and local discharges to the Works. This will require review of hydraulic capacity of inlet works, stormwater storage and overflow arrangements at Ringsend WwTW. This approach complies with the planning policies of supporting development in the existing city area ahead of new suburban green field development.

Beyond 2011, even with these arrangements, it will be necessary to develop additional treatment facilities if the development needs of the western environs in Fingal and South Dublin counties are to be satisfied. The provision of local treatment with discharge to the River Liffey, Tolka or tributaries is unlikely to be feasible given the limited hydrological resources at low flows in these rivers, current water quality conditions and objectives and the current lack of available technologies especially in relation to the size of the plant and the phosphate reductions required. Any discharges to these receiving waters would require advanced treatment almost to river water quality standards.

Given the known constraints on the future expansion of Ringsend, there is limited potential, based on the results of the water quality modelling and hydraulic modelling carried out under the GDSDS and an assessment of site constraints, to develop new WwTW facilities in the region.

A regional WwTW at Portrane, providing secondary treatment and discharging to the Irish Sea, has the potential to treat a population equivalent of 850,000 or more, if required. This plant could be used to treat flows diverted from the existing North Dublin and Fingal catchments and to free up treatment capacity at Ringsend. The plant has the capability of treating flows from South Dublin, West Fingal, Meath and Kildare.

In addition to the known constraints on the expansion of the Ringsend plant, there is limited capacity in the Grand Canal, Lucan/Clondalkin 9B sewer and the Blanchardstown/Mulhuddart 9C sewer. There is a need to make provision for the resolution of the problems of excessive CSO spills and flood risks in the City Centre and Rathmines and Pembroke catchments and provide facilities to cater for the major new development planned for South Dublin beyond 2011.

The studies indicate that one practical approach could be for the limiting of flows from the 9B catchment to 2m³/s and for the development of a local wastewater treatment facility in South Dublin of 350,000PE from which treated effluent could be conveyed to the Grand Canal storm cell for discharge to the Liffey Estuary adjacent to Grand Canal Dock. The treatment standards applicable to this discharge would be determined having regard to modelling and water quality assessment of the receiving water. Water quality modelling using the Dublin Bay model (Reference Chapter 8.5) would indicate the need for higher than normal secondary treatment, most probably, incorporating UV treatment, along with nitrogen and phosphate removal. Such an option could offer interim facilities to meet South Dublin needs in advance of a Portrane outfall or as an alternative to non-domestic load reduction.

Further options would be to accelerate the Portrane option, to allow transfer of South Dublin flows and loads to a new regional plant located at Portrane, discharging to the Irish Sea, or to divert North Dublin and other flows to Portrane to free up capacity at Ringsend for future South Dublin development.

To summarise, the Wastewater Treatment Strategy for the Dublin Region is in the first instance to maximise the capacity of existing facilities. This requires immediate expansion of Ringsend WwTW to its maximum capacity while engaging on an active programme of load management of existing and new non-domestic effluent loads to buy time to allow for the planning and construction of both the expansion of Ringsend and new regional drainage and WwTW infrastructure. Thereafter, it would appear that development in South Dublin beyond that currently zoned would require provision of local treatment with a suitable outfall, or the transfer of flows and loads to a new regional facility, or alternatively diversion of flows from existing catchments away from Ringsend to free up capacity for
South Dublin. These options are further examined in the context of the future foul sewerage network infrastructure needs.

10.9 Foul Sewerage Strategy

It has been demonstrated in the modelling studies that the existing sewer system is overloaded by virtue of the extent of stormwater entering the system and being passed forward to pumping and treatment. While this condition is associated with relatively infrequent stormwater events, with limited durations, the consequences are unacceptable in terms of:-

- Flood risk to areas and properties
- Pollution impacts of overflows, many of them unplanned to relieve flooding of streets and properties
- Excessive flows for pumping and treatment involving significant additional costs, potential flooding risk at the downstream end of the system and ultimately overflows at the treatment plant.

Apart from limited elements of the existing system that can accommodate further development, it follows that continued connection of new development to the existing sewers, without upgrading the WwTW or moderating stormwater inflows, will further exacerbate current problems. Apart from flood risk to people and property, the Local Authorities in the Region have legal responsibilities with regard to the collection system in terms of:-

- The requirement to provide collection systems in accordance with the Urban Wastewater Treatment Directive and Regulations (best technical knowledge not entailing excessive costs).
- The obligation to protect the water environment under the Water Framework Directive and other Water Quality Directives.

Subject to adequate dilution and having regard to water quality designations of receiving waters, a minimum standard adopted for overflows to receiving waters requires that the foul system should retain flows up to “Formula A” values, before spills to receiving waters are permitted. This is intended to ensure minimum levels of dilution before discharge. These standards have been outlined in more detail in Chapter 10.4.

For combined systems, the objective, therefore, is to retain “Formula A” flows as a minimum. For sensitive waters, a higher level of containment may be required, for example at designated bathing waters, where specific spill frequency criteria are assessed in the Bathing Water Regulations.

In some circumstances, it is not practicable to pass forward Formula A flows due to downstream system capacity limitations. In addition, treatment plants are generally designed for maximum flows below Formula A levels (typically 3 times dry weather flow). In these situations, models can be used to estimate appropriate storage volumes to achieve the Formula A equivalent criterion (i.e. spilling does not commence until Formula A inflow rates are reached). This should prevent “first flush” spills when pollution concentrations are highest. Storage volumes have been calculated in this study at a strategic level in terms of volumes required. These storage volumes can be satisfied by combinations of storage at various locations and in different arrangements such as tanks, shafts and oversize pipelines. Storage would be located on both public and private lands.

In the newer developments in Dublin, the sewers were designed as separate foul sewers, whose capacity is less than Formula A. Due to expedient stormwater connections, many of these sewers can experience flows in excess of their design capacity during severe rainfall. Because of stormwater connections, it may not be possible to retain all flows in the system for storm events. Relief overflows may be required provided they can be accommodated satisfactorily from an environmental viewpoint. This will require overflows designed for very low spill frequency (once in five years on average) with storage as necessary to achieve this.

Therefore, the strategy adopted is based on a practical approach combining storage with achievable sewer capacity to meet performance standards as summarised above in Table 10.3, and is generally:
• Prioritise downstream areas of the catchment where existing sewers (generally combined) would be provided with “Formula A” capacity, with overflows for excess flows above this level to the Liffey transitional (tidal) waters.

• In upstream catchments, where provision of Formula A capacity is not feasible, limit foul flows combined with storage to achieve a Formula A standard as a minimum. Where this would involve overflows to freshwater rivers and streams, a restricted standard is applied to overflows from foul sewers. Wherever practicable, this standard has been set to limit overflows to once in five years. This will require the provision of storage in tanks, tank sewers or other structures.

• In the Rathmines and Pembroke catchment, CSOs are required to limit foul flows to the Grand Canal Tunnel foul cell from the existing combined sewer system. By discharging excess flows to the storm cell which outfalls to the Liffey transitional waters, a Formula A approach is considered acceptable.

• Elsewhere, for combined sewers discharging to the Rivers Liffey, Dodder or Tolka, consideration may have to be given to limitations on spill rates or frequencies (above Formula A). The basis for setting spill standards will require survey of biological indicators to evaluate impact on quality status, followed by detailed UPM studies, where necessary. Local conditions and impacts need to be assessed for overflows to these receiving waters. A Formula ‘A’ approach is taken as a minimum.

This approach to the strategy allows the capacity of the existing systems, principally the Grand Canal system, the Main Lift Pumping Station and the Ringsend Wastewater Treatment Works to be consolidated for existing development within acceptable and reasonable service standards. The requirements for new sewers and upgrading of existing foul sewers have been determined on this basis.

10.10 Storm Drainage Strategy

As previously explained, hydraulic modelling of the stormwater systems was developed on a catchment basis. Most catchments are hydraulically independent, with gravity pipe drainage systems discharging to the local river/stream network. Stormwater pumping will only arise where back-pounding from rivers/streams in flood would inundate developed areas, for example, in the Lower Tolka or areas at risk of tidal flooding.

Stormwater drainage and flood risk management, therefore, have to be considered on a catchment-by-catchment basis. In developing a programme of Works, therefore, the following principles apply:-

• Where rivers have been modelled, these identify areas at risk for which indicative measures can be identified to alleviate them. These typically comprise flood defence structures with flapped sewer outlets, for example.

• Where storm drainage networks have been modelled, identifying flood risk locations, local solutions are anticipated, the details of which will be developed at a later stage in detailed design.

• For new developments post-2011, it has been assumed that the systematic application of Sustainable Drainage Systems (SuDS) will result in no increase in stormwater run-off rates and hence no additional flood risk.

• A 10% increase in rainfall intensity and a 150mm sea level rise have been assumed in the future modelling to allow for climate change impacts by 2031. Similar factors were applied to combined catchments.

10.11 Conveyance Strategy

The preceding sections have discussed the overall principles for treatment, foul/combined sewerage and stormwater. However the GDSDS strategy also depends heavily on how the flows will be directed through the conveyance systems. As with wastewater treatment, the conveyance strategy relies firstly on optimisation of existing facilities.
The predominant existing conveyance system is the Grand Canal Tunnel Sewer (GCTS) comprising foul and storm cells within a common tunnel, discharging flows to the Main Lift Pumping Station and thence to the Ringsend WwTW. A typical section through the tunnel, showing foul and storm cells is shown in Figure 10.2.

This system was constructed in the 1970’s at great expense and disruption, and would present even greater challenges today for duplication, bearing in mind growth and congestion in Dublin, and the difficulty in identifying another route. The GCTS presents an unequalled opportunity for conveyance through the city, and its use must be maximised.

![Figure 10.2 Cross-section Through the Grand Canal Tunnel Sewer](image)

Figure 10.2 Cross-section Through the Grand Canal Tunnel Sewer

Currently both cells have spare capacity, and therefore the GDSDS conveyance strategy has endeavoured to maximise their usage. The GDSDS has investigated maintaining existing foul/storm divisions, swapping over the usage of the cells, and even laying additional pipes within the tunnel.

10.12 Conclusions

The conclusions of this Chapter are that having adopted appropriate performance standards for the Dublin drainage infrastructure, the existing systems are fully committed to service existing and zoned development, even with upgrading. In particular, the need to provide for the development and environmental needs of the existing city catchments requires management of loads to Ringsend. New wastewater treatment facilities and connecting sewers are needed to serve the region in the longer term. However new development in South Dublin will need such facilities in the medium term.
11. STRATEGY SCENARIOS AND RESULTING OPTIONS

In considering the criteria, standards and influences outlined in Chapter 10, in developing an integrated drainage strategy for the GDSDS study area, three broad approaches have emerged.

**Strategy Approach 1**: Maximise conveyance of all flows and loads to Ringsend WwTW, on the assumption that treatment capacity will be provided. At 2011 the treatment capacity would need to be approximately 2.40mPE, and at 2031 would need to be approximately 2.80mPE (taking the minimal load management approach), as indicated in Table 4.3;

Or

**Strategy Approach 2**: Recognise the constraints on the maximum achievable treatment capacity of the Ringsend WwTW and limit flows and loads to the treatment works by the provision of upstream treatment, with priority being given to the needs of existing catchments (City Centre, High Level R&P, etc).

Or

**Strategy Approach 3**: Maximise conveyance of flows and loads from the western development environs to Ringsend, but overcome the capacity constraints at the Ringsend WwTW by transferring existing flows and loads from Ringsend to a new treatment facility.

Within each approach there are a number of possible scenarios and sub-scenarios, which could realise the objectives of each strategy. The most probable of these scenarios are developed herein and discussed in terms of technical, social, economic and environmental merits and impacts.

The development of scenarios within each of the above strategy approaches addresses the criteria, standards and influences discussed in Chapter 10, in the context of the principal trunk sewers systems shown in Figure 11.1. These are overviewed as follows:

- **Grand Canal Trunk Sewer (GCTS)**: recognising this system as the ‘key’ strategic sewer in the existing network, and attempting to optimise the use of both foul and storm cells (of approximate hydraulic capacity 9m³/s and 22m³/s respectively). The scenarios utilise the GCTS principal branch sewers while acknowledging the limiting hydraulic capacities of the downstream facilities, being the Contract 14 tunnel, the Main Lift Pumping Station (MLPS) and the siphons to the inlet works of the Ringsend WwTW.

  - **Route 9B Sewer**: serving the Lucan and Clondalkin catchment and the villages of Newcastle, Rathcoole and Saggart on the western and south-western edges of the city, and outfalling to the GCTS. The 9B sewer catchment has significant potential for future development and sewerage infrastructure must be provided for sustainable growth, while recognising that existing downstream capacity must be maintained for the discharge requirements of the City Centre and Rathmines & Pembroke catchments.

  - **Route 9C Sewer**: serving the Blanchardstown/Mulhuddart catchment in Fingal and the villages of Ashbourne, Ratoath, Dunboyne and Kilbride in County Meath, and outfalling to the GCTS. This area also has significant potential for future development. However pass forward flows to the GCTS are hydraulically constrained by the limiting capacity (2.72m³/s) of the twin siphons under the River Liffey, and therefore flooding and CSO issues associated with this sewer will be addressed locally within the catchment.

- **City Centre Sewers**: involving consideration of the principal interceptor sewers in the North and South Quays, with particular reference to CSO spill regimes and their impact on the River Liffey.

- **Docklands Area**: This area is undergoing major development and the catchment to the North and South of the Liffey Estuary is the subject of a separate DAP study, outside of the GDSDS. The DAP is being carried out with a view to upgrading the foul/combined drainage systems and alleviating the pollution impact of many of the CSOs in the area on the Liffey Estuary. New pumping and storage arrangements in the Docklands area are being proposed as part of the DAP. Draft proposals from the DAP have been reviewed under the GDSDS. Although some of the
principles and details have been adopted in the GDSDS, it has been necessary to develop some of them further, to assist in overcoming problems further west. It is recommended that the improvements in the Docklands area be designed on the basis of the Formula A standard, with the remaining overflows discharging to the transitional waters of the Liffey Estuary

- **Rathmines and Pembroke (Lower Level):** where separate studies have been carried out to address CSO issues and associated water quality problems at Sandymount and Merrion Strands. These studies have proposed a number of local rehabilitation schemes, including storage tanks to reduce CSO spills to meet Formula A standard. These schemes are included in the GCTS model and no further options are considered.

- **Rathmines and Pembroke (High-Level);** has also been the subject of a separate DAP study which has considered a number of options to relieve significant flooding risk in this combined sewer catchment. One option involves upgrading the local sewerage system and constructing a new interceptor tunnel direct to the MLPS, where large-scale storage would be required to manage flows. Given the cost and practical difficulty of this option, a second DAP option has been investigated involving upgrading of local sewers with a number of interceptor sewers, which would transfer flows to the GCTS. Foul flows would be accommodated in the foul cell to Formula A standard with flows above that overflowing to the storm cell and, hence, to the Liffey Estuary. Since this option offers significant savings compared with the first option (€40million compared to €58million), these arrangements have been incorporated in the GCTS model.

- **Dodder Valley Sewer;** connected to Ringsend via twin siphons. Flooding and CSO issues associated with this major sewer are addressed locally within the catchment. This will involve upgrading of CSO arrangements with storage and some new branch sewers to cater for limited future development.

- **Dun Laoghaire Catchment;** the existing pumping station / storage tank and pumping main to Ringsend will cater for the future requirements of the Dun Laoghaire catchment with local improvements to the catchment network, as necessary.

- **North Dublin Catchment:** The North Dublin / North Fringe Catchments will be pumped from Sutton Pumping Station to Ringsend in the medium term. Local CSO issues affecting water quality of streams, the Tolka Estuary and the Bull Island Lagoons require to be addressed through local upgrading works. The option of diverting some or all of this catchment away from Ringsend to a new Fingal County Plant in the long-term is considered, to limit the organic loading at Ringsend WwTW.

For outlying catchments with local treatment facilities, local solutions are likely to be satisfactory for the medium-term and to varying degrees for the long-term. The broad strategy approaches noted above promote optimisation and the development of the drainage networks and treatment facilities in these catchments, as summarised in this report. The overall programme of works will incorporate the upgrading requirements at Shanganagh/Bray, Osberstown (Upper Liffey), Leixlip (Lower Liffey) and the Fingal coastal schemes (Malahide, Swords, Portrane, Skerries and Balbriggan).

11.1 **Strategy Approach 1 - Maximise Flows and Loads to Ringsend**

This strategy approach is based on retaining Ringsend as the terminus for all flows from an extended Ringsend catchment including all future development in South Dublin, West Fingal, and East Meath and ultimately even embracing North Kildare (Leixlip catchment). In such a strategy, there would be no constraint on flows and loads to Ringsend. Ringsend would therefore need to treat up to 2.40mPE by 2011, and 2.80mPE by 2031.

Two scenarios exist to realise this strategy approach:

- **Scenario 1A – Swap GCTS Storm & Foul Cells:** whereby the foul and storm cells would be swapped over, converting the larger storm cell for foul flows, thus allowing significant additional foul flows to be discharged to the GCTS, with the smaller cell converted to receive the storm flows;

- **Scenario 1B – New Liffey Interceptor Sewer (Lucan to Ringsend):** whereby a major new interceptor sewer would be constructed along the River Liffey Valley, largely in tunnel to convey flows to Ringsend, in parallel with the GCTS.
11.1.1 Scenario 1A – Swap GCTS Storm & Foul Cells (Figure 11.2)

In this scenario, the spare capacity of the storm cell of the GCTS would be utilised for foul flows, with the smaller existing foul cell converted to stormwater drainage use. This would permit significant volumes of foul and combined sewage to be discharged from the 9B and 9C catchments, accommodate substantial diversion of flows from the City Centre catchment (diversion at Heuston Station) and would facilitate connection of the combined flows from the Rathmines and Pembroke high level catchment. However, the cumulative flows from all these areas would exceed the downstream capacity of the connecting sewer to the MLPS (Contract 14 tunnel) and would have significant implications for the pumping station itself and for the hydraulic capacity of the Ringsend WwTW. This approach would also remove the flexibility given by the existing storm cell to accommodate new stormwater connections or hydrological or environmental conditions arising in the future.

The principal works required for this scenario are summarised in Table 11.1, and shown in Figure 11.2.
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<thead>
<tr>
<th>Area</th>
<th>2011 Requirements</th>
<th>2031 Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ringsend WwTW</td>
<td>• Upgrade capacity to 2.40m PE immediately to allow for 2011 minimal load management scenario in Table 10.1</td>
<td>• Upgrade capacity from 2.40m PE to 2.80m PE to allow for minimal load management scenario in Table 10.1, with additional 10,000m³ storage</td>
</tr>
<tr>
<td>Grand Canal Tunnel</td>
<td>• Swap storm and foul cells with manhole alterations and new connections</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• New CSO at Manhole 1 (Grand Canal Street/Estate Cottages) and spill over Formula A to the Liffey Estuary through the Grand Canal Dock Bypass Culvert</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Duplicate Contract 14 sewer with new 2.55m diameter tunnel, 1.85km long</td>
<td></td>
</tr>
<tr>
<td>Main Lift PS</td>
<td>• Operate up to 6 duty pumps 18.6m³/s (Plus one standby) and upgrade hydraulic capacity to WwTW</td>
<td></td>
</tr>
<tr>
<td>Docklands</td>
<td>• Separate Docklands Pumping station (0.6m³/s) and 5,000m³ local storage</td>
<td>• Ongoing CSO upgrading along Liffey to limit overflow impacts</td>
</tr>
<tr>
<td>City Centre Sewers</td>
<td>• Intercept North &amp; South Quay culverts near Heuston Station and pump up to 2m³/s to GCTS at Davitt Road through 1.4km rising main</td>
<td>• Trunk sewer CSOs and interceptors</td>
</tr>
<tr>
<td></td>
<td>• Ongoing CSO upgrading along Liffey to limit overflow impacts</td>
<td></td>
</tr>
<tr>
<td>9B/9C Upgrading</td>
<td>• New CSO on 9B sewer at Ballymount to limit flows to Formula A (3.18 m³/s) and overflow pipeline to spill to the GCTS &quot;storm cell&quot;. Local 9B upgrading at Lucan and Clondalkin</td>
<td>• New 9B Catchment tunnel sewer 9km long to connect Lucan and Clondalkin flows to the GCTS foul cell</td>
</tr>
<tr>
<td></td>
<td>• Duplicate 9B sewer Ballymount to Davitt Road</td>
<td>• Additional 12,000m³ storage on the 9C system at Castleknock</td>
</tr>
<tr>
<td></td>
<td>• Duplicate 9B/9C connecting sewer at Dolphin Road (Davitt Road to Herberton Road)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Duplicate 9C sewers in Blanchardstown and Mulhuddart</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• New CSO and 11,000m³ storage on 9C sewer at Castleknock</td>
<td></td>
</tr>
<tr>
<td>Rathmines &amp; Pembroke</td>
<td>• 4 sewer diversions to “foul cell” of the GCTS</td>
<td></td>
</tr>
<tr>
<td>Kildare</td>
<td></td>
<td>• New pumping station to transfer approx 390l/s (75,000 PE) to 9B new tunnel sewer through 6.5 km rising main</td>
</tr>
</tbody>
</table>

*Table 11.1 Scenario 1A (Swap GCTS Storm & Foul Cells – Figure 11.2)*
For the 2011 development horizon, Scenario 1A envisages local upgrading of the Contract 9B /9C trunk sewers serving the western development catchments, including additional trunk sewers. In relation to the works generally, the following would apply:

- The Ringsend WwTW should be extended to provide 2.40m PE capacity to treat the foul flows.
- The flows from the 9B catchment serving the Lucan / Clondalkin area would be limited to 3.18m³/s, equivalent to Formula A flows at 2011 by constructing a new CSO at Ballymount. Excess flows would discharge subject to local assessment of the receiving water through a new overflow pipeline to the new storm cell of the GCTS. Additionally, the route 9B sewer through Lansdowne Valley Park would be duplicated, to transfer the increased foul flows to the GCTS.
- In the 9C catchment serving Blanchardstown / Mulhuddart and parts of County Meath, local upgrading of the trunk sewers is required to relieve overloading and to cater for new development. The forward flows are naturally constrained by the limits of the River Liffey siphons, which would operate satisfactorily with the addition of a new CSO and 11,000m³ storage.
- The trunk sewer along Dolphin Road connecting the 9B and 9C trunk sewers to the GCTS would require to be augmented between Davitt Road and Herberton Road.
- For the Grand Canal Trunk Sewer, the principal works would involve swapping the foul and storm cells with appropriate adjustment of manholes and connections.
- For the City Centre sewers, the current overflow regime along the north and south quays is unsatisfactory with frequent spills even for small storm events. This is largely due to the major extension of the City Centre catchment to the west (Navan Road to the north west and Ballyfermot to the south west) resulting in frequent overflows along the section of the River Liffey between Heuston station and the Docklands. Diverting the catchments upstream of Heuston station from the City Centre sewers to the GCTS would significantly relieve the downstream overloading of the interceptor sewers, permitting the overflow issue to be addressed by local upgrading of the CSO structures. This involves the construction of a new pumping station in the vicinity of Heuston station and the transfer of flows (up to 2m³/s) from the City Centre catchment to join the GCTS at Davitt Road.
- A new pumping station, which is proposed as part of the short-term solution for the Docklands Development, has a maximum pump rate of 0.6 m³/s and discharges directly to Ringsend WwTW. Future drainage of the Docklands must accommodate high-density development. The detailed drainage proposals to cater for this development are being developed in the Docklands DAP study.
- All flows from the Rathmines and Pembroke High Level system would be discharged to the new “foul cell” of the GCTS.
- The cumulative foul/combined flows in the GCTS would now exceed the capacity of the downstream section of sewer tunnel at Grand Canal Street (Contract 14) connecting to the MLPS. Scenario 1A envisages limiting pass forward flows at this point to Formula A (13.3m³/s). A new CSO would therefore be required at Manhole 1, near Estate Cottages, with flows in excess of Formula A spilling to the estuary via the Grand Canal Bypass Culvert. The Contract 14 sewer would also need to be duplicated by constructing a new 2.55m diameter tunnel, 1.85km in length. Spill volumes of up to 33,000 m³ at 2011 and 77,000 m³ at 2031 would arise for a 30-year storm event.
- The MLPS would require operation of all six pumps to give a maximum pumping rate of 18.6 m³/s. A similar standby pump would be required, thus raising total installed pumping capacity to 22m³/s. This compares with an existing maximum discharge from the MLPS of 16.5 m³/s for up to 5 pumps. The capacity of the siphons between the MLPS and Ringsend WwTW would need to be increased, as they are currently limited to the existing flows. It is recognised that there would be major practical difficulty in achieving this.
For the 2031 development horizon, the 2011 works need to be extended and augmented to provide conveyance and treatment capacity for the substantial additional flows from the developments to the west of Dublin. These works would involve:

- Ringsend WwTW would require further expansion to provide 2.80m PE treatment capacity, with additional 10,000m³ of storm tank volume for flow balancing

- Ongoing CSO upgrading on the City Centre Interceptor Sewers to limit overflow impacts to the Liffey Estuary.

- A new tunnel sewer, 9km in length would be required to transfer flows from developments in Lucan and Clondalkin to the Grand Canal foul cell.

- Storage at Castleknock would need to be increased from 11,000m³ to 23,000m³ to improve spill performance from the 9C system

- Towards 2031 the maximum treatment capacity of the Osberstown and Leixlip WwTW (130,800 PE) would be exceeded (Figure 8.4), and therefore some 75,000 PE (390l/s approximately) would need to be diverted to the GCTS foul cell, by means of pumping station and rising main of 6.5km length, and via the new 9B tunnel sewer.

### 11.1.2 Scenario 1B - New Liffey Valley Interceptor Sewer (Figure 11.3)

This scenario envisages the construction of a major new interceptor tunnel sewer along the River Liffey Valley from Lucan to Ringsend, to operate in parallel with the GCTS in conveying flows to the Ringsend WwTW.

- The new interceptor sewer would total 23km in length and vary from 2.1m to 3.1m in diameter. A new deep shaft pumping station would be required at the downstream end of the Liffey Valley Interceptor Sewer to lift flows into the Ringsend WwTW.

- The majority of sewage flows from the developing areas of the Lucan and Clondalkin catchments, and some flows from parts of the existing catchments, would be routed/diverted to the new Liffey Valley Interceptor Sewer. The existing 9B sewer would therefore contribute lower flows to the GCTS from the reduced catchment. However it would still be necessary to limit pass forward flows to 3.18m³/s (Formula A) in the short term (2011). The GCTS would remain unchanged in this scenario.

- Flows from the High Level Rathmines and Pembroke catchment would be connected to the GCTS foul cell with new CSO’s diverting flows in excess of Formula A (0.74m³/s) to the storm cell.

- City Centre flows would still require to be managed, by intercepting the catchments upstream of Heuston Station and connecting them to the new Liffey Valley Interceptor Sewer.

- Flows from the Leixlip and Osberstown catchments in excess of the maximum treatment capacity would also be diverted to the new Liffey Valley Interceptor Sewer.

- The Contract 14 tunnel sewer, the MLPS and inlet siphons to Ringsend WwTW would remain as existing in this scenario.

The principal works required for Scenario 1B are summarised in Table 11.2 and shown on Figure 11.3.
<table>
<thead>
<tr>
<th>Location</th>
<th>2011 Requirements</th>
<th>2031 Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ringsend WwTW</td>
<td>• Upgrade capacity to 2.40m PE immediately to allow for the minimal load management scenario in Table 10.1</td>
<td>• Upgrade capacity to 2.80m PE to allow for the minimal load management scenario in Table 10.1</td>
</tr>
<tr>
<td>Grand Canal Tunnel</td>
<td>• No change from existing</td>
<td>• No change from existing</td>
</tr>
<tr>
<td>Sewer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Main Lift Pumping</td>
<td>• No change from existing</td>
<td>• No change from existing</td>
</tr>
<tr>
<td>station</td>
<td></td>
<td></td>
</tr>
<tr>
<td>City Centre Sewers</td>
<td>• Intercept North &amp; South Quay culverts near Heuston Station and discharge 2m³/s to new Liffey Valley sewer</td>
<td>• Ongoing CSO upgrading along Liffey to limit overflow impacts</td>
</tr>
<tr>
<td></td>
<td>• Trunk sewer CSOs and interceptors</td>
<td></td>
</tr>
<tr>
<td>Docklands</td>
<td>• Separate Docklands Pumping station (0.6m³/s) and 5,000m³ local storage</td>
<td></td>
</tr>
<tr>
<td>9B/9C Upgrading</td>
<td>• New River Liffey trunk sewer constructed in tunnel, 6km length, diameter 3.1m from Islandbridge to receive flows from City Centre</td>
<td>• Extend River Liffey trunk sewer constructed in tunnel to 23km length, diameter 2.1m to 3.1m</td>
</tr>
<tr>
<td></td>
<td>• New deep shaft pumping station to raise flows to Ringsend WwTW</td>
<td>• New 9B catchment trunk sewers connecting development areas to the new River Liffey trunk sewer, total length 8km, diameter between 0.9m and 2.1m</td>
</tr>
<tr>
<td></td>
<td>• New CSO on 9B sewer at Ballymount to limit flows to Formula A (3.18 m³/s) and overflow pipeline to spill to the GCTS storm cell. Local 9B upgrading at Lucan and Clondalkin</td>
<td>• Additional 12,000m³ storage on the 9C system at Castleknock</td>
</tr>
<tr>
<td></td>
<td>• Duplicate 9B sewer Ballymount to Davitt Road</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Upsize 9B/9C connecting sewer at Dolphin Road (Davitt Road to Herberton Road)</td>
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<tr>
<td></td>
<td>• Duplicate 9C sewers in Blanchardstown and Mulhuddart</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• New CSO and 11,000m³ storage on 9C sewer at Castleknock</td>
<td></td>
</tr>
<tr>
<td>Rathmines &amp; Pembroke</td>
<td>• 4 sewer diversions to foul and storm cells of the GCTS</td>
<td>• New pumping station to transfer 75,000 PE flows (390l/s approx.) to new Liffey Valley Interceptor Sewer through 4km rising main</td>
</tr>
<tr>
<td>Kildare</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 11.2**  
*Scenario 1B (New Liffey Valley Interceptor Sewer – Figure 11.3)*
For the **2011 development horizon** the following would apply:

- The Ringsend WwTW would be extended to provide 2.40m PE capacity to treat the foul flows.
- As with Scenario 1A, flows from the 9B catchment serving the Lucan / Clondalkin area would be limited to 3.18m$^3$/s, equivalent to Formula A flows, by constructing a new CSO at Ballymount, with excess flows, subject to local assessment of receiving water quality, discharging to the storm cell of the GCTS. Additionally, the route 9B sewer through Lansdowne Valley Park would be duplicated.
- In the 9C catchment serving Blanchardstown / Mulhuddart and parts of County Meath, local upgrading of the trunk sewers is required to relieve overloading and to cater for new development. Pass forward flows are naturally constrained by the limits of the River Liffey siphons, which would operate satisfactorily with the addition of a new CSO and 11,000m$^3$ storage.
- The trunk sewer along Dolphin Road connecting the 9B and 9C trunk sewers to the GCTS would require to be augmented between Davitt Road and Herberton Road.
- The first stage of the Liffey Valley Interceptor would be constructed, comprising the deep pumping station, and the downstream 6km of sewer to collect city centre flows.
- As with Scenario 1A, diverting the catchments upstream of Heuston station from the City Centre sewers to the new Liffey ValleyInterceptor Sewer would significantly relieve the downstream overloading of the existing interceptor sewers, permitting poor overflow performance to be addressed by local upgrading of the CSO structures.
- A new pumping station, which is proposed as part of the short-term solution for the Docklands Development, has a maximum pump rate of 0.6 m$^3$/s and discharges directly to Ringsend WwTW. Future drainage of the Docklands must accommodate high-density development. The detailed drainage proposals to cater for this development are being developed in the Docklands DAP study.
- Four new CSO’s would be constructed on the GCTS where the connections from the high level R&P system join. The CSO’s would direct Formula A flows to the foul segment and storm flows to the storm segment.

For the **2031 development horizon**, the 2011 works need to be extended and augmented, which would involve:

- Ringsend WwTW would require further expansion to provide 2.80m PE treatment capacity.
- The second stage of the Liffey Valley Interceptor would be constructed, extending the first stage tunnel by 17km upstream of Islandbridge to transfer flows from developments in Lucan and Clondalkin.
- New trunk sewers would be required for the western developments to connect the Adamstown, Newcastle, Rathcoole and Saggart areas, as well as the Esker and Low Level Lucan pumping stations to the Liffey Valley Interceptor Sewer.
- Storage at Castleknock would need to be increased from 11,000m$^3$ to 23,000m$^3$ to improve spill performance from the 9C system.
- Towards 2031 the maximum treatment capacity of the Osberstown and Leixlip WwTW would be exceeded (Figure 8.4), and therefore some 75,000 PE would need to be diverted to the Liffey Valley Interceptor Sewer, by means of pumping station (390l/s approx.) at Leixlip and rising main of 4km length.
11.2 **GCTS Strategy Approach 2 - Limit flows and loads to Ringsend**

Strategy Approach 2 recognises the constraint on the maximum achievable treatment capacity at the Ringsend WwTW of 2.16M PE (Reference Chapter 8.7), and proposes to limit flows and loads to the Works accordingly, with priority being given to existing catchment needs, particularly the City Centre and High Level R&P catchments. This approach also recognises the practical constraints on the MLPS System (Contract 14 tunnel, pumps and siphons) and the difficulties in enlarging them. In limiting loads to the Ringsend WwTW, this strategy approach recognises that additional treatment capacity, in the approximate value of 850,000PE must be provided elsewhere in the area, either at a single location, or as a combination of two or more locations.

The strategy also endeavours to maximise the use of existing sewer infrastructure. However new sewers have also been considered, particularly where necessary to divert flows to the new treatment works.

Three scenarios, 2A, 2B and 2C, have been developed in investigating how this strategy approach could be realised.

The three scenarios control the loads on the Ringsend WwTW by limiting flows from the outer development catchments entering the central sewerage system, and by provision of additional treatment capacity in South Dublin (e.g. Grange Castle) and/or Fingal (e.g. Portrane).

The scenarios share similar scope for dealing with flows and loads to 2011, but deal differently with flows and loads to 2031, as the options for additional treatment capacity are explored.

### 11.2.1 Scenarios 2A, 2B and 2C – Limiting Flows from Outer Catchments

Scenarios 2A, 2B and 2C would include the following elements:

- The GCTS would remain as currently configured, with a foul cell of 8 to 9m$^3$/s capacity and a storm cell of approximately 22m$^3$/s capacity. It follows that foul flows received from the various contributing catchments would have to be accommodated within the available capacity of the GCTS foul segment, requiring restriction on the amount of flow passed through.

- Rathmines and Pembroke high-level catchment flows to the foul cell would be limited to Formula A, with flows in excess of this value overflowed to the storm cell of the GCTS, in turn discharging to the Liffey Estuary. Formula A flows at 2011 total 0.74 m$^3$/s, and at 2031 they total 0.73 m$^3$/s.

- For the City Centre sewers: the current overflow regime along the north and south quays is unsatisfactory with frequent spills even for small storm events. This is largely due to the major extension of the City Centre catchment to the west (Navan Road to the north west and Ballyfermot to the south west) resulting in frequent overflows along the section of the River Liffey between Heuston station and the Docklands. Diverting the catchments upstream of Heuston station from the City Centre sewers to the GCTS would significantly relieve the downstream overloading of the interceptor sewers, permitting the overflow issue to be addressed by local upgrading of the CSO structures. This involves the construction of a new pumping station in the vicinity of Heuston Station and the transfer of flows (up to 2m$^3$/s) from the City Centre catchment to join the GCTS at Davitt Road.

- Connection of the High Level R&P catchment and part of the City Centre catchment to the GCTS foul cell leave insufficient residual capacity to accept Formula A flows from the developing western catchments of Blanchardstown/Mulhuddart (9C system) and Lucan/Clondalkin (9B system). It is therefore necessary to restrict pass forward flows from both of these catchments.

- The maximum flow from the 9C Trunk Sewer (Blanchardstown-Mulhuddart) would be limited to the capacity of the River Liffey siphons of 2.72m$^3$/s for a 30-year storm. This compares with an upstream Formula A flow of 5.37m$^3$/s at 2011, and 7.7m$^3$/s at 2031. The balance would be managed by storage, with very low frequency overflows.

- The forward flow from the 9B sewer at Naas Road would have to be limited to a maximum of 2m$^3$/s, where Formula A for the 9B catchment (serving Lucan-Clondalkin) is calculated as 3.18m$^3$/s at 2011, and 7.5m$^3$/s at 2031. Therefore, this will require significant storage in order to manage
stormwater flows to achieve spills above Formula A, but subject to local assessment of impacts of spills on the receiving waters.

The combination of these measures would limit the flow discharged to the foul cell of the GCTS to 8.82 m³/s, which is within the capacity of the system. The downstream “Contract 14” sewer and MLPS would then be operating within their existing capacity during storm events.

**For the 2011 development horizon** of scenarios 2A, 2B and 2C, therefore, the following works are proposed:

- Upgrade the capacity of the Ringsend WwTW to 2.16mPE immediately, being the practical maximum capacity achievable on the site.

- Local upgrading of the 9B trunk sewers and pumping stations in Lucan and Clondalkin. A new CSO would be installed at Ballymount to limit pass forward flows to 2 m³/s with approximately 11,000 m³ of storage, with flows greater than Formula A spilling into the storm section of the Grand Canal tunnel. A new overflow pipeline would be constructed to transfer spill flows from the CSO to the storm cell of the GCTS.

- Sewers serving the 9C catchment of Blanchardstown and Mulhuddart would be duplicated. The existing River Liffey siphons would be retained with the addition of a new CSO and 11,000m³ storage at Castleknock.

- The trunk sewer along Dolphin Road connecting the 9B and 9C sewers to the GCTS would be augmented between Davitt Road and Herberton Road.

- New pumping station located at Heuston Station to divert flows of 2 m³/s from the City Centre catchment to help relieve downstream unsatisfactory CSO problems. Rising main to connect near to the head of the GCTS on Davitt Road.

- New CSO chambers would be required for each of the four connections to the GCTS from the R&P High Level catchment. CSO settings would ensure that Formula A flows pass to the foul cell and excess flows pass to the storm cell.

- A new pumping station, which is proposed as part of the short-term solution for the Docklands Development, has a maximum pump rate of 0.6 m³/s and discharges directly to Ringsend WwTW. Future drainage of the Docklands must accommodate high-density development. The detailed drainage proposals to cater for this development are being developed in the Docklands DAP study.

**For the 2031 development horizon**, the above works could not accommodate the scale of development that is envisaged, in South Dublin in particular. This assumes that the future population and housing needs of the region will be catered for as envisaged in the land use projections for 2031, and that a significant proportion of this development will be located to the south of the existing Lucan/Clondalkin catchments. It is envisaged that Formula A flows from the full ultimate development of this catchment could be up to 7.8 m³/s for which a pass-forward flow limit of 2 m³/s to the GCTS would not be adequate.

With the capacity of Ringsend WwTW limited to 2.16m PE, additional treatment capacity would be required shortly after the 2011 development horizon with treatment capacity increased in stages to meet the 2031 horizon. The exact timing of the additional treatment capacity coming on-stream would be dependent on the ultimate success of the load management strategy. These WwTWs could either be located close to the development in South Dublin and Fingal or alternatively transferred to a new regional facility at Portrane.

### 11.2.2 Scenario 2A - High Level Treatment and Liffey Discharge (Figure 11.4)

This scenario envisages a new Wastewater Treatment Works with state of the art technology to produce a high quality effluent suitable for discharge to the River Liffey upstream of Islandbridge. No particular site has been identified for this Works although lands at Ballyowen Park offer a possibility.

The principal works required for Scenario 2A are summarised in Table 11.3 and shown on Figure 11.4.
<table>
<thead>
<tr>
<th>Location</th>
<th>2011 Requirements</th>
<th>2031 Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ringsend WwTW</td>
<td>• Upgrade capacity to 2.16m PE immediately</td>
<td></td>
</tr>
<tr>
<td>City Centre Sewers</td>
<td>• Intercept North &amp; South Quay culverts near Heuston Station and pump up to 2m³/s to GCTS at Davitt Road</td>
<td>• Ongoing CSO upgrading along Liffey to limit overflow impacts</td>
</tr>
<tr>
<td></td>
<td>• Trunk sewer CSOs and interceptors</td>
<td></td>
</tr>
<tr>
<td>Grand Canal Tunnel Sewer</td>
<td>• No change from existing</td>
<td>• No change from existing</td>
</tr>
<tr>
<td>Main Lift PS</td>
<td>• No change from existing</td>
<td>• No change from existing</td>
</tr>
<tr>
<td>Docklands</td>
<td>Separate Docklands Pumping station (0.6m³/s) and 5,000m³ local storage</td>
<td></td>
</tr>
<tr>
<td>9B/9C Upgrading</td>
<td>• New CSO on 9B sewer and 11,000m³ storage at Ballymount to limit flows to 2.00 m³/s and overflow pipeline to spill to the GC storm cell. Local 9B upgrading at Lucan and Clondalkin</td>
<td>• New 350,000PE WwTW in 9B catchment with high level treatment for discharge to River Liffey, 14,000m³ of storage and 1.5m diameter outfall</td>
</tr>
<tr>
<td></td>
<td>• Upsize 9B/9C connecting sewer at Dolphin Road (Davitt Road to Herberton Road)</td>
<td>• Additional 12,000m³ storage on the 9C system at Castleknock</td>
</tr>
<tr>
<td></td>
<td>• Duplicate 9C sewers in Blanchardstown /Mulhuddart</td>
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<tr>
<td></td>
<td>• New CSO and 11,000m³ storage on 9C sewer at Castleknock</td>
<td></td>
</tr>
<tr>
<td>Rathmines &amp; Pembroke</td>
<td>• 4 sewer diversions to foul and storm cells of the GCTS</td>
<td></td>
</tr>
<tr>
<td>Fingal</td>
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<td>• Upgrade existing Portrane WwTW to 450,000PE</td>
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<td>• 8.5km length of new Orbital Sewer from Swords to Portrane WwTW</td>
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<tr>
<td></td>
<td></td>
<td>• Partial diversion of flows from Swords and Malahide catchments to orbital sewer to upgraded Portrane WwTW</td>
</tr>
<tr>
<td>NDDS</td>
<td></td>
<td>• New pumping station and rising main to divert North Fringe flows to Portrane via Orbital Sewer</td>
</tr>
<tr>
<td>Kildare</td>
<td></td>
<td>• New pumping station to transfer 75,000 PE flows (390l/s) to WwTW in the 9B catchment</td>
</tr>
</tbody>
</table>

Table 11.3 Scenario 2A (High Level Treatment and Liffey Discharge – Figure 11.4)
For the 2031 development horizon, new treatment facilities would be located in both West and north Dublin, together with conveyance systems, comprising:

- Construction of a new WwTW of 350,000PE at Ballyowen, discharging to the River Liffey, and therefore treating to a high level standard to meet strict discharge standards. Discharge to the River Liffey would use a 1.5m diameter outfall pipeline, 1.0km in length.

- Upgrading of the existing WwTW at Portrane from capacity of 35,000PE to 450,000PE to treat excess load from the Dublin area, in particular the North Fringe. The upgraded Portrane WwTW would also treat excess loads from the Swords and Malahide catchments, thus relieving overloading of their own WwTWs and pollution of the sensitive receiving waters of Broadmeadow Estuary.

- Construction of the Swords to Portrane segment of the Orbital Sewer to facilitate connection from the North Fringe, Swords and Malahide catchments to the new WwTW at Portrane.

- Towards 2031 the maximum treatment capacity of the Osberstown and Leixlip WwTWs would be exceeded (Figure 8.4), and therefore some 75,000 PE (390l/s) would need to be diverted to the new WwTW in the 9B catchment.

11.2.3 Scenario 2B – Medium Level Treatment and Discharge to Grand Canal Storm Cell (Figure 11.5)

This scenario envisages that flows from new developments would be treated at a new Wastewater Treatment Works to an appropriate standard for discharge to the River Liffey Estuary through the Grand Canal Storm Cell and the Grand Canal Dock bypass culvert. The treatment standards applicable would be determined having regard to detailed assessment of the receiving waters. Indicative water quality modelling carried out as part of this study suggest that a secondary treatment standard of 20mg/l BOD, 30mg/l SS, with phosphate and nitrate removal and UV disinfection to reduce bacterial concentrations to acceptable levels, would be an appropriate level of treatment on which to base this scenario.

A possible site for the new WwTW is identified at Grange Castle, centrally located in the catchment and zoned for industrial development purposes. The WwTW would need to be covered and equipped with odour control systems, to minimise environmental impact. Stormwater storage of 15,600 m³ is also envisaged at this treatment works. Treated effluents would be discharged to the storm cell of the GCTS through a new 1500 mm diameter sewer, approximately 9.6km long. The treatment works could also be located at any suitable site downstream along this 9.6km long sewer.

The principal works required for Scenario 2B are summarised in Table 11.4, and shown on Figure 11.5.
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<thead>
<tr>
<th></th>
<th>2011 Requirements</th>
<th>2031 Requirements</th>
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<td>Ringsend WwTW</td>
<td>• Upgrade capacity to 2.16m PE immediately</td>
<td></td>
</tr>
<tr>
<td>City Centre Sewers</td>
<td>• Intercept North &amp; South Quay culverts near Heuston Station and pump up to 2m³/s to GCTS at Davitt Road&lt;br&gt;• Trunk sewer CSOs and interceptors</td>
<td>• Ongoing CSO upgrading along Liffey to limit overflow impacts</td>
</tr>
<tr>
<td>Grand Canal Tunnel Sewer</td>
<td>• No change from existing</td>
<td>• No change from existing</td>
</tr>
<tr>
<td>Main Lift PS</td>
<td>• No change from existing</td>
<td>• No change from existing</td>
</tr>
<tr>
<td>Docklands</td>
<td>• Separate Docklands Pumping station (0.6m³/s) and 5,000m³ local storage</td>
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<tr>
<td>9B/9C Upgrading</td>
<td>• New CSO on 9B sewer and 11,000m³ storage at Ballymount to limit flows to 2.00 m³/s and overflow pipeline to spill to the GC storm cell. Local 9B upgrading at Lucan and Clondalkin&lt;br&gt;• Upsize 9B/9C connecting sewer at Dolphin Road (Davitt Road to Herberton Road)&lt;br&gt;• Duplicate 9C sewers in Blanchardstown /Mulhuddart&lt;br&gt;• New CSO and 11,000m³ storage on 9C sewer at Castleknock</td>
<td>• New WwTW of 350,000PE treatment capacity centrally located in 9B catchment with medium level treatment for discharge to the storm cell of the GCTS, through 1.5m diameter outfall tunnel, 9.6km long. 15,600m³ of storage&lt;br&gt;• Additional 12,000m³ storage on the 9C system at Castleknock</td>
</tr>
<tr>
<td>Rathmines &amp; Pembroke</td>
<td>• 4 sewer diversions to foul and storm cells of the GCTS</td>
<td></td>
</tr>
<tr>
<td>Fingal</td>
<td>• Upgrade existing Portrane WwTW to 450,000PE</td>
<td>• 8.5km length of new Orbital Sewer from Swords to Portrane WwTW&lt;br&gt;• Partial diversion of flows from Swords and Malahide catchments to orbital sewer to upgraded Portrane WwTW</td>
</tr>
<tr>
<td>NDDS</td>
<td>• New pumping station and rising main to divert North Fringe flows to Portrane via Orbital Sewer</td>
<td></td>
</tr>
<tr>
<td>Kildare</td>
<td>• New pumping station to transfer 75,000 PE flows (390l/s) from Leixlip to WwTW in the 9B catchment</td>
<td></td>
</tr>
</tbody>
</table>

Table 11.4  Scenario 2B  (Medium Level Treatment with Discharge to GCTS Storm Cell – Figure 11.5)
For the 2031 development horizon, new treatment facilities would be located in both the west and north of Dublin, together with conveyance systems, comprising:

- Construction of a new WwTW in South Dublin with an ultimate capacity of 350,000PE, discharging to the River Liffey Estuary through the storm cell of the GCTS, and therefore treating to an appropriate standard for the estuary waters. Discharge to the storm cell of the GCTS would be by 1.5m diameter pipeline, 9.6km in length.

- Upgrading of the existing WwTW at Portrane from capacity of 35,000PE to 450,000PE to treat excess load from the Dublin area, in particular the North Fringe. The upgraded Portrane WwTW would also treat excess loads from the Swords and Malahide catchments, thus relieving overloading of their own WwTWs and pollution of the sensitive receiving waters of Broadmeadow Estuary.

- Construction of the Swords to Portrane segment of the Orbital Sewer to facilitate connection of the North Fringe, Swords and Malahide catchments to the new WwTW at Portrane. This orbital sewer would be sized to facilitate ultimate extension to the west of Dublin as the metropolitan area expands beyond 2031.

- Towards 2031 the maximum treatment capacity of the Osberstown and Leixlip WwTWs would be exceeded (Figure 8.4), and therefore some 75,000 PE would need to be diverted to the new South Dublin WwTW. Pumping at 3DWF would correspond to 390l/s.

11.2.4 Scenario 2C – Orbital Sewer to Treatment at Portrane (Figure 11.6)

This scenario envisages that foul flows are intercepted in a new orbital sewer connecting the development areas in the west and north west of the study area (including Lucan, Clondalkin, Blanchardstown, Mulhuddart and east Meath) and transferred to a new WwTW on the Fingal Coastline, preferably near Portrane. This would involve a major sewer, constructed predominantly in tunnel, with a number of pumping interfaces. The scheme would provide a comprehensive long-term solution, which would ensure that the Ringsend WwTW would be available to deal with its original catchment, and which would facilitate new development into the future.

It follows that such a scheme could intercept parts of the Route 9C catchment and existing County Meath catchments such as Rathoath and Ashbourne. It could also receive excess flows from the Leixlip, Swords, and Malahide catchments beyond those capable of being treated by their current ultimate design capacities.

The principal works required for Scenario 2C are summarised in Table 11.5 and are shown on Figure 11.6.
## Table 11.5 Scenario 2C (Diversion to New Treatment Works at Portrane – Figure 11.6)

<table>
<thead>
<tr>
<th>Location</th>
<th>2011 Requirements</th>
<th>2031 Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ringsend WwTW</td>
<td>• Upgrade capacity to 2.16m PE immediately</td>
<td></td>
</tr>
</tbody>
</table>
| City Centre Sewers| • Intercept North & South Quay culverts near Heuston Station and pump up to 2m³/s to GCTS at Davitt Road  
• Trunk sewer CSOs and interceptors | • Ongoing CSO upgrading along Liffey to limit overflow impacts                     |
| Grand Canal Tunnel Sewer | • No change from existing                                                          | • No change from existing                                                          |
| Main Lift PS      | • No change from existing                                                          | • No change from existing                                                          |
| Docklands         | • Separate Docklands Pumping station (0.6m³/s) and 5,000m³ local storage            |                                                                                   |
| 9B/9C Upgrading   | • New CSO on 9B sewer and 11,000m³ storage at Ballymount to limit flows to 2.00 m³/s and overflow pipeline to spill to the GC storm cell. Local 9B upgrading at Lucan and Clondalkin  
• Upsize 9B/9C connecting sewer at Dolphin Road (Davitt Road to Herberton Road)  
• Duplicate 9C sewers in Blanchardstown/Mulhuddart  
• New CSO and 11,000m³ storage on 9C sewer at Castleknock | • Pumping station at Ballyowen and rising main 5km length, for transfer of 9B flows to the new orbital trunk sewer  
• 15,600m³ of storage at Ballyowen  
• Diversion of 9C flows to the new orbital trunk sewer |
| Rathmines & Pembroke| • 4 sewer diversions to foul and storm cells of the GCTS                           |                                                                                   |
| Fingal            |                                                                                   | • Upgrade existing Portrane WwTW to 850,000PE  
• Orbital trunk sewer tunnel, 2.0m diameter and 22km length  
• Partial diversion of flows from Swords and Malahide catchments to orbital sewer to upgraded Portrane WwTW |
| Meath             | • Rising main and sewer, length 6.5km transferring flows from upgraded Kilbride pumping station to the new orbital sewer |                                                                                   |
| Kildare           | • New pumping station to transfer 75,000 PE flows (390l/s) from Leixlip to the orbital sewer |                                                                                   |
For the 2031 development horizon, new treatment facilities would be located in the north of Dublin, together with conveyance systems, comprising:

- Construction of a new WwTW at Portrane of 850,000PE capacity to treat excess load from the Dublin area. The upgraded Portrane WwTW would also treat excess loads from the Swords and Malahide catchments, thus relieving overloading of their own WwTWs and pollution of the sensitive receiving waters of the Broadmeadow Estuary.

- Construction of the Orbital Sewer to facilitate connection from the west Dublin developments, and the Meath, Swords and Malahide catchments to the new WwTW at Portrane. For the west Dublin developments, connections would be made directly from the 9B and 9C systems to the Orbital Sewer. Flows from the Meath catchments would be transferred by the existing Kilbride pumping station through rising mains and gravity sewers. The Swords and Malahide connections would be achieved by gravity trunk sewers.

- Towards 2031 the maximum treatment capacity of the Osberstown and Leixlip WwTW would be exceeded (Figure 8.4), and therefore some 75,000 PE would need to be diverted to the orbital sewer, by means of pumping station (390l/s) and rising main.

11.3 GCTS Strategy Approach 3 – Transfer Flows and Load to New WwTW via Ringsend

In this strategy approach all flows and loads from an extended Ringsend catchment, including all future development in South Dublin, West Fingal, East Meath and ultimately an element of the Leixlip catchment in North Kildare, would be transferred to Ringsend. This strategy acknowledges that the capacity of the Ringsend plant is limited to 2.16m PE and seeks to avoid exceeding this capacity by the:

- Diversion of flows from North Dublin away from Ringsend to a new regional WwTW located on the coast near Portrane.

- Transfer of excess flow and loads from Ringsend across Dublin Bay to Sutton by reversing flows in the existing submarine pipeline and allowing for onward transfer to Portrane.

Three scenarios have been identified to realise this strategy approach. All relate to the method of flow conveyance to Ringsend. The method of flow transfer from Ringsend to North Dublin and onward to the Portrane WwTW remains the same in all three scenarios.

- **Scenario 3A** – swap the GCTS storm and foul cells whereby the foul and storm cells are swapped over, converting the larger storm cell for foul flows thus allowing significant additional foul flows to be transferred to Ringsend via the GCTS.

- **Scenario 3B** – construct new Liffey Trunk Sewer whereby the flows from the 9C catchment are intercepted and transferred by a new sewer along the Liffey Quays to Ringsend. This sewer would intercept other CSO spills along the quays as well as the new Dockland flows.

- **Scenario 3C** – construct a new Foul Cell within the GCTS whereby a new segment or pipeline is constructed within the existing GCTS in order to pass forward foul flows from the South Dublin catchment to Ringsend.

11.3.1 Scenario 3A – Swap GCTS Storm and Foul Cells  (Figure 11.7)

As with Scenario 1A the significant residual capacity of the GCTS storm cell would be utilised for foul flows. This would permit significant volumes of foul and combined sewage discharged from the developing 9B and 9C catchments to be accommodated along with substantial diversion of flows from the City Centre (diversion at Heuston Station). It would also facilitate the combined flows from the Rathmines and Pembroke high-level catchment.

However, the cumulative flows from these areas would exceed the downstream capacity of the connecting sewer to the MLPS (Contract 14 tunnel). This would have significant implications for the MLPS itself and on the hydraulic capacity of the Ringsend WwTW.
The Ringsend WwTW requires upgrading to 2.16m PE, and flow diversion to a new pumping station located adjacent to the works possibly in the locality of Irishtown Park would be required. This pumping station should have a sufficient capacity to pump flows to Sutton and release the potential overload at Ringsend.

Significant work would be required to retrofit the existing Sutton Pumping Station in order to reverse flows and to increase the capacity and service pressures of the existing sewers. A new pumping station, storage tank and rising main would be required at Grange and the Portrane WwTW would have to be upgraded to a regional facility.

The principal works required for Scenario 3A are summarised in Table 11.6, and shown on Figure 11.7.
<table>
<thead>
<tr>
<th></th>
<th>2011 Requirements</th>
<th>2031 Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ringsend WwTW</td>
<td>• Upgrade capacity to 2.16m PE immediately</td>
<td>• Upgrade inlet works and overflow to Irishtown PS</td>
</tr>
<tr>
<td>Grand Canal Tunnel</td>
<td></td>
<td>• Swap storm and foul cells with manhole alterations and new connections</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• New CSO at Manhole 1 (Grand Canal Street/Estate Cottages) and spill over Formula A to Grand Canal Dock (Bypass Culvert)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Duplicate Contract 14 sewer with new 2.55m diameter tunnel, 1.85km long</td>
</tr>
<tr>
<td>City Centre Sewers</td>
<td>• Intercept North &amp; South Quay culverts near Heuston Station and pump up to 2m³/s to GCTS at Davitt Road</td>
<td>• Ongoing CSO upgrading along Liffey to limit overflow impacts</td>
</tr>
<tr>
<td></td>
<td>• Trunk sewer CSOs and interceptors</td>
<td></td>
</tr>
<tr>
<td>Main Lift PS/Ringsend WwTW</td>
<td>• Separate Docklands Pumping station (0.6m³/s) and local storage</td>
<td>• Operate up to 6 duty pumps at 18.6m³/s (plus one standby) and upgrade hydraulic capacity to WwTW</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• New pumping station of 2.0m³/s capacity at Irishtown to pump flows in reverse through the submarine pipeline to Sutton PS</td>
</tr>
<tr>
<td>9B/9C Upgrading</td>
<td>• 9B CSO and 11,000m³ storage at Ballymount to limit flows to 2.00 m³/s and overflow pipeline to spill to the GC storm cell. Local 9B upgrading at Lucan and Clondalkin</td>
<td>• New 9B Catchment tunnel sewer 9.6km long to connect Lucan and Clondalkin flows to the GC foul cell</td>
</tr>
<tr>
<td></td>
<td>• Duplicate 9B/9C connecting sewer at Dolphin Road (Davitt Road to Herberton Road)</td>
<td>• Additional 12,000m³ storage on the 9C system at Castleknock</td>
</tr>
<tr>
<td></td>
<td>• Duplicate 9C sewers in Blanchardstown /Mulhuddart</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• New CSO and 11,000m³ storage on 9C sewer at Castleknock</td>
<td></td>
</tr>
<tr>
<td>Rathmines &amp; Pembroke</td>
<td>• 4 sewer diversions to “foul cell” of the GCTS</td>
<td></td>
</tr>
<tr>
<td>North Dublin Drainage System</td>
<td></td>
<td>• Upgrade Sutton PS to 4.6m³/s capacity and reinforce the existing 1600mm diameter sewer between Sutton and Grange for pumping use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Rising main from Sutton PS to Grange Tank</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• New pumping station at Grange Storm Tank 6.6m³/s, additional 5,000m³ storm tank, and rising main 9.7km long, from Grange to Portrane</td>
</tr>
<tr>
<td>Fingal</td>
<td></td>
<td>• Increase Portrane WwTW to 850,000PE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Segment of Orbital trunk sewer tunnel, 2.0m diameter and 8.5km length, from Swords to Portrane WwTW</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Partial Diversion of flows from Swords and Malahide catchments via orbital sewer to the new Portrane WwTW</td>
</tr>
<tr>
<td>Kildare</td>
<td></td>
<td>• New pumping station to transfer 75,000PE flows (390l/s) from Leixlip to new 9B trunk sewer</td>
</tr>
</tbody>
</table>

Table 11.6  Scenario 3A (Reversing Flow to Sutton and Swapping GCTS Cells Figure 11.7)
For the 2011 development horizon the following would apply:

- The Ringsend WwTW would be extended immediately to provide its maximum capacity of 2.16m PE to treat foul flows.

- The flows from the Lucan/Clondalkin area would be limited to 2m³/s. A new CSO and 11,000m³ storage tank would be constructed at Ballymount. Flows greater than Formula A would, subject to assessment of receiving water quality, spill to the storm cell of the GCTS. A new overflow pipeline would be constructed to transfer these spill flows to the GCTS.

- The existing Liffey siphon would be retained to restrict forward flows to the GCTS to 2.7m³/s. A new CSO and 11,000m³ of additional storage would be required at Castleknock.

- A new CSO chambers would be required for each of the four connections from the R&P High Level catchment. CSO settings would ensure that Formula A flows pass to the foul cell and excess flows pass to the storm cell.

- A new pumping station, which is part of the short-term solution for the Docklands Development, has a maximum pump rate of 0.6m³/s and discharges directly to Ringsend WwTW. Future drainage to the Docklands must accommodate high-density development. The detailed drainage proposals to cater for this development are to be developed as part of the Docklands DAP.

For the 2031 development horizon the 2011 works needs to be extended and augmented to provide conveyance and treatment capacity for the substantial additional flows from the developments to the west of Dublin. These would involve:

- A new tunnel sewer 9.6km in length to transfer flows from the developments in Lucan and Clondalkin to the Grand Canal foul cell.

- Storage at Castleknock would be increased from 11,000m³ to 23,000m³ to improve spill performance.

- Towards 2031 the maximum capacity of the Osberstown and Leixlip WwTWs would be exceeded and therefore some 75,000 PE (390 l/s approximately) would need to be diverted to the GCTS foul cell by means of a pumping station and rising main of 6.5km length discharging to the new 9B tunnel sewer.

- The existing foul cell in the GCTS would have insufficient capacity for the catchment flows. The principal works would involve the swapping of the storm and foul cells with appropriate adjustment to manholes and connections.

- The cumulative foul/combined flows in the GCTS would now exceed the capacity of the downstream section of the sewer tunnel at Grand Canal Street (Contract 14) connecting to the MLPS. Forward flows would be limited to 13.3m³/s. A new CSO would be required at Manhole 1, near Estate Cottages with flows in excess of Formula A spilling to the Liffey Estuary via the Grand Canal Dock Bypass Culvert. The Contract 14 sewer would also need to be duplicated by constructing a new 2.55m diameter tunnel 1.85km in length.

- The MLPS would require operation of all six pumps to give a maximum pumping rate of 18.6m³/s. A stand-by pump would be required raising the installed capacity to 22m³/s.

- The capacity of the siphons between the MLPS and Ringsend WwTW would have to be increased, as would the capacity of the inlet works to incorporate the higher flow and provide an overflow chamber to the new pumping station.

- New pumping station of 2.0m³/s at Irishtown to pump flows in reverse through the submarine pipeline to Sutton.
• Upgrade the Sutton pumping station to 4.6m$^3$/s and reconfigure pumping arrangements to reverse flows to Grange.

• Strengthen the existing gravity sewer from the Grange storm tank to take pressurised flows and construct new rising main between Sutton and Grange.

• New pumping station with 6.6m$^3$/s installed capacity at Grange including 5,000m$^3$ of additional stormwater storage.

• Rising main 9.7km in length from Grange to Portrane. The route of this main could follow either a land based or marine route.

• New Regional WwTW at Portrane would be developed. The existing capacity would be increased to 850,000 PE.

• Diversion of excess flows from Swords and Malahide WwTW to Portrane via trunk sewers and pumping mains.

11.3.2 Scenario 3B – New Liffey City Interceptor Sewer (Figure 11.8)

With this scenario a new City Interceptor sewer would be constructed along the Liffey Quays intercepting flows from the 9C catchment at the Phoenix Park siphon. At Heuston Station it would intercept the Ballyfermot and Parkgate/Navan Road sewers thus relieving the existing City Centre sewers. It would also intercept other CSO spills along the quays as well as new Dockland flows. The interception of these flows would make capacity available in the GCTS for the developing Lucan and Clondalkin areas of South Dublin.

At the lower end on the interceptor a major deep shaft pumping station would be required to lift flows to the Ringsend WwTW. New stormwater storage, inlet screening and overflow arrangement would be required at Ringsend.

The elements of this Scenario from Ringsend to Sutton and on to Portrane are the same as those described under Scenario 3A.

The principal works required for Scenario 3B are summarised in Table 11.7, and shown on Figure 11.8.
<table>
<thead>
<tr>
<th></th>
<th>2011 Requirements</th>
<th>2031 Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ringsend WwTW</td>
<td>• Upgrade capacity to 2.16m PE immediately</td>
<td>• Upgrade inlet works and overflow to Irishtown PS</td>
</tr>
<tr>
<td>Grand Canal Tunnel</td>
<td>• No change from existing</td>
<td>• No change from existing</td>
</tr>
<tr>
<td>City Centre Sewers</td>
<td>• No change from existing</td>
<td>• Liffey Interceptor Sewer 1.8m diameter, from Phoenix Park to Docklands, intercepting 9C and North and South Quay sewers near Heuston Station</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Deep Shaft PS of 6m³/s capacity to lift flows to Ringsend</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Ongoing CSO upgrading along Liffey to limit overflow impacts</td>
</tr>
<tr>
<td>Main Lift PS/Ringsend WwTW</td>
<td>• Separate Docklands Pumping station (0.6m³/s) and 5000m³ local storage</td>
<td>• New pumping station of 2.0m³/s capacity at Irishtown to pump flows in reverse through the submarine pipeline to Sutton PS</td>
</tr>
<tr>
<td>9B/9C Upgrading</td>
<td>• 9B CSO and 11,000m³ storage at Ballymount to limit flows to 2.0 m³/s, and overflow pipeline to spill to the GC storm cell. Local 9B upgrading at Lucan and Clondalkin</td>
<td>• New 9B Catchment tunnel sewer 9.6km long to connect Lucan and Clondalkin flows to the GC foul cell</td>
</tr>
<tr>
<td></td>
<td>• Duplicate 9B/9C connecting sewer at Dolphin Road (Davitt Road to Herberton Road)</td>
<td>• Additional 12,000m³ storage on the 9C system at Castleknock</td>
</tr>
<tr>
<td></td>
<td>• Duplicate 9C sewers in Blanchardstown/Mulhuddart</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• New CSO and 11,000m³ storage on 9C sewer at Castleknock</td>
<td></td>
</tr>
<tr>
<td>Rathmines &amp; Pembroke</td>
<td>• 4 sewer diversions to foul and storm cells of the GCTS</td>
<td></td>
</tr>
<tr>
<td>North Dublin Drainage System</td>
<td>• Upgrade Sutton PS to 4.6m³/s capacity and reinforce the existing 1600mm diameter sewer between Sutton and Grange for pumping use</td>
<td>• Rising main from Sutton PS to Grange Tank</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• New pumping station at Grange Storm Tank 6.6m³/s, additional 5,000m³ storm tank, and rising main 9.7km long, from Grange to Portrane</td>
</tr>
<tr>
<td>Fingal</td>
<td>• Increase Portrane WwTW to 850,000PE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Segment of Orbital trunk sewer tunnel, 2.0m diameter and 8.5km length, from Swords to Portrane WwTW</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Partial Diversion of flows from Swords and Malahide catchments to orbital sewer to the new Portrane WwTW</td>
<td></td>
</tr>
<tr>
<td>Kildare</td>
<td>• New pumping station to transfer 75,000PE flows (390l/s) from Leixlip to new 9B trunk sewer</td>
<td></td>
</tr>
</tbody>
</table>

Table 11.7 Scenario 3B (Reversing flows to Sutton and New Liffey Interceptor Figure 11.8)
For the 2011 development horizon the following would apply.

- The Ringsend works would be extended to provide 2.16m PE capacity to treat foul flows.

- The flows from Lucan/Clondalkin area would be limited to 2m³/s. A new CSO and 11,000m³ storage tank would be constructed at Ballymount. Flows greater than Formula A would, subject to local receiving water assessment, spill to the storm cell of the GCTS. A new overflow pipeline would be constructed to transfer these spill flows to the GCTS.

- Sewers serving the 9C catchment of Blanchardstown and Mulhuddart would be duplicated. The existing Liffey siphons would be retained to restrict forward flows to the GCTS to 2.7m³/s. A new CSO and 11,000m³ of additional storage would be required at Castleknock.

- The trunk sewer along Dolphin Road connecting the 9B and 9C sewers to the GCTS would be augmented between Davitt Road and Herberton Road.

- Work on the City Centre sewers to intercept flows and relieve the downstream unsatisfactory CSO problems would have to be deferred until the Liffey Valley Sewer is constructed to meet the 2031 development requirement.

- New CSO chambers would be required for each of the four connections from the R&P High Level catchment. CSO settings would ensure that Formula A flows pass to the foul cell and excess flows pass to the storm cell.

- A new pumping station, which is part of the short-term solution for the Docklands Development, has a maximum pump rate of 0.6m³/s and discharges directly to Ringsend WwTW. Future drainage to the Docklands must accommodate high-density development. The detailed drainage proposals to cater for this development are being developed as part of the Docklands DAP.

For the 2031 development horizon the 2011 works needs to be extended and augmented to provide conveyance and treatment capacity for the substantial additional flows from the developments to the west of Dublin. These would involve

- A new tunnel sewer 9.6km in length to transfer flows from the developments in Lucan and Clondalkin to the Grand Canal foul cell.

- Storage at Castleknock would be increased from 11,000m³ to 23,000m³ to improve spill performance.

- Towards 2031 the maximum capacity of the Osberstown and Leixlip WwTWs would be exceeded and therefore some 75,000 PE (392 l/s approximately) would need to be diverted to the GCTS foul cell by means of a pumping station and rising main of 6.5km length discharging to the new 9B tunnel sewer.

- The construction of a new interceptor sewer in tunnel along the Liffey Quays to intercept flows from the 9C catchment at the Phoenix Park siphons, and free up capacity in the GCTS for the 9B catchment. The sewer would also intercept the Ballyfermot and Parkgate/Navan Road sewers, other CSO spills along the Quays and the new Dockland flows, as well as provide on-line storm storage to control spills to the estuary.

- Deep shaft pumping station in the Docklands area with capacity of 6m³/s to lift flows to the inlet works at Ringsend.

- New inlet works at Ringsend WwTW to take the higher flows and provide an overflow to the new pumping station at Irishtown.

- New pumping station of 2.0m³/s at Irishtown to pump flows in reverse through the submarine pipeline to Sutton.

- Upgrade the Sutton pumping station to 4.6m³/s and reconfigure pumping arrangements to reverse flows to Grange.
• Strengthen the existing gravity sewer from the Grange storm tank to take pressurised flows and construct new duplicate rising main between Sutton and Grange.

• New pumping station with 6.6m³/s installed capacity at Grange including 5,000m³ of additional stormwater storage.

• Rising main 9.7km in length from Grange to Portrane. The route of this main could follow either a land based or marine route.

• Diversion of excess flows and loads from Swords and Malahide WwTW to Portrane via trunk sewers and pumping mains.

• New Regional WwTW at Portrane would be developed. The existing capacity would be increased to 850,000 PE.

11.3.3 Scenario 3C – New Foul Cell in the GCTS (Figure 11.9)

This Scenario envisages the construction of a new foul cell within the storm section of the GCTS in order to transfer foul flows to Ringsend and onwards. The possible arrangement of a pipe or segment conveyance is shown on Figures 11.10 and 11.11. As with Scenario 3A a new CSO chamber would be required at the downstream end of the GCTS to spill flows over Formula A to the Liffey Estuary through the Grand Canal Dock bypass culvert.

As with Scenario 3A the Contract 14 sewer would have to be duplicated and the MLPS and siphons would have to be upgraded to take 18.6m³/s. To allow for standby the MLPS would have an installed pump capacity of 22m³/s.

The Ringsend WwTW would be upgraded to 2.16m PE and the inlet works would be required to take additional flows and allow for part division to a new pumping station located adjacent to the Works, possibly in the location of Irishtown Park.

The remaining elements of the scheme between Ringsend, Sutton and Portrane are the same as those described under Scenario 3A and 3B.

The principal work required for Scenario 3C is summarised in Table 11.8, and shown on Figure 11.9.
<table>
<thead>
<tr>
<th></th>
<th>2011 Requirements</th>
<th>2031 Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ringsend WwTW</td>
<td>• Upgrade capacity to 2.16m PE immediately</td>
<td>• Upgrade inlet works and overflow to Irishtown PS</td>
</tr>
<tr>
<td>Grand Canal Tunnel</td>
<td>• New Foul conduit 4.45km in length, within the GCTS Storm Cell</td>
<td>• New CSO at Manhole 1 (Grand Canal Street/Estate Cottages) and spill over Formula A to Grand Canal Dock (Bypass Culvert)</td>
</tr>
<tr>
<td></td>
<td>• Duplicate Contract 14 sewer with new 2.55m diameter tunnel, 1.85km long</td>
<td>• Ongoing CSO upgrading along Liffey to limit overflow impacts</td>
</tr>
<tr>
<td>City Centre Sewers</td>
<td>• Intercept North &amp; South Quay culverts near Heuston Station and pump up to 2m³/s to GCTS at Davitt Road</td>
<td>• Operate up to 6 duty pumps to 18.6m³/s (plus one standby) and upgrade hydraulic capacity to WwTW</td>
</tr>
<tr>
<td></td>
<td>• Trunk sewer CSOs and interceptors</td>
<td>• New pumping station of 2.0m³/s capacity at Irishtown to pump flows in reverse through the submarine pipeline to Sutton PS</td>
</tr>
<tr>
<td>Main Lift PS/Ringsend WwTW</td>
<td>• Separate Docklands Pumping station (0.6m³/s) and local storage</td>
<td>• New 9B Catchment tunnel sewer 9.6km long to connect Lucan and Clondalkin flows to the GC foul cell</td>
</tr>
<tr>
<td></td>
<td>• 9B CSO and 11,000m³ storage at Ballymount to limit flows to 2 m³/s and overflow pipeline to spill to the GC storm cell. Local 9B upgrading at Lucan and Clondalkin</td>
<td>• Additional 12,000m³ storage on the 9C system at Castleknock</td>
</tr>
<tr>
<td>9B/9C Upgrading</td>
<td>• Duplicate 9B/9C connecting sewer at Dolphin Road (Davitt Road to Herberton Road)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Duplicate 9C sewers in Blanchardstown /Mulhuddart</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• New CSO and 11,000m³ storage on 9C sewer at Castleknock</td>
<td></td>
</tr>
<tr>
<td>Rathmines &amp; Pembroke</td>
<td>• 4 sewer diversions to foul and storm cells of the GCTS</td>
<td></td>
</tr>
<tr>
<td>North Dublin Drainage System</td>
<td>• Upgrade Sutton PS to 4.6m³/s capacity and reinforce the existing 1600mm diameter sewer between Sutton and Grange for pumping use</td>
<td>• Rising main from Sutton PS to Grange Tank</td>
</tr>
<tr>
<td></td>
<td>• New pumping station at Grange Storm Tank 6.6m³/s, additional 5,000m³ storm tank, and rising main 9.7km long, from Grange to Portrane</td>
<td></td>
</tr>
<tr>
<td>Fingal</td>
<td>• Increase Portrane WwTW to 850,000PE</td>
<td>• Partial Diversion of flows from Swords and Malahide catchments to orbital sewer to the new Portrane WwTW</td>
</tr>
<tr>
<td></td>
<td>• Segment of Orbital trunk sewer tunnel, 2.0m diameter and 8.5km length, from Swords to Portrane WwTW</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• New pumping station to transfer 75,000PE flows from Leixlip to new 9B trunk sewer</td>
<td></td>
</tr>
</tbody>
</table>

Table 11.8 Scenario 3C (Reversing Flows to Sutton and New Foul Cell in GCTS Figure 11.9)
For the **2011 development horizon** the following would apply.

- The Ringsend WwTW would be extended immediately to its maximum capacity of 2.16m PE to treat foul flows.

- The flows from the Lucan/Clondalkin area would be limited to 2m³/s. A new CSO and 11,000m³ storage tank would be constructed at Ballymount. Flows greater than Formula A would, subject to local assessment of water quality, spill to the storm cell of the GCTS. A new overflow pipeline would be constructed to transfer these spill flows to the GCTS.

- Sewers serving the 9C catchment of Blanchardstown and Mulhuddart would be duplicated. The existing Liffey siphon would be retained to restrict forward flows to the GCTS to 2.7m³/s. A new CSO and 11,000m³ of additional storage would be required at Castleknock.

- A new pumping station in the Heuston Station locality is required to divert flows of 2m³/s from the City Centre catchment to help relieve downstream unsatisfactory CSO problems. A rising main is required to connect to the head of the GCTS at Davitt Road.

- New CSO chambers would be required for each of the four connections from the R&P High Level catchment. CSO settings would ensure that Formula A flows pass to the foul cell and excess flows pass to the storm cell.

- A new pumping station, which is part of the short-term solution for the Docklands Development, has a maximum pump rate of 0.6m³/s and discharges directly to Ringsend WwTW. Future drainage to the Docklands must accommodate high-density development. The detailed drainage proposals to cater for this development are to be developed as part of the Docklands DAP.

For the **2031 development horizon** the 2011 works needs to be extended and augmented to provide conveyance and treatment capacity for the substantial additional flows from the developments to the west of Dublin. These would involve

- A new tunnel sewer 9km in length to transfer flows from the developments in Lucan and Clondalkin to the Grand Canal foul cell.

- Storage at Castleknock would be increased from 11,000m³ to 23,000m³ to improve spill performance.

- Towards 2031 the maximum capacity of the Osberstown and Leixlip WwTWs would be exceeded and therefore some 75,000 PE (390 l/s approximately) would need to be diverted to the GCTS foul cell by means of a pumping station and rising main of 6.5km length discharging to the new 9B tunnel sewer.

- A new foul cell would be constructed within the storm cell of the GCTS to take foul/combined flows from the developing 9B catchment. This would require modifications to the access shafts and cross connecting pipework.

- The cumulative foul/combined flows in the GCTS would now exceed the capacity of the downstream section of the sewer tunnel at Grand Canal Street (Contract 14) connecting to the MLPS. Forward flows would be limited to 13.3m³/s. A new CSO would be required at Manhole 1, near Estate Cottages with flows in excess of Formula A spilling to the Liffey Estuary via the Grand Canal Bypass Culvert. The Contract 14 sewer would also need to be duplicated by constructing a new 2.55m diameter tunnel 1.85km in length.

- The MLPS would require operation of all six pumps to give a maximum pumping rate of 18.6m³/s. A stand-by pump would be required raising the installed capacity to 22m³/s.

- The capacity of the siphons between the MLPS and Ringsend WwTW would have to be increased, as would the capacity of the inlet works to incorporate the higher flow and provide an overflow chamber to the new pumping station.

- New pumping station of 2.0m³/s at Irishtown to pump flows in reverse through the submarine pipeline to Sutton.
11.4 Conveyance Issues for the Scenarios

As stated in Chapter 10, the various strategy options were tested hydraulically against the maximum hydraulic capacities of the small and large cells in the GCTS of 9m³/s and 22m³/s. Options were also tested in the InfoWorks hydraulic models to assess the effects of 1 in 30 year storms. The hydraulic models would also simulate the effects of surcharge and particularly attenuation, which has a significant influence with such a large system.

Flow diagrams for the existing and 2011 situations, and the 2031 options are contained in Appendix D. These maps show the layout of the Grand Canal system, with dry weather flow, calculated Formula A flow, pass forward flow, 30-year storm flow, etc, at significant locations.

Existing Scenario in Appendix D shows the existing inflows from the 9B and 9C systems, with a nominal inflow from the High Level R&P systems, pending DAP upgrading works. 6DWF at the downstream end of the GCTS is 5.02m³/s, well within the hydraulic capacity of the foul cell. Calculated Formula A flows at the MLPS are 11.6m³/s. Inputs from Heuston Station and Docklands Pumping Stations are zero because such facilities are yet to be built.

2011 Development Scenario in Appendix D show the hydraulic situation after improvements have been made to the city sewerage to reduce CSO spills in the City Centre and High Level R&P catchments. These improvements would retain flows within the city catchments up to Formula A within the foul system, rather than spilling over the CSOs, as happens at present. The city catchments have no alternative practical discharge system, other than the GCTS/MLPS/Ringsend WwTW and hence reducing spills from their CSOs has the effect of increasing flows in the GCTS foul cell. Pass forward flow at the downstream end of the GCTS (Contract 14 tunnel) is limited to 8.62m³/s to comply with the overall maximum hydraulic capacity of around 9m³/s.

Inflows from the city catchments determine the hydraulic capacity available for discharges from the 9B and 9C systems. Flows from the 9C system are hydraulically constrained by the Phoenix Park siphons to 2.72m³/s, leaving the remaining inputs from the 9B system as 2m³/s. These available inflows from both the 9B and 9C systems are below Formula A, hence flow control systems would be needed. For the 9C system flow control would be needed to reduce pass forward flows from 5.37m³/s to 2.72m³/s, and for the 9B system to reduce pass forward flows from 3.18m³/s to 2m³/s. Storage volumes on the 9C system are based on 1 in 5-year spills to the receiving waters, being the Tolka River.

The 2011 development scenario demonstrates the hydraulic interdependence between CSO improvements in the city catchments and the control of discharges from the 9B and 9C catchments.

2031 Development Scenario 1A This scenario involves swapping over the foul and storm cells of the GCTS, thus using the hydraulic capacity of the larger cell to enable full Formula A flows to be received from the 9B system. These flows produce a pass forward flow at the downstream end of the GCTS of 13.3m³/s, which requires that the hydraulic capacity of the downstream system (Contract 14 and MLPS) be radically increased to 14m³/s. Storm flows in the smaller cell of the GCTS reach a maximum of 6.7m³/s, below the hydraulic capacity of 7.3m³/s.
**2031 Development Scenario 1B** This scenario hydraulically isolates the western development environs from the GCTS by directing flows to Ringsend WwTW through the Liffey Valley Interceptor Sewer. Flows from the City Centre flow diversion (2m³/s from the Heuston Station area) would be discharged to the Liffey Valley Interceptor Sewer, releasing additional capacity for the 9B system. Thus the 9B system could discharge full Formula A flows of 3.2m³/s to the GCTS. The 9C system would be hydraulically constrained by the Phoenix Park siphons as before.

**2031 Development Scenario 2A** This scenario also hydraulically isolates the western development environs from the GCTS by directing flows to a new WwTW, discharging high level treated effluent to the Liffey. The flow regime for the city, 9B and 9C systems is similar to that for 2011 development, in that discharges from the 9B and 9C catchments are constrained by the downstream systems and the overall hydraulic capacity of the smaller cell of the GCTS. Flows exceeding Formula A are discharged from the city catchments to the larger storm cell of the GCTS, with peak flows of 15.1m³/s remaining within the maximum hydraulic capacity of 21m³/s to 22m³/s.

**2031 Development Scenario 2B** This scenario involves treating flows from the western development environs to a medium level and discharging flows into the larger storm cell of the GCTS. The hydraulic capacity of the smaller foul cell of the GCTS dictate that flows from the 9B and 9C catchments be controlled to 2m³/s and 2.72m³/s respectively. Modelled peak flows in the larger storm cell reach 16.1m³/s, remaining within the maximum hydraulic capacity of 21m³/s to 22m³/s.

**2031 Development Scenario 2C** This scenario also hydraulically isolates the western development environs from the GCTS by transferring flows to a new orbital sewer. The flow regime for the city, 9B and 9C systems is similar to that for Scenario 2B, in that discharges from the 9B and 9C catchments are constrained by the downstream systems and the overall hydraulic capacity of the smaller cell of the GCTS. Flows exceeding Formula A are discharged from the city catchments to the larger storm cell of the GCTS, with peak flows of 15.1m³/s, remaining within the maximum hydraulic capacity of 21m³/s to 22m³/s.

**2031 Development Scenario 3A** This scenario is hydraulically similar to Option 1A in that it involves swapping over the foul and storm cells of the GCTS, thus using the hydraulic capacity of the larger cell to enable full Formula A flows to be received from the 9B system. These flows produce a design Formula A flow at the downstream end of the GCTS of 14m³/s, which requires that the hydraulic capacity of the downstream system (Contract 14 and MLPS) be radically increased. Storm flows in the smaller cell of the GCTS reach a maximum of 6.7m³/s, below pipe capacity.

**2031 Development Scenario 3B** This scenario intercepts the 9C flows, the City Centre flow diversion (2m³/s from the Heuston station area) and the Docklands flows and transfers them, by a new Liffey Interceptor Sewer, directly to Ringsend WwTW, thus releasing additional capacity for the 9B system. Thus the 9B system could discharge the majority (6.3m³/s) of its Formula A flow (7.5m³/s) to the GCTS. The 9C system would be hydraulically constrained by the Phoenix Park siphons to 2.7m³/s flow into the Liffey Interceptor. Flows in the storm cell of the GCTS would reach a maximum of 13.6m³/s for a 30-year event, compared with the maximum capacity of 21m³/s.

**2031 Development Scenario 3C** This option proposes that the foul flows from the western development environs (Formula A of 4.3m³/s) be transferred to Ringsend WwTW through a new pipeline or segment within the larger storm cell of the GCTS. The foul flow regime for the City, 9B and 9C systems would be similar to that for Scenario 2B, in that discharges from the 9B and 9C catchments are constrained by the downstream systems and the overall hydraulic capacity of the smaller cell of the GCTS.

Peak flows in the GCTS would be 19.4m³/s (foul) and 6.7m³/s (storm) totalling 26.1m³/s, compared with the maximum available capacity of 28.3m³/s (21.0m³/s large segment plus 7.3m³/s small segment) from both segments. Thus the GCTS is at or near hydraulic capacity even before construction of a separate conduit within the tunnel.

Conduit construction using a liner or thin wall would present the minimum interference to flow capacity, as shown in Figure 11.10. However even if such thin sections could be constructed, installation would require substantial modification or replacement of the existing dividing walls, which would be impractical.
Should the more practical approach of using a separate pipe with concrete surround be used, then the reduction in hydraulic conveyance is much larger and there would be totally insufficient hydraulic capacity in the storm cell to pass 30-year storm flows. This arrangement is shown in Figure 11.11.

11.5 Treatment Issues for the Scenarios

As stated in Chapter 10.8 the overall strategy for wastewater treatment is based on the optimisation of the existing and currently planned facilities. The total treatment capacity requirements for the region are projected to increase from a 2002 base figure of 2.22m PE, to 2.94m PE in 2011 and to 3.67m PE in 2031 (Reference Chapter 4 Table 4.3).

The key element of this overall strategy is the Ringsend WwTW. The population equivalent from domestic and non-domestic development within the combined Ringsend catchment is projected to increase to 2.4m PE in 2011 and 2.81m PE in 2031.

The design capacity of the existing Ringsend WwTW is 1.64m PE. The load at the works currently varies between 1.75 and 1.9m PE. While this load exceeds the design, the plant is currently performing satisfactorily in terms of effluent quality. The receiving waters in Dublin Bay are classified as sensitive waters under the Urban Wastewater Treatment Regulations 2001. Under these regulations, the WwTW will have to reduce nitrogen levels to 10mg/l by May 2008. The works requires immediate expansion to cater for the increased loads and to meet the nitrogen standards.

The planning, design, procurement and implementation of an extension to Ringsend WwTW and the development of new facilities to cater for this projected development within the current Ringsend
catchment will take time to deliver. The only practical option to make capacity available, in the short to medium term, is to achieve a reduction in existing non-domestic loads.

2011 Development Scenarios

All scenarios considered are based on the immediate expansion of the Ringsend WwTW and a systematic load management programme to reduce existing non-domestic loads. Scenarios 1A and 1B require the extension of the Ringsend works to 2.4m PE. The viability of these scenarios is questioned given the known site constraints and the currently available treatment technologies for plants of this scale. All other scenarios assume that Ringsend would be expanded to 2.16m PE. This is considered the safe upper limit that could be provided within the existing site boundary and by adopting proven treatment technologies. The existing and currently planned works at the other treatment plants in the region will be sufficient to cater for the projected development up to the 2011 horizon.

2031 Development Scenarios

All 2031 scenarios are based on either a further extension of Ringsend or the development of alternative facilities in South Dublin and Fingal to cater for the projected growth.

The ultimate capacity of some of the current and planned WwTWs in the region will be overloaded by 2031 while others will be marginal. In developing the 2031 scenarios the following assumptions have been made.

- Bray/Shanganagh would be marginal and could be expanded to 240,000 PE on the existing site. Current designs should allow for phased expansion to 240,000 PE.
- Osberstown WwTW is currently constrained in terms of further development by the assimilative capacity of the receiving waters to 130,000 PE. Further development of this catchment would require an additional 25,000 PE. This could be catered for by redirecting some of the Osberstown catchment to the Leixlip catchment for ultimate transfer of additional flows to the new treatment facility proposed in this strategy.
- Balbriggan/Skerries could be expanded to the 2031 horizon of 99,000 by prudent development of the existing site.
- Leixlip, Swords and Malahide WwTWs, if they require expansion, have receiving water constraints (River Liffey and Broadmeadow Estuary) and provision has been made for additional loads from these catchments within the proposed new regional treatment facilities.

Scenarios 1A and 1B assume the expansion of Ringsend to 2.8m PE. The ability to provide for this level of expansion given the site constraints and the currently available treatment technologies is questionable and undermines the viability of both these scenarios.

Scenarios 2A and 2B assume that the capacity of Ringsend WwTW will be capped at 2.16M PE and that new treatment facilities will be developed in South Dublin (350,000 PE) and Fingal at Portrane (450,000 PE). The first phase of the South Dublin plant would be required close to the 2011 horizon. The exact timing would depend on the level of success of the load management strategy. In the ultimate this plant would also cater for the projected overload at Osberstown and Leixlip WwTWs of 75,000 PE. The expansion of the Portrane WwTW would be required closer to the 2031 horizon and would take additional loads from Swords WwTW (20,000 PE) and possibly Malahide WwTW which in terms of overload would be marginal at that stage.

Scenarios 2C, 3A, 3B and 3C assume that Portrane would become the new regional WwTW. It would require staged development up to 850,000 PE. The first stage of development would be required close to the 2011 horizon. The exact timing would be dependent on the level of success of the load management strategy. In the ultimate this plant would also cater for the projected overload at Leixlip WwTW (50,000 PE) and Swords WwTW (20,000 PE). It could also cater for Malahide, which in terms of overload would be marginal at that stage.
11.6 Analysis of Scenarios

11.6.1 Scenario 1A Swap GCTS Foul and Storm Cells

These works would represent a major engineering challenge, particularly where large diameter pipelines have to be constructed in roadways already saturated with utility services. Even with tunnel construction, the accommodation of shafts and protection of existing works, traffic management and general management of environmental impacts would be extremely difficult.

The most critical section to be upgraded in the city centre would be the “Contract 14” sewer, which connects the GCTS to the MLPS. This sewer currently has capacity of approximately 9m$^3$/s compared with Formula A flow of over 13 m$^3$/s. There is no possibility of developing a storage-based solution due to site constraints with the result that a new sewer would be essential to transfer the flows to the MLPS.

Duplication of the existing Contract 14 Sewer would offer the shortest route but may not be practically achievable on the basis of the poor ground conditions in the area, the need to protect the existing sewer and other utilities, the relatively shallow cover and the likely social impacts. An alternative route for the additional flows could be to accommodate them within the profile of the proposed new storm bypass outfall at Grand Canal Dock and then to continue in a new Docklands sewer along the south bank of the River Liffey (by tunnel to the Ringsend WwTW). This would greatly increase the scale and complexity of these works.

The existing maximum pump forward flow from MLPS to Ringsend WwTW is 16.1m$^3$/s, which would have to be increased to a maximum pump rate of 18.6m$^3$/s. Allowing for standby facilities an overall installed pump capacity of 22m$^3$/s would be required.

Flow to the works currently comes from 4 sources, as shown in the Table 11.9.

<table>
<thead>
<tr>
<th>Location</th>
<th>Existing Max. Flows (m$^3$/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sutton Pumping Station</td>
<td>2.25</td>
</tr>
<tr>
<td>Dun Laoghaire Rathdown</td>
<td>1.0</td>
</tr>
<tr>
<td>Dodder Siphon</td>
<td>2.85$^*$</td>
</tr>
<tr>
<td>MLPS</td>
<td>16.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>22.6</strong></td>
</tr>
</tbody>
</table>

Table 11.9  Maximum Flows to Ringsend WwTW

$^*$ Dodder Siphon, as modelled, is getting more flow through, over 3.5 m$^3$/s.

Increasing the flow to the MLPS to 18.6m$^3$/s would mean that the flow at the inlet to the Ringsend WwTW would increase to 24.1m$^3$/s. This is beyond the current hydraulic capacity of the Works and hence would require upgrading. Lands would have to be acquired to accommodate the additional 10,000m$^3$ of stormwater storage required, and to upgrade the Works itself to the interim 2011 capacity of 2.40mPE and the ultimate 2031 capacity of 2.81m PE.

There is currently only 0.8ha available land on the existing Ringsend site. This area would not be capable of achieving the 2011 or 2031 projected treatment capacity using currently available and proven technologies. Attempts to obtain additional lands on the Ringsend peninsula during the planning phase of the existing WwTW proved unsuccessful. Reclamation is not considered an option, given that the area of Dublin Bay is designated as an SPA and SAC. Dublin City Council has recently published a Local Area Plan for the development of the Ringsend Peninsula, which includes residential properties and amenity area. This Plan does not provide for expansion of the existing WwTW, outside the existing site boundary.
Scenario 1A requires that the maximum possible flows from the existing city catchments and outlying rapidly developing lands be brought through the City to Ringsend. This would transfer greatly increased volumes of stormwater within the foul sewer system, to be ultimately overflowed at the treatment plant.

Maximising flows to the Dublin peninsula would raise particular concerns, including:

- Increased reliance on the Main Lift Pumping Station, which does not have an emergency overflow and already requires close operational supervision, due to the disastrous consequence of failure
- Security of power supply to the existing and additional pumping installations needed to keep the system operational
- Necessity of keeping the Main Lift Pumping Station and WwTW fully operational during the extensive modification works
- Public perception of foul flows from future development being increased and transferred through the City for treatment and discharge to Dublin Bay

**Overall Assessment (Infeasible)**

**Technical:**

- Conveyance Works to Ringsend only marginally feasible with great difficulty and cost uncertainty.
- Inadequate flexibility to protect Ringsend area from flood risk due to scale of flows to MLPS.
- Siphons capacity to WwTW inadequate and duplication infeasible.
- Inadequate site area for WwTW and storm flow balancing needs.

**Environmental:**

- Major long-term risk that receiving water capacity would be exceeded.
- Social impacts of works during construction unacceptably severe in Ringsend area.
- Expanded WwTW site at Ringsend (if obtainable) would adversely impact on development and/or amenity objectives of the area.
- Long-term climate change might require availability of some storm capacity taken up by foul flows.
- Future plant over-loading (due to development or excessive loads (non-domestic)) could impact on sensitive waters in the Liffey estuary or the high amenity waters of Dublin Bay.

### 11.6.2 Scenario 1B New Liffey Valley Interceptor Sewer

The Liffey Valley Interceptor Sewer could be seen as an attractive solution. By utilising the river channel as an access corridor, flows and loads could be transferred through the City to Ringsend. The engineering would be extremely challenging and would require construction of a tunnel in the alluvial sediments under or adjacent to the River Liffey, as well as the construction of the major deep shaft pumping station required to lift flows to Ringsend.

However, the impacts of implementing the scheme are particularly formidable. These include:

- Restricted working periods in the River Liffey due to its salmonoid water status, which will greatly lengthen the construction period
• Water pollution resulting from major disturbance of the aged sediments in the River Liffey

• Interference with archaeological sites, with the potential to greatly lengthen the construction period and incur project cost overruns

• Potential damage to foundations of aged river walls and bridges, with the unacceptable risk of major damage or in the worst case, collapse of Dublin landmark structures

• Public and tourist perception of major and extremely visible works through the centre of Dublin

Lands would have to be acquired at Ringsend to accommodate the required plant upgrade, to 2.40M PE at 2011 and 2.81M PE at 2031. For the reasons stated in Scenario 1A, this would prove difficult to deliver due to land shortages, SPA and SAC designations and the current development planned for the area.

The particular concerns relating to the transfer of large quantities of stormwater within the foul sewer system to be overflowed at the treatment plant, as stated in Scenario 1A, also apply to this scenario.

Overall Assessment (Infeasible)

Technical:

• Scale of the works along the river would be complex and high risk.

• Protection of old structures and services would be extremely difficult and costly.

• Inadequate site area for WwTW.

• New Ringsend pumping station would be difficult to accommodate and construct.

Environmental:

• River Liffey works have major environmental impact.

• Dublin Bay receiving water capacity may be exceeded (long-term risk).

• Social impact of major works likely to be severe.

• Expanded WwTW site at Ringsend (if obtainable) would adversely impact on development and/or amenity objectives of the area.

• Future plant over-loading (due to development or excessive loads (non-domestic)) could impact on sensitive waters in the Liffey estuary or the high amenity waters of Dublin Bay.

11.6.3 Scenario 2A High Level Treatment with Discharge to the River Liffey

As the strategic sewers for this option would be limited in general to duplication of the 9C sewer, the installation of an overflow pipeline from the 9B sewer and the rising main between Heuston Station and the GCTS, this option should prove feasible compared with those considered under Scenarios 1A and 1B.

The Ringsend WwTW would require upgrading to 2.16M PE. This is considered technically viable within the existing site and current treatment technology constraints discussed fully in Chapter 10.8.

The main technical challenge with this scenario is the construction of a WwTW in South Dublin, to serve a PE of 350,000 discharging to the River Liffey. The plant would be a high-cost solution in both CAPEX and OPEX terms, given that it would be operating at the limits of current technology, in order to
achieve the extremely low phosphate standards required due to the existing discharges from the Leixlip and Osberstown WwTWs to the Liffey. Such treatment technology may not be practical for a plant of this scale. Given the projected rate of development in South Dublin, the first stage of this WwTW would be required shortly after the 2011 design horizon. In the ultimate, it would also treat excess flows transferred from the Leixlip catchment.

To meet the 2031 design requirements additional treatment facilities at Portrane would be required. The expansion of the existing WwTW to 450,000PE, adopting secondary treatment and with a discharge to the Irish Sea, would be sufficient to meet the statutory requirement. However, UV treatment may be required to protect water quality at the designated bathing beaches in the area.

A new pumping station would be required at Grange to divert North Fringe flows northward to Portrane. The most challenging issue with the diversion would be the selection of a route for the transfer main and the collection of flows from Swords WwTW and possibly Malahide WwTW which will be approaching their ultimate design capacities around 2031.

Overall Assessment (Infeasible)

Technical :
- Treatment technology unproven at this scale for the effluent standards required.
- Major feasibility issues in siting / routing works.
- High risk operating regime for advanced technology including escalating costs of energy, chemicals.
- Poor mixing regime available in River Liffey at low flows.
- Aesthetic, health and safety and general adverse social impacts and issues for a major outfall to the River Liffey.

Environmental :
- River Liffey environment unlikely to have capacity for additional loads in the context of the EU Water Framework Directive (WFD).
- Combination of pressures on the River Liffey may be considered unsustainable in the context of overall pressures (abstractions and discharges).
- Construction of the works would have major social impact, especially outfall pipelines (foul and overflow).
- Unacceptable pollution risk for emergency or storm overflows from new WwTW.

11.6.4 Scenario 2B Medium Level Treatment with Discharge to GCTS Storm Cell

As with Scenario 2A, upgrading of strategic sewers would be limited, and construction of the conveyance systems should prove feasible compared with those considered under Scenarios 1A and 1B. However a new sewer would be required between the proposed South Dublin WwTW and the storm cell of the GCTS. This would involve complex sewerage construction in both tunnel and open cut.

Again the Ringsend WwTW would require upgrading to 2.16M PE, a level considered viable, given the site constraints and the current treatment technologies available.

The South Dublin WwTW serving a PE of 350,000 would be located on industrial zoned lands, and discharge to the GCTS storm cell and ultimately to the Liffey Estuary. Depending on the results of
future water quality modelling of the Liffey Estuary, the new WwTW could require a combination of UV treatment, and phosphate and nitrogen reduction. Such standards, while more onerous than those required at Ringsend, are less onerous than those required in Scenario 2A for discharge to the River Liffey and are achievable on plants of this scale, using currently available technology. Given the projected rate of development in South Dublin, the first stage of this WwTW would be required shortly after the 2011 design horizon. In the ultimate, it would also treat excess flows transferred from the Leixlip catchment approaching 2031.

As with Scenario 2A, the Portrane WwTW would be upgraded to 450,000 PE and a pumping station at Grange would transfer North Fringe flows to this site. Pumping mains and trunk sewers would be required and these would collect flows from the Swords WwTW and Malahide WwTW.

**Overall Assessment (Feasible)**

**Technical :**

- Conveyance and treatment requirements can be satisfied within feasible technologies.
- Siting / routing of works would be challenging but feasible.
- Can be developed with modular treatment approach to suit changing needs over time.

**Environmental :**

- Current discharge criteria for transitional waters of Liffey Estuary and Dublin Bay seem feasible.
- Long-term risk of higher standards for this discharge, particularly in the context of the Water Framework Directive (WFD) and other pressures.
- Environmental impacts of WwTW plant can be moderated by full building enclosure of the plant, air treatment etc.

**11.6.5 Scenario 2C Diversion to New Treatment Plant at Portrane**

The major technical challenge with this scenario is the construction of a new sewer to collect flows from the developing areas of South Dublin and Blanchardstown, and transfer them to a new regional WwTW serving a PE of 850,000, located at Portrane and discharging to the Irish Sea. Such a sewerage system must accommodate a wide range of flows over its working life.

Water quality modelling carried out as part of the Study would indicate that secondary treatment should suffice. The level of treatment at Portrane would have to be confirmed following detailed water quality modelling at the proposed outfall. The addition of UV treatment may be required to ensure compliance with Bathing Waters Regulations at the designated bathing beaches in the area.

The route of the trunk sewer as indicated on Figure 11.6 while having the benefit of taking Meath flows from Kilbride PS is generally through undeveloped lands. Such routing would limit the social impacts of construction, but could lead to planning pressures. Depending on the type of pipeline (pressure main / deep tunnel), it may not readily facilitate such development in any case. Another option would be to route the sewer to the south and east of the airport keeping it closer to the zoned lands. These options would be explored fully in detailed feasibility stage studies.

In order to cater for the projected development in the western suburbs both the trunk sewer and the first stage of the regional WwTW would be required shortly after the 2011 design horizon. While the WwTW is suited to phasing the trunk sewer would have to be constructed at its ultimate capacity and over its entire length. This would prove challenging in terms of planning and programme. Given that the overall length of the trunk sewer is some 22km, multiple faces would have to be opened and multiple contracts awarded. It is likely that a considerable proportion of the sewer would be constructed in tunnel and
tunnelling methodologies would be developed depending on the results of the geotechnical investigations, as would other configurations such as pumping options.

Given the low initial flows in the trunk sewer compared with its design capacity and the length of travel operational problems would be expected. These would include deposition of solids in the sewers due to the low velocities and septicity. These issues would have to be carefully considered at design stage.

As for Scenario 2A and 2B, the Ringsend WwTW would be upgraded to 2.16M PE treatment capacity, which is considered achievable given the site constraints and the treatment technologies currently available.

### Overall Assessment (Feasible)

**Technical :**

- Both conveyance and treatment works fall within feasible technologies.
- Conveyance system will require careful design to suit phasing of loads, but is feasible.
- Siting and routing is facilitated by lower level of development in affected areas.
- Health and Safety risks can best be managed in less developed areas with proven technologies.

**Environmental :**

- Provides a secure long-term disposal option to Irish Sea.
- Protects Dublin Bay and Liffey Estuary from risk of overloading.
- Social and environmental impacts of construction and operation can be managed.

### 11.6.6 Scenario 3A Reversing Flows to Sutton and Swapping GCTS Cells

There are many technical challenges with all the Scenario 3 options identified. The methodology of transferring flows from West Dublin to the GCTS and onward to Ringsend is the same as that identified in Scenario 1A. The swapping over of the foul and storm cells within the GCTS would require the installation of new chambers and the modification of sewer connections within a live sewer.

The Contract 14 sewer would have to be duplicated at high social and economic cost and the MLPS, siphons and inlet works at Ringsend WwTW would have to be upgraded. This would involve working in facilities that are currently operational. This would adversely impact on the construction methodology and programme and the method and timing of flow transfer. As already outlined, these options are only marginally feasible at best and the operational risk of flooding is unacceptable.

While the expansion of the Ringsend WwTW to 2.16M PE is considered viable, given the site constraints and the current treatment technologies available, all Scenario 3 options require the construction of a new pumping station adjacent to the WwTW. As for Scenarios 1A and 1B the environmental designation of land in the area and the development plans for the Ringsend peninsula would make it difficult to acquire a suitable site.

Maximising flows to the Dublin peninsula would raise particular concerns, including:

- Increased reliance on the Main Lift Pumping Station, which does not have an emergency overflow and already requires close operational supervision, due to the disastrous consequence of failure
- Security of power supply to the existing and additional pumping installations needed to keep the system operational
Necessity of keeping the Main Lift Pumping Station and WwTW fully operational during the extensive modification works

Public perception of foul flows from future development being increased and transferred through the City for treatment and discharge to Dublin Bay

The works in North Dublin present similar significant technical difficulties. The Sutton Pumping Station would have to be upgraded to deliver 4.5m³/s thus doubling its current capacity. Even if additional space was available within the existing footprint of the station, the reconfiguring of the existing pumps and the diversion of flows northwards while mitigating the risk of environmental damage due to flooding and overflows of untreated sewage appear infeasible.

Any understanding of the Sutton system will show that re-configuring the Sutton Pumping Station to pump northwards will be limited to diversion of the North Dublin Catchment (NDDS) only due to:

- The limitations of station and pipework size
- The limited overflow capacity (2.75m³/s)
- The limitations of the 1600mm North Fringe pipeline, relined as a pumping main.

The reversing of flows would require changing the existing 1600mm diameter gravity sewer into a pumping main. This would entail relining of the sewer over its entire length to take the design pressures and the laying of a new parallel pressure main to convey the significant additional flows.

Overall Assessment (Infeasible)

Technical:

- Conveyance of full flows to Ringsend is high risk, with no flexibility for extreme event conditions. Issues similar to Scenario 1A apply.
- Site facilities cannot accommodate the extra storm flow loads.
- Sutton system cannot be practically re-configured for the scale of works involved.
- Sutton P.S. cannot be taken out of service for lengthy period while flows are reversed.
- Major risk of flooding where inflows exceed overflow capacity at Sutton.

Environmental:

- Duplication of North Fringe sewer may be unacceptable at Baldoyle Estuary.
- Major storm flows must be dealt with at Ringsend with pollution and operational risk.
- Further pumping at Malahide Road requires emergency overflow (unavailable except to Mayne River / Baldoyle estuary), with pollution risk.
- Long distance transfer of loads from development (South Dublin) via city network, Dublin Bay and onwards to Portrane conflicts with proximity principle for sustainable development and increases risks / consequences of system failure (e.g. series of major pumping installations at S. Dublin, MLPS, Ringsend outlet, Sutton, Malahide / Grange Road etc. for same flows).
11.6.7 Scenario 3B Reversing Flows to Sutton and New Liffey Interceptor

The only difference between this Scenario and the previous Scenario 3A is that there would be no requirement to swap the foul and storm cells in the GCTS, duplicate the Contract 14 sewer or upgrade the MLPS and the siphons to Ringsend WwTW. Capacity is made available for the developing areas of Lucan and Clondalkin in South Dublin by intercepting significant flows from the 9C catchment including Castleknock, Blanchardstown and areas of east Meath and transferring them to Ringsend via a new sewer along the Liffey quays.

The construction of this sewer would need to be at considerable depth in order to intercept the 9C sewer, the flows from the Ballyfermot and Parkgate/Navan road sewers, the existing CSOs along the Liffey and the Docklands, and provide for on-line storage. This would prove challenging in tunnelling terms as the tunnel would be in waterbound sands and gravels, close to period properties and structures of architectural significance. Even with tunnel construction, the accommodation of shafts and protection of existing works, traffic management and general management of environmental impacts would be extremely difficult. The construction of a deep shaft pumping station at the eastern end of the interceptor and within the Docklands development area would present difficulties in relation to site selection and construction methods.

The formidable technical difficulties and environmental and social impacts relating to the proposed Irishtown PS, the Sutton PS and other works in North Dublin as fully articulated in Scenario 3A also apply to this scenario.

Overall Assessment (Infeasible)

Technical :
- Both Liffey Sewer and Sutton works deemed infeasible (See Options 1B and 3B).

Environmental :
- Liffey works would have major environmental impact as would pipeline works in Baldoyle estuary (See Options 1B and 3A).

11.6.8 Scenario 3C Reversing Flows to Sutton and New Foul Segment in GCTS

This scenario is similar to Scenario 3A, the only difference being that instead of swapping the foul and storm cells a new foul segment would be constructed within the existing storm cell by either installing a pipe or preformed segmental liner. This new cell would take flows from the development areas of Lucan and Clondalkin.

Modelling has shown that the viability of this new segment is marginal in hydraulic terms and that it is sensitive to assumptions made relating to pipe or segment support and protective surround. To meet the 2011 design requirements significant flows would be diverted to the GCTS storm cell from the proposed Heuston Station PS and the Rathmines and Pembroke High Level catchment. On Health and Safety grounds the new foul sewer and the downstream infrastructure would have to be installed prior to diversion of these flows. Even allowing for this programming of the works, this scenario still presents considerable H&S risks. New working shafts, sunk on to the existing tunnel in heavily trafficked roads, would be required for safe access and provision for fluming through flows and overpumping would be necessary. Under high flow conditions the contractor would have to abandon the works. This would lead to downtime, slow progress and high construction costs. Social costs would be high in terms of traffic disruption and noise associated with 24 hour pumping.

The formidable technical difficulties and environmental and social impacts relating to the proposed duplication of the Contract 14 sewer, the MLPS, siphon and Ringsend inlet works upgrades, the Irishtown PS, the Sutton PS and other works in North Dublin as fully articulated in Scenario 3A apply to this scenario as do the risks of flooding associated with transfer of large quantities of stormwater within the foul sewer system to the Ringsend WwTW via the MLPS.
This option involves committing all flexibility in the GCTS / MLPS systems to conveying future West Dublin flows through critical existing infrastructure for transfer on to Portrane, via Sutton. The engineering works required would be extremely challenging, while the consequences would be to remove all residual capacity for contingency flows within the existing catchments for which these works have been designed.

### Overall Assessment (Infeasible)

**Technical:**
- Both the GCTS and Sutton works deemed infeasible (see Options 1A and 3A).
- Operational flexibility of the GCTS and MLPS systems deemed inadequate with no spare capacity for extreme event or system failure contingency.

**Environmental:**
- Major environmental objections and risks as stated for Option 3A.

### 11.7 Summary

Based on the assessment in Chapter 11.6 above, there are only two feasible options:

- **2B – Medium level Wastewater Treatment in South Dublin and discharge via the GCTS to Liffey Estuary, combined with development of new Regional Treatment Works at Portrane and diversion of North Dublin flows to it.** The ultimate development of an orbital sewer to Portrane serving the West of Dublin would provide for the long-term needs of the region beyond the current design horizon.

- **2C – Regional Wastewater Treatment at Portrane with development of an orbital sewer to serve the Northern and Western environs of the city and with pumped connection from South Dublin beyond 2011 and from Leixlip prior to 2031.**
12. PROPOSED WORKS AND COST ESTIMATES

12.1 Basis of Cost Estimation

Estimates of cost of the proposed works have been prepared and are based on current tender and out-turn costs of construction projects managed by the Consultant’s team members.

Estimates have been prepared for the two feasible strategic options, plus the catchment requirements for both foul/combined and storm catchments and the cost of upgrading the other wastewater treatment plants in the Region. Where the two strategic options have different operating cost characteristics, the respective operating costs have been assessed and integrated to a whole life cost comparison.

Estimates have been prepared for capital works expenditures up to the 2011 design horizon and between the 2011 and 2031 horizon. An initial attempt has been made to establish the phasing of costs based on a realistic implementation and funding profile, including the comparative whole life cost of the operational elements of the strategic options (NPV).

For budgeting purposes the cost of contingencies planning, legal, consultancy fees and land acquisition have been included and VAT has been included at a composite 15% rate.

12.2 Strategic Options – Capital Cost Estimates

The capital cost estimates for all of the strategic scenarios considered in Chapter 11 are included in Appendix B. Whilst the costs have been prepared for a range of scenarios, it has been established in Chapter 11 that only two options are feasible having regard to technical and environmental criteria critical to strategy success. Both these options are deemed worthy of detailed economic consideration as summarised in Table 12.1.

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
<th>2011 Cost</th>
<th>2031 Cost</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>2B</td>
<td>Storm Quality Treatment at South Dublin and discharge to the Storm Cell of GCTS</td>
<td>256m</td>
<td>566m</td>
<td>821m</td>
</tr>
<tr>
<td>2C</td>
<td>Divert flows to new WwTW in Fingal with links to Blanchardstown and South Dublin</td>
<td>256m</td>
<td>734m</td>
<td>990m</td>
</tr>
</tbody>
</table>

Table 12.1 Strategic Options Capital Cost Estimate Summary (incl. VAT)

Details of Table 12.1 are set out in Table 12.2 and Table 12.3. In addition to both options 2B and 2C a range of local catchment upgrades are required and these are listed in Table 12.4 and 12.5. Overall costs are shown in Table 12.9.
12.3 Option 2B – Capital Cost Estimate

Chapter 11 has identified that Option 2B is a feasible option catering for medium and long term needs. This option includes a range of projects as follows:-

- Retain Ringsend WwTW for the existing catchments with load management to accommodate short-term treatment needs. In the period up to 2011, residual network capacity is needed for development and resolution of pollution and flooding issues (e.g. Rathmines, City Quay Sewers).
- Extend Ringsend now to provide maximum treatment capacity;
- Major medium term development in South Dublin to be dealt with by a local treatment works outfalling to the storm section of the GCTS; and
- Develop a regional WwTW at Portrane, to cater for local needs with the option of intercepting some or all of the North Dublin catchment. In the long-term this will be extended to collect the Blanchardstown and South Dublin catchments post 2031.

The capital cost estimates for Option 2B, together with necessary upgrading of the network infrastructure are summarised in Table 12.2 below.

<table>
<thead>
<tr>
<th>Description</th>
<th>2011 Cost €</th>
<th>2031 Cost €</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upgrade Ringsend WwTW to 2.16m PE</td>
<td>50.0m</td>
<td>Nil</td>
</tr>
<tr>
<td>9C Blanchardstown Storage, CSOs and Trunk Sewers</td>
<td>15.6m</td>
<td>3.6m</td>
</tr>
<tr>
<td>9B Lucan Clondalkin Storage, CSOs and Trunk Sewers</td>
<td>22.2m</td>
<td>86.2m</td>
</tr>
<tr>
<td>City Centre Interceptors, Heuston Station PS and CSOs</td>
<td>42.5m</td>
<td>5.0m</td>
</tr>
<tr>
<td>Rathmines and Pembroke Foul Diversions to GCTS</td>
<td>26.5m</td>
<td>-</td>
</tr>
<tr>
<td>Main Lift PS Docklands</td>
<td>8.0m</td>
<td></td>
</tr>
<tr>
<td>Leixlip PS/Kildare Rising Main</td>
<td>-</td>
<td>19.3m</td>
</tr>
<tr>
<td>South Dublin WwTW for 300,000 PE including storage</td>
<td>-</td>
<td>69.7m</td>
</tr>
<tr>
<td>Expansion of Portrane WwTW to 300,000</td>
<td>-</td>
<td>70m</td>
</tr>
<tr>
<td>Orbital Sewer Swords to Portrane</td>
<td>-</td>
<td>34m</td>
</tr>
<tr>
<td>NDDS Sewer/Rising Main joining Sutton PS to Orbital Sewer</td>
<td>-</td>
<td>70m</td>
</tr>
<tr>
<td>Diversion of Swords Malahide Flow to Portrane</td>
<td>-</td>
<td>6.5m</td>
</tr>
<tr>
<td>Sub Total</td>
<td>164.7m</td>
<td>364.3m</td>
</tr>
<tr>
<td>Contingency 15%</td>
<td>24.7m</td>
<td>54.6m</td>
</tr>
<tr>
<td>Planning, Legal, Consultancy and Land Acquisition 20%</td>
<td>32.9m</td>
<td>72.9m</td>
</tr>
<tr>
<td>Total Excl. VAT</td>
<td>222.4m</td>
<td>491.7m</td>
</tr>
<tr>
<td>Total Incl. VAT (15%)</td>
<td>255.7m</td>
<td>565.5m</td>
</tr>
</tbody>
</table>

Table 12.2 Cost Estimates for the Proposed Option 2B Strategic Works
An element of the planning, legal, consultancy and land acquisition costs associated with the 2031 capital works will be incurred in the period up to 2011 and the above estimates reflect this requirement.

Any consideration of Option 2B compared with Option 2C will identify that post 2031 further major investment is inevitable to complete the orbital sewer and Portrane WwTW plant for long term regional needs. This recognises the limitation on capacity of the Liffey estuary receiving water and the risk that more rigorous Regulatory Standards could further limit this outlet over time.

12.4 Option 2C – Capital Cost Estimate

Chapter 11 has also identified that Option 2C (based on a single new regional wastewater treatment facility at Portrane) is a feasible option to cater for medium and long-term needs of the region. This option includes a range of projects as follows:-

- Retain Ringsend WwTW for the existing catchments with load management to accommodate short-term treatment needs (as Option 2B).
- Extend Ringsend now to provide maximum treatment capacity for short-term requirements in the existing catchment.
- Develop a regional WwTW at Portrane to cater for both local and regional needs, complete with the development of an orbital sewer to collect the western suburbs (Blanchardstown), with facility for connecting Swords, Malahide and the North Fringe area. At the same time, the option of a local treatment plant in South Dublin (as Option 2B) would be replaced by a pumping station and rising main to pump future development loads from South Dublin to the new orbital sewer.
- In the longer term, this orbital sewer would cater for diversion of additional loads from North Dublin and Kildare (Leixlip/Osberstown catchments) as the needs require it.

The capital cost estimates for Option 2C and necessary upgrading of the strategic network infrastructure are summarised in Table 12.3 below.
<table>
<thead>
<tr>
<th>Description</th>
<th>2011 Cost €</th>
<th>2031 Cost €</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upgrade Ringsend WwTW to 2.16m PE</td>
<td>50.0m</td>
<td>Nil</td>
</tr>
<tr>
<td>9C Blanchardstown Works</td>
<td>15.6m</td>
<td>1.0m</td>
</tr>
<tr>
<td>9B Lucan Clondalkin Works</td>
<td>22.2m</td>
<td>4.7m</td>
</tr>
<tr>
<td>City Centre Works (as 2B)</td>
<td>42.5m</td>
<td>5.0m</td>
</tr>
<tr>
<td>Rathmines &amp; Pembroke Works (as 2B)</td>
<td>26.5m</td>
<td>-</td>
</tr>
<tr>
<td>Main Lift PS Docklands</td>
<td>8.0m</td>
<td>-</td>
</tr>
<tr>
<td>Leixlip PS/Kildare Rising Main</td>
<td>-</td>
<td>19.3m</td>
</tr>
<tr>
<td>Develop Portrane WwTW</td>
<td>-</td>
<td>140m</td>
</tr>
<tr>
<td>Orbital Sewer Portrane to West Dublin</td>
<td>-</td>
<td>218m</td>
</tr>
<tr>
<td>9B South Dublin PS and Rising Main to Orbital Sewer</td>
<td>-</td>
<td>64.7m</td>
</tr>
<tr>
<td>Swords / Malahide Diversion to Orbital Sewer</td>
<td>-</td>
<td>6.5m</td>
</tr>
<tr>
<td>Meath Catchments Diversion to Orbital Sewer</td>
<td>-</td>
<td>18.3</td>
</tr>
<tr>
<td>Sub-Total</td>
<td>164.7m</td>
<td>472.7m</td>
</tr>
<tr>
<td>Contingency 15%</td>
<td>24.7m</td>
<td>70.9m</td>
</tr>
<tr>
<td>Planning, Legal, Consultancy and Land Acquisition 20%</td>
<td>32.9m</td>
<td>94.5m</td>
</tr>
<tr>
<td>Total excl. VAT</td>
<td>222.4m</td>
<td>638.1m</td>
</tr>
<tr>
<td>Total incl. VAT (15%)</td>
<td>255.7m</td>
<td>733.8m</td>
</tr>
</tbody>
</table>

Table 12.3  Cost Estimates for Proposed Option 2C Strategic Works

A significant element of the planning, legal, consultancy and acquisition costs associated with the 2031 works would be incurred in the period up to 2011 in order to provide for the long-term needs satisfactorily. The above estimates are intended to reflect this requirement. In Option 2C, the nucleus for the long-term alternative regional drainage system (to Ringsend) would be put in place. For this reason, Option 2C involves investment in infrastructure which will provide regional needs well beyond 2031. This factor will need to be considered in the economic comparison.

12.5  Other Catchment and WwTW Upgrading Requirements

The Capital investment requirements for upgrading of the foul and storm catchments and the smaller wastewater treatment facilities in the Region are identical between Option 2B and Option 2C and are summarised in Tables 12.4, 12.5 and 12.6 below.

12.5.1  Catchment Requirements – Capital Cost Estimates

A full breakdown of capital cost estimates including summary quantities and unit rates for the recommended works for each catchment within the GDSDS is included in Appendix B. This summarises the works identified at individual catchment level in the Phase 3 – Needs, Options and Strategy Reports. These works form part of the required strategy in both Options 2B and 2C.

Table 12.4 provides a summary of costs for the foul catchments and Table 12.5 a summary of storm catchment costs. Catchments which were not covered by the GDSDS but were the subject of separate study have not been included in the cost estimates.
<table>
<thead>
<tr>
<th>Catchment Ref.</th>
<th>Foul Catchment</th>
<th>2011 Cost €</th>
<th>2031 Cost €</th>
</tr>
</thead>
<tbody>
<tr>
<td>F001</td>
<td>City Centre Dockland</td>
<td>80.2m</td>
<td>Nil</td>
</tr>
<tr>
<td>F002</td>
<td>Grand Canal Phase 1</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>F003</td>
<td>Grand Canal</td>
<td>20.5m</td>
<td>0.2m</td>
</tr>
<tr>
<td>F004</td>
<td>NDDS and North Fringe</td>
<td>28.4m</td>
<td>0.5m</td>
</tr>
<tr>
<td>F005</td>
<td>Rathmines and Pembroke</td>
<td>16.5m</td>
<td>Nil</td>
</tr>
<tr>
<td>F006/007</td>
<td>Dodder Valley</td>
<td>17.4m</td>
<td>3.6m</td>
</tr>
<tr>
<td>F008</td>
<td>Lucan Clondalkin</td>
<td>32.2m</td>
<td>48.5m</td>
</tr>
<tr>
<td>F009</td>
<td>Newcastle/Rathcoole/Saggart</td>
<td>1.2m</td>
<td>35.9</td>
</tr>
<tr>
<td>F010</td>
<td>Dun Laoghaire WPE</td>
<td>0.9m</td>
<td>Nil</td>
</tr>
<tr>
<td>F011</td>
<td>Dun Laoghaire WPW</td>
<td>5.4m</td>
<td>0.3m</td>
</tr>
<tr>
<td>F012</td>
<td>Shanganagh Bray</td>
<td>25.8m</td>
<td>Nil</td>
</tr>
<tr>
<td>F013</td>
<td>Upper Liffey Valley/Osberstown</td>
<td>50.3m</td>
<td>Nil</td>
</tr>
<tr>
<td>F014</td>
<td>Lower Liffey Valley</td>
<td>39.5m</td>
<td>39.0m</td>
</tr>
<tr>
<td>F015</td>
<td>Rush and Lusk</td>
<td>Excl.</td>
<td>Excl.</td>
</tr>
<tr>
<td>F016</td>
<td>Malahide</td>
<td>2.5m</td>
<td>0.7m</td>
</tr>
<tr>
<td>F017</td>
<td>Balbriggan Skerries</td>
<td>Excl.</td>
<td>Excl.</td>
</tr>
<tr>
<td>F018</td>
<td>Swords</td>
<td>5.6m</td>
<td>13.2m</td>
</tr>
<tr>
<td>F019</td>
<td>Donabate/Portrane</td>
<td>Excl.</td>
<td>Excl.</td>
</tr>
<tr>
<td></td>
<td>Sub Total</td>
<td>326.4m</td>
<td>141.9m</td>
</tr>
<tr>
<td></td>
<td>Contingency 15%</td>
<td>49.0m</td>
<td>21.3m</td>
</tr>
<tr>
<td></td>
<td>Planning, Legal Consultancy and Land Acquisition 20%</td>
<td>65.3m</td>
<td>28.4m</td>
</tr>
<tr>
<td></td>
<td>Total excl. VAT</td>
<td>440.6m</td>
<td>191.6m</td>
</tr>
<tr>
<td></td>
<td>Total incl. VAT (15%)</td>
<td>506.7m</td>
<td>220.3m</td>
</tr>
</tbody>
</table>

*Table 12.4 Cost Estimates for Foul Catchments*
<table>
<thead>
<tr>
<th>Catchment Ref.</th>
<th>Storm Catchment Name</th>
<th>2011 Cost €</th>
<th>2031 Cost €</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1001</td>
<td>Mayne River</td>
<td>1.8m</td>
<td>0.1m</td>
</tr>
<tr>
<td>S1002</td>
<td>Santry River</td>
<td>1.6m</td>
<td>6.9m</td>
</tr>
<tr>
<td>S1003</td>
<td>Finglas River</td>
<td>2.4m</td>
<td>0.1m</td>
</tr>
<tr>
<td>S1004</td>
<td>Camac River</td>
<td>16.1m</td>
<td>0.9m</td>
</tr>
<tr>
<td>S1005</td>
<td>Puddle River</td>
<td>14.2m</td>
<td>0.2m</td>
</tr>
<tr>
<td>S1006</td>
<td>Swan Stream</td>
<td>Excl.</td>
<td>Excl.</td>
</tr>
<tr>
<td>S1007</td>
<td>Deansgrange River</td>
<td>9.6m</td>
<td>Nil</td>
</tr>
<tr>
<td>S1008</td>
<td>Carrickmines River</td>
<td>0.6m</td>
<td>Nil</td>
</tr>
<tr>
<td>S2001</td>
<td>River Lyereen Ryewater</td>
<td>6.7m</td>
<td>0.2m</td>
</tr>
<tr>
<td>S2002A</td>
<td>Broadmeadow Malahide</td>
<td>2.5m</td>
<td>Nil</td>
</tr>
<tr>
<td>S2002B</td>
<td>Broadmeadow Portmarnock</td>
<td>1.2m</td>
<td>Nil</td>
</tr>
<tr>
<td>S2003</td>
<td>Broadmeadow Swords</td>
<td>9.3m</td>
<td>0.5m</td>
</tr>
<tr>
<td>S2004</td>
<td>Broadmeadow Donabate/Portrane</td>
<td>4.1m</td>
<td>Nil</td>
</tr>
<tr>
<td>S2007</td>
<td>Tolka Blanchardstown</td>
<td>14.8m</td>
<td>1.3m</td>
</tr>
<tr>
<td>S2008</td>
<td>Tolka NDDS</td>
<td>9.2m</td>
<td>Nil</td>
</tr>
<tr>
<td>S2009</td>
<td>Dodder Owendoher</td>
<td>6.4m</td>
<td>0.5m</td>
</tr>
<tr>
<td>S2011</td>
<td>Dundrum/Slang</td>
<td>9.8m</td>
<td>Nil</td>
</tr>
<tr>
<td>S2012</td>
<td>Naniken</td>
<td>1.1m</td>
<td>Nil</td>
</tr>
<tr>
<td>S2013</td>
<td>Dargle</td>
<td>2.7m</td>
<td>Nil</td>
</tr>
<tr>
<td>S2014</td>
<td>DLR West Pier West</td>
<td>3.9m</td>
<td>0.2m</td>
</tr>
<tr>
<td>S2015</td>
<td>Clontarf</td>
<td>1.4m</td>
<td>Nil</td>
</tr>
<tr>
<td><strong>Sub Total</strong></td>
<td></td>
<td><strong>119.4m</strong></td>
<td><strong>10.9m</strong></td>
</tr>
<tr>
<td><strong>Contingency 15%</strong></td>
<td></td>
<td><strong>17.9m</strong></td>
<td><strong>1.6m</strong></td>
</tr>
<tr>
<td><strong>Planning, Legal Consultancy and Land Acquisition 20%</strong></td>
<td></td>
<td><strong>23.9m</strong></td>
<td><strong>2.2m</strong></td>
</tr>
<tr>
<td><strong>Total excl. VAT</strong></td>
<td></td>
<td><strong>161.2m</strong></td>
<td><strong>14.7m</strong></td>
</tr>
<tr>
<td><strong>Total incl. VAT (15%)</strong></td>
<td></td>
<td><strong>185.4m</strong></td>
<td><strong>16.9m</strong></td>
</tr>
</tbody>
</table>

*Table 12.5  Cost Estimates for Storm Catchment Work*
12.5.2 Wastewater Treatment Plants

The cost of upgrading the Ringsend WwTW, the staged development of a new WwTW in South Dublin and the development of a coastal WwTW at Portrane are included in the two feasible strategic Options 2B and 2C.

There are seven additional WwTW schemes that will require staged expansion to meet the needs of the Region to 2031 which are common to each option. Table 12.6 summarises the estimated costs of development of these facilities.

<table>
<thead>
<tr>
<th>WwTW</th>
<th>2011 Cost €</th>
<th>2031 Cost €</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shanganagh</td>
<td>50m</td>
<td>15m</td>
</tr>
<tr>
<td>Osberstown</td>
<td>15m</td>
<td>15m</td>
</tr>
<tr>
<td>Leixlip</td>
<td>15m</td>
<td>40m</td>
</tr>
<tr>
<td>Portrane</td>
<td>20m</td>
<td>Nil</td>
</tr>
<tr>
<td>Malahide</td>
<td>Nil</td>
<td>5m</td>
</tr>
<tr>
<td>Balbriggan/Skerries</td>
<td>40m</td>
<td>15m</td>
</tr>
<tr>
<td>Swords</td>
<td>40m</td>
<td>15m</td>
</tr>
<tr>
<td><strong>Sub Total</strong></td>
<td><strong>180m</strong></td>
<td><strong>105m</strong></td>
</tr>
<tr>
<td>Contingency 15%</td>
<td>27m</td>
<td>15.7m</td>
</tr>
<tr>
<td>Planning, Legal Consultancy and Land Acquisition 20%</td>
<td>36m</td>
<td>21m</td>
</tr>
<tr>
<td><strong>Total excl. VAT</strong></td>
<td><strong>243m</strong></td>
<td><strong>141.7m</strong></td>
</tr>
<tr>
<td><strong>Total incl. VAT (15%)</strong></td>
<td><strong>279.5m</strong></td>
<td><strong>163.0m</strong></td>
</tr>
</tbody>
</table>

*Table 12.6 Cost Estimate for Treatment Works Expansion*

12.6 Option 2B - Overall Capital Costs

The overall cost inclusive of VAT of the strategic Option 2B and catchment upgrading is summarised in Table 12.7 below.

<table>
<thead>
<tr>
<th>Description</th>
<th>2011 Cost €</th>
<th>2031 Cost €</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategic Option (2B)</td>
<td>255.7m</td>
<td>565.5m</td>
</tr>
<tr>
<td>Foul Catchments</td>
<td>506.7m</td>
<td>220.3m</td>
</tr>
<tr>
<td>Storm Catchments</td>
<td>185.4m</td>
<td>16.9m</td>
</tr>
<tr>
<td>Treatment Works</td>
<td>279.5m</td>
<td>163.0 m</td>
</tr>
<tr>
<td><strong>Total Option 2B</strong></td>
<td><strong>1,227.3m</strong></td>
<td><strong>965.7m</strong></td>
</tr>
</tbody>
</table>

*Table 12.7 Overall Cost Estimate Summary – Strategic Option 2B*
Capital investment required to implement works identified in the GDSDS based on Option 2B amounts to €2,193M inclusive of VAT comprising €1,227m up to 2011 and €966m between 2011 and 2031. Based on identified needs and development pressures, there is a severe back-log of investment required in the short-term. The recommendations to 2011 provide the basis of a detailed programme of works to be managed for short-term delivery in the Dublin region to address this backlog.

12.7 Option 2B – Whole Life Operating Costs

Whole Life Operating costs for Option 2B have been calculated over a thirty year period, taking into account wastewater treatment and pumping arrangements required as part of the option. The Net Present Value (NPV) spreadsheet showing details of the calculations is included in Appendix B. In summary the NPV of operational costs associated with Option 2B is in the region of €240 million. This brings the Whole Life Cost (WLC) of Option 2B to €2,433 million.

12.8 Option 2C - Overall Capital Costs

The overall cost, inclusive of VAT, of the Strategic Option 2C and catchment upgrading is summarised in Table 12.8 below:

<table>
<thead>
<tr>
<th>Description</th>
<th>2011 Cost €</th>
<th>2031 Cost €</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategic Option (2C)</td>
<td>255.7m</td>
<td>733.8m</td>
</tr>
<tr>
<td>Foul Catchments</td>
<td>506.7m</td>
<td>220.3m</td>
</tr>
<tr>
<td>Storm Catchments</td>
<td>185.4m</td>
<td>16.9m</td>
</tr>
<tr>
<td>Treatment Works</td>
<td>279.5m</td>
<td>163.0m</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,227.3m</strong></td>
<td><strong>1,134.1m</strong></td>
</tr>
</tbody>
</table>

Table 12.8 Overall Cost Estimate Summary – Strategic Option 2C

Capital investment required to implement works identified in the GDSDS, based on Option 2C, would amount to €2,361m inclusive of VAT, being €1,227m to 2011 (as Option B) and €1,134m to 2031. Based on identified needs and development and the nature of Option 2C, very significant front-loading of investment is essential in order to meet the regional needs in the short to medium-term while catering for the long-term requirements. In this option the Portrane Regional WwTW and associated orbital sewer, with South Dublin connection, will be needed early in the post 2011 period to serve the planned development in the expanding Blanchardstown 9C and Lucan/Clondalkin 9B catchments and beyond.

12.9 Option 2C – Whole Life Operating Costs

Whole Life Operating costs for Option 2C have been calculated over a thirty year period, taking into account wastewater treatment and estimated pumping arrangements required as part of the option. The Net Present Value (NPV) spreadsheet showing details of the calculations is included in Appendix B. In summary the NPV of operational costs associated with Option 2C is in the region of €224 million. This brings the Whole Life Cost (WLC) of Option 2C to €2,585 million.
12.10 Options 2B and 2C – Whole Life Costs Comparison

In summary, the following cost estimates apply:-

<table>
<thead>
<tr>
<th>Description</th>
<th>Option 2B</th>
<th>Option 2C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2011 Cost €</td>
<td>2031 Cost €</td>
</tr>
<tr>
<td>Strategic Option</td>
<td>255.7m</td>
<td>565.5m</td>
</tr>
<tr>
<td>Foul Catchments</td>
<td>506.7m</td>
<td>220.3m</td>
</tr>
<tr>
<td>Storm Catchments</td>
<td>185.4m</td>
<td>16.9m</td>
</tr>
<tr>
<td>Treatment Works</td>
<td>279.5m</td>
<td>163.0m</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1,227.3m</td>
<td>965.7m</td>
</tr>
<tr>
<td>Capital Costs Total</td>
<td>2,193m</td>
<td></td>
</tr>
<tr>
<td>Operational Whole Life</td>
<td>240m</td>
<td></td>
</tr>
<tr>
<td>Costs Total</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comparative Whole Life</td>
<td>2,433m</td>
<td></td>
</tr>
<tr>
<td>Cost</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 12.9 Strategic Options 2B and 2C - Comparison

Financial analysis and comparison of options leads to the following conclusions:-

The total capital cost of Option 2B is €2,193 million. The total capital cost of Option 2C is €2,361 million. These total costs include strategic option costs, foul and storm catchment costs and wastewater treatment plant costs, plus contingencies, overheads, planning and VAT.

The operational Whole Life Cost of Option 2B is €240 million, whereas the operational Whole Life Cost of Option 2C is €224 million.

When added together, the Capital Cost plus the operational Whole Life Costs for Option 2B and 2C amount to €2,433 million and €2,585 million respectively.

The strategy study has identified the requirement for capital investment of the order of €1.2 billion for 2011 needs and €1.0 – 1.1 billion to meet the further needs of the region to 2031.

The estimated capital cost difference between Options 2B and 2C is calculated at €168m in favour of Option 2B (inclusive of overheads and VAT). This figure is reduced to the order of €152m when relative operating costs are accounted for in an NPV calculation. This represents a 6% difference in favour of Option 2B. Given the sensitivity to changes in quantities and the unit rates used in estimation of costs at strategy stage, this difference cannot be regarded as significant. Furthermore, the level of risk associated with Option 2C is considered to be lower than for Option 2B, given that a larger proportion of the works can be accommodated in green-field sites.
13. STRATEGY OPTION RECOMMENDATION

13.1 Regional Context and Selection Criteria

The recommendations of this GDSDS Strategy Report should identify the best regional approach to provide for the future drainage needs of the Greater Dublin Region at 2011, 2031 and beyond. This approach is one which meets certain critical criteria:

- **Technical;** it is technically achievable both from a construction and operational viewpoint. This requires that it could be delivered by means of practical measures within an acceptable risk management framework and that its operation would be expected to successfully cater for the range of flow and load conditions likely to arise across the region. The analysis of the scenarios in Chapter 11 demonstrated that many of the options involving re-configuring of existing infrastructure fail to meet this criterion of technical feasibility.

- **Environmental;** the selected option should be consistent with environmental standards and objectives applicable to the construction and operation of the works. Inevitably, there is a risk that future standards will be more restrictive than those currently envisaged. Therefore, it is appropriate to consider the relative risks due to more restrictive standards associated with feasible technical options in the final selection of the Strategy Recommendations.

- **Economic;** it is considered that the whole life cost comparison between the feasible options emerging from Chapter 11, as reviewed in Chapter 12, shows only a marginal difference, having regard to the margin of error which must apply to cost estimates in advance of detailed engineering feasibility studies. The list of projects involved in the Strategy Recommendation require detailed cost appraisal as they are developed through planning, design development and procurement. As this detailed planning evolves, it is likely that sub-options will emerge for consideration due to siting, timing and general constraints, leading to refinement of the strategy elements.

The development of the options and their associated capacities takes account of the anticipated regional needs, in the context of the limitations of regional and strategic local infrastructure. Current systems are overloaded and are at serious risk of failure (flooding and pollution threats). They are incapable of meeting present and future needs, without large scale upgrading. Failure to deliver this upgrading will result in:

- Increased frequency of flooding and pollution emergencies.

- The need to restrict development.

- Cost liabilities associated with system overloading and performance failures.

The alternative offered by this strategy, therefore, is for an integrated regional approach to upgrading the infrastructure in line with the Regional Planning Guidelines, National Spatial Strategy, Environmental Directives and Regulations governing the management and disposal of wastewater and the protection of the water environment. These objectives cannot be satisfied without a co-ordinated and agreed regional approach to each of the following aspects:

- Planning and development.

- Implementation of environmental and network management policies developed in this study.

- Co-ordinated programme of infrastructure upgrading to the required sequence and timing.

- Co-ordinated approach to load management within the catchment including management of pollution loads from the non-domestic sector, management of stormwater inflows to sewers and regulation of forward flows within the stated capacities of the downstream systems.

The recommended infrastructure option is selected within this context.
13.2 Feasible Strategy Options

Based on the assessment in Chapter 11, it is clear that the way forward for drainage planning in the Greater Dublin Region is limited to two broad options, namely:

- **Option 2B**: where **two new wastewater treatment facilities** are developed to meet the regional needs beyond 2011, in addition to the full development of the Ringsend Works. This will involve developing a regional plant at Portrane in North Dublin to which the North Fringe and, ultimately, the North Dublin Catchments (in addition to Malahide and Swords) would be discharged. This option would facilitate the ultimate development of an orbital sewer to West Dublin to meet long term needs beyond 2031. Because development in South Dublin beyond 2011 will exceed the capacity of the Route 9B and Grand Canal Tunnel (GCTS) / Ringsend systems, a new wastewater treatment facility would be required to serve development to the South of the existing Lucan / Clondalkin catchments discharging a high quality treated effluent to the storm cell of the Grand Canal Tunnel Sewer through a long outfall tunnel, availing of the spare capacity which the storm cell offers. Such a plant would be required to satisfy all of the environmental criteria appropriate for a modern plant within an industrial zoned area (full enclosure and noise / air emission controls).

- **Option 2C**: where **a single regional wastewater treatment facility** at Portrane in North Dublin with the short term development of a major orbital sewer to serve both the Northern and Western environs of the City would be required. The South Dublin needs beyond 2011 will be met by connecting the new South Dublin Catchments to the orbital sewer by means of a pumped system.

Both of these schemes would have to be developed having regard to both short and long term capacity requirements. For example, it would be necessary to make provision for relieving the Leixlip Catchment in North Kildare by pumping to the Dublin Regional Scheme approaching 2031.

As outlined above, the ultimate whole life cost difference between these two major alternative approaches is not statistically significant. Accordingly, the decision as to which option should be proceeded with should be determined on technical and environmental grounds primarily. However, the affordability of the preferred option and funding of its implementation will have to be considered carefully by the Client / Funding Authorities. Chapter 14 develops an indicative programme and funding profile for the strategy recommendations.

13.2.1 2B – Combination of South Dublin and Portrane Wastewater Treatment Facilities

This option provides for parallel development of two new wastewater treatment facilities in order to meet the medium term development needs of the Dublin region, over and above the maximum capacity of the Ringsend plant (2.16M PE). In this option, the following facilities will be developed:

- A new wastewater treatment plant would be provided in South Dublin to cater for additional developments south of Lucan / Clondalkin with an independent outfall to the Grant Canal Tunnel Stormwater Cell. Existing development in South Dublin to 2011 would be satisfied by an upgraded Route 9B infrastructure. The new treatment plant would then be developed and gradually expanded to meet future development needs beyond those currently zoned, including excess loads at Leixlip over and above the capacity of the River Liffey at this location.

- The Portrane Regional Wastewater Treatment Facility would be developed to cater for Portrane itself, to intercept Swords and Malahide and to divert the North Fringe flows away from Sutton and from the Ringsend Treatment Plant. It is considered that this level of development would allow Ringsend to satisfy the 2031 requirements in the residual catchment. Post 2031, an orbital sewer would be developed to intercept the expanding western environs of Dublin and this orbital sewer could ultimately intercept the load from the South Dublin plant. This approach would allow for postponement of the full scope of the orbital sewer construction until a significant base load has been generated to give reasonable utilisation of the facilities.

Key **advantages** of this option would appear to be the following:

- It provides for development in the Dublin region beyond 2011 without compromising the ability (subject to effective load management) of the Ringsend plant and its associated collector system to meet the needs of the existing Dublin conurbation for the foreseeable future.
• It allows for the development of two separate facilities, each located close to the development areas which they are required to service. While the connecting sewers would have to be sized for the long-term needs, the plants themselves could be modular and expanded in stages to keep pace with the development. This would be beneficial to technical operation and in terms of the funding requirements.

• The South Dublin plant could be designed and operated on a fixed term operational contract for a defined period (say 20 years), following which it could be eventually made redundant when the Western Orbital Sewer is in place and South Dublin can be connected.

• The two Local Authorities with responsibility for the major proportion of future development (Fingal and South Dublin County Councils) would each have independent control over the planning and implementation of these proposals, largely within their jurisdictions, in line with local development planning and policies.

**Disadvantages** with this strategy can be identified as:

• The South Dublin discharge to the transitional waters of the Liffey Estuary will require to be treated to a significantly higher standard than discharges at Portrane. Moreover, future European and National Policy is likely to result in tighter standards for such waters, particularly where they are subjected to significant environmental pressures, with the risk that more advanced treatment technologies might be required over time.

• There are considerable practical difficulties to be overcome in the implementation of the South Dublin facility in terms of siting of the plant and the 9.5km long outfall sewer to the GCTS, including the requirement for a substantial stormwater storage volume as an integral part of the plant development.

• Any South Dublin plant will be required to comply with rigorous environmental constraints by virtue of its siting in a developed area, requiring the highest standards of environmental design and operational management.

• It is likely that the operating cost of two plants will exceed that for a single integrated plant, though this may be less significant if the conveyance system to Portrane involves multiple pumping stages (to be determined from detailed engineering studies).

In summary, the twin plant option is feasible and achievable but has a number of disadvantages, the principal one being uncertainty as regards the treated effluent criteria which would apply to the South Dublin discharges to the Liffey Estuary via the GCTS Storm Sewer Cell.

**13.2.2 Single New Regional Wastewater Treatment Plant at Portrane**

The only feasible alternative to a twin plant option is for the provision of a new large capacity wastewater treatment facility at Portrane, discharging to the Irish Sea, with capacity to be expanded in stages to meet the long-term needs of the Dublin region. In this option, the Portrane scheme would include a major western orbital sewer which would relieve the western environs of Dublin and would provide for pumped transfer of flows from South Dublin and, ultimately, from Kildare (Leixlip and Osberstown catchments), thereby satisfying all of the future needs of the major development areas outside of the existing serviced catchment. The scheme would provide for connecting in Swords and Malahide and would provide flexibility for intercepting flows from the North Fringe catchment to reduce the load on Ringsend.

The principal **advantages** of this scheme would appear to be:

• It provides an integrated and comprehensive scheme to meet the development needs of the Dublin region, with the Ringsend plant to be dedicated to the existing serviced catchment.

• This scheme could be designed to have considerable flexibility for long-term regional needs by effective management of storm water loads and by providing for modular expansion of the Portrane treatment facility in appropriate phases.
• Given that the discharge would be to the Irish Sea, the risks associated with future environmental standards are minimised.

The principal disadvantages of this option are considered to be:

• The full orbital sewer is required to be constructed in conjunction with the initial development of the Portrane treatment plant in order to facilitate an early connection from Blanchardstown and South Dublin.

• Given the need to provide for the long-term regional needs, the design will have to be able to cater satisfactorily for a wide range of load conditions.

• Successful delivery of the scheme will require an agreed integrated approach between the different Authorities as regards the planning and funding of the scheme, particularly the level of up-front capital funding required.

13.3 Strategy Recommendation

Both of the foregoing schemes have the capacity to meet the regional needs, in conjunction with the Ringsend system, for the design horizon specified (2031). Whichever option is adopted, it will require to be accompanied by implementation of the necessary upgrading of the existing collection and treatment facilities, many of which are immediate priorities to meet short-term needs to 2011. These measures include upgrading Ringsend WwTW to its maximum capacity as a matter of urgency, completing the upgrading of the plants at Shanganagh-Bray, Fingal coastal towns, Leixlip, and Osberstown and implementing major upgrading of the collection system, in order to reduce flooding risk and to relieve pollution from unsatisfactory combined sewer overflows (CSO’s), e.g., the Liffey Quays sewers in the City Centre catchment.

The Option 2B whole life cost is some 5% lower than those of Option 2C for the works required at 2031. However, beyond that date, it is envisaged that the Western orbital sewer (and South Dublin / Kildare connections) would be required in any event. Therefore, if a longer design horizon were to be adopted, this cost difference may be reversed. Accordingly, the choice of strategy cannot be decided solely on economic grounds.

Given that both schemes are technically feasible and that the long-term whole life cost difference between the options is not decisive, it would appear that the Portrane option for a single new regional plant, combined with the major western orbital sewer, offers the most robust solution. Notwithstanding the technical and funding challenges which it presents, it is recommended as the preferred outcome of this strategy study on the basis that:

• It offers the least environmental risk in the context of receiving water standards and community impacts, and

• It offers the most robust and secure operational regime, relying largely on proven technologies and with lower community impact where the bulk of the works can be constructed outside of existing developed areas.

Implementation of this recommendation will require an agreed regional approach between the Local Authorities and the Department of the Environment, Heritage and Local Government in support of the successful planning, funding arrangements and procurement strategies for implementation according to the required timescales.
14. IMPLEMENTATION OF THE STRATEGY PLAN

14.1 General

The strategy proposals recommended in Chapter 13 embrace a framework of works which will be subject to further design development prior to implementation.

The process of strategy Implementation is summarised in Figure 14.1 identifying the following steps:-

- **Strategy Adoption;** whereby the overall strategy is adopted by the Local Authorities and submitted to the Department of the Environment, Heritage and Local Government as the blueprint for the development and performance management of the storm and foul drainage systems for the Greater Dublin Region for the next 20-25 years, recognising a significant front-loading requirement due to a back-log of investment needs.

- **Strategy Implementation Planning;** whereby the Local Authorities, in consultation with DoEHLG develop a detailed strategy implementation plan which differentiates between policy and operational components to be implemented across the Local Authorities and a Programme of Capital Projects for which phasing, budgets and funding proposals require to be determined.

- **Strategic Environmental Assessment;** the application of the EU Directive on Strategic Environmental Assessment may require to be considered for the strategy as a whole, within which individual project assessments would be carried out as part of a risk management strategy for statutory process implementation.

- **Programme of Capital Projects;** a Programme of Capital Projects will be evolved for implementation, identifying the general scope, timescale and outline budgets for these projects in the context of the overall phasing of the strategy. This stage would include identification of a lead Authority for the individual projects to oversee implementation and an overall assessment of PPP suitability. On this basis, the promoting Authority can determine which procurement strategies are to be contemplated.

- **Preliminary Report;** the Preliminary Report for individual projects will address the detailed project requirements as a basis for defining the scope of work, budgets and timeframe. At that stage, more detailed studies will be necessary to optimise the work, evaluate local options, take account of physical, environmental and other constraints, consider stakeholder impacts and general environmental appraisal. This element will include detailed siting and sizing of the works. In conjunction with completion of the Preliminary Report, it will be necessary in accordance with DoEHLG Policy to complete
  - A Water Charging Policy Report
  - Public Private Partnership Assessment in accordance with the Department’s Guidelines of August 2001 for Water Services Projects. In conjunction with this Assessment, issues of funding may require to be addressed, where public funding is not immediately available for the preferred funding option.

- **Project Delivery Stage;** approval of Preliminary Report, Water Charging Policy and PPP Assessment provides the basis for the implementation stage of the Project involving project design development, statutory processes, contract documentation, procurement, construction and commissioning. This phase would follow established procedures whether as traditional or PPP project, depending on the outcome of earlier studies.

- **Performance Management and Operation;** during which the project works are operated as an integral part of the Greater Dublin Drainage System.

The precise timetable for strategy implementation, therefore, can only be fully determined in the context of the foregoing process for project delivery. However, given the current rate of development for the region and the known inadequacies with the existing drainage infrastructure, there is a need to progress the 2011 works and in particular the upgrade of the Ringsend WwTW as a matter of urgency.
### 14.2 Indicative PPP Assessment

Table 14.1 provides a general overview of the principal work categories, key elements and their phasing according to the Strategy. This considers works required to meet the 2011 demands and the ultimate works required to satisfy estimated demands at 2031.

<table>
<thead>
<tr>
<th>Work Items</th>
<th>2011 Required</th>
<th>2031 Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Wastewater Treatment</td>
<td>• Ringsend upgraded</td>
<td>• Regional WwTW at Portrane</td>
</tr>
<tr>
<td></td>
<td>• Local plant upgrades</td>
<td>• Further Local Plant Upgrades</td>
</tr>
<tr>
<td></td>
<td>- Shanganagh</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Leixlip</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Osberstown</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Fingal Coastal</td>
<td></td>
</tr>
<tr>
<td>2. Major Trunk/Diversion Foul Sewers</td>
<td>• Blanchardstown and Mulhuddart (9C upgrade)</td>
<td>• Orbital Sewer to Portrane</td>
</tr>
<tr>
<td></td>
<td>• Lucan/Clondalkin (9B) Upgrade/Overflow link to GCT Storm Cell</td>
<td>• South Dublin Transfer to Orbital Sewer</td>
</tr>
<tr>
<td></td>
<td>• Heuston Station diversion to GCT Foul Cell</td>
<td>• Kildare transfer to Orbital Sewer</td>
</tr>
<tr>
<td></td>
<td>• R &amp; P New Sewers and CSO connections to GCT</td>
<td>• Diversion of Swords and Malahide to Portrane</td>
</tr>
<tr>
<td></td>
<td>• City Centre/Docklands Works</td>
<td>• Kilbride / Meath Diversion</td>
</tr>
<tr>
<td>3. Existing Foul Network Upgrading</td>
<td>• Detailed DAP Studies</td>
<td>• Full CSO Upgrading Works</td>
</tr>
<tr>
<td></td>
<td>• Priority CSO Rationalisation &amp; Upgrading</td>
<td>• Long-term Rehabilitation Programme</td>
</tr>
<tr>
<td></td>
<td>• Stormwater Separation and Rehabilitation</td>
<td></td>
</tr>
<tr>
<td>4. Stormwater Management</td>
<td>• Priority Flood Protection Works on Rivers</td>
<td>• River Management Programme</td>
</tr>
<tr>
<td></td>
<td>• Local Storm Sewer Upgrading</td>
<td>• SuDS Implementation and Management</td>
</tr>
<tr>
<td></td>
<td>• SuDS Promotion, Development and Implementation</td>
<td></td>
</tr>
</tbody>
</table>

**Table 14.1 Overview of Works and Phasing**

From the Table, the works are classified in 4 principal categories, namely:

- **Wastewater Treatment**: either upgrading of existing treatment facilities or development of new facilities
- **Major Trunk/Diversion Foul Sewers**: identifying the principal major new strategic sewerage infrastructure elements required to meet future needs.
- **Existing Foul Network Upgrading**: involving local strengthening of the network, rationalisation of overflows, stormwater separation/infiltration reduction works and general rehabilitation, for which
design development will involve further detailed surveys and assessment (impermeable area, infiltration, receiving water quality, modelling and detailed drainage area plans) in order to prioritise works and minimise costs.

- **Stormwater Management**: involving river flood protection works, storm sewer strengthening and upgrading, river and floodplain management planning and the systematic implementation of Sustainable Drainage Systems (SuDS) for future developments.

A Preliminary Assessment of these elements for implementation as Public Private Partnership (PPP) options is shown in Table 14.2. By definition, this is preliminary in nature having regard to the generalised description of Works available at strategy level.

This assessment follows the steps set out in the Guidelines for Preparing a PPP Assessment Report. It is envisaged that more detailed assessments will be carried out on a project by project basis at Preliminary Report stage.

The provision of upgraded or new wastewater treatment facilities will involve implementation of a number of projects which can be briefly reviewed as follows:-

- **Upgrading of the Ringsend Works** which involves expansion of existing facilities within the framework of an existing DBO contract. A preliminary set of issues are identified in the Table, which will require to be assessed in detail. There is scope within the existing DBO contract framework to upgrade the Works and this will need to be reviewed along with other procurement strategies to ensure value for money and early delivery of the expanded facility.

- **Local Plant upgrades at Shanganagh, Leixlip, Osberstown and Fingal Coastal towns** are reviewed. The review indicates that these projects can proceed as DB or DBO projects in accordance with current procedures and policies. Again, public finance is likely to be preferred on value for money grounds.

- **Portrane Wastewater Treatment Works**; the development of a strategic long-term facility at Portrane for the ultimate future needs of the Region, apart from Ringsend, is an essential recommendation of the strategy. This facility could be provided by current DB/DBO procedures with availability of public finance. It could be considered for private finance, subject to detailed consideration of the phasing requirements and revenue risk. It would appear likely that any potential DBOF contract would require some form of guarantees on this key risk.
Table 14.2  PPP Preliminary Assessment

<table>
<thead>
<tr>
<th>Strategy Element</th>
<th>Initial Output Specification</th>
<th>Preliminary Risk Assessment</th>
<th>Legal Viability Assessment</th>
<th>Stakeholder Issues</th>
<th>Value for Money</th>
<th>Bankability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Plant Upgrades</td>
<td>Retain - Planning - Load Management - Regulatory - Staff Stakeholder Possible Transfer (as Ringsend)</td>
<td>Established Legal Framework for DB/DBO contracts - Inter-Authority Agreement (Shanganagh)</td>
<td>Staff Transfer or alternative - Residual Planning issues - River Liffey alternative uses</td>
<td>DB/DBO competitive markets - Public Sector Benchmark to be developed</td>
<td>Public Finance likely to be lower cost - Extensive due diligence required for Finance, if private</td>
<td></td>
</tr>
<tr>
<td>Strategy Element</td>
<td>Initial Output Specification</td>
<td>Preliminary Risk Assessment</td>
<td>Legal Viability Assessment</td>
<td>Stakeholder Issues</td>
<td>Value for Money</td>
<td>Bankability</td>
</tr>
<tr>
<td>------------------</td>
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<td>-----------------------------</td>
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<td>-------------</td>
</tr>
<tr>
<td>2. Major Trunk/ Diversion Foul Sewers including the Orbital Sewer</td>
<td>Defined by Capacity Required at 2011, 2031</td>
<td>Construction Risk Management in - Traditional - Design-Build - Target Cost Options</td>
<td>Planning Wayleaves and Construction agreements</td>
<td>Planning Consultees Sites and Wayleaves Construction impacts</td>
<td>Competitive Markets for works Out-turn Cost Budgets required</td>
<td>Public Finance is the norm Development Contributions where new development planned</td>
</tr>
<tr>
<td>3. Existing Network Upgrading</td>
<td>Detailed scope to be defined from local studies</td>
<td>Key risks in - site/route selection - traffic &amp; utilities - benefit impact - construction cost</td>
<td>None Required</td>
<td>Normal Consultees Works will have major public impact</td>
<td>Specialist skills required in restricted procedure to manage quality and cost out-turn</td>
<td>Public Finance for environmental upgrading</td>
</tr>
<tr>
<td>4. Stormwater Management</td>
<td>Detailed scope to be defined from Local Studies</td>
<td>Integrated approach needed on catchment basis Project specific construction and operating risks</td>
<td>SuDS ownership, liabilities and operational systems Shared use and management of SuDS</td>
<td>OPW LA Depts. Developers</td>
<td>Balance capital and operational costs</td>
<td>Public Finance or Developer lead under Planning Process</td>
</tr>
</tbody>
</table>
The remaining elements of the strategy can be defined in terms of their general requirements, principal risks and contract characteristics. Under current circumstances, public funding of such works is likely to be the only viable option. A traditional contract approach could be modified by elements of Design-Build or Target Cost arrangements as a basis for achieving greater security of out-turn costs and maximising achievable risk transfer to contractors.

In summary, therefore, an indicative PPP review of the proposed strategy would suggest implementation as set out in Table 14.3.

<table>
<thead>
<tr>
<th>Work Elements</th>
<th>Procurement Approach</th>
<th>Comments/Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Wastewater Treatment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ringsend Upgrade</td>
<td>DB &amp; Negotiated Operation</td>
<td>Contract Variation</td>
</tr>
<tr>
<td>Local Plant Upgrading</td>
<td>DB or DBO</td>
<td>Subject to Individual PPP Assessment</td>
</tr>
<tr>
<td>Portrane Long term plant</td>
<td>DBO with phasing</td>
<td>Finance option may not be bankable</td>
</tr>
<tr>
<td><strong>2. Major Foul Sewers</strong></td>
<td>Conventional Design and</td>
<td>Target Price Options to be examined</td>
</tr>
<tr>
<td>(Trunk &amp; Diversion)</td>
<td>Construction</td>
<td></td>
</tr>
<tr>
<td><strong>3. Existing Network Upgrading</strong></td>
<td>Conventional Design and</td>
<td>Programme may benefit from framework contracts</td>
</tr>
<tr>
<td></td>
<td>Construction</td>
<td></td>
</tr>
<tr>
<td><strong>4. Stormwater Management</strong></td>
<td>Conventional Design and</td>
<td>Integrated Catchment Context for Schemes</td>
</tr>
<tr>
<td></td>
<td>Construction</td>
<td></td>
</tr>
<tr>
<td>River Works</td>
<td>Private Developer Led</td>
<td>Adopt or Develop Standards &amp; Codes &amp; Maintenance</td>
</tr>
<tr>
<td>SuDS Schemes</td>
<td></td>
<td>Agreements</td>
</tr>
</tbody>
</table>

*Table 14.3  Indicative PPP Review of Strategy*

**14.3 Implementation of Policies and Operational Elements of the Strategy**

The implementation of the policy elements of the strategy are crucial to its delivery of a satisfactory and sustainable drainage system for the Dublin Region. Formal adoption of these policies should be followed by active implementation of the following steps:

- Formation of regional implementation committees in respect of all Policies especially the Environmental Management and New Development Policies;
- Development and agreement on operational structures for promotion, development, taking-in-charge and future management of systems, whether conventional or SuDS systems. In the case of SuDS, this will entail establishment of new operational procedures between Planning, Water Services, Road Services, Parks and other relevant areas of Local Authorities. It will also require an allocation of appropriate budgets to cover operational and maintenance costs.
- Development of codes and standards through specialist technical groups based on International Best Practice, local conditions and issues.
- Promotion and implementation of pilot projects, with technical and financial support, to pioneer implementation of Best Practices for urban drainage in the Region. Successful pilot projects could improve and greatly accelerate the take-up of Best Practice drainage options in new developments.
The relevant Committees and Local Authorities should establish close working liaison with OPW and other stakeholders in relation to the protection, conservation and enhancement of river environments within the developed area. This will include protection of riparian areas and flood plains and conservation of river ecologies, including good water quality.

Active implementation of New Development and Environmental Management policies form essential components of the future drainage strategy for the Dublin Region. These policies provide a basis for protecting the environment and ensuring that new foul and stormwater infrastructure can cope with the level of development anticipated to 2031. Failure to successfully implement these policies would result in continued degradation of the water environment contrary to the Water Framework Directive, continued over-loading of sewerage infrastructure and limitations on the level of development which can be catered for as well as incurring unnecessary additional operational and capital costs.

### 14.4 Major Infrastructure – Implementation Timetable

It is impossible to provide a definitive time schedule for implementation of the individual component works within the Strategy. Much will depend on the timetable for overall approval of the Strategy and of the associated capital programme, including funding strategies. In addition, it may be that urgent elements of the Strategy can be fast-tracked in conjunction with private developments or as extensions to existing programmes and projects.

Having regard to conventional procedures, the minimum timeframe likely to apply to the major components of the Strategy are indicated in Table 14.4. This table recognizes the time constraints of the process as currently applicable.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Ownership</th>
<th>Stage Time Months</th>
<th>Total Time Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Formal Strategy Adoption</td>
<td>LAs</td>
<td>6 – 12</td>
<td>6 – 12</td>
</tr>
<tr>
<td>2. Development of Programme,</td>
<td>LAs &amp; DOEHLG</td>
<td>6 – 12</td>
<td>12 – 24</td>
</tr>
<tr>
<td>Funding Plan and Approval</td>
<td>LAs &amp; Advisers</td>
<td>3 – 6</td>
<td>15 – 27</td>
</tr>
<tr>
<td>Possible SEA (Additional)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Approval to Implement</td>
<td>LAs &amp; DOEHLG</td>
<td>6 – 12</td>
<td>33 – 57</td>
</tr>
<tr>
<td>5. Project Delivery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advisers/Consultants</td>
<td>LAs/DOEHLG</td>
<td>6 – 12</td>
<td>39 – 69</td>
</tr>
<tr>
<td>Statutory Process</td>
<td>LAs &amp; Advisers</td>
<td>6 – 12</td>
<td>45 – 81</td>
</tr>
<tr>
<td>Design &amp; CDs (extra)</td>
<td>Project Team</td>
<td>6 – 12</td>
<td>51 – 93</td>
</tr>
<tr>
<td>Procurement</td>
<td>Project Team</td>
<td>12 – 18</td>
<td>63 – 111</td>
</tr>
<tr>
<td>Construction &amp; Commissioning</td>
<td>Project Team</td>
<td>24 – 42</td>
<td>87 - 153</td>
</tr>
</tbody>
</table>

**Table 14.4 Major Infrastructure Timetable**

This Table indicates a timetable of 7 – 13 years for major infrastructure, having regard to the various stages of approval, statutory processes, procurement processes and institutional delays. Acceleration of this timeframe would require agreements between all of the stakeholders to a project schedule governed by a strong project management discipline. Notwithstanding this, projects of this nature involve substantial stakeholder consultation and consideration which cannot be overlooked. In addition, many of the processes are outside the direct control of the local authorities and a significantly longer timeframe may be required if funding constraints are critical.

It is likely that the larger individual project elements will be implemented through separate contracts, procured individually. However, consideration might be given to framework contracts whereby a
number of contractors could be engaged in a single procurement exercise to implement network improvement/upgrading and rehabilitation works with defined periods, say, 5 years. This approach could assist in delivering these works efficiently and economically.

An outline indicative programme for the Strategy, excluding any priority fast-tracked items, has been developed. This programme is used to predict cash flow profiles for the strategy options to be used in NPV calculations included in Appendix B.

### 14.5 Cashflow Forecasts

The recommendations in the Strategy have been costed based on current out-turn estimates, on the basis of which an indicative cashflow forecast can be made. This forecast excludes ongoing spending on existing committed projects which are not covered by the Strategy. In the first instance, it is necessary to formulate a phasing of the works to suit the study needs in terms of:

- Strategic Works: 2011 and 2031 Programmes.

- Similar phasing for catchment upgrading for foul and storm works. Given the range of works involved, a detailed programme for individual elements is impractical at this stage. Instead, a notional cash-flow model has been developed for each of the periods, present - 2011 and 2011-2031, consistent with implementation of the works in an orderly programme, taking account of the urgent needs of the region.

The implementation programme for the overall strategy is shown on Figure 14.2 and the cash flow to meet this programme is illustrated on Figure 14.3.

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**Figure 14.3 Capital Costs per Annum**
This diagram illustrates the major investment needed to overcome the capacity and performance deficits identified in the strategy. These deficits arise both in terms of development needs and compliance with minimum level of service and environmental standards. Given the financial profile in Fig. 14.3, co-ordinated management approach is required to oversee the planning, procurement and implementation of the programme with identification of priorities where funding constraints apply. In practice, a minimum 2-3 year lead-in time would be required to achieve Year 1 target expenditure having regard to planning and procurement of pipeline works, while wastewater treatment facilities will have a much longer lead-in time (refer Table 14.4). Delayed delivery beyond the target dates will increase the infrastructure deficit and would lead to the need to place embargos on planning or alternatively accept inadequate environmental standards.
15. **SUMMARY AND CONCLUSIONS**

15.1 **Summary of Findings**

An assessment of the status of the current systems indicates the following in relation to the existing system.

**Wastewater Treatment:** The WwTW at Ringsend is currently overloaded and requires immediate expansion to the ultimate capacity that can be achieved on the site (2.16m PE). In parallel with the planning of this expansion, the Authorities should embark on a comprehensive monitoring survey to measure discharges from significant industries review licenses and generally engage with industry in order to reduce loads from this sector.

Given the constraints on the development potential at Ringsend, additional wastewater treatment capacity will be required to meet the medium and long-term requirements of the Region. The capacity should be available as soon as practicable after 2011 to serve new development in the Blanchardstown, South Dublin and, ultimately, in the Leixlip catchments and to relieve overloading at Swords / Malahide and Ringsend via diversion of the North Fringe flows.

The other plants in the Region including Shanganagh, Osberstown, Leixlip and the Fingal Coast Plants can meet their local catchment needs with planned upgrading. However, some may be marginal by 2031.

**Foul Networks:** The modelling results have confirmed the following in relation to the existing strategic foul sewer network.

**Grand Canal Trunk Sewer** – The foul cell has capacity for the original catchment only. Spare capacity is needed for planned development and to resolve overloading issues. The storm cell has some spare capacity.

**Lucan/Clondalkin (9B)** – This sewer is hydraulically overloaded with current development due to excess storm inflows and the planned level of development. There is currently a risk of local flooding.

**Mulhuddart/Blanchardstown (9C)** – This sewer is hydraulically overloaded with current development due to excess storm inflows and increased catchment development which now includes connections from Dunboyne, Clonee and Ashbourne in Co. Meath.

**Dodder Valley Sewer** – This sewer is at capacity and there are local flooding risks. Relief measures are required to accommodate planned developments.

**North Dublin Sewers** – The trunk sewers recently installed are adequate for the foreseeable development in the North Fringe area. There are some local CSO and flooding risk issues in the NDDS catchment.

**City Centre Docklands** – This system is hydraulically overloaded with excessive spill flows at CSOs causing pollution of the River Liffey and localised areas are at risk of flooding. Upgrading is required to cater for infill development including the Docklands redevelopment.

**Rathmines and Pembroke** – This combined sewer system is overloaded with areas of high flood risk requiring relief. New sewer outlets are required.

**Dun Laoghaire** – The cross bay pipelines and trunk sewers are adequate for future planned development.

**Catchments in General** – There are problems with CSOs and local flooding risk even on nominally separate sewers. Significant levels of inflow and infiltration have been identified throughout the study area.
Storm Systems:

**Rivers and Streams** – Many local flood risk areas have been identified along with areas that are at potential risks from future development, tidal risk and the impacts of climate change.

**Storm Sewers** – Areas of local flood risk have been identified including areas of potential back-pounding from rivers and tidal waters.

### 15.2 Summary of Proposed Works

**General**

The strategy relies on the optimisation of both the existing facilities at the eight WwTWs within the Region and the existing sewer assets.

In developing the overall strategy for the Region a number of Scenarios were considered. Following technical, and environmental assessment, it was concluded that the only viable options available were:

- **Option 2B** South Dublin Treatment and Discharge to the GCTS Storm Cell in conjunction with a local treatment plant at Portrane (serving Swords / Malahide and North Fringe)
- **Option 2C** Diversion of Flows to a single Extended Treatment Work Plant at Portrane by a means of a new Western orbital sewer.

Technical, environmental and economic consideration of these two feasible options has confirmed Option 2C (Portrane WwTW and orbital sewer) as the preferred solution, giving long-term security and capable of being developed on a phased basis (treatment / pumping elements) to meet medium and long-term development needs. This option will involve substantial upfront planning and investment as soon as practical to achieve:

- Major orbital sewer to serve Blanchardstown catchment, together with pumped outlet from South Dublin and,
- In the longer term, this sewer will provide for ultimate needs of North Kildare (Leixlip catchment, in particular). And local diversion of Swords and Malahide loads to cater for future development and to relieve pressure on Broadmeadow estuary.

Detailed engineering of this scheme will inevitably develop sub-options for consideration to optimise the scheme based on understanding of the detailed constraints, supported by the system models developed in this strategy.

**Wastewater Treatment Plants**

Ringsend must be extended to the maximum capacity that can be achieved on the existing site, taken as 2.16m PE, as an immediate priority in conjunction with load management.

The development of the new Portrane regional plant is envisaged in two stages, the first stage for an estimated 400,000PE in 2013 and the second stage to 880,000PE at 2024. In the first stage, the orbital sewer to Blanchardstown would be provided together with the connection from South Dublin. Swords / Malahide loads would be intercepted. North Fringe diversion to Portrane would be influenced by the effectiveness of load management and the associated pressure on Ringsend.

The expansion of the other seven WwTWs in the Region should progress as planned to meet the requirements of the individual catchments.
Foul/Combined Sewers

For 2011 conditions, the network upgrading should include:

- Upgrading the 9B and 9C networks as well as the City Centre / Rathmines and Pembroke works to resolve CSO pollution and flooding issues.
- Catchment foul sewer upgrading works scheduled in Table 12.4.

For 2031 conditions, the orbital sewer development and South Dublin link will be followed by diversion of Swords, Malahide and County Meath sub-catchments and link from Leixlip. In this period, significant ongoing upgrading of the catchment networks will continue as scheduled in Table 12.4.

Storm Systems

The storm systems are considered non-strategic and improvements will be required at individual catchment level. These works are identified in the Phase 3 – Needs, Options and Strategy Reports and summarised in Appendix B and are summarised in Table 12.5 for the 2011 and 2031 needs.

15.3 Cost Estimates

Cost estimates inclusive of VAT have been prepared for both strategic and non-strategic capital works. These are summarised in Table 15.1 below based on the recommended Option 2C.

<table>
<thead>
<tr>
<th>Description</th>
<th>2011 Cost €</th>
<th>2031 Cost €</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategic Option</td>
<td>256m</td>
<td>734m</td>
</tr>
<tr>
<td>Foul Catchments</td>
<td>506m</td>
<td>220m</td>
</tr>
<tr>
<td>Storm Catchments</td>
<td>186m</td>
<td>17m</td>
</tr>
<tr>
<td>Treatment Works</td>
<td>279m</td>
<td>163m</td>
</tr>
<tr>
<td>Total</td>
<td>1,227m</td>
<td>1,134m</td>
</tr>
</tbody>
</table>

*Table 15.1 Overall Cost Estimate Summary*

Capital investment required to implement works identified in the GDSDS amounts to €2,361m inclusive of VAT.

15.4 Implementation Programme

It is impossible to provide a definite time schedule for implementation of individual components of work within the overall strategy as much will depend on the timetable for the approval of the strategy and the associated capital programme, and the adopted funding strategies. It is likely that some more urgent elements of the strategy can be fast-tracked in conjunction with private developments or as extensions to existing programmes and projects.

Chapter 14 provides an over-view of the phasing and investment needs to achieve the strategy objectives within the development timeframes considered.

15.5 Recommendation

The strategy recommendations in this report, therefore, should be adopted in principle to achieve the stated objectives, namely:

- To relieve overloading at Ringsend while catering for committed development to 2011 of zoned lands and resolving pollution and flooding risks within the existing networks.
To provide for necessary ongoing development in the Greater Dublin Region, while ensuring that existing networks, Ringsend and other local WwTWs can accommodate the needs of the existing catchments to 2031.

This will require approval to a major programme of works and funding needs in parallel with systematic implementation of policies and operational recommendations. A strong co-ordinated regional approach will be required to deliver successfully on these recommendations.
APPENDIX A
CATCHMENT MAPS
APPENDIX B

COST ESTIMATES
APPENDIX C

POPULATION AND LAND USE MAPS
APPENDIX D

FLOW DETAILS OF OPTIONS
APPENDIX E

ASSESSMENT OF EXISTING WASTEWATER TREATMENT WORKS
APPENDIX F

CONSTRAINTS MAPS
APPENDIX G

STRATEGY DETAILS