

# RIVER DODDER CATCHMENT FLOOD RISK MANAGEMENT PLAN



## PROJECT INCEPTION REPORT





# River Dodder Catchment Flood Risk Management Plan

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# **1 INTRODUCTION**

## **1.1 PROJECT INCEPTION DOCUMENT PURPOSE**

In accordance with the Client (Dublin City Council) Project Brief, the purpose of this Project Inception Document is to provide;

- The interpretation of all data identified, collected and reviewed.
- The requirements for and likely cost of any surveys required as part of the Study. (This has been addressed at negotiation stage)
- A preliminary hydrological assessment, including a review of historical floods and hydrometric and meteorological data as defined in Section 2.7 of the Brief.
- A preliminary assessment of flooded areas, flood damages and flooding mechanisms
- A detailed programme to complete the study

It was also agreed at Progress Meeting Number 2 that all data collected (in digital format or hardcopies if not available digitally) as detailed in Section 2.5 of the Brief will not be provided as part of the inception report. However this data is available in the project system and a summary is provided in Appendix B.1.

## **1.2 OBJECTIVES**

The main objectives of the River Dodder Catchment Flood Risk Assessment and Management Study (CFRAMS) are to:

- Assess the spatial extent and degree of flood hazard and risk within the Dodder Catchment,
- Examine future pressures that could impact on flood risk, and
- Develop a long-term strategy for managing flood risk that is economically, socially and environmentally sustainable.

The following objectives of the River Dodder CFRAMS will help to produce the Catchment Flood Risk Management Plan (CFRMP);

- Collection and Analysis of data relevant to flooding within the study area;
- Identification and condition assessment of flood defence assets;
- Managing and undertaking surveys required for the assessment;
- Analysis of the Hydrology of the River Dodder Catchment;
- Hydraulic Analysis of the main river channel and significant tributaries;
- Development of flood hazard and flood risk mapping;
- Determination of economic, environmental, social and flood related risks;

- Development and appraisals of possible flood risk management measures;
- Preparation of a Strategic Environmental Assessment which is to evaluate at the earliest possible stage the environmental constraints, opportunities, impacts and consequences which the plan may have;
- Determination of an appropriate flood risk management strategy;
- Preparation of reports on the findings of the project and a River Dodder CFRMP.

The River Dodder Catchment Flood Risk Assessment and Management Study (CFRAMS) will also support the objectives of the 2002 Flood Policy Review undertaken by the Office of Public Works (OPW) and the forthcoming EU “Floods” Directive.

### **1.3 BACKGROUND**

Dublin City Council (DCC) defined its project requirements in the Project Brief, issued on 24<sup>th</sup> February 2006. This brief has been used as the guideline for defining the scope of services and for programming RPS-CE activities and resources and are as given in the ‘Submission Report’ provided by RPS-CE (see Submission Report document dated April 2006). Following an interview and fee negotiation process, the scope of works were further clarified and adjusted and a lump sum fixed fee agreed. DCC formally appointed RPS-CE as Consulting Engineers for the Project on 13<sup>th</sup> February 2007. The minutes of the fee negotiation meetings are included in Appendix D.

### **1.4 PROGRAMME**

The Brief stipulates that the Project is to be completed within 18 months. RPS originally proposed a shorter programme in the Submission Report, however during the contract negotiations the OPW requested that an additional period of 60 working days be provided in the programme to allow for consultation on the draft CFRAMS and SEA Environmental Report. The current programme indicating all tasks agreed during the contract negotiations is provided in Appendix A and will be updated as the project progresses.

### **1.5 PROJECT DELIVERABLES**

The following reports will be issued during the Dodder CFRAMS:

- Inception Report
- Hydrology Report
- Hydraulics Report
- SEA Scoping Report
- Preliminary Options Report
- Urban Drainage Accommodation Report
- Catchment Flood Risk Management Plan
- Draft Final Report

- SEA Environmental Report
- SEA Statement
- Final Report
- Progress Reports – prepared in advance of CA Project Team meetings.

The project team members and the role they play in producing these deliverables are outlined in Figure 1-1.

## **1.6 AGREED FEE PROPOSAL**

A breakdown of the agreed fees are provided in Appendix C.



# Project Team

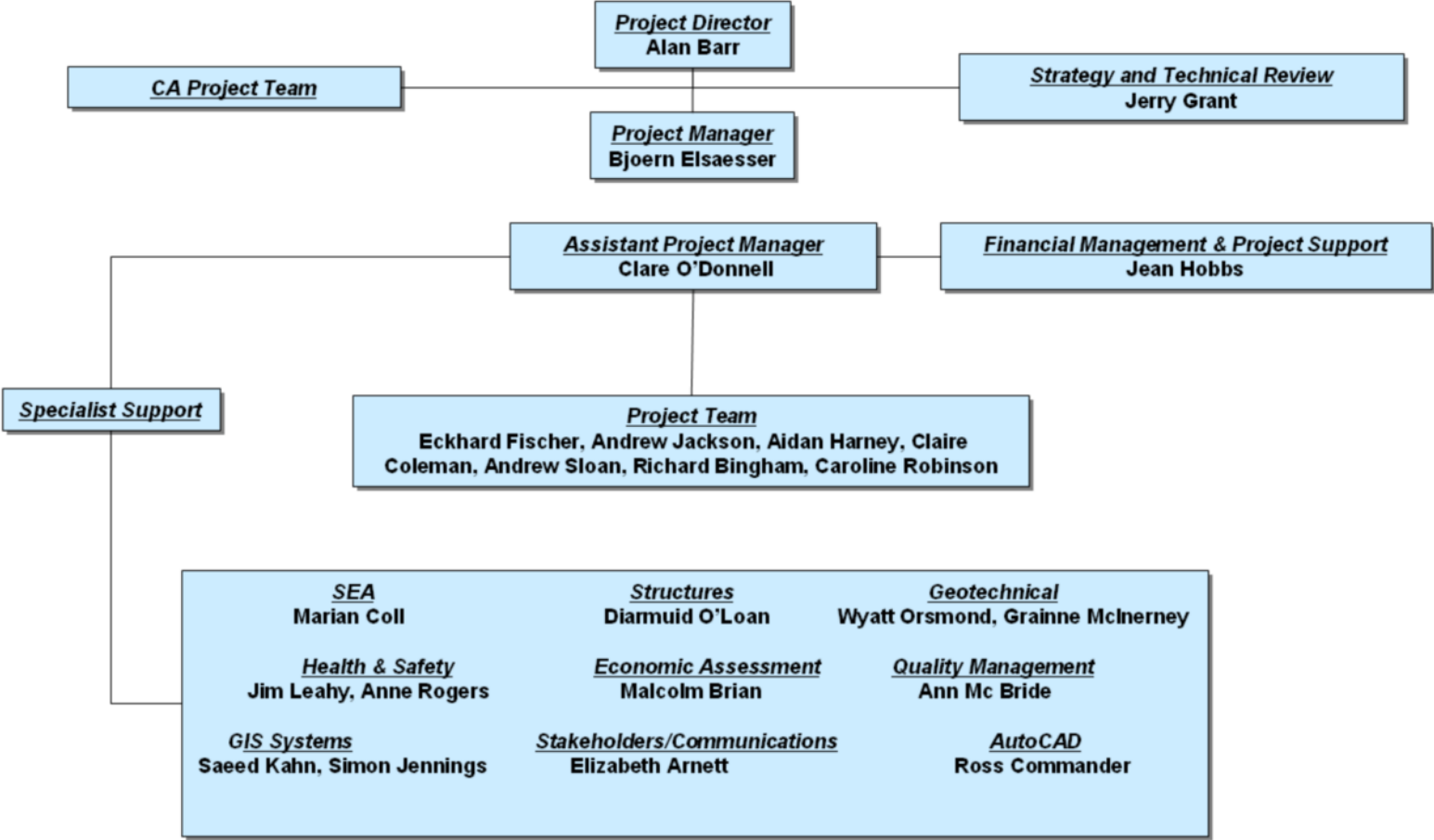


Figure 1-1 Project Team



## **2 DATA COLLECTION**

Data collection has been an integral part of the Inception Report for the River Dodder CFRAMS. This section provides an overview of all data identified, collected and reviewed. A data register for all the data received is given in Appendix B.1.

### **2.1 FLOOD RELIEF / RISK MANAGEMENT MEASURES:**

The Data Collection Register contained in Appendix B.1 includes a list of data sourced in relation to flood relief / risk management measures.

### **2.2 HISTORIC FLOOD DATA:**

A list of historic flood data sourced for this project is included in the Data Collection Register in Appendix B.1. It is noted that all but one item relates to flooding on the Dodder River Main Channel and furthermore the majority of that data concerns the Hurricane Charlie event of 1986. It is concluded that little or no published data is available on flooding of the River Dodder tributaries. However, the OPW provided a GIS table taken from the “floodmaps.ie” website showing the location of flood events within the Dodder River Catchment. This GIS table includes flood events on the tributaries.

A map showing the Hurricane Charlie flood extent as well as isolated flood locations throughout the Dodder River Catchment is provided in Appendix B.2.

### **2.3 HYDROMETRIC DATA:**

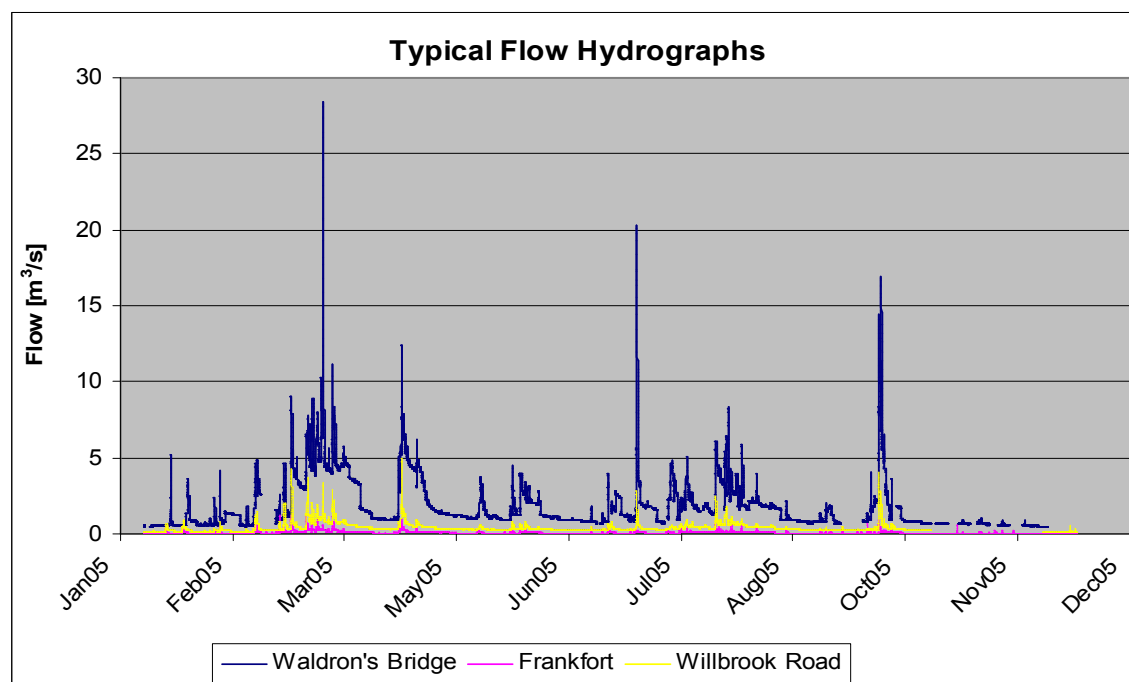
#### **2.3.1 Fluvial data**

The Environmental Protection Agency (EPA) operates four gauging stations within the River Dodder Catchment, namely Waldron’s Bridge, Willbrook Road, Frankfort and the new station at Bohernabreena Reservoir. Following a meeting with the EPA in February 2002, all flow data available digitally was forwarded to RPS for use in the River Dodder CFRAMS. The following data was received from the EPA with some large data gaps. :

- |                    |                              |
|--------------------|------------------------------|
| • Waldron’s Bridge | January 1986 – February 2007 |
| • Willbrook Road   | January 1980 – February 2007 |
| • Frankfort        | January 1986 – February 2007 |

The gauging station at Bohernabreena has only recently been installed and therefore there is limited gauged data currently available. For this reason data from the Bohernabreena gauge is not being utilised in this study.

Figure 2-1 presents typical flow hydrographs for the each of the three gauging stations.



**Figure 2-1: Typical flow hydrographs**

## 2.3.2 Coastal data

Coastal water levels are recorded at a number of locations in Dublin. Long term observations are available from DCC and Dublin Port which recorded coastal water levels at Poolbeg Lighthouse. This gauge was later moved to North Wall Quay and recently an additional gauge has been installed at Kish Bank Lighthouse. RPS have analysed these values and have a peak over threshold data set for the period January 1980 to December 2004. In addition RPS have different return period coastal water levels used by the Dept. of Communications, Marine and Natural Resources (DCMNR) in the Irish Coastal Protection Strategy. This data set will be used as downstream boundary conditions for the hydraulic model. Furthermore, the recent study carried out by Royal Haskoning Ireland for DCC will be used to provide extreme water level for the tidal section of the Dodder.

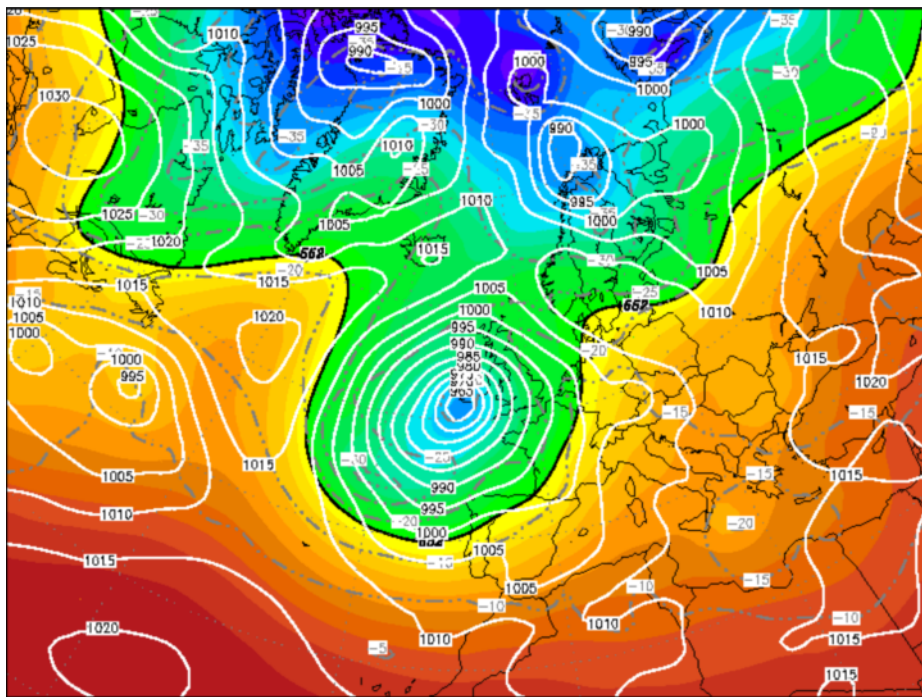
## 2.3.3 Joint probability assessment of extreme coastal and fluvial events

A significant part of the lower section of the Dodder is influenced both by fluvial and coastal events in terms of extreme water level. While it is relatively easy to derive the return periods for each component separately, under certain circumstances both extreme coastal water levels (storm surge) and extreme discharges in the river can occur. This can result in back water effects potentially giving higher water levels compared to the levels expected from fluvial or coastal events on their own.

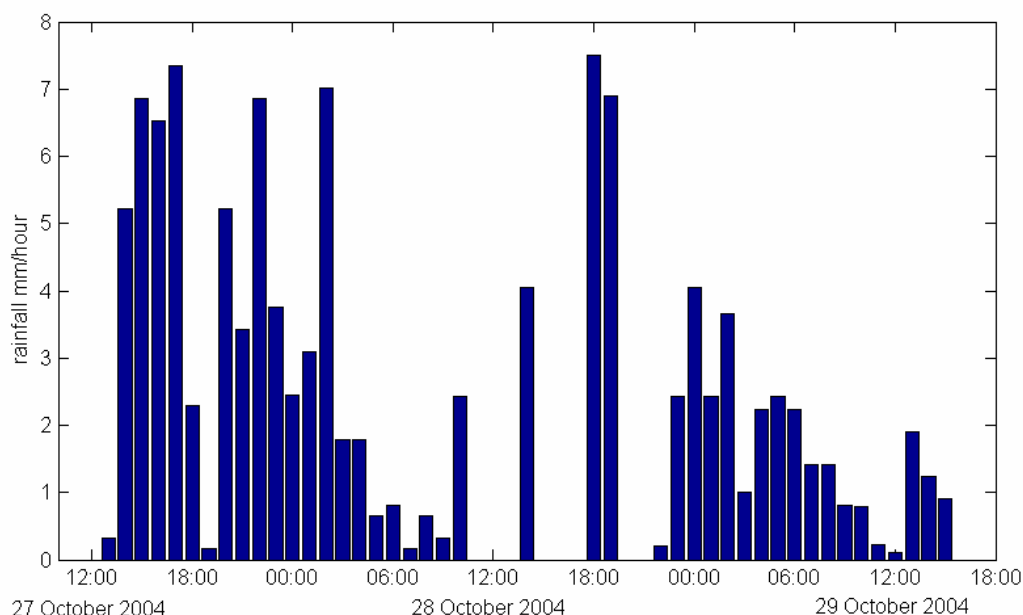
The likelihood of the combination of events is referred to as probability of joint occurrence or joint probability and needs to be addressed in this study. Essentially typical storm surges are associated with cyclones tracking in from the Atlantic over Ireland occasionally combined with zonal fronts associated with rainfall and sudden changes in wind direction. One very good example is the October 2004 storm surge event, which gave large water levels along the south coast and Wexford area and combined with large rainfall gave rise to significant

flooding in southern parts of Ireland. The meteorological condition of this event are given in Figures 2-2 and 2-3. Even in Dublin the total rainfall on the 27<sup>th</sup> & 28<sup>th</sup> of October 2004 reached a value of over 100mm, with most rain falling when wind speeds peaked.

Detailed analysis of the joint probability of extreme fluvial flows and extreme coastal water levels have been undertaken in the UK as part of a Research & Development project lead by the Department for Environment, Food and Rural Affairs (DEFRA). RPS have been contributing to this and it is intended that the methodologies developed as part of this project and published in *Joint Probability: Dependence Mapping and Best Practice R&D Interim Technical Report FD2308/TR1* (Hawkes, P., Svensson, C. 2003) will be used to assess the joint probability for the Dodder catchment. DEFRA have provided guidelines for various coastal regions of the UK, however these are not transferable to the Dodder catchment. Thus an analysis will be carried out based on recorded surge values at Dublin against observed rainfall for the Dodder catchment. Based on the combined occurrence of surge and precipitation, the  $\chi$  dependency measure is derived, which provides the likelihood of joint occurrence. This analysis will also include an estimate of the confidence intervals using either Bootstrap, Monte-Carlo or Jack-Knife resampling.



**Figure 2-2: Mean Sea Level (MSL) pressure field (white lines) in hPa and 500hPa geopotential (colors)**



**Figure 2-3: Hourly rainfall during October 2004 storm surge event for Dodder catchment**

## 2.4 METEOROLOGICAL DATA:

All available digital rainfall gauge data from within the Dodder River catchment was requested from the relevant Local Authorities (Dublin City Council (DCC), Dun Laoghaire Rathdown County Council (DLRCC) and South Dublin County Council (SDCC)).

A summary of the rain gauge data received from the Local Authorities is presented in Table 2-1.

Rain Gauge	Start (Year)	End (Year)	Source	Data Type
Roundwood	2003	2007	DCC	Hourly
Bohernabreena	2003	2007	DCC	Hourly
Ballymore Eustace	2003	2007	DCC	Hourly
Donnybrook	2004	2007	DCC	Hourly
Ballyboden	2004	2007	DCC	Hourly
Sandyford	2003	2007	DLRCC	Daily

**Table 2-1: Rain Gauge Data Provided by Local Authorities**

In addition, Met Éireann have provided an extensive amount of data from their rainfall gauges throughout the Dodder River catchment and surrounding area. The OPW coordinated the provision of this data and Met Éireann kindly supplied it free of charge for use in the River Dodder CFRAMS.

Table 2-2 presents a summary of the rain gauge data received from Met Eireann.

Rain Gauge	Start (Year)	End (Year)	Source	Data Type
Dublin Airport	1941	1994	Met Eireann	Daily
Dublin Airport II	1994	2007	Met Eireann	Daily
Dublin Airport Check	1994	1997	Met Eireann	Daily
Dublin (Phoenix Park)	1941	2007	Met Eireann	Daily
Dublin (Glasnevin)	1941	2006	Met Eireann	Daily
Glenasmole D.C.W.W.	1941	2006	Met Eireann	Daily
Dun Laoghaire (People's Park)	1941	1989	Met Eireann	Daily
Dublin (Ringsend)	1941	2006	Met Eireann	Daily
Ballyedmonduff	1967	1984	Met Eireann	Daily
Ballyedmonduff House	1985	2007	Met Eireann	Daily
Stillorgan (Vartry House)	1941	1999	Met Eireann	Daily
Tallaght (St. Maelruain's)	1945	1950	Met Eireann	Daily
Peamont (San.)	1941	1979	Met Eireann	Daily
Glenasmole (Castlekelly)	1959	2007	Met Eireann	Daily
Glenasmole (Supt.'s Lodge)	1959	2006	Met Eireann	Daily
Dublin (Merrion Square)	1948	2007	Met Eireann	Daily
Leixlip (Gen. Stn.)	1949	2006	Met Eireann	Daily
Dublin (Ballsbridge)	1959	1972	Met Eireann	Daily
Killiney (Tedburn)	1961	1987	Met Eireann	Daily
Milltown (Golf Club)	1963	2000	Met Eireann	Daily
Ballyboden	1966	2001	Met Eireann	Daily
Tallaght	1966	1969	Met Eireann	Daily
Tibradden (Larch Hill)	1967	1990	Met Eireann	Daily
Clondalkin	1967	1985	Met Eireann	Daily
Rathcoole Saggart	1969	2001	Met Eireann	Daily
Rathfarnham (St. Columba Coll.)	1972	1995	Met Eireann	Daily
Dublin (Simmonscourt)	1972	2006	Met Eireann	Daily
Dublin (Pembroke Road)	1975	1978	Met Eireann	Daily
Brittas (Glenaraneen)	1975	2006	Met Eireann	Daily
Dublin (Dundrum)	1975	1995	Met Eireann	Daily
Blackrock	1982	1997	Met Eireann	Daily
Kippure (T.V. Trans. Stn.)	1962	1968	Met Eireann	Daily
Blackrock	1982	1985	Met Eireann	Daily
Dundrum (Dromartin)	1997	2001	Met Eireann	Daily
Dun Laoghaire	1997	2006	Met Eireann	Daily
Knocklyon (St. Colmcille's)	2004	2005	Met Eireann	Daily
Bray G.S.	1949	1993	Met Eireann	Daily
Enniskerry (Kilmalin)	1975	2006	Met Eireann	Daily
M. Ballinatona	1993	2006	Met Eireann	Daily
M. Sally Gap	1943	2006	Met Eireann	Daily
Casement Aerodrome	1954	2007	Met Eireann	Daily
Casement Aerodrome	07/04/1986	04/09/1986	Met Eireann	Hourly
Casement Aerodrome	30/11/2003	05/12/2003	Met Eireann	Hourly

**Table 2-2: Rain Gauge Data Provided by Met Eireann**

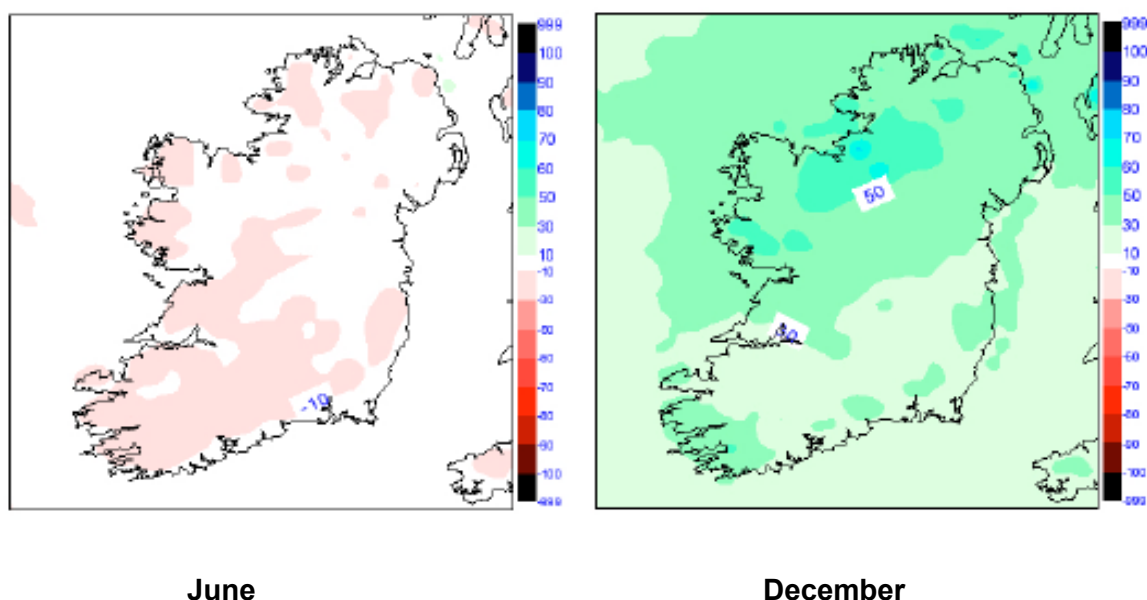
Met Éireann also supplied Extreme Rainfall Return Period Charts for the rainfall gauges at Casement Aerodrome, Glenasmole and Dundrum. These will assist in the derivation of rainfall return period growth factors which will be used for the very small catchments with concentration times of less than one hour.

## 2.5 CLIMATE CHANGE SCENARIOS

### 2.5.1 Effect of climate change on precipitation

The proposed climate change scenarios to be used in this study are based on the results published in the EPA report on Climate Change: Regional Climate Model Predictions for Ireland (McGrath, R. et al 2005) and further information based on the Community Climate Change Consortium for Ireland 2004 annual report (C4i), with additional data available on their website ([www.c4i.ie](http://www.c4i.ie)). The Community Climate Change Consortium for Ireland (C4i) Project was established in 2003 and is based in the headquarters of Met Éireann. In the Regional Climate Analysis, Modelling and Prediction Centre (RCAMPC), housed in Met Éireann, C4i uses a regional climate model, RCA, from the Rossby Centre to investigate the characteristics of the past and future climate of Ireland. This regional climate model is used to downscale the results from a global atmospheric model called ECHAM4. The ECHAM climate model has been developed from the ECMWF atmospheric model and a comprehensive parameterisation package developed at the Max Planck Institute for Meteorology in Hamburg, which allows the model to be used for climate simulations.

The downscaled data set uses the RCA-F scenario and is based on moderately increasing greenhouse gas emission (ECHAM4 SRES-B2) and the period 2021 to 2060. Some examples of the changes in mean monthly precipitation are shown in the following figures:



**Figure 2-4 and Figure 2-5: Changes in Mean Monthly Precipitation**

Figures 2-4 and 2-5 show changes in precipitation in per cent for period 2021 to 2060 compared to 1961 to 2000 for the month June and December.

It is proposed to artificially generate climate change scenarios for this study based on historic rainfall data as proposed in *Climate change scenarios and impact on catchment and rainfall*

*runoff response (Elsaesser, B., Bell, A.K., Glasgow, G. IHP conference Tullamore 2003).* The main reason for using artificially generated data is in the systematic bias of some of the meteorological modelling as discussed in the above paper.

The key assumptions in terms of change of precipitation are listed in Table 2-3.

Monthly Accumulation	RCA(ECHAM4) 61-00 (mm)	RCA(ECHAM4) 21-60 (mm)	% Change
January	125	150	20.0
February	115	130	13.0
March	85	90	5.9
April	83	93	12.0
May	95	105	10.5
June	105	93	-11.4
July	105	100	-4.8
August	105	105	0.0
September	110	130	18.2
October	125	145	16.0
November	140	150	7.1
December	135	150	11.1
Total	1328	1441	8.5

**Table 2-3: Summary of climate change scenario**

There is limited information provided in the C4i report on evaporation. Based on the assumption that average temperatures are expected to rise by around 1° to 1.5°, the evaporation is expected to increased by 15% for summer months and to be left unchanged for winter months.

Given that a rainfall runoff model is being used, changes can be applied to the rainfall datasets and new runoff events derived. This will be carried out by applying the changes in rainfall runoff pattern taken from the C4i estimates to the existing data set. It is expected that the summer rainfall will change from mostly frontal rainfall to convective rainfall and that longer drier periods will occur. On the other hand it is assumed that the number of extreme rainfall events (>20mm/day) will increase and in particular summer rainfall will become significantly heavier (concentrated). Based on these characteristics the reference rainfall data set will be modified, obtaining more concentrated rainfall events all year and, where applicable, reducing the number of days with precipitation in the summer.

Further guidance is currently being sought from Met Éireann on the proposed climate changes for the 2100 scenario in terms of precipitation. At present there is limited data available on these scenarios on downscaled level valid for Ireland. Given that the European Union adopted a long term target to limit global mean temperature increase to less or equal than 2°, this can be seen as an overall target line for 2100 scenarios. Under this assumption a further change in precipitation patterns is likely to occur after 2060 and mean annual



precipitation is anticipated to increase by at least the same amount compared to the 2040s scenario.

## **2.5.2 Effect of climate change on coastal water levels**

The recent publication and update on climate change provided by the Intergovernmental Climate Change Programme (IPCC2007) has effectively confirmed some of its estimates in terms of increasing temperature in the next 100 years. Overall it can be assumed that mean global temperatures will rise between 1.5° and 3°C in the next century using different relatively moderate emission scenarios and global atmospheric models. This rise in temperature will have a significant impact on coastal water levels in several ways. In relation to changes in Ireland there are a number of factors which could or are likely to impact in the next 100 years.

Firstly, it is expected that the overall increase in temperature will increase the total volume of seawater and consequently cause a rise in sea level by between 0.1 and 0.4 metres. In addition, the melting of some of the glacial sheets covering parts of the northern hemisphere will add to this. The largest contribution will be from the Greenland Ice Sheet, which is largely situated above sea level at the moment and therefore will provide a net contribution to the volume of sea water. Estimates for the volumes expected from these sheets vary greatly, since the exact thickness of the ice sheet is unknown and the rate of thawing is difficult to estimate. This thawing is related to the rise in temperature and a long term temperature increase by the above values is likely to cause most of the ice on Greenland to melt. If this happens global water levels are likely to rise in the order of 5 metres in the next 4 to 8 centuries. Overall, it is estimated that this will add a further 0.1 to 0.4 metres to the current water levels within the next 100 years, with some experts forecasting an increase in the order of 1.2 metre in total by the end of this century. However in general a water level increase in the order of 0.4 to 0.6 metres is assumed.

This overall increase in water level will have an impact on the way the tides and storm surges will propagate around Ireland and it is expected that this will increase the tidal range and the surge residual in some cases, though at this stage this has not been confirmed.

As a result of the changing global climate it is expected that Ireland will in future experience a milder but wetter climate with the frequency of storms shifting slightly further north and thus decreasing. However due to the increased temperature difference between the arctic waters and Europe, it is assumed that the intensity of storms will increase and thus more extreme surges will be experienced. The exact impact of this on Ireland is difficult to assess, since the track of each cyclone plays an important role in the actual surges observed along the shoreline. If the track of the cyclones does not change significantly, an increase in surge residual (the value the water rise above the normal tide due to the storm) in the order of 0.05 to 0.3 metres could be expected. However these surges would be less frequent, thus it is assumed at this stage that the surge residual will have no significant impact. Met Éireann are currently simulating storm surges based on past and future climate scenarios, with results expected later in the year.

The above is complicated in Ireland by the change of land level in relation to surrounding area which is due to changes in climate after the last ice age. Essentially the mass of the glacial sheets which covered large parts of the northern hemisphere during the last ice age caused the tectonic plates to sink. Since the ice has mostly melted now the land level has risen in the more northern areas whereas southern parts of Ireland are sinking similar to a float being ballasted down on one end and now being relieved. This whole process is termed isostatic recovery and a detailed report on this and the relevance to Ireland is expected to be published later this year. From the information available to date it appears that Dublin is

close to the pivot point of this isostatic recovery and therefore not affected by this change in land level.

Concluding from the above, an overall increase in coastal water levels of 0.5 metres is currently assumed to be a likely scenario, however as the study progresses more recent estimates will be assessed and the above values will be reviewed if required.

## 2.6 LAND-USE DATA:

For the purposes of land-use assessment, the Dodder River watershed has been broken down into 18 sub-catchments (A to R) ranging in size for 37km<sup>2</sup> to 0.8km<sup>2</sup>. The sub-catchments boundaries have been assigned based on the tributary catchment areas and on the rural / urban divide. The boundary between the rural and urban catchments was taken at 160mOD elevation as it is assumed that major future development will not occur beyond this point due to water supply restrictions and this elevation is also seen as a limit in terms of landscaping and conservation. Sub-catchments A, B, C, D, E, G, J, M, O, Q and R are classed as “urban” (u), while sub-catchments F, H, I, K, L, N and P are classed as “rural” (r). A map showing the Dodder River watershed and the sub-catchment boundaries with sub-catchment names can be seen in Figure 2-6.

### 2.6.1 Current Development Situation

As part of the Greater Dublin Strategic Drainage Study (GDSDS), a comprehensive Population and Land Use Study was undertaken. One element of this land use study involved the assessment of the 2002 development situation in the Greater Dublin Area. Given the time lapse since the preparation of the GDSDS Population and Land Use Study and given the level of development in the Greater Dublin Area in the intervening years, the GDSDS current development land use figures were revisited for this project.

To update the GDSDS land use figures to reflect the current level of development in the Dodder River catchment, the latest 1:1000 OSI mapping was overlaid on the GDSDS mapping and recent developments identified. The current level of development in the catchments is illustrated in the table below:

Catchment Name	Catchment Area (km2)	Development 2007 (%)	Development 2007 (km2)
A (u)	9.53	58.70	5.59
B (u)	4.81	54.10	2.60
C (u)	8.62	67.30	5.80
D (u)	7.32	88.28	6.46
E (u)	5.93	67.00	3.97
F (r)	37.46	3.00	1.13
G (u)	4.67	52.70	2.46
H (r)	9.37	5.00	0.49
I (r)	3.03	4.00	0.12
J (u)	1.50	78.20	1.17
K (r)	4.36	4.00	0.17
L (r)	5.30	4.00	0.21
M (u)	3.68	30.10	1.11
N (r)	1.03	9.00	0.09
O (u)	7.65	72.15	5.518
P (r)	0.83	5.00	0.06
Q (u)	3.26	85.34	2.79
R (u)	2.64	76.40	2.015

**Table 2-4: Current Development Scenario**

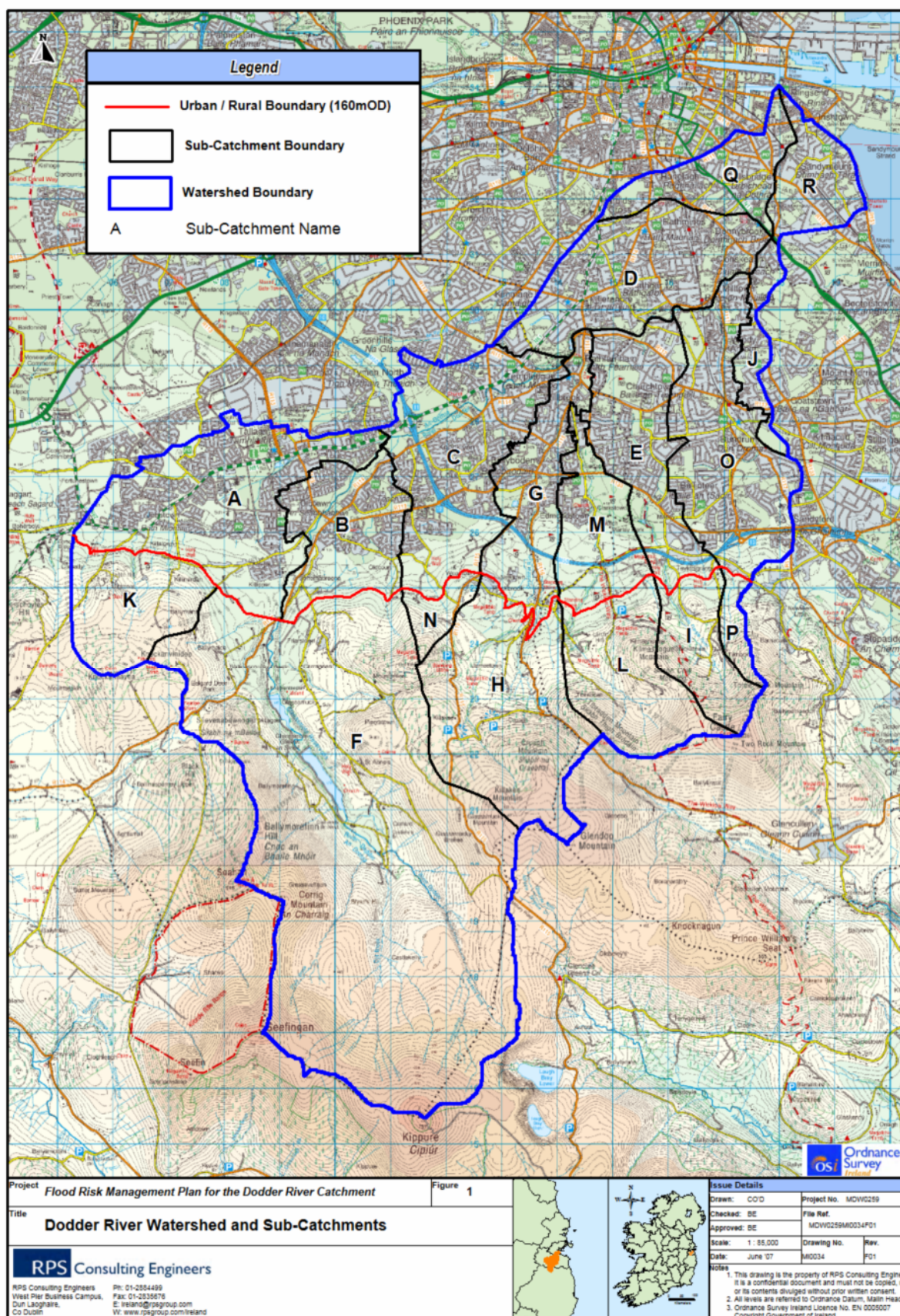


Figure 2-6 Dodder River Watershed and Sub-Catchments



## 2.6.2 Future Development Scenarios

The GDSDS Population and Land Use Study included future development scenarios for 2011 and 2031. When these development scenarios are applied to the Dodder River catchments in addition to the current development situation, the following table can be produced:

Catchment Name	Catchment Area (km <sup>2</sup> )	% Development		
		2007	Plus GDSDS Projected Development 2011	Plus GDSDS Projected Development 2031
A (u)	9.53	58.70	68.60	68.60
B (u)	4.81	54.10	56.00	56.00
C (u)	8.62	67.30	74.70	74.70
D (u)	7.32	88.28	89.69	89.87
E (u)	5.93	67.00	67.30	67.30
F (r)	37.46	3.00	3.00	3.00
G (u)	4.67	52.70	55.30	64.50
H (r)	9.37	5.00	5.00	5.00
I (r)	3.03	4.00	4.00	4.00
J (u)	1.50	78.20	80.72	80.72
K (r)	4.36	4.00	4.00	4.00
L (r)	5.30	4.00	4.00	4.00
M (u)	3.68	30.10	30.10	37.60
N (r)	1.03	9.00	9.00	9.00
O (u)	7.65	72.15	72.59	72.59
P (r)	0.83	5.00	5.00	5.00
Q (u)	3.26	85.34	87.38	88.14
R (u)	2.64	76.40	76.81	78.14

**Table 2-5: GDSDS Future Development Scenario**

It can be seen from this table that the projected development scenario for 2011 has nearly been realised within all “urban” sub-catchments. It would therefore appear that the future development scenarios proposed in the GDSDS were underestimated for the Dodder River catchment. However, it should be noted that the GDSDS scenarios were developed based on the 2002 census. The underestimation of recent population projections is discussed in the Department of the Environment and Local Government Circular SP1/07 – Revised National and Regional Population Targets to 2020.

To construct a realistic picture of future development in the sub-catchments, it has been assumed that development will continue at the current rate until 2100. To ascertain this, current annual rates of development were calculated for each sub-catchment between 2005 and 2007 and development figures for 2100 were extrapolated from these. The 2005 development figures were prepared for a Flood Impact Assessment carried out by RPS for a private developer for a site along the Dodder River.

A limit of 85% development was placed on the projections for urban sub-catchments with current development levels not already in excess of this figure. This limit was based on the observation that urban development is limited to approximately 87% to 89% in the inner city areas and approximately 83% to 85% in the urban areas outside the immediate city centre. Where this limit was already exceeded we retained the current development figures. It is assumed that no future development will occur in the “rural” sub-catchments since all of these are above the 160mOD elevation line.

The table below presents the projected future development percentages for each sub-catchment for the 2100 scenarios as extrapolated from current annual rates of development.

Catchment Name	Catchment Area (km2)	% Development			
		2005	2007	Annual % Increase	2100
A (u)	9.53	52.40	58.70	3.15	85.00
B (u)	4.81	50.20	54.10	1.95	85.00
C (u)	8.62	62.60	67.30	2.35	85.00
D (u)	7.32	83.80	88.28	2.24	88.28
E (u)	5.93	66.60	67.00	0.20	85.00
F (r)	37.46	3.00	3.00	0.00	3.00
G (u)	4.67	49.50	52.70	1.60	85.00
H (r)	9.37	5.00	5.00	0.00	5.00
I (r)	3.03	4.00	4.00	0.00	4.00
J (u)	1.50	77.26	78.20	0.45	85.00
K (r)	4.36	4.00	4.00	0.00	4.00
L (r)	5.30	4.00	4.00	0.00	4.00
M (u)	3.68	27.20	30.10	1.45	85.00
N (r)	1.03	9.00	9.00	0.00	9.00
O (u)	7.65	66.34	72.59	3.13	85.00
P (r)	0.83	5.00	5.00	0.00	5.00
Q (u)	3.26	80.80	85.34	2.27	85.34
R (u)	2.64	71.10	76.40	2.65	85.00

**Table 2-6: Revised Future Development Scenario**

It should be noted that there is a high degree of uncertainty in projecting future development scenarios for the Dodder River Catchment. A limit of 85% has been placed on development in all urban sub-catchments which have not yet reached this level of urbanisation. It is assumed that a minimum of 15% of the catchments will be retained as “green-belt” areas. This is a conservative approach to future development projections as it ignores any potential effects from the introduction of Sustainable Urban Drainage Systems (SUDS) into developments in the sub-catchments. However, the role SUDS could play as a flood risk management measure will be further investigated in this study.

### 2.6.3 Most Likely Future Development Scenario

The most likely future scenario will see development in the Dodder River “urban” sub-catchments continue at current rates until it is capped due to a lack of available lands. It is not expected that any future development will occur in the “rural” sub-catchments above 160mOD elevation.

## 2.7 DEFENCE AND COASTAL PROTECTION ASSET DATA:

Field data is collected using “Toughbooks” (handheld devices for field-based working). These are compatible with a desktop PC and record onto electronic forms customised to record the attribute information for each channel reach. The use of Toughbooks achieves efficiency through the elimination of double-handed data entry, leading to a reduction in human error in manually transferring large data sets.

The topographical survey completed for the River Dodder CFRAMS assigned numbers to each river cross-section surveyed and recorded their locations. The location of these cross-sections is used as a reference for the collection of asset data. Each bank of the river is reviewed on site. If there is a constant defence asset type between any two sections then this data is recorded. If there are two or more defence asset types in any one section then the extent of each is recorded on a set of site drawings and all descriptive data is also recorded. Descriptive information is recorded onto the Toughbook as well as at least one photograph of each defence asset type. The extents of each defence asset are then drawn up using GIS software and labelled accordingly.

For any given channel reach the following data is recorded;

- Number of different defence asset types in a given channel reach;
- GIS drawing showing the extent of each defence asset types;
- Descriptive information relating to each asset, i.e. its structures and elements including a physical description, material type, an assessment of condition and other information;
- One or more photographs

This information can then be output in report format using the Toughbook.



Figure 2-7: Toughbook

## **2.8 EXISTING SURVEY / GEOTECHNICAL DATA:**

The Data Collection Register in Appendix B.1 lists information sourced in relation to Existing Survey / Geotechnical Data.

A Desktop Geotechnical Survey Report has been prepared by RPS for the River Dodder CFRAMS detailing all available geotechnical data.

## **2.9 ENVIRONMENTAL DATA:**

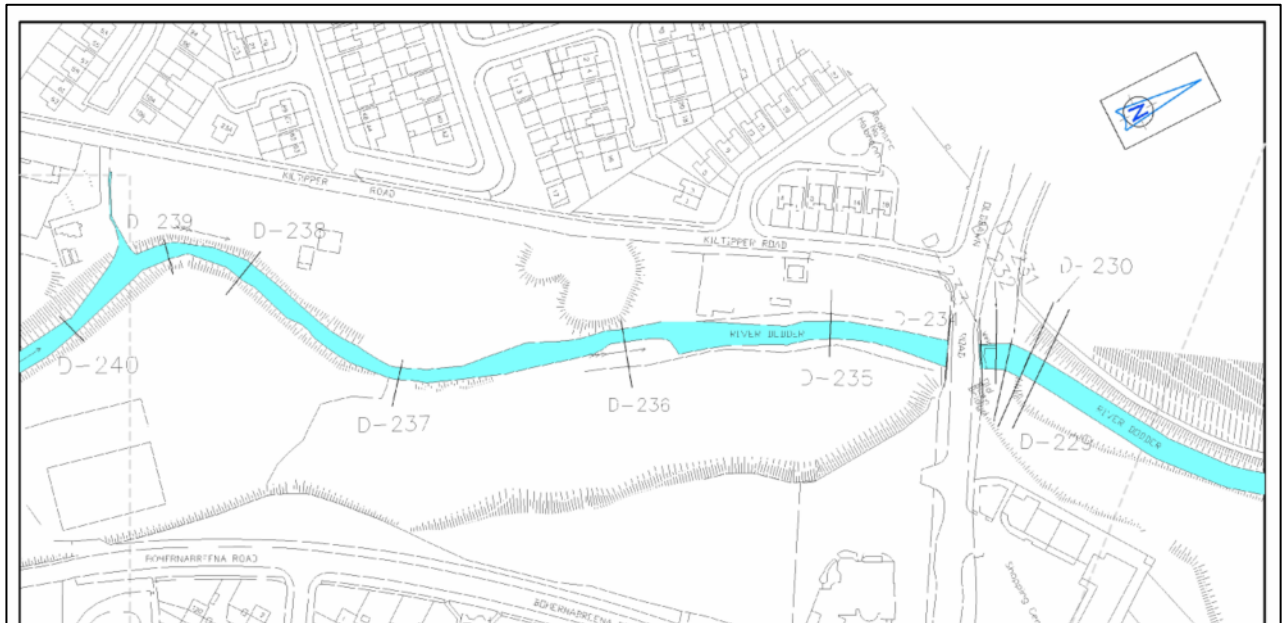
The SEA Regulations specify 12 aspects of the environment that must be considered in the SEA. These are as follows: biodiversity, flora and fauna; population and human health; water; air and climatic factors; soils and geology; landscape; cultural heritage; material assets and inter-relationship which occurs between each of them. The baseline environment for each aspect is currently being gathered. Most of the available data on water quality, biodiversity, flora and fauna has been collected. Water quality data was available on the Environmental Protection Agency (EPA) website. Aspects of biodiversity, flora and fauna were available from the National Parks and Wildlife Service (NPWS), the Eastern River Basin District (ERBD) and the Eastern Regional Fisheries Board as well as from various previous reports. Maps detailing Water Quality and Special Area's of Conservation have been prepared and are included in Appendix B.5. All of this data will be used to describe the existing environmental conditions.

Baseline environmental data is being gathered through desk based research from previously collected or currently available information, reports, studies, zoning and assessments of environmental and archaeological status, issues, constraints and impacts. Relevant data is available through the Eastern Rivers Basin District (ERBD), on the website of the National Parks and Wildlife Service (NPWS) and from the relevant statutory and non-statutory environmental bodies. A register of relevant reports, data, information and websites is provided in the Data Register in Appendix B.1. The information identified shall however not be taken as being comprehensive, and further efforts to locate additional information shall be required. Statutory consultations with the relevant Environmental Authorities, Local Authorities, Environmental Groups and the public may produce more relevant environmental information. A list of all the relevant plans and programmes is currently being compiled.

The likely evolution of the environmental aspects without implementation of the CFRMP will further be discussed in the SEA. The likely significant effects on the environment from the implementation of certain aspects of the CFRMP have been outlined and these will need to be investigated further as the plan evolves. The relationship of the plan with other relevant plans, programmes and environmental objectives are being investigated.

## **2.10 RIVER SURVEY DATA:**

Survey requirements for the Dodder River main channel and each of the five major tributaries (Owendoher, Whitechurch, Dundrum/Slang, Little Dargle and Tallaght Stream) were discussed and agreed with the Contracting Authority throughout the survey process. A survey brief including drawings of the Dodder Main Channel and all five tributaries was produced indicating the required cross-section locations. Below is an example drawing which formed part of the survey brief:



**Figure 2-8: Typical Survey Brief Drawing**

Dublin City Council Surveying and Mapping Section with the assistance of Paul Corrigan & Associates (PCA) Surveyors carried out the river surveys which took approximately 6 months to complete.

River survey data has been received and reviewed by RPS for the Dodder River main channel and the five tributaries.

The survey data package for each river includes the following:

- ASCII files for river cross-sections in two separate formats for import into the hydraulic modelling software;
- AutoCAD drawing of river centreline (alignment);
- AutoCAD drawing of cross-section locations showing chainages;
- AutoCAD drawing of each cross-section;
- AutoCAD drawing of long-section through centreline of river;
- 3D AutoCAD model of river including structures;
- Photographs taken at each cross-section, structure and outfall ;
- Floor Levels.

Figures 2-9 to 2-11 show examples of some of the survey data received.

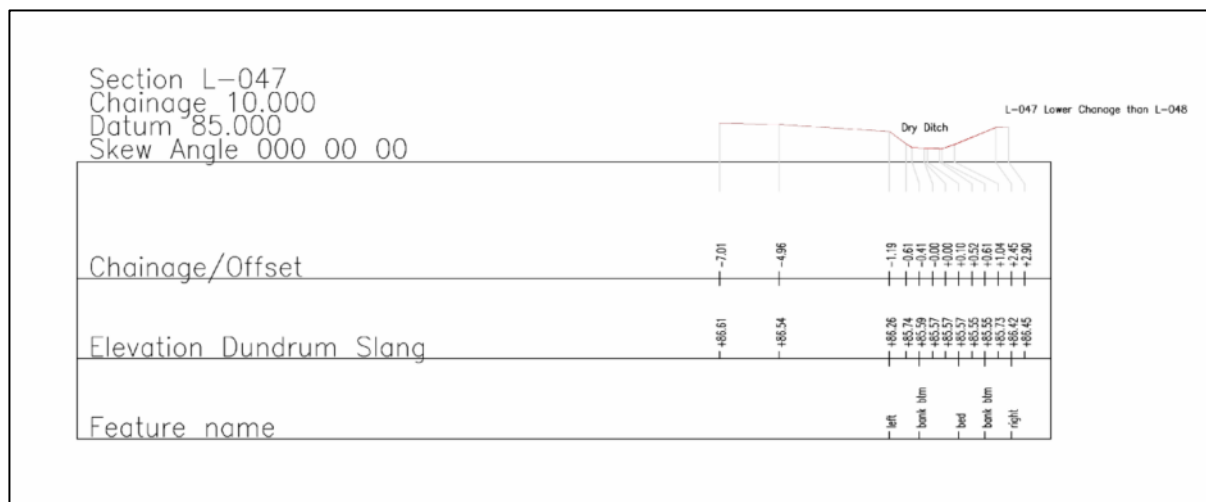


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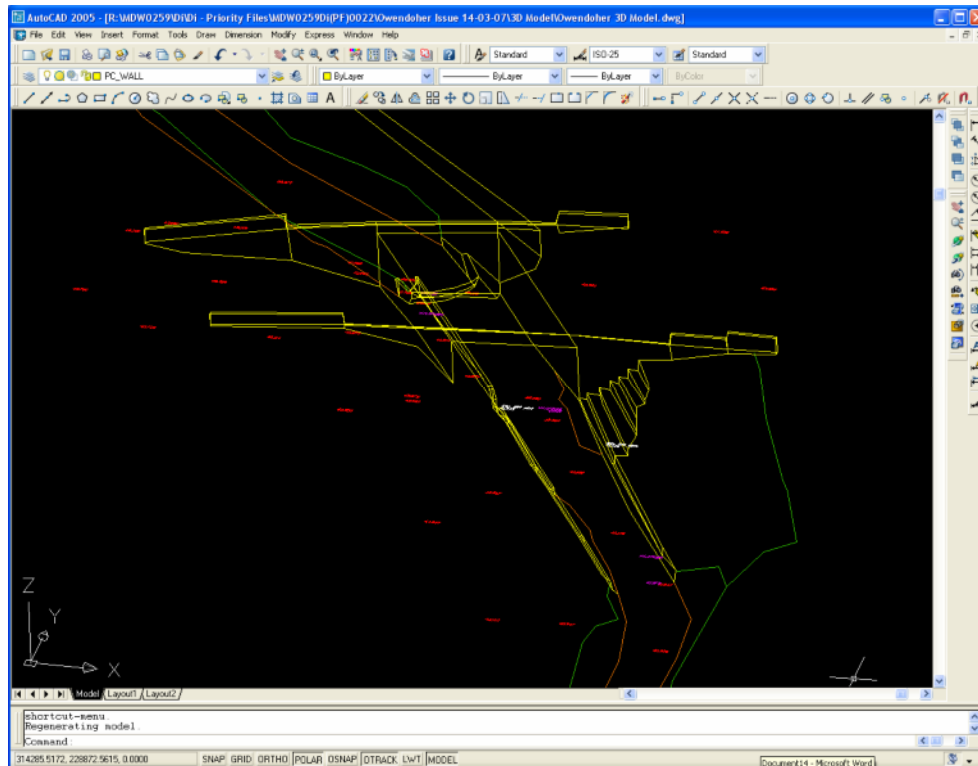
A
Little Dargle Main Channel
10.000
COORDINATES
1 315815.75 226450.39
FLOW DIRECTION
0
DATUM
0
RADIUS TYPE
2
DIVIDE X-SECTION
0
SECTION ID
L-047
INTERPOLATED
0
ANGLE
000 00 00
PROFILE      13
-7.01  86.61  0.03
-4.96  86.54  0.03
-1.19  86.26  0.03<#1>
-0.61  85.74  0.03
-0.41  85.59  0.03
-0.00  85.57  0.03
0.00   85.57  0.03
0.10   85.57  0.03<#2>
0.52   85.55  0.03
0.61   85.55  0.03
1.04   85.73  0.03
2.45   86.42  0.03<#4>
2.90   86.45  0.03
*****

```

**Figure 2-9: Typical ASCII File**



**Figure 2-10 Typical AutoCAD drawing of river cross-section**



**Figure 2-11: 3D AutoCAD model**

A summary of the topographical survey data received is presented in the Table 2-7.

River Name	Approx. Length of Channel Surveyed (m)	No. Cross-Sections Surveyed	No. of Bridges Surveyed	No. of Other Structures Surveyed	No. Photos Taken
Dodder Main Channel	15,670	253	22	15	489
Dundrum / Slang	5,215	83	22	36	184
Little Dargle	4,240	47	9	24	76
Owendohr	4,080	99	26	23	150
Tallaght Stream	5,800	110	18	19	207
Whitechurch	3,355	92	39	16	142
<b>Total</b>	<b>38,360</b>	<b>684</b>	<b>136</b>	<b>133</b>	<b>1248</b>

**Table 2-7: Topographical Survey Summary Table**

### 2.10.1 Existing Survey Data

Topographical survey data for two sections of the River Dodder were already in the possession of RPS before starting the River Dodder CFRAMS. These surveys were carried out for two separate flood impact assessments for private developers in 2005 and 2006.

The first section is between Balls Bridge and Anglesea Road Bridge and includes 21 river cross-sections and details of the 3 bridges along this reach. The second section is between Orwell Weir and the Milltown Viaduct and includes 20 river cross-sections and details of 4 bridges. These sections of the river were not re-surveyed for the River Dodder CFRAMS. RPS provided Dublin City Council Surveying and Mapping Section with the existing survey data so that it could be incorporated into their data.

### **2.10.2 Digital Terrain Model Data**

Airborne laserscanning technology was utilised to provide the required digital terrain model data for use in the River Dodder CFRAMS. It is a recent technology for capturing topography data of the earth and offers highly accurate height information.

The Contracting Authority supplied the following data from a specially commissioned LiDAR (Light Detection and Ranging) survey:

- 2m, 5m and 10m grid Digital Terrain Model (DTM);
- 2m grid Digital Surface Model (DSM);
- Contour Data

The data was supplied in ASCII, AutoCAD and MapInfo formats. The DSM identifies raised objects on the ground surface while the DTM is a “bare-earth” model. The 2m grid provides a detailed resolution of the topography which is vitally important for an accurate representation of the two dimensional flood flow computation. Figure 2-12 provides an overview of the LiDAR data received.





### 3 HYDRAULIC ANALYSIS

The MIKE Flood modelling system will be utilised for the hydraulic analysis component of the River Dodder CFRAMS. MIKE Flood is a software shell comprising the following three components:

- A hydrological model (MIKE 11 Rainfall-Runoff Editor) as discussed further in Section 4 of this report.
- A one-dimensional river model (MIKE 11 HD) to describe the flow in linear rivers and channels.
- A two-dimensional model (MIKE 21 HD) which will be used to describe the flow in coastal and estuarine regions and free surface flow in the river flood plain.

All three components will be fully dynamically linked and exchange data in each time step of simulations. Having all model elements combined and coupled is beneficial for the solution of hydrological and hydraulic conditions.

#### One-Dimensional Modelling

Individual 1-D hydrodynamic models will be established in MIKE 11 for the River Dodder Main Channel and each of the five major tributaries (Owendocher, Whitechurch, Dundrum/Slang, Little Dargle and Tallaght Stream). The models will be set up by inputting survey cross-section ASCII files directly into the software and then manually entering any structures by reading the survey information from the 3-D AutoCAD drawings of each river. An example cross-section taken from the MIKE 11 Cross-Section Editor is shown in Figure 3.1.

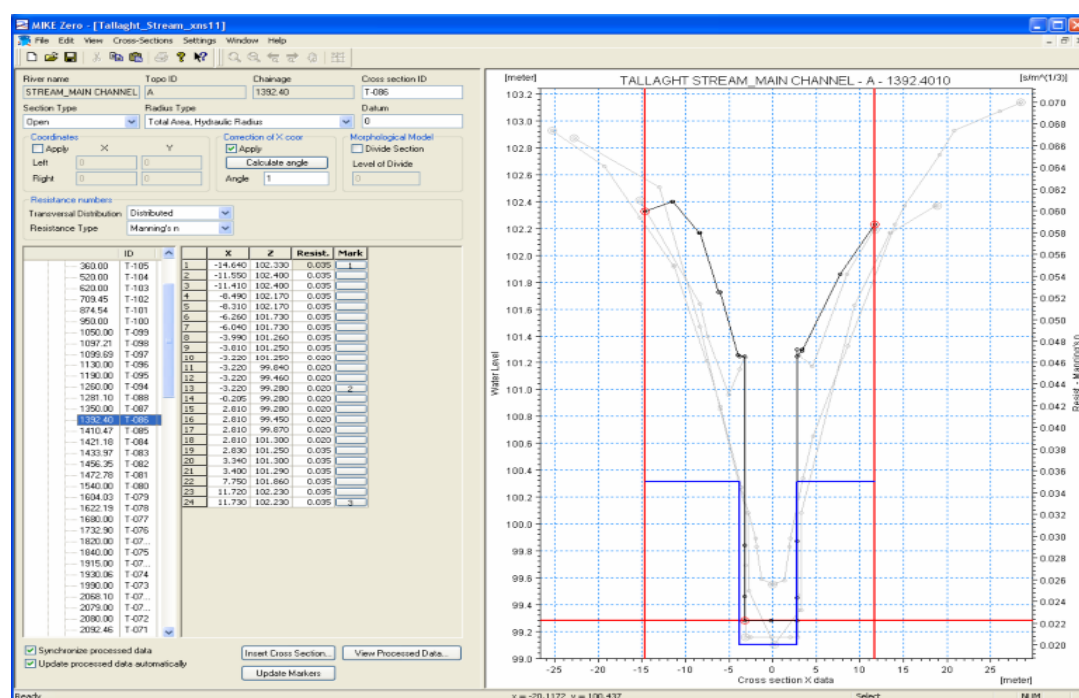


Figure 3-1 MIKE 11 Cross-Section Editor

The 1-D hydrodynamic river models will have an automatic coupling to the rainfall-runoff models, receiving routed runoff from dry catchment areas and direct effect precipitation from flooded areas. The models will be calibrated and verified directly against historic water level and discharge measurements.

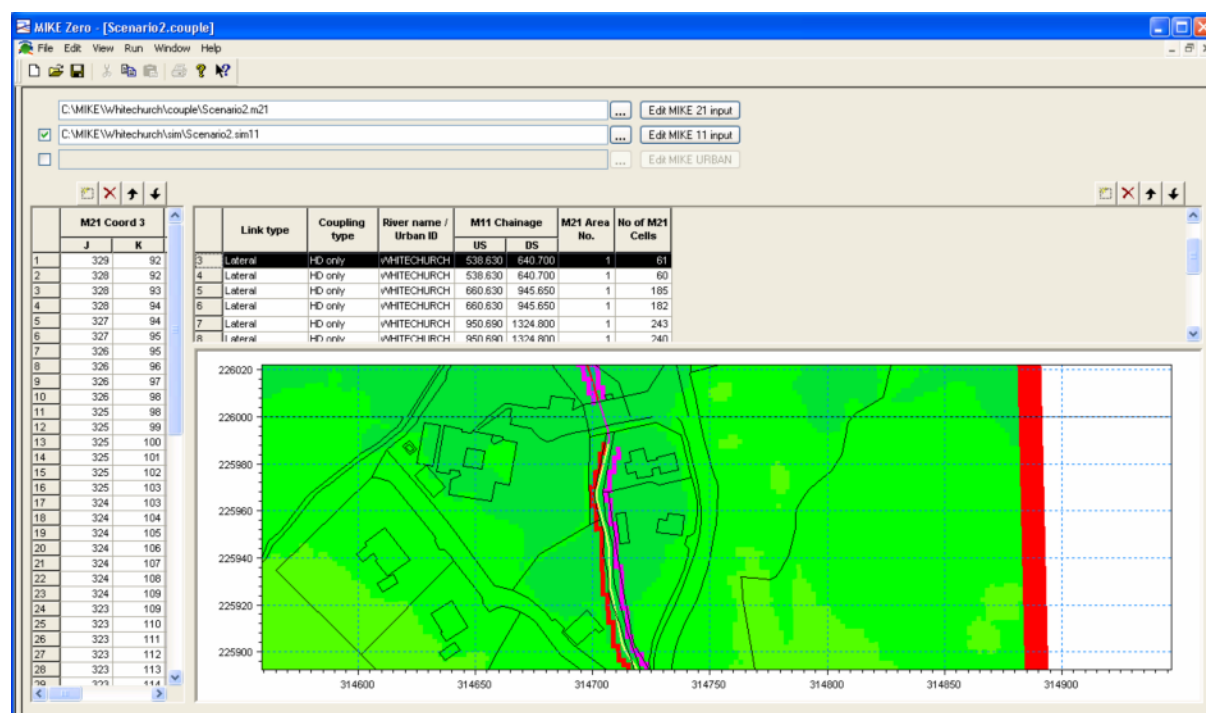
The cross-section survey data entered into the one-dimensional hydrodynamic model includes portions of the flood plains on either side of the river channel. These will be manually reduced to only describe the river channel before the 1-D fluvial models are coupled with the two-dimensional model to allow flow computation within the flood plain. Once the water level exceeds the level of the riverbanks it will spill into the two-dimensional floodplain model.

## Two-Dimensional Modelling

Individual two-dimensional flow models will be established in MIKE 21 for the River Dodder Main Channel and the five major tributaries. The models will be developed from the digital terrain model (DTM) using a grid size of two metres. Figure 2-12 provides an overview of the DTM data available.

Upstream boundary condition will be estimated from the MIKE hydrological models or from gauging station data, as appropriate. The downstream boundary condition will be set using the relevant stage time series data as derived from the appropriate downstream model. Alternatively, a simple stage time relationship will be estimated as a downstream boundary condition.

The links between the 1D/ 2D model will be established as lateral links for the entire length of each model. Links will be established for the left bank and the right bank separately, to take account of the different elevations of each bank. Sections that do not allow overspill into the flood plain, such as walled bridges and culverts, will not be coupled to the 2D model. Figure 3-2 provides a schematic of the coupled 1D/ 2D Model.



### **Figure 3-2: Schematic of the coupled 1D/ 2D Model**

On completion of the development of the hydrodynamic models they will be run for current and future scenarios and then using the MIKE Flood software suite a range of flood maps will be produced. This mapping will be undertaken by using the GIS model of MIKE Flood and then exporting flood information to MapInfo / ArcGIS.

## 4 PRELIMINARY HYDROLOGICAL ASSESSMENT

During the data collection phase of the study, hydrometric data from three flow measurement gauges within the River Dodder watershed was collated as described in Section 2.3 of this report. However, the majority of this data was recorded from historic times when the river catchment characteristics differed greatly from the current situation. This historic flow data will therefore not be solely used in the hydrological assessment as the historic events in respect to their intensity of runoff will not correspond with the current catchment runoff response. Instead, flow data recorded within the past ten years will be used along with corresponding meteorological data to calibrate hydrological models. The calibrated hydrological models will then be run with historic meteorological data and current and future catchment characteristics and the resulting discharges analysed to produce extreme event runoff scenarios. The hydrological assessment procedures are discussed further in Sections 4.1 and 4.2 below.

### 4.1 HYDROLOGICAL MODELLING

The hydrological modelling will be carried out using the Rainfall-Runoff Editor component of the MIKE 11 river modelling software. Given the distinct rural and urban components of the River Dodder Watershed, both the NAM and the Urban models within the Rainfall-Runoff Editor will be utilised. Sub-catchments draining to each of the three flow measurement gauges in the catchment will be defined and the hydrological models will be calibrated for each of these sub-catchments and design runoff events simulated.

#### NAM

The NAM hydrological model simulates the rainfall-runoff processes occurring at the catchment scale. The rainfall-runoff module can either be applied independently or used to represent one or more contributing catchments that generate lateral inflows to a river network. NAM is the abbreviation of the Danish "Nedbør-Afstrømnings-Model", meaning precipitation-runoff-model. This model was originally developed by the Department of Hydrodynamics and Water Resources at the Technical University of Copenhagen, Denmark.

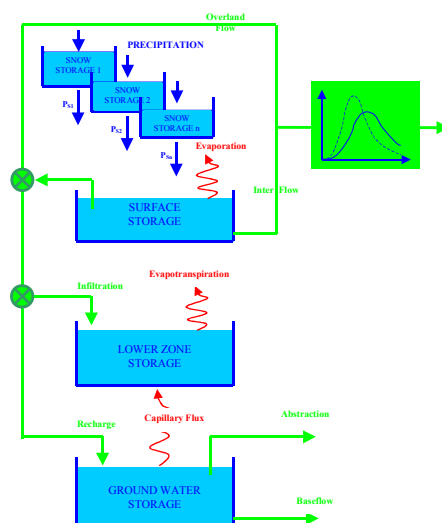
The NAM rainfall runoff model is a deterministic conceptual lumped sum model, which simulates the catchment response by continuously accounting for the water storage in three interconnected reservoirs. A schematic drawing of the model is shown in Figure 4-1. The model is split into a surface storage, a lower or soil layer storage and a ground water reservoir. A key part of the modelling system is a soil moisture content module, which apportions the rainfall between ground water recharge, surface water run off, intermediate runoff and actual evapotranspiration depending on the soil moisture content. Overland flow can only occur if the surface storage is completely replenished and recharge of the groundwater body only occurs if the soil moisture is above a certain threshold. Similarly the discharge from the overland and interflow can only occur if the water content in the soil moisture model is above independently controlled thresholds.

The water discharged from the model is released through linear reservoirs with independent storage constants. Overland flow and interflow are routed through two cascaded linear storages with the time constant changing depending on the actual discharge. Thus for large flows a slightly faster discharge is achieved, which ensures that the routing of real surface flow is kinematic. The groundwater is also released with an independent time constant. In addition the groundwater body can be split into two reservoirs, with different discharge constants. This allows the split of the baseflow into faster and slower components and



enables the simulation of, for example, the release of water from undrained bogs or groundwater bodies with different permeability. Input into the calibrated rainfall runoff simulation is in the form of time series information of total rainfall and actual evapotranspiration.

For calibration purposes, NAM models will be established for each of the three flow measurement gauge sub-catchments. Meteorological data from the past ten years will be used in the NAM models to simulate the corresponding runoff response.



**Figure 4-1: Schematic diagram of NAM rainfall run-off model**

## **URBAN**

The Urban modelling component of the Rainfall-Runoff Module includes two distinct modelling methods, Urban Runoff Model A (Time/Area Method) and Urban Runoff Model B (Non-linear Reservoir Method). Urban Runoff Model B has been chosen for this study as it facilitates the detailed description of runoff surfaces in the catchments which enhances the accuracy of the hydrological models.

The basis of the surface runoff calculations of Urban Runoff Model B is the kinematic wave computation. The concept of kinematic wave is used to solve unsteady, one-dimensional, gradually varied, open channel flow problems. In this model the runoff is calculated as flow in an open channel with only gravitational and frictional losses accounted for. The volume of the runoff is dictated by the size of the contributing catchment and hydrological losses while the shape of the runoff hydrograph is controlled by the length, slope and surface roughness of the catchment.

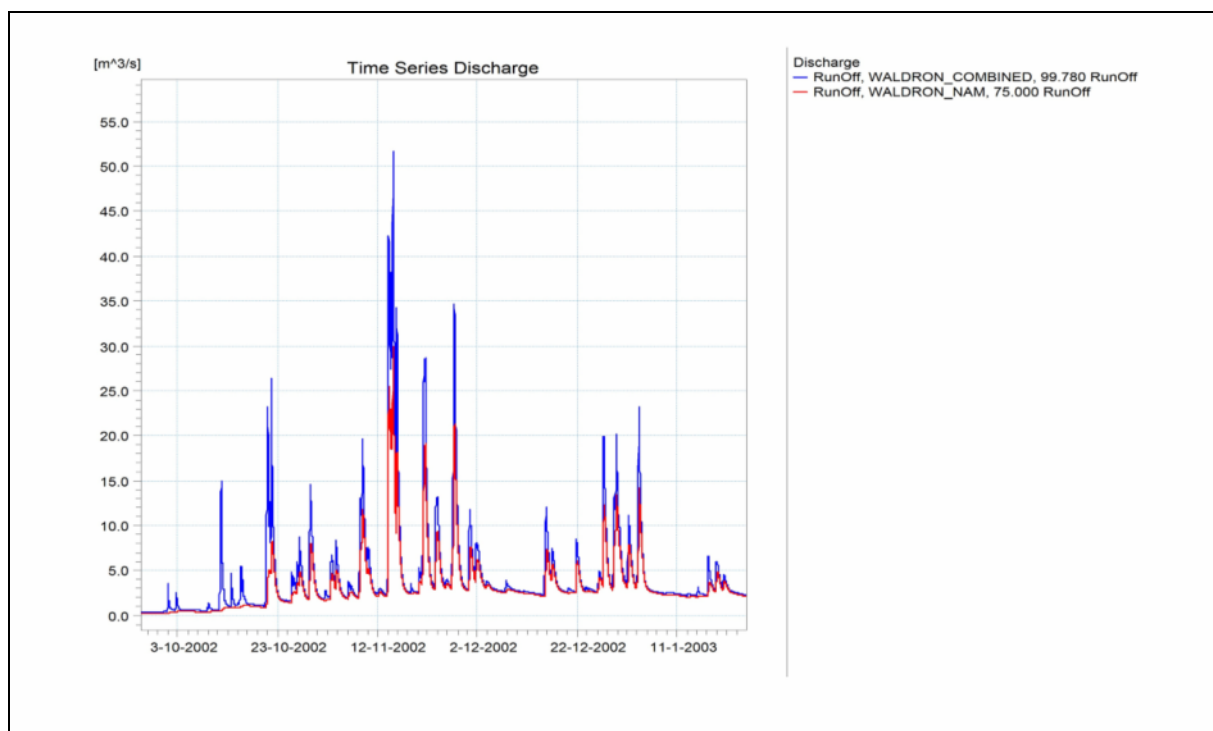
Urban Runoff Model B calculates the effective precipitation intensity (the precipitation which directly contributes to the surface runoff) by taking account of various hydrological losses including evaporation, wetting, infiltration and surface storage. When the effective precipitation intensity is greater than zero, runoff occurs and this is described by the kinematic wave equations for the whole surface at once. This model facilitates the description of five different surface types in one catchment, with the runoff computations for each catchment calculated individually.

For calibration purposes, Urban models will be established for each of the three flow measurement gauge sub-catchment. Meteorological data from the past ten years will be used in the Urban models to simulate the corresponding runoff response from the urban portion of the sub-catchments.

## **COMBINED**

Combined models will be produced by joining together the NAM and Urban models for each of the three flow measurement gauge sub-catchments in the River Dodder watershed. These combined models will then be calibrated against recorded flow data from the gauges for the past ten years. Once calibrated, the combined models will be run with historic meteorological data and current and future catchment characteristics to simulate appropriate runoff responses.

Example time series discharges comparing outflows from the NAM Model and the Combined Model (NAM & Urban) can be seen in Figure 4-2. It can be seen that the Urban model contributes most of the peaks to the Combined Model runoff discharge file.



**Figure 4-2 Example Time Series Discharge for NAM and Combined Model**

## **4.2 DERIVING EXTREME RUNOFF EVENTS**

The calibrated hydrological models will be run with historical meteorological data, i.e. the model will be run with time series rainfall from the past 60 years and current catchment characteristics in terms of urbanisation and land use. Extreme flows will be inspected from the resulting runoff discharge files and peak over threshold analyses carried out. Extreme

discharge events will then be derived for Q2, Q5, Q10, Q25, Q50, Q100, Q200 and Q1000 using extreme value analysis (EVA).

Additionally, the 2050 and 2100 development scenarios discussed in Section 2.6 and climate change scenarios discussed in Section 2.5 will be simulated in the hydrological models. These scenarios will be reproduced by appropriately altering the urban percentages and increasing rainfall volumes in the hydrological models. Extreme value analyses will be carried out on the resulting runoff discharge files to derive extreme discharge events for each scenario as discussed above.

Using the hydrological models and relevant GIS information the model parameters can be changed and the catchment response for locations further up or downstream of the flow measurement gauge sites can be calculated. The key variation is the degree of urbanisation and the slope of the catchment.

The extreme value analysis will be carried out on these simulated rainfall runoff events by peak over threshold (POT) analysis also known as partial duration series. The selection can be made on the basis of a fixed number of the largest values or by applying a threshold level over which the events are selected for inclusion into the data series. POT analysis has been found to give a better representation and statistical distribution compared to annual maximum series and is therefore preferred in this case. Extreme value analysis will be undertaken by fitting theoretical probability distributions to the observed values.

Candidate probability distributions are then fitted to the data. Seven distributions are available in the toolbox used by RPS Consulting Engineers and are as follows:

- Weibull,
- Generalised Pareto,
- Gamma/Pearson Type 3,
- Log-Pearson Type 3,
- Log-normal,
- Exponential and
- Truncated Gumbel.

For the estimation of the parameters relating to the probability distributions generally three methods can be applied; the method of moments, the method of L-moments and maximum likelihood method. The goodness of fit of the resulting distributions can then be tested using five statistical methods; Chi-squared, Kolmogorov-Smirnov test, standardised least squares criterion, probability plot correction co-efficient and Log-likelihood measure. The uncertainty of these distributions is evaluated by application of the Jackknife resampling technique, which provides confidence limits for each return period event.

Using the above techniques the distribution with the best fit to the simulated runoff data set can be identified and the return period discharge values for the above range of return periods including confidence limits can be derived. These can then be applied to the hydraulic model as hydrographs either artificially generated (i.e. for the 1 in 100 year return period) or selected and modified from the simulated events (since 60 years of runoff are simulated, lower return period events are included in the POT data set).

These hydrographs can then be applied either as point sources on the upstream boundary or in case of the urban sections as longitudinal (line) sources feeding into the river along the modelling section. Thus an increase in discharge moving downstream can be observed and rainfall runoff events can be most realistically modelled.

## 5 PRELIMINARY FLOOD ASSESSMENT

### 5.1 RIVER DODDER MAIN CHANNEL

The River Dodder has a history of regular flooding in the 20<sup>th</sup> Century, as evidenced in Table 5-1. This table presents a list of highest ranked floods at Waldron's Bridge Gauge for the past 100 years (extracted from "A Selection of Extreme Flood Event – The Irish Experience", A.M. Cawley and C.Cunnane).

Date	Peak Flow (m <sup>3</sup> /s)
25th August 1986	232
25th August 1905	198
5th November 2000	156
3rd September 1931	153
17th November 1965	139
19th December 1958	116
2nd December 2003	112
3rd February 1994	110
5th November 1982	106
9th April 1998	87
2nd November 1968	85
December-83	82
11th June 1993	81
26th August 1912	80
25th September 1957	74

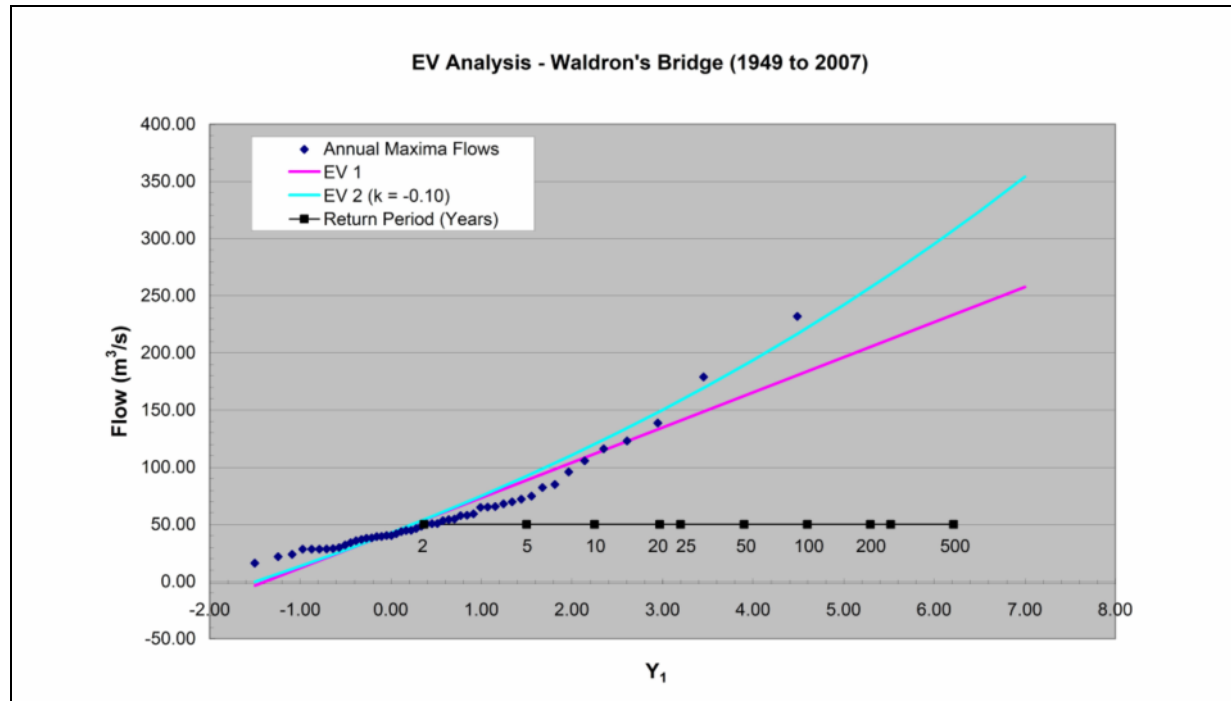
**Table 5-1 Highest Ranked Floods at Waldron's Bridge Gauge for the 20<sup>th</sup> Century**

Information on flooding in the years before 1900 is more difficult to garner, although the table of historical flood events in Jack Keyes' paper presented to the Institute of Engineers of Ireland in 1987 ("Flood in Dublin City Rivers 25<sup>th</sup>/26<sup>th</sup> August 1986") includes mention of floods from 1880, 1883, 1891 and 1898. In addition, The Old Dublin Society Paper, "Weather in Old Dublin" (F.E. Dixon) references flooding on the River Dodder in 1739, 1787, 1794, 1802 and 1851. However, no gauged flow quantities are provided in either of these papers. It is mentioned in the EPA paper on flooding in the Dodder Catchment (Micheál Mac Cárthaigh, August 2005) that the construction of Bohernabreena Reservoir in 1883 has helped to alleviate downstream flooding.

The initial flooding assessment of the River Dodder main channel has found that flooding of the low-lying section of the river is a result of the inadequate hydraulic capacity of the channel. Given the heavily urbanised nature of the lower catchment, the river channel has been largely modified in its lower reaches. The proposed hydraulic modelling will expand on the initial assessment and reproduce current and future flooding scenarios.

Annual Maximum Values from the flow measurement gauge at Waldron's Bridge between 1949 and 2007 have been collated from the EPA paper (Micheál Mac Cárthaigh, August

2005) and the IEI Dodder River Flood Study Report (P. Hennigan, J. McDaid, J. Keyes, Nov.1988). An extreme value analysis has been carried out on these figures for comparison purposes as shown in Figure 5-1.



**Figure 5-1 EV Analysis of Annual Maxima Flows from Waldron's Bridge Gauge**

Maps outlining the historical flood extent of the River Dodder as well as isolated flooding points throughout the catchment are provided in Appendix B.2

## 5.2 TRIBUTARIES

As discussed in Section 2.2 of this report, there is very little published data available on flooding along the main tributaries of the River Dodder. The exception is a report on the Little Dargle River prepared in 1958 by Dublin Corporation. This document references flooding on the Little Dargle in September 1931, December 1956, September 1957 and February 1958. It also discusses proposed flood alleviation works which were put in place circa. 1958. Other information on flooding along the tributaries was gathered from the OPW website ([www.floodmaps.ie](http://www.floodmaps.ie)).

An initial assessment of flood mechanisms of the tributaries to the Dodder has shown that flooding is associated mainly with local blockages of culverts and crossings rather than the hydraulic capacity of the channel and this is most likely due to the channelled and walled characteristics of the tributaries. Hydraulic modelling of the tributaries will assess areas likely to block and reproduce blockage conditions for current and future scenarios.

The proposed detailed flood assessment will identify areas where the risk of blockage and consequent flooding could be reduced, propose mitigation measures to control blockages (for example cutting back trees, sedimentation control) and put forward flood risk management options.

## **6 STRATEGIC ENVIRONMENTAL ASSESSMENT (SEA)**

### **6.1 SEA PROCESS**

SEA is a systematic process for evaluating, at the earliest appropriate stage, the environmental impact and consequences that the River Dodder CFRMP may have. The SEA process runs in tandem with the CFRAM Study. The SEA comprises of the following stages;

- Scoping report - to identify key issues of concern that should be addressed in the environmental assessment of the Plan so that they can be considered in appropriate detail;
- An Environmental Report - containing the findings of assessment on the likely significant effects on the environment from the implementation of the Plan;
- Consultation on draft plan and associated Environmental Report;
- A SEA Statement - identifying how environmental considerations and consultation have been integrated into the final plan.

The CFRMP will take into account the findings of the Environmental report and the outcome of the consultations when deciding on whether to adopt or modify the draft plan. The SEA process should lead to a more sustainable development by screening out less acceptable options at the early stages of the plan.

### **6.2 SCOPING REPORT**

We are currently at the scoping phase. The purpose of scoping is to gain an insight into the surrounding environmental media that may be affected by the implementation of the key measures proposed in the plan. For this reason the SEA team work closely with the flood study team. This ensures that key issues of the plan are considered by the SEA and that key environmental issues are understood by the flood study team early in the planning process. The scoping report can be split into five stages as follows:

1. Determining the key goals and objectives of the plan that relate to the environment. So far the key environmental objectives of the plan have been listed as:
  - Reduce flood risk to people, property and the environment;
  - Enhance the natural functioning of the floodplain and achieve a diverse river profile;
  - Promote sustainable land use by recommending areas to be free from development;
  - Maintain and improve water quality standards;
  - Maintain and improve angling facilities;
  - Enhance public access through walkways and cycle paths;
  - Protect and enhance landscape and townscape character and visual amenity;
  - Protect and enhance features of archaeological and cultural heritage;
  - Promote the principles of sustainable construction;

- Maintain and improve biodiversity, flora and fauna particularly at designated areas of conservation.
2. Determining the environmental issues to be assessed. The SEA Regulations specify 12 aspects of the environment that must be considered in the SEA process. These are;
    - Biodiversity, Flora, Fauna
    - Population, Human Health
    - Water
    - Air, Climatic factors
    - Soils
    - Landscape
    - Cultural Heritage
    - Material Assets
    - Inter-relationship between the above
  3. Reporting on relevant international, national and local policies, plans and programmes that may influence the plan.
  4. Developing draft environmental objectives, indicators and targets which allows for the evaluation of impacts based on the findings in Stages 2 and 3 above. A draft example of the objectives, indicators and targets for biodiversity flora and fauna can be seen in Table 6-1 below.

Environmental Aspect	Objective	Indicator	Target	Opportunity
Biodiversity, Flora & Fauna	Maintain and Improve Biodiversity, flora and fauna particularly at designated areas of conservation	Loss or impairment of designated habitat and species due to construction and operational phases of the strategy	No significant negative impact on designated habitats or species	Increase habitat diversity
		Reduction in biodiversity (species richness and diversity) due to the implementation of the Plan	No significant effect on species richness and diversity	
			No significant effect on species richness and diversity	

**Table 6-1: Draft Environmental Objectives, Indicators and Targets**

5. Identifying reasonable alternative means for achieving the strategy goals of the plan/programme. Some of the various strategies that the plan may put in place are listed in Table 6-2 below. The likely significant impacts that each of these may have on the environment will be described. An example is given in Table 6-3.

Strategy	Description
Do Nothing	No flood defences are to be put in place and flood maintenance already in place would cease.
Do Minimum	Current flood maintenance practices are kept but no further provisions are put in place
New Storage	Constructing a new attenuation unit
Existing reservoirs	Creating additional storage in existing reservoirs
Defences	Raising existing walls or constructing new ones.
Channel Widening	Widening the river channel
Altering structures	Underpinning or raising the soffit of bridges, modifying removing weirs
Landuse Management, Planning & development Control	To attenuate flood water with a view to reduce run-off. Zoning of land for flood development, prevention of incremental development etc.

**Table 6-2: Plan Strategies**

Option	Key Issues / Impacts
<b>'DO NOTHING'</b>	
This entails that no further flood defence works take place. The current management of current flood practices along the river would also stop. This option is used for comparing the various flood management options, in terms of their effectiveness, benefits and costs.	<p>If no flood defence measures are put in place then the likelihood of habitat loss from the inundation of flood waters is increased. The inundation of flood waters to wetlands can reduce their biodiversity (Foundation for Water Research, 1998). Flooding can reduce the level of dissolved oxygen (DO) in a river and aquatic vegetation can be sensitive to such changes (Foundation for Water Research, 1998)</p> <p>Flooding can result in intermittent discharges from Combined Sewer Overflow (CSO's) and Surface Water Outfall (SWO'S) and storm tanks can lead to adverse affects on the quality of water in urban areas (Foundation of water Research, 1998). These impacts include; a reduction of dissolved Oxygen (DO) leading to degradation of dissolved BOD and an increase in river concentrations of ammonia, bacteria, COD and suspended sediments as well as heavy metals and other toxic substances (Foundation of water research,1998). If flood defence works are not put in place there is an increased risk of such adverse impacts occurring.</p> <p>Designated areas, recreational areas and public parks would be affected by flooding</p> <p>There would be considerable economic impacts through damages to infrastructure, industry and housing</p> <p>There would also be an increase in impacts of flooding on safety, economy and communities.</p> <p>The natural environment would return to equilibrium which would have overall positive effects on the overall environment</p>

**Table 6-3: Example of Likely Significant Impacts of 'Do Nothing' Scenario**



To ensure a robust scoping procedure, the process will be carried out with various stages of consultation. These are discussed in more detail below.

## Consultation

Under S.I. No. 435 of 2004, designated environmental authorities must be consulted in relation to the scope and level of detail to be included in the Environmental Report of the SEA. The designated environmental authorities as well as primary and secondary stakeholders will be informed about the preparation of the SEA. The SEA stakeholders are listed in Table 6-4. Submissions, observations and comments resulting from any consultation will be taken into account during the preparation of the various reports throughout the SEA process.

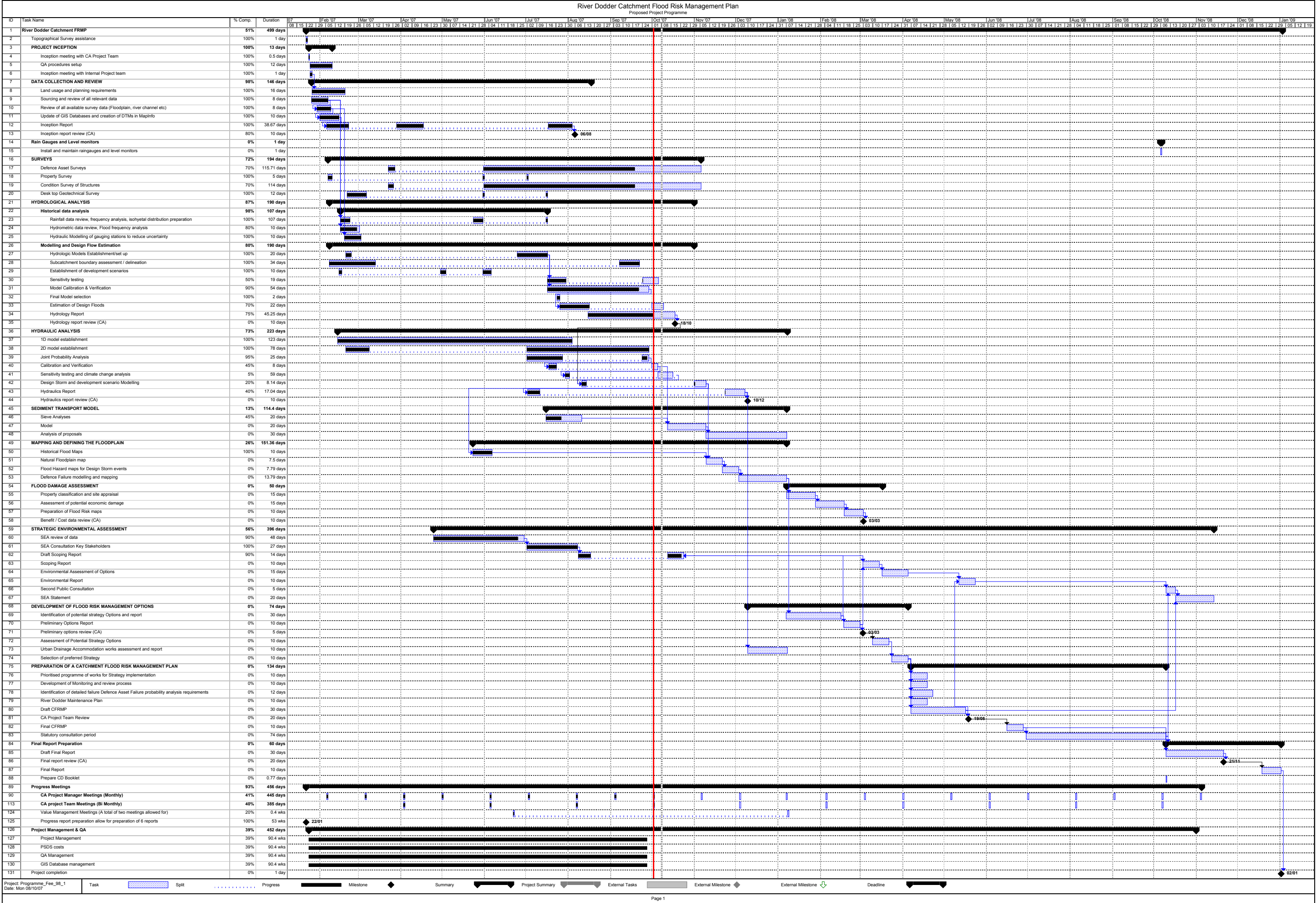
SEA STAKEHOLDERS	
Environmental Authorities	Secondary Stakeholders
Environmental Protection Agency (EPA) Dept. of Environment Heritage & Local Government (DEHLG) Dept. of Communications Marine and Natural Resources (DCMNR)	Central Fisheries Board Dublin Transport Office (DTO)/Iarnród Éireann / Dublin Bus  BirdWatch Ireland, Dodder Valley Project Dodder Anglers Group Residents Associations Bat Conservation Ireland Geological Survey of Ireland An Taisce, The national Trust for Ireland Waterways Ireland Irish Wildlife Trust
Primary Stakeholders	
Office of Public Works (OPW) Dublin City Council (DCC) - Dublin Cities Heritage Office - Dublin City Planning South Dublin County Council (SDCC) Dun Laoghaire Rathdown County Council (DLRCC) River Basin District - Eastern Region (ERBD) ESB Eastern Region Fisheries Board (ERFB) National Parks and Wildlife Service (NPWS) The Heritage Council	National Roads Authority (NRA) Sustainable Water Network (SWAN) Coilte Teagasc Marine Institute Irish Farmers Association (IFA) Dublin Naturalists Field Club

**Table 6-4: SEA Stakeholders**

Each of the stakeholders has been sent information in the form of a letter and a report outlining the key aspects of the project and the SEA process. They have been asked to comment and forward any information that they find relevant.

## **APPENDIX A**

### **Programme**



## **APPENDIX B**

### **Data Collection**

**APPENDIX B.1**

**Data Collection Register**

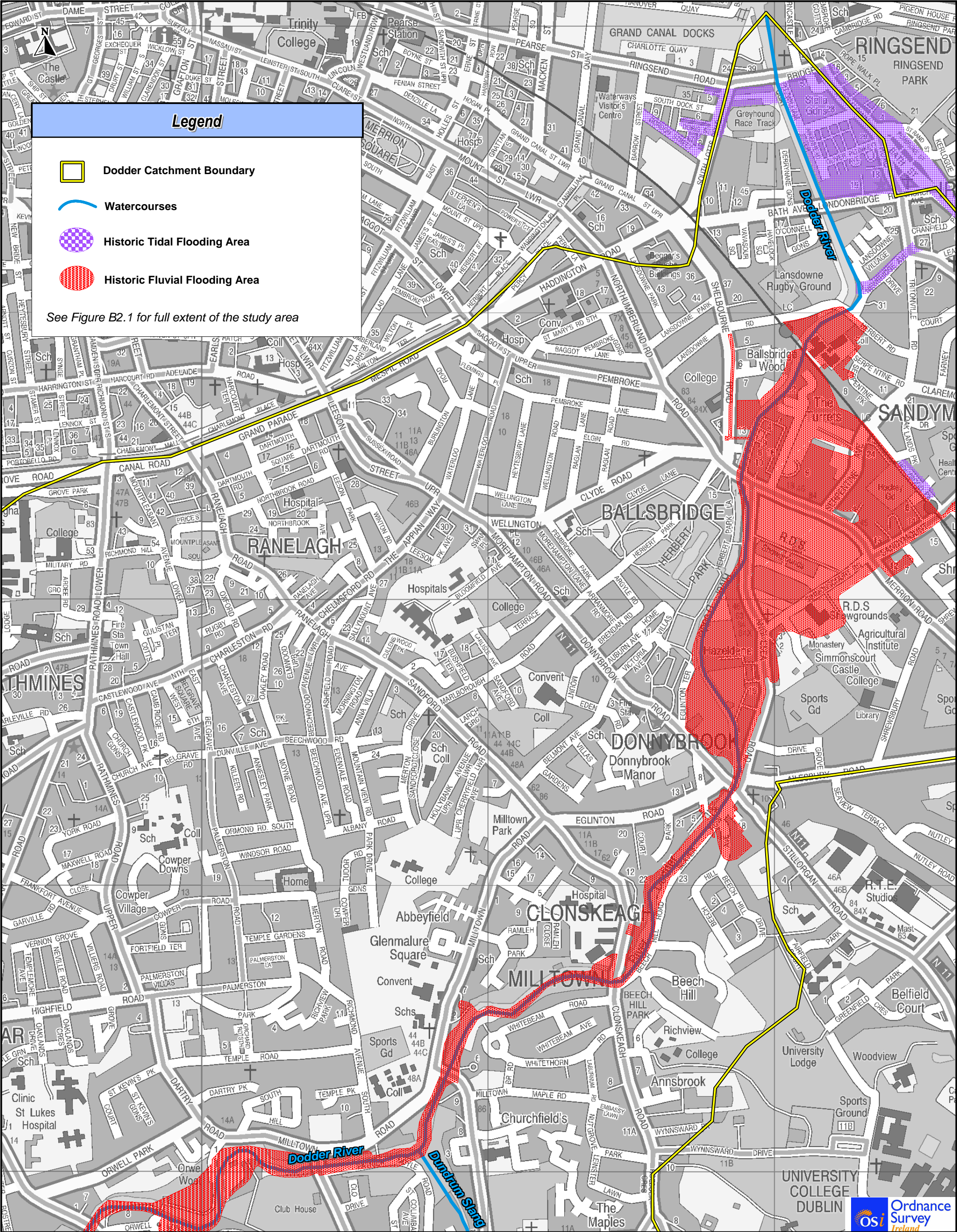
Data Collection Register				
Ref.	Data	Format	Source	Date Provided
1	Flood Relief / Risk Management Measures			
1.1	<a href="#">River Dodder Inundation Study (ESBI for Dublin Corporation 1994)</a>	Digital / Hardcopy	Previous Project	-
1.2	<a href="#">River Dodder Improvement Scheme 1966 (Anglesea Road Section) - DCC</a>	Digital / Hardcopy	George Peter (OPW)	13.08.05
1.3	<a href="#">Report on Little Dargle River 1958</a>	Digital / Hardcopy	George Peter (OPW)	13.08.05
1.4	<a href="#">Proposed Retaining Wall at Orwell Gardens 1953</a>	Digital	George Peter (OPW)	13.08.05
1.5	Report on Spillway Uprating for Bohernabreena Upper and Lower Reservoirs - DCC 1987	Hardcopy	Brian Hennelly (DCC)	22.01.07
1.6	<a href="#">Dublin Coastal Flooding Protection Project (DCFPP) - Draft Report</a>	Hardcopy	Brian Hennelly (DCC)	31.01.07
1.7	<a href="#">Details of operation of Bohernabreena Reservoir</a>	Digital / Hardcopy	Brian Hennelly (DCC)	01.05.07
1.8	DCFPP - Dodder Flood Alleviatin Works Phase 1 - Draft Final Report	Hardcopy	Brian Hennelly (DCC)	23.07.07
2	Historic Flood Data			
2.1	<a href="#">River Dodder Flooding Report - Dec 1986 (DCC)</a>	Digital / Hardcopy	George Peters (OPW)	13.08.05
2.2	Hurricane Charlie - An Overview Activities of An Foras Forbatha	Hardcopy	Previous Project	-
2.3	<a href="#">EPA Report on Flooding in the Dodder Catchment 26 August 1986 (Hurricane Charlie) and 2 December 2003 (EPA July 2005)</a>	Digital / Hardcopy	Micheál Mac Cárthaigh (EPA)	19.08.05
2.4	Presentation of Analysis Carried Out by Drainage Design Division of Dublin County Council on The Dodder River With Particular Reference to Flooding Which Occurred on 25th/26th August 1986 to IEI	Hardcopy	Previous Project	-
2.5	Dodder River - Flood Study (IEI Paper 1988)	Hardcopy	Previous Project	-
2.6	<a href="#">Tidal Flooding of 1st February 2002 (IEI Paper)</a>	Digital / Hardcopy	Previous Project	-
2.7	<a href="#">River Dodder 1986 Floodplain</a>	Digital / Hardcopy	George Peters (OPW)	13.08.05
2.8	<a href="#">Photographs of Flooding During Hurricane Charlie</a>	Digital / Hardcopy	George Peters (OPW)	13.08.05
2.9	<a href="#">Photographs following Hurricane Charlie Flooding</a>	Digital	George Peters (OPW)	13.08.05
2.10	<a href="#">Photographs of Flooding During 1987 Flood Event</a>	Digital / Hardcopy	George Peters (OPW)	13.08.05
2.11	<a href="#">River Dodder Flooding 1958 - Interim Report</a>	Digital / Hardcopy	George Peters (OPW)	13.08.05
2.12	<a href="#">Flooding at AIB Ballsbridge (Hurricane Charlie)</a>	Digital / Hardcopy	George Peters (OPW)	13.08.05
2.13	A Selection of Extreme Flood Events - The Irish Experience (IEI Paper)	Digital / Hardcopy	Previous Project	-
2.14	Bridge Collapse - Causes, Consequences and Remedial Measures - 1987	Hardcopy	Brian Hennelly (DCC)	22.01.07
2.15	<a href="#">The Engineer Journal Vol. 40 No. 11 - Hurricane Charlie - River Dodder Flooding</a>	Digital	Brian Hennelly (DCC)	31.01.07
2.16	<a href="#">Hurricane Charlie - An Overview of Flooding in Dublin City Rivers</a>	Digital	Brian Hennelly (DCC)	31.01.07
2.17	<a href="#">Hurricane Charlie Photos</a>	Digital	Brian Hennelly (DCC)	29.11.06
2.18	Report on Little Dargle River	Hardcopy	Ed Doorly (DLRCC)	26.02.07
2.19	The use of Historical Data in Flood Frequency Estimation	Digital / Hardcopy	Internet	24.05.07
2.20	Hurricane Charlie - An Overview - Flooding in Dublin City Rivers - 25th/26th August 1986	Digital / Hardcopy	<a href="http://www.floodmaps.ie">www.floodmaps.ie</a>	18.07.07
2.21	Weather in Old Dublin (F.E. Dixon) - Old Dublin Society	Hardcopy	Pearse St. Library	26.07.07
2.22	Dodder Investigation - Flood of the 19th December 1958 - Waterworks Dept. - 20th March 1959	Hardcopy	DCC	07.08.07
2.23	Feasibility of Reservoir Control at Bohernabreena on the Dodder River - Second Report - Sept. 1978 - Dublin Corporation Main Drainage Department.	Hardcopy	DCC	07.08.07
2.24	R. Dodder - Proposed Improvement Works From Ballsbridge to Donnybrook - Dublin Corporation Sewer and Main Drainage Section - March 1966 - Report	Hardcopy	DCC	07.08.07
2.25	R. Dodder - Proposed Improvement Works From Ballsbridge to Donnybrook - Dublin Corporation Sewer and Main Drainage Section - 25th July 1966 - Drawings	Hardcopy	DCC	07.08.07
2.26	Flooding in the Dodder Catchment - 22nd June 2007	Digital	EPA	07.08.07
2.27	Report on the flooding of the Whitechurch Road, 22nd June 200	Digital	DCC	07.08.07
2.28	Pictures and video footage taken during the flooding event of the 22nd June 2007	Digital	SDCC	13.08.07
2.29	Preliminary report and additional information on the flooding 22nd June 2007	Digital	Caroll & Browne Consultants	13.08.07
2.30	Drawing & pictures of original culvert at Taylor Lane	Digital	Caroll & Browne Consultants	15.08.07
3	Hydrometric Data			
3.1	<a href="#">EPA Report on Flooding in the Dodder Catchment 26 August 1986 (Hurricane Charlie) and 2 December 2003 (EPA July 2005)</a>	Digital / Hardcopy	Micheál Mac Cárthaigh (EPA)	19.08.05
3.2	<a href="#">Flow and Level Data for Dodder River gauges</a>	Digital	Micheál Mac Cárthaigh (EPA)	14.10.05
3.3	<a href="#">Hydrographs of flow at Bohernabreena and Orwell Bridge (17.11.1965)</a>	Digital	George Peters (OPW)	13.08.05
3.4	<a href="#">River Dodder 1905 Flood Hydrographs</a>	Digital	George Peters (OPW)	13.08.05
3.5	<a href="#">River Dodder 1959 Flood Hydrographs</a>	Digital	George Peters (OPW)	13.08.05
3.6	<a href="#">FSR Method Investigation (UCD)</a>	Digital / Hardcopy	Brian Hennelly (DCC)	31.01.07
3.7	<a href="#">Flooding in the Dodder Catchment 22 June 2007</a>	Digital / Hardcopy	Micheál Mac Cárthaigh (EPA)	10.07.07
4	Meteorological Data			
4.1	<a href="#">Hourly rainfall from Casement Aerodrome for 1986 and 2003</a>	Digital	Met Eireann	07.10.05
4.2	<a href="#">Monthly Tables of Hourly Rainfall at Dublin Airport and Casement Aerodrome for August 1986 and November 2000 (Met Eireann)</a>	Digital / Hardcopy	Met Eireann	13.11.00
4.3	<a href="#">Newspaper clipping - Rainfall Map June 1963</a>	Digital	George Peters (OPW)	31.08.05
4.4	<a href="#">Annual Max Flood Flows at Orwell Bridge 1960</a>	Digital	George Peters (OPW)	31.08.05
4.5	<a href="#">Rainfall Data for Sandyford gauge (15.12.03 to 28.01.07)</a>	Digital	Liam O'Dwyer (DLRCC)	30.01.07
4.6	<a href="#">Rainfall Data for Donnybrook gauge (07.02.04 to 23.01.07)</a>	Digital	Paddy Coyle (DCC)	06.02.07
4.7	<a href="#">Rainfall Data for Ballyboden gauge (04.02.04 to 23.01.07)</a>	Digital	Paddy Coyle (DCC)	06.02.07
4.8	<a href="#">Daily Rainfall Totals for Various Gauges in Dublin and Wicklow</a>	Digital	Aidan Murphy (Met)	Apr-07
4.9	<a href="#">Hourly rainfall data for Casement Aerodrome (1964 to 2007)</a>	Digital	Aidan Murphy (Met)	May-07

Data Collection Register				
Ref.	Data	Format	Source	Date Provided
5	Land-Use Data			
5.1	- Greater Dublin Strategic Drainage Study (GDSDS) Strategy Report	Hardcopy	GDSDS	-
5.2	- GDSDS Population and Land Use Report	Hardcopy	GDSDS	-
5.3	- S1005 Poddle River	Hardcopy	GDSDS	-
5.4	- S2009 Dodder Owendoher	Hardcopy	GDSDS	-
5.5	- S2010 Dodder Whitechurch	Hardcopy	GDSDS	-
5.6	<a href="#">- S2011 Dundrum / Slang (Little Dargle)</a>	Digital / Hardcopy	GDSDS	-
5.7	- F001 City Centre / Docklands	Hardcopy	GDSDS	-
5.8	- F003 Grand Canal - Stage 2	Hardcopy	GDSDS	-
5.9	- F005 Rathmines & Pembroke	Hardcopy	GDSDS	-
5.10	- F006 Dodder Valley Sewer (DLRCC Area)	Hardcopy	GDSDS	-
5.11	- F007 Dodder Valley Sewer (SDCC Area)	Hardcopy	GDSDS	-
5.12	<a href="#">Dodder Valley Catchment Area Study (2004 Design Review)</a>	Digital / Hardcopy	GDSDS	-
5.13	Catchment Boundaries from Water Framework Project	Digital	Matthew Gamache (CDM)	27.04.07
5.14	<a href="#">Location of SDCC lands along Dodder River</a>	Digital	Brian Hennelly (DCC)	12.06.07
5.15	<a href="#">Paper - "Runoff responses to afforestation in a watershed of the Loess Plateau, China"</a>	Hardcopy	Previous Project	-
5.16	<a href="#">Paper - "The Effect of Afforestation on Water Runoff in the Woodburn Catchment Area"</a>	Hardcopy	Previous Project	-
6	Planning and Development Information			
6.1	Draft Area Plan for Ballsbridge (Jan. '07)	Hardcopy	Brian Hennelly (DCC)	12.02.07
7	Defence and Coastal Protection Asset Data			
7.1	Toughbooks Office Information	Digital	Halcrow	24.05.07
8	Existing Survey / Geotechnical Data			
8.1	River Dodder Flooding Report Phase I - London Bridge to Ringsend Bridge - Archaeology Assessment - April 2002	Hardcopy	Brian Hennlly (DCC)	22.01.07
8.2	River Dodder Flooding Report Phase II - London Bridge to Ball's Bridge - Archaeology Assessment - April 2002	Hardcopy	Brian Hennlly (DCC)	22.01.07
8.3	Site Investigation Information - River Dodder Estuary Proposed Flood Protection Works	Digital	Brian Hennlly (DCC)	10.04.07
8.4	Site Investigation Information - Landsdowne Road Development	Digital	Brian Hennlly (DCC)	10.04.07
8.5	<a href="#">SUS Data for Dundrum/Slang Area</a>	Digital	DLRCC	12.03.07
8.6	<a href="#">Areas of river bank erosion in Dodder Valley Linear Park (SDCC)</a>	Digital	DCC	12.06.07
9	Environmental Data			
9.1	Environmental Report Accompanying Draft Area Plan for Ballsbridge (Jan. '07)	Hardcopy	Brian Hennelly (DCC)	12.02.07
9.2	<a href="#">Draft City Parks Habitat Study for DCC</a>	Digital	Brian Hennelly (DCC)	12.02.07
9.3	Proposed Sheetpiling Works on The River Dodder in Ringsend, Dublin 4 - Ecological Appraisal	Hardcopy	Brian Hennlly (DCC)	22.01.07
9.4	<a href="#">Glenasmole / Bohernabreena Housing Needs Study (SDCC) - Environmental Appraisal</a>	Digital	Brian Hennelly (DCC)	31.01.07
9.5	<a href="#">Habitat Survey Report for Anglesea Road Development</a>	Digital	Marion Coll (RPS)	21.04.06
9.6	<a href="#">Dublin City Biodiversity Action Plan 2007-2010</a>	Digital	Brian Hennlly (DCC)	19.04.07
9.7	<a href="#">Dublin City Council Habitats Mapping Project Final Report</a>	Digital	The Heritage Council	20.04.07
9.8	<a href="#">Dublin City Natural Heritage Surveys</a>	Digital	Online	27.04.07
9.9	Water Quality Data	Online	EPA	
9.10	<a href="#">Otter Survey of Ireland 2004/2005</a>	Digital	Wildlife Ecology Group, Dept. of Zoology, TCD	27.04.07
9.11	<a href="#">www.npws.ie</a>		National Parks and Wildlife Service	
9.12	<a href="#">www.cso.ie</a>		Central Statistics Office	
9.13	<a href="#">www.environ.ie</a>		DOEHLG	
9.14	<a href="#">www.dcmnr.gov.ie</a>		DCMNR	
9.15	<a href="#">www.erfb.ie</a>		Eastern Regional Fisheries Board	
9.16	<a href="#">www.erbdl.ie</a>		Eastern River Basin District	
10	Topographical Survey Data			
10.1	<a href="#">Topographical Survey Data for River Dodder Main Channel</a>	Digital	Brian Hennelly (DCC)	24.11.06
10.2	<a href="#">Topographical Survey Data for Tallaght Stream</a>	Digital	Brian Hennelly (DCC)	16.01.07
10.3	<a href="#">Topographical Survey Data for Dundrum Slang</a>	Digital	Brian Hennelly (DCC)	31.01.07
10.4	<a href="#">Topographical Survey Data for Little Dargle</a>	Digital	Brian Hennelly (DCC)	16.02.07
10.5	<a href="#">Topographical Survey Data for Whitechurch</a>	Digital	Brian Hennelly (DCC)	23.02.07
10.6	<a href="#">Topographical Survey Data for Owendoher</a>	Digital	Brian Hennelly (DCC)	27.03.07
10.7	<a href="#">River Dodder Survey Drawings (1988)</a>	Digital	DCC	24.04.07
10.8	<a href="#">Bohernabreena Reservoir Survey Data</a>	Digital	DCC	10.05.07
10.9	<a href="#">Anglesea Road (MDW0248) Topo Survey Data</a>	Digital	Greg McBridge (Surveyor)	06.09.05
10.10	<a href="#">Dartry Mills (MDW0275) Topo Survey Data</a>	Digital	Techsol Ltd. (Surveyor)	19.04.06
10.11	<a href="#">Floor Levels for Dodder Main Channel and Tributaries.</a>	Digital	Brian Hennelly (DCC)	12.06.07
11	New Structures			
11.1	<a href="#">Drawings of Green Route Road Realignment (Tributary - Whitechurch)</a>	Digital	SDCC	30.04.07
11.2	<a href="#">Details of culvert under Dundrum Shopping Centre (Tributary - Dundrum/Slang)</a>	Digital	T. J. O'Connor	25.05.07

## **APPENDIX B.2**

### **Historic Flood Data**





Project

River Dodder Flood Risk Management Plan

Title

Historic Flooding Locations - 1 of 2

Figure

B2.2

Dodder Catchment Area

Issue Details

Drawn:	A. Anderssen	Project No.	MDW0259
Checked:	C. O'Donnell	File Ref.	
Approved:	G. Gillespie	MDW0259MI0022F01	
Scale:	NTS@A3	Drawing No.	MI0022
Date:	March'07	Rev.	F01

Notes

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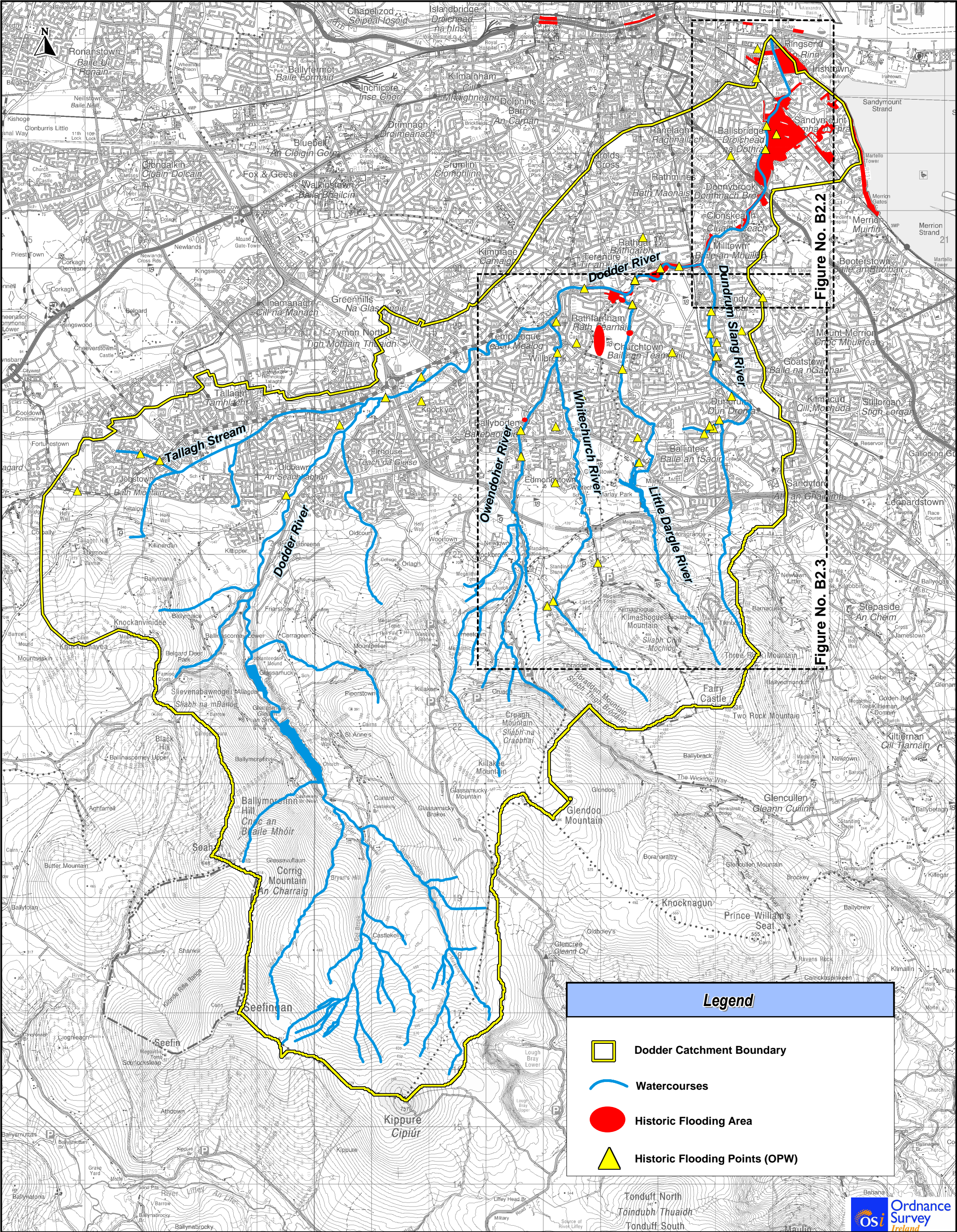
Dublin City

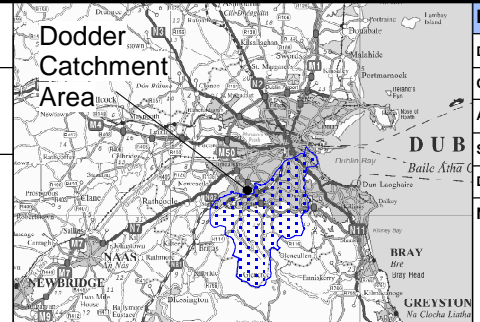
Baile Átha Cliath

Ordnance Survey

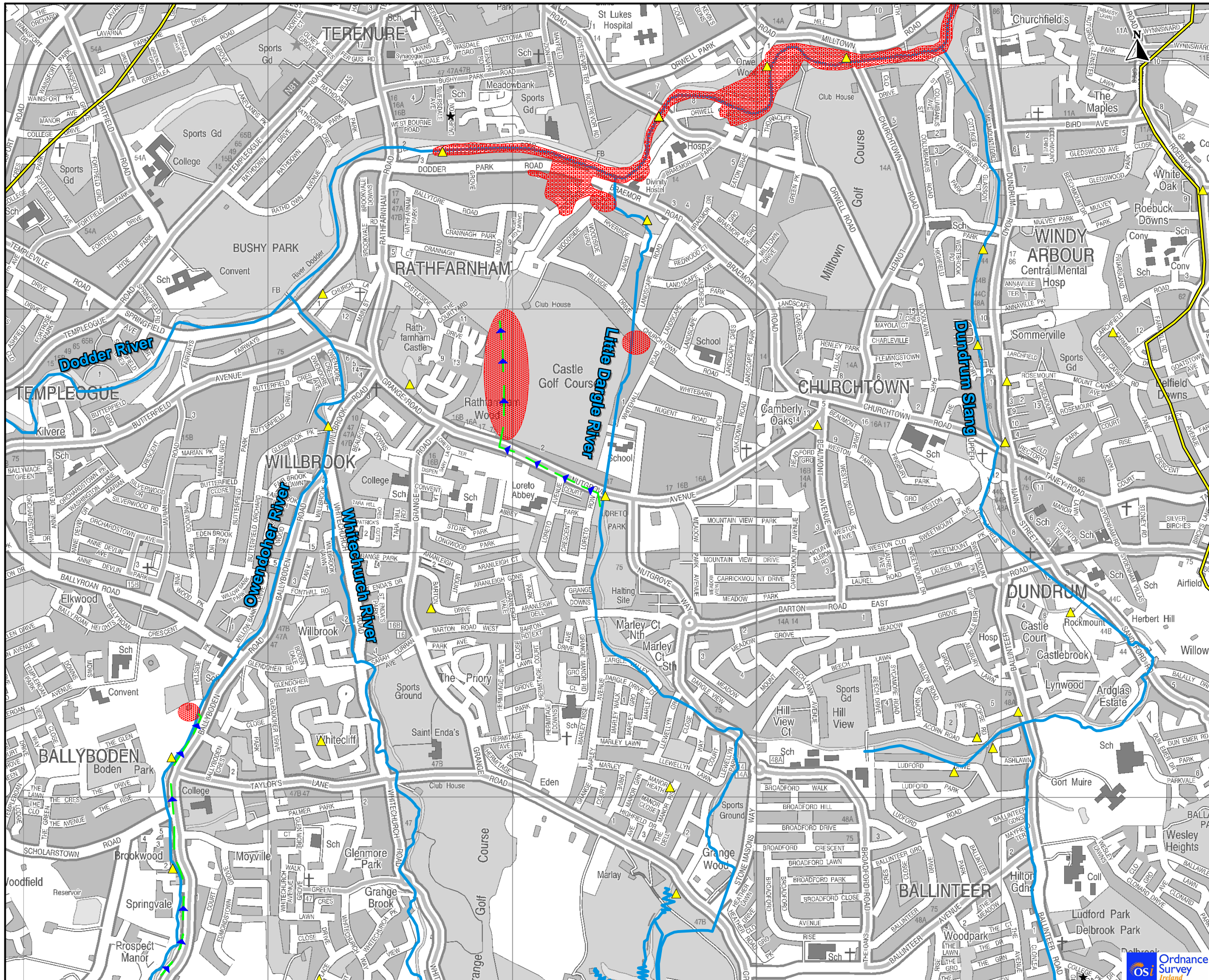
os





Project <b>River Dodder Flood Risk Management Plan</b>		Figure <b>B2.1</b>			Issue Details	
Title <b>Historic Flooding Locations - Overview</b>					Drawn: A. Anderssen	Project No. MDW0259
				Checked: C. O'Donnell	File Ref. MDW0259M0021F01	
				Approved: G. Gillespie		
				Scale: 1:60,000@A3	Drawing No. MI0021	Rev. F01
				Date: March'07		
				<b>Notes</b> 1. This drawing is the property of RPS Consulting Engineers. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent. 2. All levels are referred to Ordnance Datum, Malin Head. 3. Ordnance Survey Ireland Licence No. EN 0005007 Copyright Government of Ireland.		





### Legend

- Dodder Catchment Boundary
- Watercourses
- Flood Flow Direction
- Historic Fluvial Flooding Area
- Historic Flooding Points

See Figure B2.1 for full extent of the study area

### Dodder Catchment Area

**Dublin City Council**  
Comhairle Cathrach Bhaile Átha Cliath

**Project** River Dodder Flood Risk Management Plan

**Title** Historic Flooding Locations - 2 of 2

**Figure** B2.3

**RPS Consulting Engineers**

RPS Consulting Engineers  
West Pier Business Campus,  
Dun Laoghaire,  
Co Dublin

Ph: 01-2884499  
Fax: 01-2835676  
E: ireland@rpsgroup.com  
W: www.rpsgroup.com/ireland

Issue Details		
Drawn: A. Anderssen	Project No.	MDW0259
Checked: G. Gillespie	File Ref.	
Approved: C. O'Donnell	MDW0259M0028F01	
Scale: NTS@ A3	Drawing No.	Rev.
Date: 30 March 2007	M0028	F01

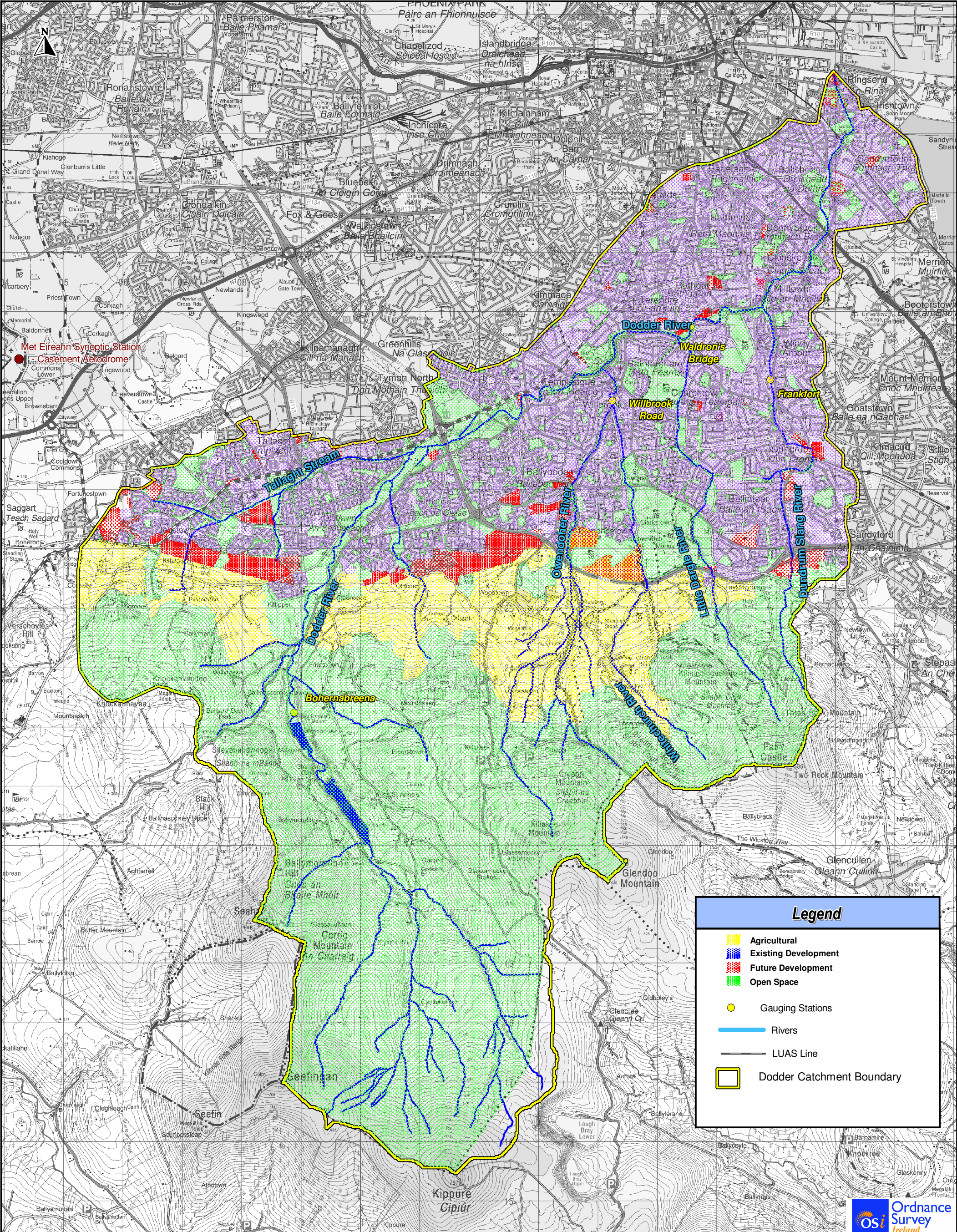
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## **APPENDIX B.3**

### **Land-Use Data**





Project

**River Dodder Flood Risk Management Plan**

Figure

**B3.2**

Dodder Catchment Area

Title

**Dodder Catchment Land Use**

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Dublin City

Baile Átha Cliath

Issue Details

Drawn:	A. Anderssen	Project No.	MDW0259
Checked:	C. O'Donnell	File Ref.	MDW0259M0017F01
Approved:	B. Elsaesser	Drawing No.	M0017
Scale:	NTS	Rev.	F01
Date:	October 2007		

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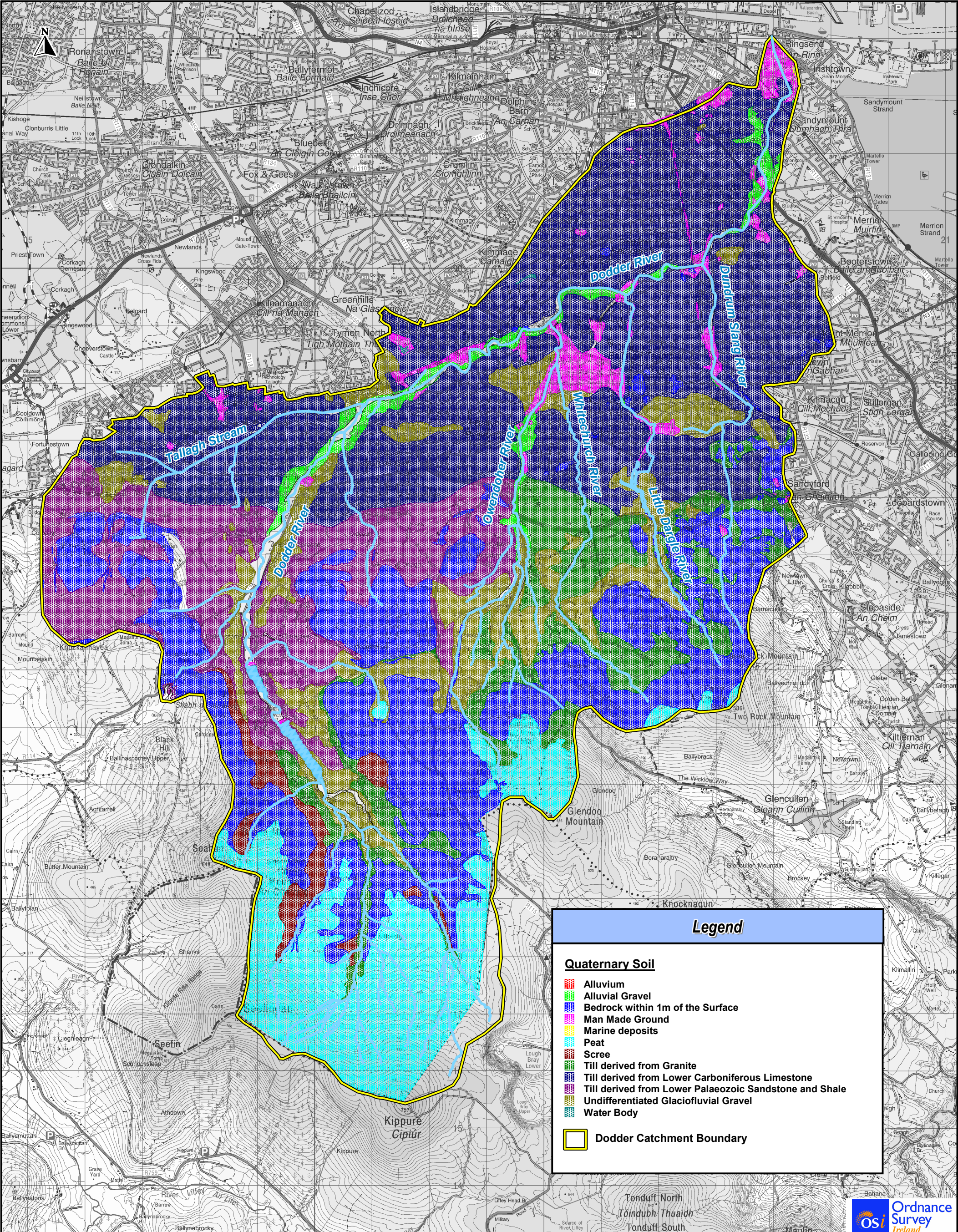




**APPENDIX B.4**

**Geotechnical Data**





Project

River Dodder Flood Risk Management Plan

Figure

3.0

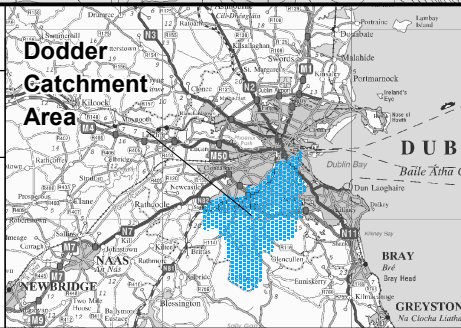
Title

Dodder Catchment Quaternary Soil Assessment

RPS Consulting Engineers

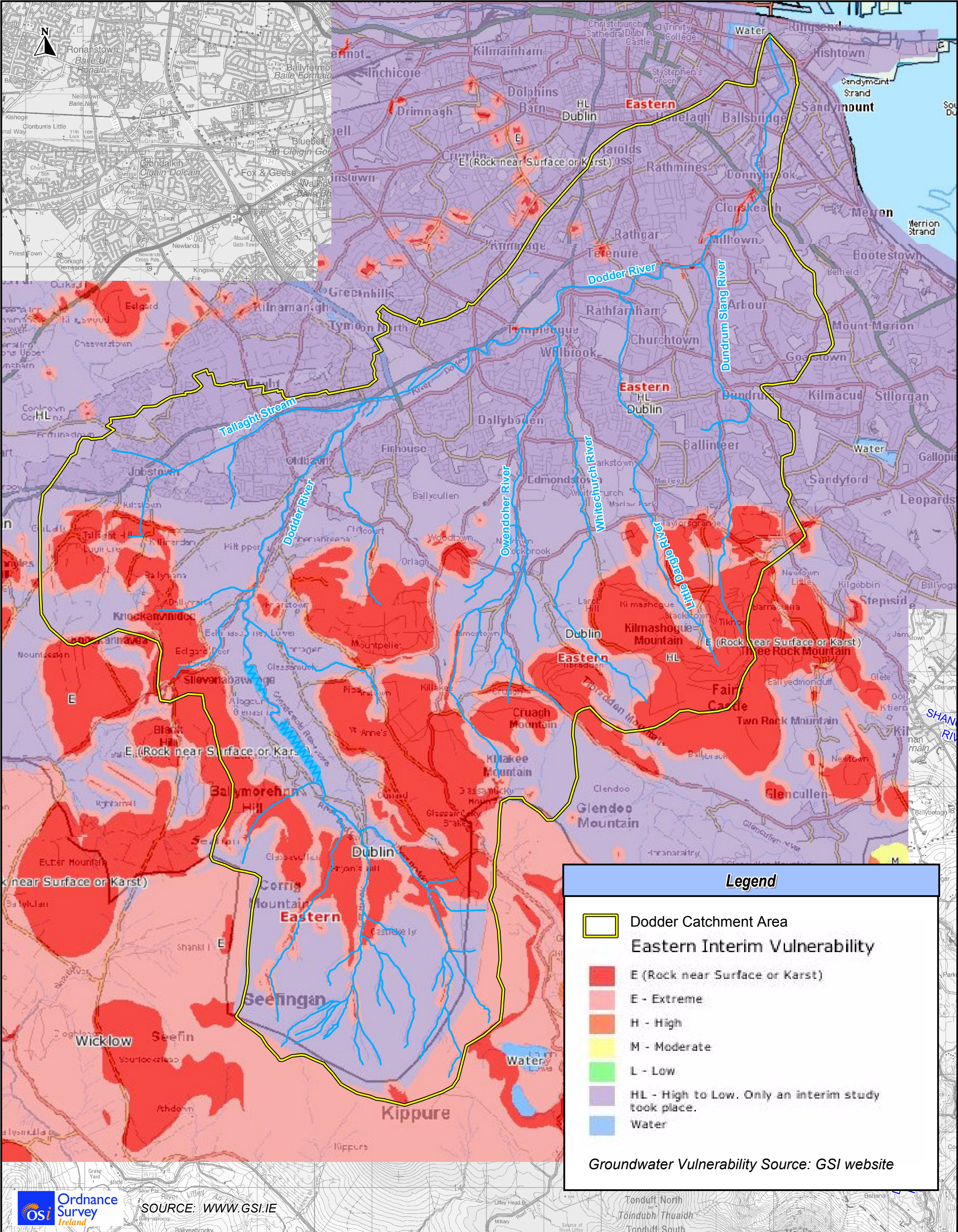
RPS Consulting Engineers  
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Baile Átha Cliath

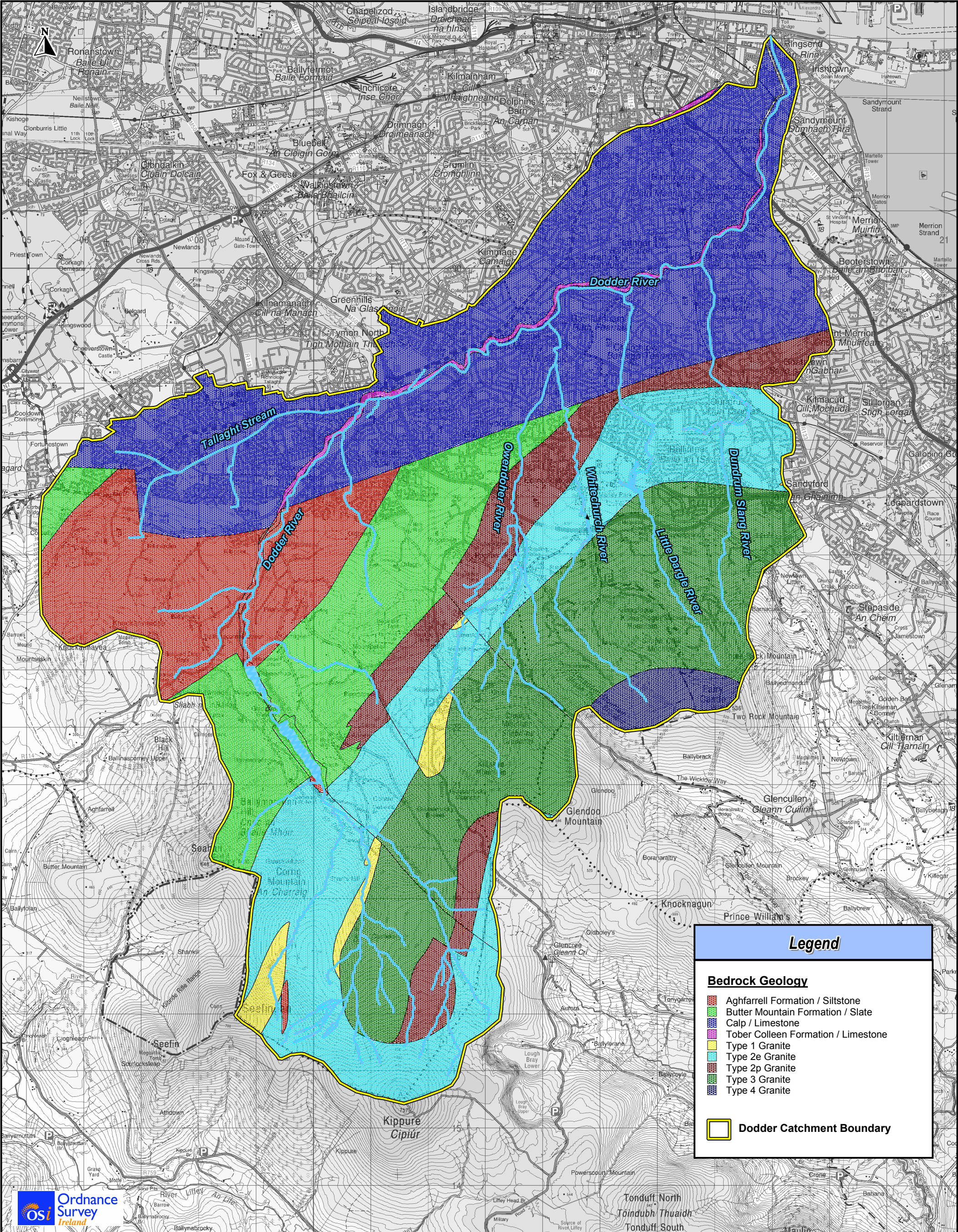


Issue Details			
Drawn:	A. Anderssen	Project No.	MDW0259
Checked:	G. McInerney	File Ref.	
Approved:	G. Gillespie	MDW0259MI0023F01	
Scale:	1:60,000@A3	Drawing No.	MI0023
Date:	19/07/2007	Rev.	F01
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**Legend**

**Bedrock Geology**

- Aghfarrell Formation / Siltstone
- Butter Mountain Formation / Slate
- Calp / Limestone
- Tober Colleen Formation / Limestone
- Type 1 Granite
- Type 2e Granite
- Type 2p Granite
- Type 3 Granite
- Type 4 Granite

 **Dodder Catchment Boundary**



Project **River Dodder Flood Risk Management Plan**

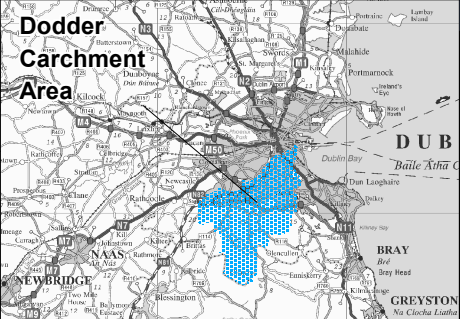
Figure **2.0**

Title **Dodder Catchment Bedrock Geology Assessment**

**RPS Consulting Engineers**

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**Dodder  
Carchment  
Area**



**Issue Details**

Drawn: A. Anderssen	Project No. MDW0259
Checked: G. McInerney	File Ref.
Approved: G. Gillespie	MDW0259MI0024F01
Scale: 1:60,000@A3	Drawing No. MI0024
Date: 19/07/2007	Rev. F01

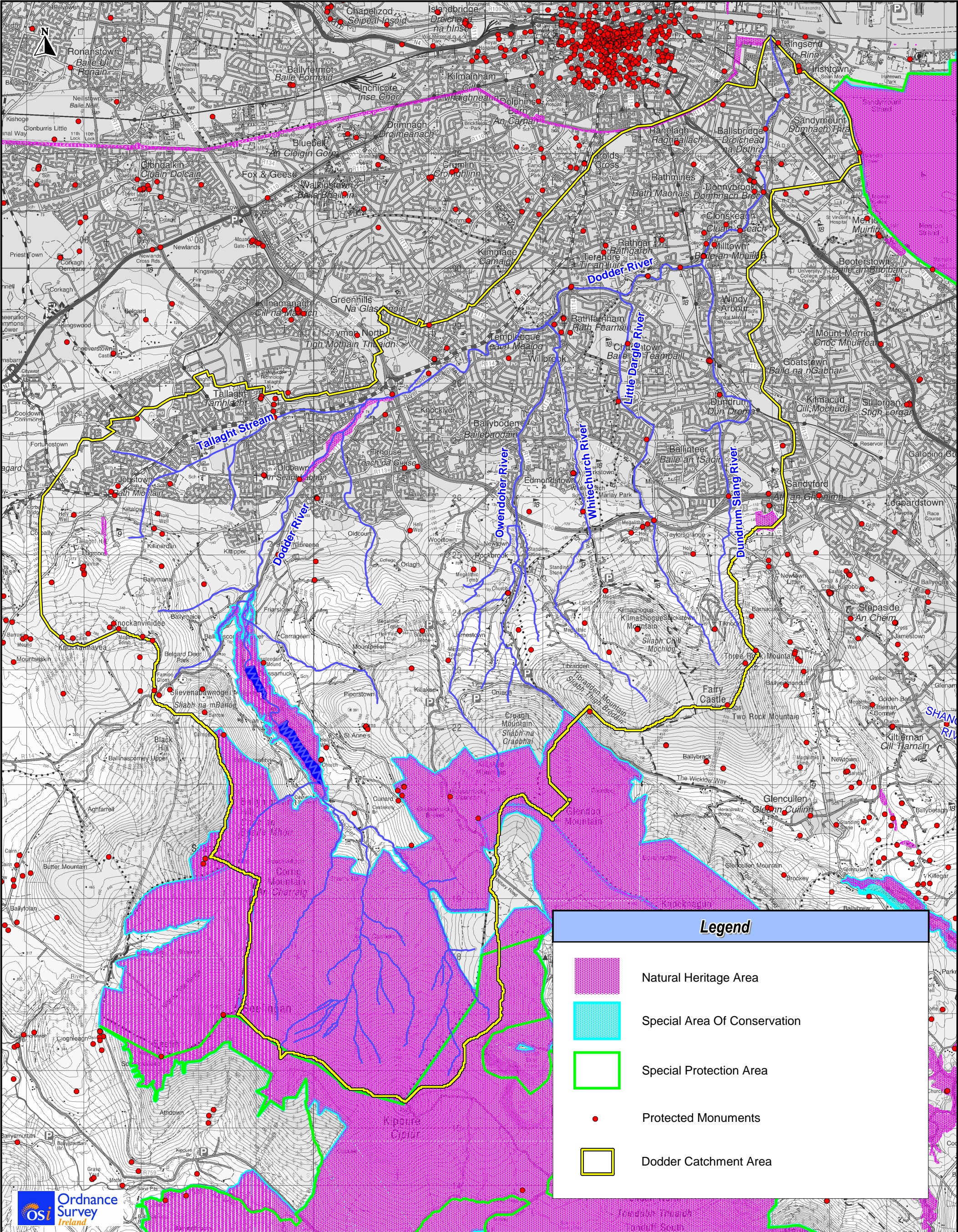
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**APPENDIX B.5**

**Environmental Data**





Project

**River Dodder Flood Risk Management Plan**

Figure

**B5.1**

Title

**Dodder Duchas Protection Areas**

RPS Consulting Engineers  
RPS Consulting Engineers  
West Pier Business Campus,  
Dun Laoghaire,  
Co Dublin

Dublin City Council  
Comhairle Cathrach Bhaile Átha Cliath

**Dodder Catchment Area**

Issue Details

Drawn: A. Anderssen

Checked: C. O'Donnell

Approved: G. Gillespie

Scale: 1:60,000@A3

Date: March'07

Project No. MDW0259

File Ref. MDW0259MI0026F01

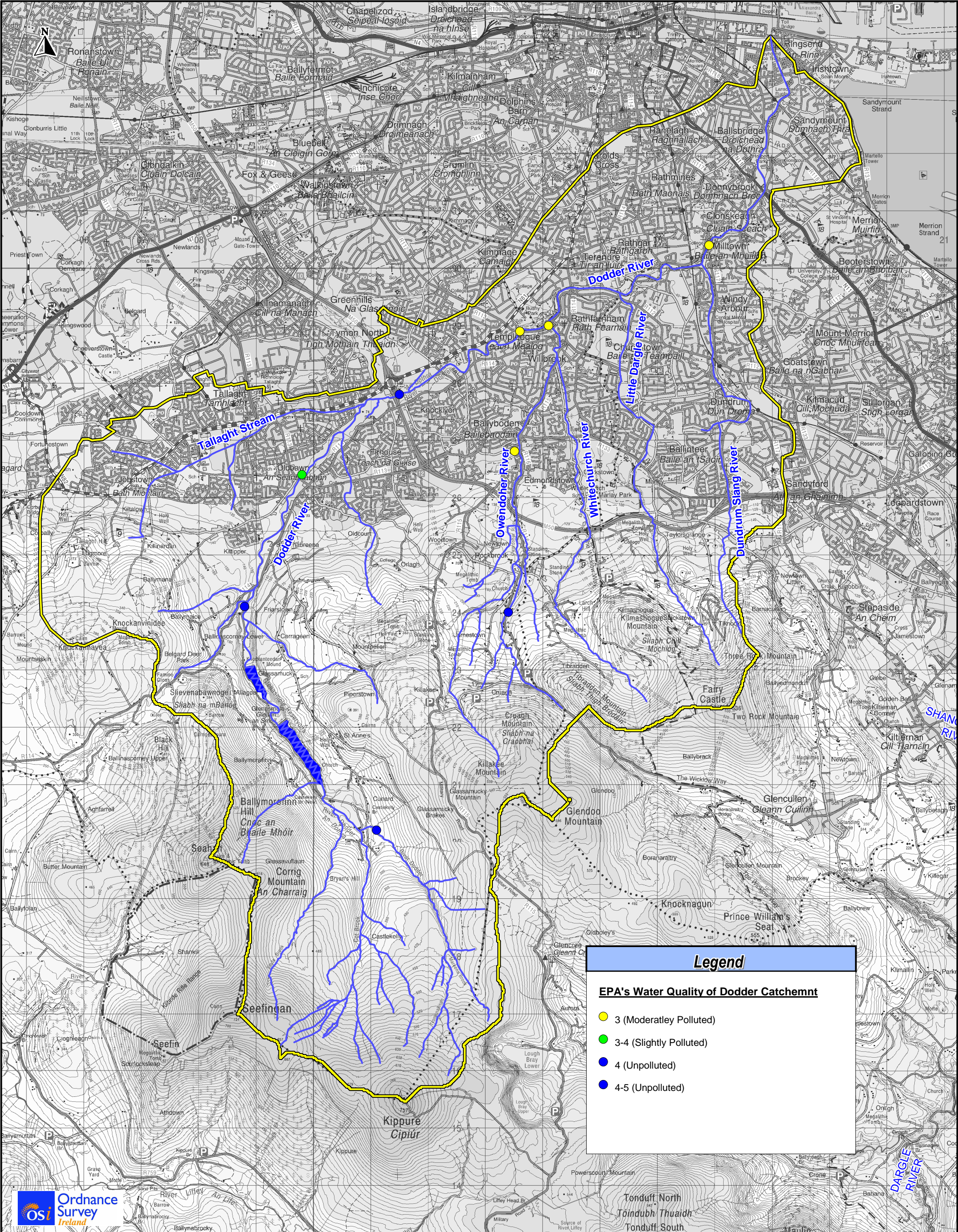
Drawing No. MI0026

Rev. F01

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**Legend**

**EPA's Water Quality of Dodder Catchment**

3 (Moderately Polluted)

3-4 (Slightly Polluted)

4 (Unpolluted)

4-5 (Unpolluted)

Project

**River Dodder Flood Risk Management Plan**

Figure

**B5.2**

Title

**River Water Quality of Dodder Catchment**

RPS Consulting Engineers  
RPS Consulting Engineers  
West Pier Business Campus,  
Dun Laoghaire,  
Co Dublin

Dublin City Council  
Comhairle Cathrach Bhaile Átha Cliath

**Dodder Catchment Area**

Issue Details

Drawn: C. Reilly

Checked: C Coleman

Approved: B Elsaesser

Scale: 1:60,000 @ A3

Date: April 07

Project No. MDW0259

File Ref. MDW0259MI0031F01

Drawing No. MI0031

Rev. F01

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**APPENDIX C**  
**FEE PROPOSAL**



## River Dodder Catchment FRMP

### Summary Fee Schedule (December 2006) - Excluding Budget and Contingency Items

1. Consultants Fee Costs		Fee Schedule
Element / Item	Status	Cost
Project Inception	Lump Sum	€7,033
Data Collection and review	Lump Sum	€17,125
Surveys	Lump Sum	€26,685
Hydrological Analysis	Lump Sum	€26,030
Hydraulic Analysis	Lump Sum	€39,394
Mapping and Defining the Flood Plain	Lump Sum	€15,240
Flood Damage Assessment	Lump Sum	€10,680
Strategic Environmental Assessment	Lump Sum	€25,070
Development of flood Risk Management Options	Lump Sum	€31,510
Preparation of a Catchment Flood Risk Management Plan	Lump Sum	€26,750
Final Report Preparation	Lump Sum	€21,580
Progress Meetings	Lump Sum	€22,500
Project Management & QA (incl. PSDS)	Lump Sum	€23,700
Sediment Transport Model	Lump Sum	€15,000
- Field work and sediment sampling	Lump Sum	€4,500
CD Booklet	Lump Sum	€7,500
Rainfall and level Monitoring	Lump Sum	€30,000
Topographical Survey management	Lump Sum	€25,000
<b>Total (Part 1) Excluding VAT</b>		<b>€375,297</b>
2. Additional Consultant Costs		
Expenses		
- Printing	Lump Sum	€16,691
<b>Total (Part 2) Excluding VAT</b>		<b>€16,691</b>
3. Consultants 3 <sup>rd</sup> Party Costs		
Topographical Survey (property floor levels)		€0
Software	Lump Sum	€21,097
Modelling software (MIKE11 ST add-on only)	Lump Sum	€2,400
<b>RPS 3<sup>rd</sup> party handling charge</b>	<b>%</b>	<b>€3,524</b>
<b>Total (Part 3) inc. 15% handling &amp; excluding VAT</b>		<b>€27,021</b>
<b>Total (Parts 1, 2 &amp; 3) (excl. VAT)</b>		<b>€419,009</b>
<b>VAT @ 21%</b>		<b>€87,992</b>
<b>Total (incl. VAT)</b>		<b>€507,001</b>

## Budget and Contingency Items

4. Budget Items		
Expenses		
- Travel & Subsistence	Budget	€1,500
<b>Total (Part 4) Excluding VAT</b>		<b>€1,500</b>
5. Contingency Items		
Defence Asset Database	Contingency Sum	€25,000
Dam break Assessment	Contingency Sum	€70,000
Public Relations/Presentations	Contingency Sum	€20,000
<b>Total (Part 5) Excluding VAT</b>		<b>€115,000</b>
<b>Total (Parts 4 &amp; 5) (excl. VAT)</b>		<b>€116,500</b>
<b>VAT @ 21%</b>		<b>€24,465</b>
<b>Total (incl. VAT)</b>		<b>€140,965</b>

<b>Total (Parts 1, 2, 3, 4 &amp; 5) (incl. VAT)</b>		<b>€647,966</b>
---	--	-----------------

Basis for Additional Services	
	cost / day
Director	€1,500
OD / TD	€1,050
Senior PM / Associate	€900
Senior Engineer / Scientist	€750
Senior Design Engineer	€565
Design Engineer / Project Scientist	€450
Graduate (1 – 2 yrs)	€400
Senior Technician	€500
Grade 1 Technician	€450
Grade 2 Technician	€340

## **APPENDIX D**

### **MINUTES FROM FEE NEGOTIATION MEETINGS**

### 1 RIVER DODDER FRMP

Date:	23 <sup>rd</sup> June 2006	Time:	10.30	Venue:	DCC Marrabone Lane
Project:	River Dodder FRMP	Project Reference:	MDW0259	Page 1 of	
		File Reference:	530		
Meeting Subject:	Fee negotiation	Minutes taken by:	GG, MP		
		Electronic Reference:	MDW0259Mn0001D01		

**Attendees;** Don McEntee (DCC), Brian Hennelly (DCC) Grant Gillespie (RPS) Matthew Pollard (RPS)

**Part Attendance;** Tom Curran & Aoibhann Byrne, Survey & Mapping Section (DCC)  
Topographical surveys

**Apologies;** Mark Adamson (OPW)

#### 1.1 INTRODUCTION

O.P.W acting as Funding Authority

Both parties note requirement to ensure that issues or assumptions that we consider important in terms of being able to offer a quality, timely and cost effective service and to ensure that the understanding of the comprehensive brief and proposal are clarified and that risks are identified at this stage. It is also agreed that a partnership approach is required to achieve the study goals. We also highlight some initial notes on the provision of data from third parties to enable this information to be collated where necessary.

GG notes that RPS feel we have a good understanding of the project requirements and can deliver it. On the basis of fixed price lump sum the key risks from RPS perspective would be the provision of good quality survey data, the unknowns in relation to interest in the study and how this may impact on the consultation aspects of the SEA and management of reporting/review requirements.

#### 1.2 CONDITIONS OF ENGAGEMENT

PI policy for 6 years including removal of at reasonable rates clause, RPS maintain these insurances however feel it is necessary to have some limit of liability to unreasonable rates.

Specific indemnity – DCC confirm they require joint insured on the policy.

#### 1.3 CONTRACTING AUTHORITIES REQUIREMENTS

DCC queries are highlighted in italic red, with response and discussions in black.

##### 1.3.1 Data Collection

*RPS propose to complete the initial data collection exercise within the first month of the project with follow-up data collection undertaken as necessary during the project. What data will RPS be updating later in the project?*

**Previous reports** –ok, RPS to forward list to date and DCC to collate any additional information.

## Minutes of Meeting

**Historical flood data** –ok, DCC have requested originals of detailed flood maps from M Corcoran to be copied, also [RPS or DCC??](#) need scanned copy of full 1986 report including book of photographs.

DCC/OPW to make available access to data website ASAP. Gerry O'Connel (DCC) excellent contact for information of tidal flooding. DM notes ~ 1865 event washed away railway bridge to Kingstown. Also that 1905 event had larger spills at reservoir than 1986 event. [2003 event involved a breach at the reservoirs.](#)

**Hydrometric data** –ok note requirement for Glenasmole data and digital version of EPA data ASAP.

Noted that river gauge data is on bypass and is therefore of little benefit, however new gauge is in place downstream of spill since approx start of 2006 and this data will be useful. Seamus Costello of DCC is contact.

MP notes proposal to install rain gauges and level monitors to improve calibration information due to significance of spatial variation in catchment. A draft proposal is appended in section 3.

**Meteorological data** – Met data ok, rain gauge data from LA's to be collected as three items ([DCC, SDCC & DLRCC](#)) and close task, DM notes 24 hour chart data is available at Glenasmole.

**Land Use Data** –ok generally in hand, plus requirement for consultation with relevant bodies.

**Planning and Development data** –ok generally in hand in GDSDS data sets to 2031, agreement on future scenario early in project and close task. [What design scenario are we using for this study \(2050\)?](#) Changes addressed in sensitivity analysis. Zoning objectives sufficient, not intending to include specific details of planning applications.

Have not allowed to undertake particular flood risk assessments for proposed developments that may arise during the study period, e.g. proposed bridges, developments impacting on flood plain.

**Defence and Coastal Protection Asset Data** ok

*What information are RPS looking for from the DCFRAS project?*

*(Downstream boundary conditions will be taken from the results of the DCFRAS which RPS expect will be a 2D TS Boundary that includes wave, tide and storm surge interactions for a range of joint probabilities.)*

Yes, also require electronic copy of report, and detailed data from tidal analysis. [BH supplied 2 pages to RPS from DCFRAS final report on Joint Probability Calculations for Combination of Tidal and Wave Events \(Figures 15.01 and 15.02\)](#)

**Existing Survey / Geotechnical data** -ok, data from LA's to be collected as three items and close task

**Environmental data** –ok, parks and wildlife, archaeology etc in hand. Listed structures and potential listed structures, review of LA GIS and fill gaps, ERBD data assumed to be generally compiled. [RPS to advise CA what data they require from the ERBD.](#) We can take in additional data during study, in advance of draft SEA statement. [BH advised of Habitats Drawings available for DCC from Biodiversity Offices. CA to supply.](#)

*What information are RPS looking for from the Bohernabreena Reservoirs project? How will they model the reservoirs?*

Spillways and pipe penstock details, plus any information on reservoir levels prior to or during 1986 and 2003 events would be useful. Assumed full reservoirs will be the worst case scenario, most likely future scenario will be developed. To be modelled as storage unit with spills and penstocks.

### 1.3.2 Surveys

#### Floodplain Survey

## Minutes of Meeting

DTM, to be received upon appointment and including break lines, assumed to be quality assured by CA, have made no allowance for post processing. RPS will update with spills etc for modelling purposes. [RPS to provide details of breaklines.](#)

DCC confirm that full QA is being undertaken and to check with OPW if breaklines have been included.

**Channel and Structure Cross-Section Survey** CA to provide quality assured survey information in the same format as River Tolka survey information including ASCII files, AutoCAD plan, sections and long sections, control information, BMks, PGM diagrams and referenced photographs. In digital and hard copy format. No allowance made for providing QA or changes to this information. Refer to section 2 for a channel cross-section specification.

*Channel and Cross Section Survey – RPS stated that the CA would be undertaking this survey in April and May with the results being ready prior to the award of the contract. If this survey is not complete what is the effect on their programme and costs? If only the main river survey results are ready what is the effect on their programme and costs?*

BH notes surveys are not as advanced as they had originally envisaged, the control network is in place and checked and that the survey team propose to start at the Liffey end and work upstream.

GG notes that Tolka surveys where 145K plus management and required 1 survey manager 2 survey teams and 2 resources for post processing for similar scale of works, RPS provided RE support for specification, QA and access along with DCC control specification and checks. (Total ~ 9 staff for 3 months)

Provision of good quality 'Quality Assured' paper and digital survey information is paramount to the timely delivery of a high quality model and the associated time demands. As above RPS had assumed information will be provided in the format of the Tolka Study.

This could potentially be a significant issue and will require review, RPS offer detailed spec on surveys for €10,000 budget for river and tributaries.

Consideration could be given to providing RE assistance in procuring surveys as in Tolka and this could be done on a cost effective basis as it assists in catchment familiarisation and model construction, and would allow for taking in data on a sequential basis to avoid significant delays to the project.

Additionally if post processing to the correct format is required we could provide a proposal for these works, however this is generally carried out by the survey team.

Survey requirements discussed with survey management team, data delivery format from Tolka noted, RPS will review proposals with a view to reducing significantly DCC's original scope and including pertinent defence asset data. The specification for the surveys was discussed and the general format is provided in section 2. Detailed specification for Dodder to be undertaken and meeting arranged for Thursday 29<sup>th</sup> June to review.

Data should be processed and checked on a regular basis whilst in surveyor's memory and allow for recheck on temporary BM's; this may also facilitate sequential data handover.

**Defence Asset Survey – ok**

*Defence Asset Survey – How is this information being recorded? Who is carrying out the geometry survey of the defence assets?*

## Minutes of Meeting

We propose to use a system similar to the Tolka with additional fields to cover the requirements of the defence asset database, in this regard it would be useful to go ahead with the defence asset database.

Noted that Royal Haskoning are undertaking detailed analysis from [Newbridge](#) to Liffey confluence and will provide data.

Geometry survey will be carried out by CA as part of the channel / cross section and floodplain surveys as per Tolka survey deliverables spec above. RPS to provide specification for surveys as above.

**Property survey** – ok, have allowed for this.

**Condition survey of Structures** –ok, can we make any improvements on information supplied in Tolka, some overlap with defence assets discussed.

**Ortho photos** – ok we have these in hand, licence transfer only, need to review if rural areas are required [and Bohernabreena in particular](#).

**Geotechnical Investigations** –ok, desk top survey only, background geology etc.

**Map Information** –ok, obtain approval and licence numbers, RPS to forward forms to Brian.

**Defence asset Database** –provisional sum 25K. If instructed, we would require decision early in negotiations to allow for development and population. General structure and content as specified. Discuss, refine. Agree, phase to be completed in 3 meetings. System development based on agreed specification. [External data set requirements and licence agreements to be satisfied by CA.? \(Explain\)](#) Population of database only for items in section 2.6.3 of brief, as outlined in brief, not all fields as in appendix C which would require significant additional input and associated deliverables.

### 1.3.3 Hydrological Analysis & Tidal Surge Analysis

**Review and analysis of Historical floods** -ok complete for Waldrons bridge, however will review.

**Analysis of Hydrometric and Meteorological Data** –ok, full detailed analysis

**Estimation of Design Floods**-ok

**Sensitivity Tests** –ok

**Future Environmental and Catchment Changes** –ok, SuDS assumptions need to be agreed.

*Can RPS provide details of survey they require of the channel characteristics at the 4 hydrometric stations?*

Yes, same as typical specification below just need specific locations for cross sections, and will specify for surveyors.

*Bohernabreena Gauges – What gauges are these and what hydrometric data is available from these gauges?*

Glenasmole gauge, discussed above.

*Hydrometric Rating Curve Extrapolation – What hydraulic model are RPS proposing to use for this? Will it be different to the River Dodder hydraulic model and if so why?*

As in proposal, Hec steady state, quick and reliable, sections will be integrated into full model. (Note: It was stated in the proposal which hydraulic model would be used “...the actual model employed will be selected based on which model is considered likely to best represent the local features.” Page 28.)

*RPS include the production of a design hydrograph for the probable maximum flood (PMF). Why?*

## Minutes of Meeting

Only included as provisional item in dambreak assessment, may be required if any raised reservoirs over 25,000 m<sup>3</sup> are proposed in accordance with reservoirs act, to ensure that spillways can pass PMF safely. The production of the design hydrograph for the PMF is listed as a deliverable in Section 2.7.3 of RPS proposal.

*Hydrology Report -- The production of the Hydrology report has not been allowed for in the Programme or the WBS. Explain. Also no review of the hydrological analysis by the CA/OPW has been allowed in the programme.*

This is associated with a printing error, the task was rolled up in Microsoft Project and does not show in the printing however it is included in the programme and summary costs and correct pdf and hard copies will be supplied. The fixed fee included in RPS proposal for this element is correct.

### 1.3.4 Hydraulic Analysis

**Development of Hydraulic model** – ok, full detailed model

**Sensitivity tests**

**Freeboard**

*Data Availability for Hydrological Modelling – What are the issues likely to restrict availability?*  
Survey information at gauges and processed digital gauge data from EPA.

*Additional Item Sediment Transport Modelling – How essential do RPS feel this item is?*

Not essential, we can use velocities and it is a steep catchment, with limited meanders, however it is beneficial in identifying areas which may be subject to scour and undermining of structures the CA is aware of some scouring issues already (DM mentioned area in Templeogue). It is also beneficial in identifying areas that have potential to deposition and will require ongoing maintenance some lab tests are required to determine soil makeup. RPS to outline in more detail the work involved and the benefits.

## 1.4 MAPPING & FLOOD PLAIN DEFINITION

**Mapping**

**Flood Hazard Mapping**

**Defence failure scenarios** - Assumed full removal of particular defence assets, have not allowed for dam break type gradual failure analysis, which requires additional modelling module and time inputs.

**Option evaluation** Ok

*Flood Hazard Mapping – Is the detail proposed by RPS for this item in excess of the requirements of the RFP Section 2.9.2?*

Yes, historical flood maps will be provided, long sections on basis of updating of long section which are to be provided as part of survey deliverables by CA. We feel these are of great benefit as a deliverable. We have assumed that mapping extents will be overlain as in the Tolka deliverables.

### 1.4.1 Flood Damage Assessment

- Flood Damage Assessment – RPS need to explain statement in relation to this element of the study included in their submission “It is possible that direct application of the methodology outlined may result in questionable results”?*
- RPS identify Techniques for valuing assets in high value areas such as South Dublin as a key factor in completing the Flood Damage Assessment. Can they explain this further?*



## Minutes of Meeting

- *Flood damages will be estimated using the methodologies and values given in the “Benefits of Flood and Coastal Defence: Techniques and Data for 2003” (Multi-Coloured Manual) with reference being made to the Goodbody Report where applicable. Are RPS aware of a 2005 manual which some of the other bidders have referred to in their submissions?*

Yes, the 2005 manual can be utilised if this is acceptable to the OPW. The 2005 manual also includes better and updated facilities for application of ‘social class distributional weights’ which will be of benefit in overcoming in particular the difficulties associated with high value residential assets identified and will be considered during the BCA.

*RPS have proposed 2 options for the flood risk maps:*

- *Taking into account flood hazard, flood damage and social and environmental risks*
- *Or only taking into account flood hazard and flood damage.*

*RPS have offered either option within the submission.*

*Can RPS clarify why the 2 options?*

At min we will provide the requirements of the brief for economic assessment, if the OPW are in agreement with the approach, and subject to the required data sets being available from National Parks and Wildlife Service, along with agreed format for ascertaining social impacts we can provide information on social and environmental risks.

### 1.4.2 Strategic Environmental Assessment

*SEA – Should the baseline environmental conditions not be completed at the initial scoping stage?*

Agreed the majority of the baseline will be completed at the initial scoping stage. The scoping stage establishes what the key issues are, what level of detail is required, the likely detail of the flood mitigation measures arising from the plan, etc, and therefore requires some baseline, however the whole process is to some degree iterative and we have allowed for additional baseline should it be necessary at stage 3.

*What is the status of the Environmental Report proposed?*

It is final and only produced once, it accompanies the Draft Flood Risk Management Plan for the second consultation.

*RPS advised at presentation that this section in their submission was incorrect. RPS need to confirm what is their proposal for completing the SEA.*

We noted that stage 3 to 5 in our submission follow the Irish SEA regulations and EPA guidance (they refer generally to Stage III in the RFP) however our submission as documented is our proposed approach and we believe it meets the requirements of the RFP the Regulations and ‘EPA publication’.

We also note that the EPA guidelines were published before the Regulations and refer to an SEA report which is in fact the Environmental Report etc and therefore the terminology is somewhat inconsistent.

### 1.4.3 Development of Flood Risk Management Options

#### Preferred design standards

**Flood Risk Management Measures** – assume review of options can rule out specific options on a general assessment of overall feasibility. eg, too costly for benefit, land acquisition costs, environmentally not feasible etc. Agree these scenarios with CA, report as such then carry out multi-criteria analysis for remaining feasible solutions.

**Strategy options** –ok

**Urban Drainage accommodation works** – ok, no updates to GDSDS, or Dodder Catchment study models based on new CCTV/SUS or development data allowed for.

**Selection of preferred strategy option** -ok

## Minutes of Meeting

### 1.4.4 Preparation of a Catchment Flood Risk Management Plan

ok

### 1.4.5 River Dodder Maintenance Plan

Ok, as per submission. Require input and agreement between OPW and LA's on responsibilities to close task.

We will consult with Brendan Murphy DCC maintenance and DLRCC, SDCC at earliest opportunity.

Comment -Rights and responsibilities of riparian landowners may require new legislation, legal input could be considered.

### 1.4.6 Reporting & Deliverables

**Reporting Standards** –ok, need to agree on branding for report covers, colour, crests design.

**Deliverables** – digital reports only for review, cost estimates provided on basis of following;

*Reporting – Have RPS included for proof-reading of all draft reports in advance of their submission for review by the CA and relevant parties?*

Yes, pricing on assumption that draft reports to be integrated into draft final report including comments as per brief, therefore there are 8 reports x 10 = 80 copies plus printing of maps.

DM suggests we need draft X 10

Draft final x 10

Final x 20

This is equivalent to 8 x 40 = 320 copies or 4 times that budgeted.

We can provide additional hard copies however a larger printing budget should be allowed. DM requests that a estimate for provision of CD's in book format should be supplied also as this was very successful for the Tolka deliverables.

For the final report we have allowed for;

1 draft –D01, electronic

1 final draft (approval) A01, electronic

1 Final report F01. Hardcopy and CD

CA to distribute, receive and manage comments on reports, including response for conflicting comments from third parties. Review process in times allotted in programme or otherwise agreed.

One timely, review of progress reports and minutes coordinated by CA manager.

### 1.4.7 Programme

Reduced programme of 14 months and associated reduced costs, no charge for any extension resulting from RPS. However costs incurred after 18 months eg. ongoing project management and resourcing associated with third party delays or agreed additional works will be recoverable.

*RPS have not made an allowance for Christmas 2006 holidays or bank holidays in their submission programme.*

Noted, we will provide an updated programme when the start date is agreed and include public holidays etc.

### 1.4.8 Other Items

*The printing and travelling expenses allowed by RPS appear very small.*

Provided as budget as requested, Printing rates were based on draft reports being issued in electronic format, therefore the majority of the printing is associated with the Final report including supplementary reports. If additional printing is required a larger budget sum should be allowed for.

Travel and Subsistence budgets are based on relatively short journey to Dodder from RPS office and required meetings at Marrowbone lane.

*What is the Project GIS database?*

It is the in-house system that RPS maintain for each project including all spatial data and associated metadata, file links, model links, etc (it includes draft approval and final information and links to centrally held and updated datasets such as corine, NRA, ESB, GSI satellite, rainfall etc, etc, and is not transportable)

The difficulties in providing full GIS linked data is discussed - GG suggests that as per the Tolka deliverables we provide what is developed from the project eg, survey information, photographs, model files, catchments, flood extents, solutions, DTM's etc, He notes the background GIS data is continually updated by stakeholders and the drawings are provided in pdf and hard copy format, all other data is archived and can be retrieved if required.

*Grace Glasgow – What is her role in the project as she was not included in the original submission. Her inclusion does not increase RPS's price?*

Assistant to Jerry Grant to integrate with work being done for the Rivers Agency NI, the RBD projects and Lee strategic catchment study. (if won), and also as an expert in this area generally. No additional cost.

#### 1.4.8.1 Provisional Items

*The Public Relations/Presentations Item included as a provisional item (€20,000). Is this for the SEA or is in addition to the SEA?*

At this stage it is very difficult to determine the complexity of the issues arising from the SEA and the level of interest in it. Therefore we have indicated that a provisional item of €20,000 for Public Relations / Presentations should be retained when determining overall project budgets. This item would cover presentations materials and we have proposed the use of Elizabeth Arnett and her stakeholder communications team should this be required and agreed with the CA at the time.

RPS are to forward clarification to CA in relation to what work was allowed by RPS in their fixed fee element for the SEA particularly in relation to the Public Information Days.

*The software figure of €15,000 – is this for a copy of MIKE FLOOD?*

The provisional sum of €15,000 is provided in the tender document for Mike Flood software based on a limited node module. Full details and costs for various options can be provided.

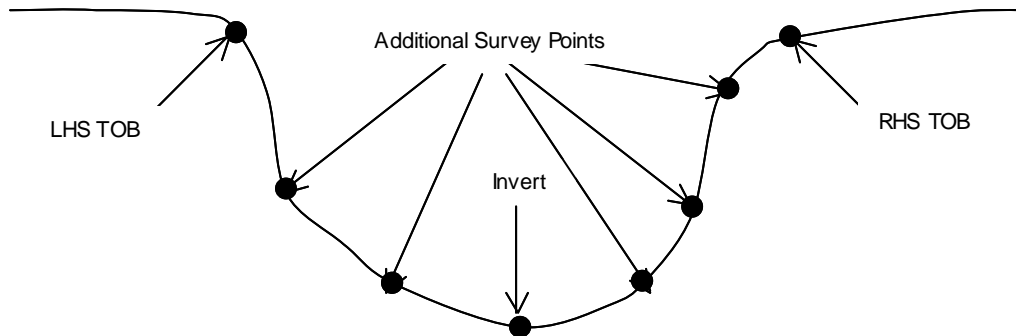
It was agreed by CA/RPS that the original RPS proposal would be revised to incorporate any changes resulting from the fee negotiation discussions and that these changes would be highlighted.

The main issues for resolution are: Provisional items, Clarify SEA, Printing Expenses, Costs for Topographical Survey Management.

## 2 CROSS SECTION SURVEY SPECIFICATION

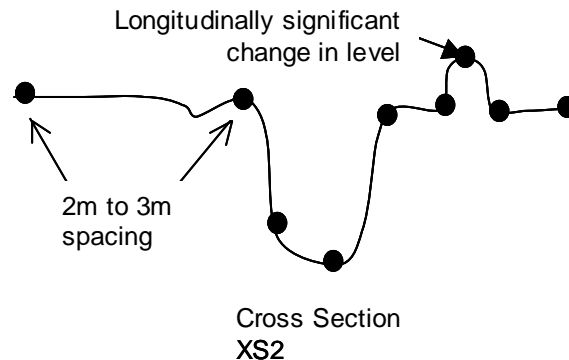
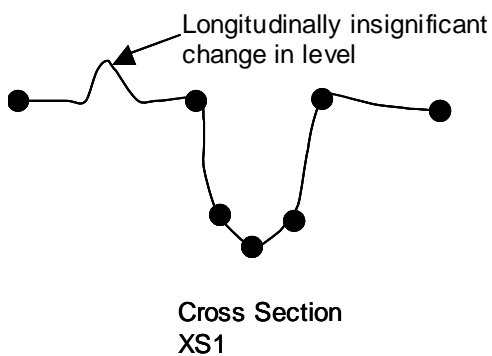
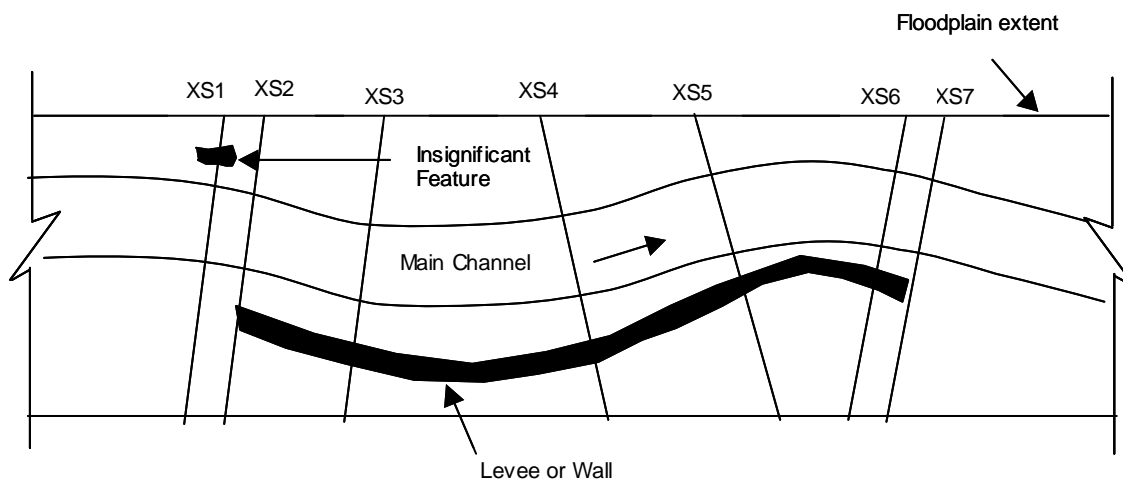
### 2.1.1 Required survey points:

- LHS Top of Bank;
- Invert;
- RHS Top of Bank; and
- Additional points such that the channel profile is adequately defined.



### 2.1.2 River Corridor (top of bank to 10m out)

Required survey points spacing should not be more than 3.0m and should adequately define the profile by showing any additional points as necessary where any significant lateral and longitudinal change of level occurs. See following example:



### 2.1.3 Floodplain (beyond 10m from top of banks)

Required survey points should be between 5m to 10m spacing and should adequately define the floodplain profile by showing any additional points as necessary where any significant lateral and longitudinal change of level occurs.

### 2.1.4 Required format for digital data

All channel cross section data is required in ASCII format. This should be in the format specified in Table 2-1 below, which is compatible with the MIKE FLOOD hydraulic model cross-section datafile.

**Table 2-1: ASCII File Format – Cross-sections**

1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
RIVER	Surveyed ...			<i>Unit name and (optional) comment</i>		
SECTION				<i>Unit Type</i>		
AA1200				<i>Cross-section name (max. 12 chars)</i>		
200				<i>Distance to downstream section</i>		
17				<i>Number of points in cross-section</i>		
0	3.12	0.04	1.000		0.00	0.00
4.8	3.00	0.04	1.000		0.00	0.00
9.3	3.39	0.04	* 1.000	Left	0.00	0.00
12.23	3.01	0.04	1.000		0.00	0.00
15.09	1.56	0.04	1.000		0.00	0.00
18.12	0.83	0.04	1.000		0.00	0.00
21.1	-0.32	0.04	1.000		0.00	0.00
24	-0.31	0.04	1.000	Bed	0.00	0.00
26.69	-0.16	0.04	1.000		0.00	0.00
29.65	0.56	0.04	1.000		0.00	0.00
32.57	1.43	0.04	1.000		0.00	0.00
35.3	2.86	0.04	1.000		0.00	0.00
38.21	3.21	0.04	1.000		0.00	0.00
41.1	3.49	0.04	* 1.000	Right	0.00	0.00
46	3.20	0.04	1.000		0.00	0.00
50.9	3.09	0.04	1.000		0.00	0.00
55.5	3.45	0.04	1.000		0.00	0.00
<i>Offset/ x</i> <i>(m)</i>	<i>Level/Z</i> <i>(mOD)</i>	<i>Default</i>	<i>*/</i> <i>default</i>	<i>L/R/B</i>	<i>Easting</i>	<i>Northing</i>

Notes:

1. In the above example no real co-ordinates are available and the easting and northing points are shown as '0.00'.
2. All italic text in Table 2-1 is for guidance only and not to be placed in ASCII file. A panel '\*' point should be put on the left hand side of the fourth column (ie 31st character, based on fields of ten) in rows containing 'Left' and 'Right' bank points.
3. The longitudinal measurement of the cross sections along the course of the river will be from upstream to downstream.

## 3 ADDITIONAL MONITORING

### 3.1 RAINFALL DISTRIBUTION

In order to calibrate rainfall data from radar measurements it is proposed to install three tipping bucket raingauges at strategic locations within the Dodder Catchment. The tipping bucket will have a resolution of 0.2mm. This will supplement recordings from the Casement Aerodrome station and provide a detailed resolution of the rainfall distribution throughout the catchment and a better understanding design rainfall distributions to utilise in the most likely future scenario modelling. Detailed design hyetographs can then be developed for each sub-catchment for effective flood defence measures.

### 3.2 MAX LEVEL MONITORING

In order to improve the calibration of the hydraulic model it is proposed to undertake level monitoring at significant existing structures along the River Dodder and Tributaries. This will be carried out at approximately 30 locations and it is envisaged to install a measurement staff or plastic tube in combination with a paper maximum level recorder. This would be required to be surveyed in during the topographical survey exercise and if installed early in the project it is envisaged that at least 1 significant ;winter flood event and possibly other events could be recorded. This would provide a robust and cost effective method of measurement and dramatically improve the accuracy of model level predictions and the calibration of the impact of major structures.

**Table 3: Fee estimate for rainfall and max level monitoring**

Element/ Job Item		Team Member Role Daily Rate	Grant Gillespie Associate € 900	Wolfram Schlüter Engineer € 450	Aidan Harney Engineer € 450	
<b>Labour</b>	<b>Status</b>		<b>Days</b>	<b>Days</b>	<b>Days</b>	<b>Cost</b>
<b>Management &amp; Specification</b>	Lump Sum		0.5	3		€ 1,800
<b>Rainfall Monitoring</b>						
Installation	Budget			1	1	€ 900
Data download & maintenance	Budget			8		€ 3,600
<b>Max Level Monitoring</b>						
Pre-installation visit	Budget			1	1	€ 900
Installation	Lump Sum			8.5	8.5	€ 7,650
Data monitoring & maintenance	Budget			12	12	€ 5,400
<b>Total Consultant Fees Ex VAT</b>			0.5	33.5	22.5	<b>€ 20,250</b>
<b>Equipment</b>						
<b>Raingauge: Product Code &amp; Product Description</b>	<b>Status</b>	<b>No</b>	<b>Cost/ Unit</b>			<b>Cost</b>
VF1e IP65 single channel logger	Lump Sum	3	322.5			€ 968
C21 Sensor Card: raingauges and pulse inputs	Lump Sum	3	52.5			€ 158
Casella 0.2mm TBR	Lump Sum	3	547.5			€ 1,643
Communication Software: ISODAQ	Lump Sum	3	0			€ 0
CBL-PC9 PC RS232 (9 way) to VF series logger cable	Lump Sum	3	37.5			€ 113
OP232e Infrared comms adaptor	Lump Sum	1	67.5			€ 68
Postage and Packing	Lump Sum	1	67.5			€ 68
<b>Sub Total</b>						<b>€ 3,015</b>
<b>Level monitoring equipment</b>						
<b>Level monitoring equipment</b>	<b>Status</b>	<b>No</b>	<b>Cost/ Unit</b>			<b>Cost</b>
Staffs	Lump Sum	40	100			€ 4,000
Tubes and Fitting equipment	Lump Sum					€ 2,000
<b>Sub Total</b>						<b>€ 6,000</b>
<b>TOTAL</b>						<b>€ 29,265</b>

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## 4 MULTI COLOURED MANUAL 2005

February, 2006

### The Benefits of Flood and Coastal Risk Management A Handbook of Assessment Techniques A Manual of Assessment Techniques

Download now the [FHRC Flyer Order](#).

**Note:** The flyer is in pdf format. If you do not have Acrobat Reader to view pdf files, you can download the free software from our website on our [publications page](#).

This project represents the second phase of research and development to update the FHRC's previous project appraisal Manuals for Flood and Coastal Erosion Risk Management [FCERM]. Those Manual were published in 1977; 1987; & 1992. The first phase was undertaken in project FD 1705 between 2001 and 2003 and resulted in the draft Multi-Coloured Manual and CD that was finished in December 2003.

During this time Government policy for flood and coastal erosion risk management has changed significantly from that of the 1990s. The Department for the Environment, Food and Rural Affairs (Defra) has superseded the Ministry of Agriculture, Fisheries and Food (MAFF) as the government department responsible for flood and coastal erosion risk management (previously 'flood defence' and before that 'land drainage'). In turn, Defra has developed an important new FCERM policy in the form of 'Making Space for Water' (MSFW) which has significant implications for project appraisal – e.g. balancing national and local priorities – and for government investment priorities.

#### **Making Space for Water: The aim**

*"To manage the risks from flooding and coastal erosion by employing an integrated portfolio of approaches which reflect both national and local priorities, so as:*

- *To reduce the threat to people and their property; and*
- *To deliver the greatest environmental, social and economic benefit, consistent with the Government's sustainable development principles.*

*To secure efficient and reliable funding mechanisms that deliver the levels of investment required to achieve the vision of this strategy."*

The rationale of the Manual and Handbook that are the result of this project is to aid and improve investment decision-making so as to try "To deliver the greatest environmental, social and economic benefit, consistent with the Government's sustainable development principles" (see above). The relevant decisions are about investment in fluvial flood risk management schemes (including non-structural projects), and at the coast in schemes to manage the risks of both coastal flooding and the erosion of the land by the sea. These decisions should be seen in the context of the modern philosophy of an integrated approach to catchment and coastal zone management.

The Manual and Handbook do not exist in isolation. As indicated in Table 1 (below), they sit alongside Defra and HM Treasury guidance on the appraisal of FCERM schemes and public sector investment generally. The Manual and the associated CD together provide much of the benefit data on which project appraisals are based, in the context of the theoretical and policy context provided by the other documents.

## 5 THE PROJECT'S OBJECTIVES

This second phase was designed to provide a new completed Multi-Coloured Manual reference work and facilitate the systematic updating of flood damage tables and indices. The background objective was to enable Defra, and others, to allow FCERM decisions to be made based on the most up-to-date information, methodologies and guidance available.

<p><b>Table 1.</b> <b>Sources of guidance on appraising flood and coastal erosion risk management schemes</b></p>
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and plans		
Source	Document	Purpose
HM Treasury	'Green Book'	Identifies the preferred approach to public sector investment appraisal
Defra	PAG series, particularly PAG3, plus addendums	How a project appraisal and CBA should be completed for flood and coastal erosion risk management projects
Middlesex University FHRC	The 'Multi-Coloured Manual' (MCM)	Gives details of relevant research and detailed guidance on benefit assessment methods and data
Middlesex University FHRC	The 'Multi-Coloured Handbook' (MCH)	Summarises the guidance in the MCM for easier access

## 6 THE PROJECT'S METHODS

The methods used included: Web and literature searches; discussions meetings with the owners or managers of non-residential properties; data collection; case studies; interview surveys with those flooded who had received flood warnings; searches of secondary data sources (e.g. for household inventories; benefit transfer datasets); consultations with stakeholders.

## 7 THE PROJECT'S FINDINGS

### 8 Results

The results from this project are the new Multi-Coloured Manual, the Multi-Coloured Handbook (2005) and their associated Multi-Coloured CD. The main enhancements in the Manual are as follows:

- An experimental scheme for assessing the impact of data quality on the appraisal process (Ch. 3).
- A better set of data on flood damages to residential properties, on the MC CD, backed up with a better system for updating that data in the future.
- Better data on the impact of social class on flood damages with which to base the weighting of flood damages to houses by Distributional Weights (on the MC CD).
- More data on flood damages to Non-Residential properties, although this data set is by no means as good as the one for residential properties (because of the high variance in the NRP sector).
- Better data (by a long way) on the damage-reducing effects of flood warnings to residential properties.
- A significantly better Chapter on the impact of FCERM schemes on recreation (Ch. 8).
- A new approach to the assessment of the benefits of FRM for agriculture, that is consistent with new Defra policies.
- An enhanced chapter on the impacts of FCERM schemes on the environment.
- A report on the economic methods for valuing wetland resources (from the University of East Anglia).

## 9 Conclusions



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The principal conclusions from this work are as follows:

As far as residential and non-residential flood damages and other losses are concerned:

- The potential damage to residential properties is much higher than we had hitherto assessed.
- The potential flood damage to NRPs is also much higher than we had hitherto assessed.
- The variance of damages within this NRP sector is large and generalisation and averaging is problematic (i.e. the data is subject to large standard errors).
- Only in rare cases of extreme floods affecting major utility installations would the impacts be large enough to warrant intensive study of utility impacts within a benefit assessment in a project appraisal.
- The new approach to appraising the benefits of FCERM to agriculture will result in values that will be higher than hitherto as the subsidies to agriculture are not now included in the calculations.

As far as the Manual/handbook are concerned:

- The 2005 MCM has been based heavily on the 2003 MCM. The 2003 to 2005 period has been used to "Road-test" the Manual, involving widespread stakeholder consultation.
- The Manual (and CD) has come through that process successfully, but with numerous changes that should enhance its value to its users.
- In turn this has made possible the development of the parallel Handbook, which should ease the benefit assessment process considerably.
- The last major update of this Manual material – before 2003 – occurred in 1992 (now 13 years ago). The evidence from the FD2014 project suggests that a period of less than 10 years between major updates is desirable for the Manual to remain in tune with both Defra policy and its users' needs.
- A system for updating the data on the MCM CD and in the MCM in the future needs to be agreed with the Environment Agency.

## **River Dodder Flooding Study -- Fee Negotiation -- Meeting 2**

**Thursday 2/11/2006 Time: 10.00am**

**Venue: Conference Room, Floor 1, Marrowbone Lane**

### **Present:**

Mark Adamson	(MA)	Manager	Floor Relief Design Section, OPW
Grant Gillespie	(GG)	Project Manager	RPS Consulting Engineers
Clare O'Donnell	(COD)	Modeller	" " "
Alan Barr	(AB)	Director	" " "
Don McEntee	(DMcE)	Senior Engineer	Dublin City Council (DCC)
Brian Hennelly	(BH)	Project Leader	" " "
Alan O'Regan	(AOR)	Clerical Administrator	" " "

ITEM	ACTION
<ul style="list-style-type: none"><li>There was a general introduction by each attendee and their role in relation to the study. AB advised that he was sitting in at meeting on behalf of Grace Glasgow who was unable to attend today's meeting. Grace will be co-ordinating the study for RPS on behalf of their Belfast Office's involvement. MA advised that John Martin will be the Project Manager for the OPW for the study but was unavailable for today's meeting. MA will still be involved in a monitoring role for the OPW.</li><li>BH advised that the main issues for today's meeting were to finalise any outstanding issues in relation to RPS submission, any items outstanding from the minutes of the Fee Negotiation Meeting 1 held on 23/6/2006 and to finalise the Provisional Items and Fees. The opportunity would be used also to review the extent of the topographical survey required for the tributaries with the OPW.</li></ul> <p><b><u>Provisional Items</u></b></p> <ul style="list-style-type: none"><li><b>Dam Break Assessment (€70,000)</b> --It was agreed that a detailed assessment was not required. An assessment had been carried out previously by ESBI as part of the River Dodder Inundation Study in 1994 for DCC. This study had led to the recommendation of the upgrading of the spillways for the dams at the Bohernabreena Reservoirs which was completed earlier this year by DCC. However BH felt for the completeness of this study and to avoid challenge of the study's findings, there should be a section included in the Final Report to address the issue of the flood risk with the dams and outlining the reasons why the detailed assessment was not necessary for this study. MA said that the flood risk with the dams needs to be identified in the Flood Risk Assessment as a potential risk and addressed as such. It was agreed that the Dam Break Assessment would be left as a Provisional Item in the final fees to act as a contingency sum.</li><li><b>Defence Asset Database (€25,000)</b> --MA advised that the OPW have commissioned Halcrow to complete the defence asset database as part of the River Lee Study and this database should be completed by February/March 2007. The plan is to enter the data on site using tough-books supplied by the OPW which will enter the data directly in to the</li></ul>	<b>GG</b>

<p>books supplied by the OPW which will enter the data directly in to the defence asset database using a web linked system. GG confirmed that RPS have only allowed in their fee submission for entry of the defence asset data indicated in Section 2.6.3 of the RFP and not all the additional fields indicated in Appendix C of the RFP. MA said that he would forward on a list of the required fields within the database to GG as soon as they had been finalised which should be within the next couple of weeks. GG said that to populate the database would be a lot of secondary work but that ideally they would like to collect data in the same way for everyone's benefit. MA advised that the database system should be ready in March 2007 in time for the Asset Condition Survey. GG said that this timeline would fit in with the RPS programme for the study. It was agreed to leave the €25,000 as a Provisional Item in the Final Fees to cover any necessary crossover between RPS and Halcrow and any costs for additional populating of the database by RPS.</p>	<p><b>MA</b></p>
<ul style="list-style-type: none"> <li>BH queried with GG if RPS would be taking their own digital photos for the Defence Asset Survey, separate to the digital photos being taken by DCC as part of the Topographical Surveys. GG confirmed RPS would be taking their own digital photos and RPS had allowed for this in their fee submission.</li> <li><b>Sediment Transport Model (€15,000)</b> –AB stated that this type of modelling had previously only been done for navigatable rivers and that it may have limited value here. The fee did not allow for the detailed analysis of the sediment material but this could be included as a recommendation of the Catchment Flood Risk Management Plan (CRFMP). GG suggested that it be set up and run to see the benefits. MA said that it should be determined first by DCC as to whether sediment or scouring is a risk with the Dodder. DMcE stated that scouring is an issue and had occurred in Tempelogue. BH advised that DCC's Drainage Maintenance Section carry out sediment removal from the river on an annual basis and that new access gates have been installed this summer in the river wall at Beatty's Avenue, Ballsbridge to facilitate the sediment removal. BH proposed it was worth leaving in, as it would also assist the development of the Maintenance Plan which is one of the Study's deliverables. The general consensus was to go with the Sediment Transport Model but MA stated that more detail is required on exactly what RPS propose to do. DMcE clarified that the Sediment Transport Model is to determine where materials would build up in the river in the event of a flood. AB said that this was the case. RPS to provide a more detailed proposal of work necessary for the completion of the sediment transport model and include as a fixed fee element.</li> </ul>	<p><b>GG</b></p>
<ul style="list-style-type: none"> <li><b>Public Relations/Presentations (€20,000)</b> –GG stated that RPS had only allowed for staff preparation for the 4 Public Information Days in their fee submission for the Strategic Environmental Assessment (SEA) but had not allowed for the carrying out of the Public Information (PI) Days. GG accepted RPS had misinterpreted the RFP. GG said that he had not factored in the attendance of staff members at the PI days. MA stated that the presentations at the PI days would be in an exhibition style (information stands, etc.) but that staff would be required to be in attendance (e.g. SEA Team member on the 1<sup>st</sup> day plus Engineering staff on the 2<sup>nd</sup> day). RPS will not incur expenses for the cost of location of the PI days and the production/printing of materials for these PI days can be claimed as a reimbursable expense. MA said that the attendance of the RPS staff on the</li> </ul>	<p><b>GG</b></p>

<p>PI days would have to be borne by RPS as part of the their fixed fee element included for the SEA in their submission. If any other expenses occur they can be reviewed by DCC/OPW. It was agreed that the €20,000 would be left as a Provisional Item in the final fees to cover any additional presentations that may be needed outside of the SEA as deemed necessary by DCC/OPW and to cover attendance of RPS staff at these presentations (e.g. ERBD Councils or any other relevant stakeholders).</p>	GG
<ul style="list-style-type: none"> <li>• BH clarified with GG that the Environmental Report referred to in the RPS submission and the SEA report referred to in the RFP were the same report. MA noted that the SEA must be in compliance with EPA requirements and GG confirmed that the SEA would be completed by RPS in accordance with the requirements of the RFP.</li> <li>• MA said that, in terms of keeping the public up-to-date, the OPW are producing monthly Newsletters for the River Lee Study that serve as progress reports and that there is an e-mail address where the public can forward queries. These newsletters will be posted on the OPW website. BH said that if RPS are involved in compiling the newsletters for the Dodder study this work could be paid for from the Public Relations/Presentations provisional fee.</li> </ul>	
<ul style="list-style-type: none"> <li>• <b>Software (€15,000)</b> –GG have proceeded and purchased a new licence for MIKE 11/MIKE FLOOD specifically for this study for €21,000 from Danish Hydraulics Institute (DHI). This price is based on the fact that RPS have a multiple licence agreement with DHI and so may be higher if purchasing a single licence. MA stated that OPW have a licence for MIKE FLOOD on trial at present but asked if the new RPS licence is transferable. GG to check with DHI if licence is transferable to the OPW and what is the exact price of purchase including VAT for the licence. The cost of the licence for the sediment transport modelling add-on would be additional to the MIKE 11/MIKE FLOOD.</li> </ul>	GG
<ul style="list-style-type: none"> <li>• <b>Rain Gauges and Maximum Level Monitors (€30,000)</b> --BH queried with GG if it was too late to proceed with this item. GG said ideally he would have liked to install these gauges before winter but they would still provide valuable information if we can install them soon. BH advised that DCC currently have operational rain gauges at Donnybrook Fire Station and Ballyboden Waterworks. DMcE suggested that RPS contact SDCC because they have some Rain Gauges already in operation. BH stated that it was necessary to find out where there are Rain Gauges installed already (SDCC) so as to get a proper spread for the installation of them. DMcE said that if RPS are purchasing the rain gauges that it would be helpful to consult with DCC as DCC have found that some rain gauges work better than others. BH queried if DCC would own the 3 rain gauges following completion of the study. GG confirmed this would be the case. MA had some concerns with the Level Gauges proposed by RPS as they had only a metre long range. The gauges are also made of glass which would not survive in an insecure environment. GG said RPS had noted MA's concerns. MA asked that RPS source a more secure alternative product for the level gauges and put together a fixed fee for procurement, installation and monitoring costs and that this would be included in the final fixed fees. MA suggested GG contact Alex McAllister, in the OPW's Headford Office regarding a suitable level gauge. For the actual level gauge installation, DCC Drainage Maintenance crews would assist RPS would maintain the rain gauges and carry out level readings. BH informed</li> </ul>	GG
	GG

<p>GG of the 2 new tide level recorders that have been recently installed by DCC, one on the River Dodder at Beatty's Avenue, Ballsbridge and one on the River Liffey at Rory O'Moore Bridge. BH to supply RPS with the location details for the River Dodder recorder.</p>	<p><b>BH</b></p>
<ul style="list-style-type: none"> <li>• <b>Topographical Survey Management</b> – GG advised that to date RPS costs were €20,000 for topographical survey management. This work had been undertaken by RPS at the bid fee rates included in the Work Breakdown Schedule (WBS) of their submission and not at the additional services rates. GG advised that this element of work is almost complete apart from some finalisation of cross section identification drawings and attendance by COD at some further survey progress meetings. BH suggested a cost of €25,000 to complete this element of work and GG agreed to this figure. BH queried if the 3<sup>rd</sup> party cost of €6,500 for Topographical Survey of Property Floor Levels included in RPS submission could be removed, as DCC's Survey &amp; Mapping Section would be completing the survey of these floor levels. GG confirmed this item would be removed from RPS final fees. The topographical survey management was proving beneficial to RPS also with their staff involved becoming familiar with the main Dodder River and its tributaries for the study.</li> </ul>	<p><b>GG</b></p> <p><b>GG</b></p>
<ul style="list-style-type: none"> <li>• <b>CD-Rom Booklet for Final Data Handover</b> -- GG gave an overall price of €15,000 for the production of the booklets. In the breakdown of this, he said there would be 20 days @ €500 to get the information together and 20 booklets @ €250 each with 2 booklets produced per day. DMcE demonstrated the CD-Rom booklet completed for the River Tolka Study and which had been supplied to the OPW and the relevant local authorities. GG felt there would be more information in the River Dodder CD-Rom booklet than the River Tolka CD-Rom booklet. MA asked GG if RPS could review this initial cost and the possibility of a reduced figure for completing the booklet as this initial price appeared to be expensive.</li> </ul>	<p><b>GG</b></p>
<ul style="list-style-type: none"> <li>• <b>Printing</b> – With regards to the 3 stages of each report needed (working draft, draft final and final), MA said that the working draft could be circulated electronically, so no hardcopy of the report would be needed for that stage. GG asked if the number of reports required could be calculated. MA calculated that there would be 6 interim reports and that 10 copies of the draft final and 10 copies of the final for each of those would be required. 100 copies of the Non-Technical SEA Summary Report plus 20 copies of the SEA report would be needed. 20 copies of the Draft Final Report and 20 copies of the Final Report would be required. GG said that he will do up a price indicating the number of reports they have allowed and provide this to DCC/OPW. BH asked if the CD-Roms are included in the printing costs (3 copies of each report digitally as per RFP). GG said that these would be supplied. BH queried the printing of material (brochures, questionnaires, information posters, power point presentations) for the Public Relations Presentations days. The cost for these materials would be left as a provisional item to be recouped by RPS as a reimbursable expense.</li> </ul>	<p><b>GG</b></p> <p><b>GG</b></p> <p><b>GG</b></p>
<ul style="list-style-type: none"> <li>• MA stated that the OPW would like a final fixed fee amount from RPS (ideally provided in November 2006) and to include what DCC/OPW will get for that fixed fee as well as a projection for 2007 based on the Provisional Items so OPW can make provision in their budgets.</li> </ul>	<p><b>GG</b></p>

<ul style="list-style-type: none"> <li>• MA raised a few issues from the minutes of the Fee Negotiation Meeting 1 held on 23/6/2006 that he wanted to clarify:</li> <li>➤ MA advised that the new <b>OPW Flood Hazard Mapping web site</b> was now in operation and available to the general public. BH queried the registered user access and that he had e-mailed George Peters OPW requesting registered access. MA advised that registered access users have only a little additional information above that provided to the general user. MA stated that registered access would be provided to local authorities but not to Consultants.</li> <li>➤ MA had a query for GG regarding the <b>DTM Break Lines</b>. GG clarified why RPS required them. MA said that RPS would have been provided with x, y, z points and that DTM Break Lines would not be available. GG confirmed that RPS had received the OPW LiDAR data from BH and had completed the DTM using the LiDAR data. GG confirmed that RPS are not looking for any additional payments for processing the LiDAR data into a DTM. COD provided BH with a CD-Rom containing the DTM completed by RPS using the LiDAR data.</li> <li>➤ <b>Tributaries Topographical Survey</b> – BH confirmed that there would be a lot more cross-sections than originally anticipated by DCC. BH was concerned that RPS might be going into too much detail. MA said that it was necessary to take cross-sections of structures and reviewed the proposed cross section survey drawings completed by Survey and Mapping for the Tallaght Stream and the Whitechurch Stream. He agreed that the cross sections indicated for survey on these drawings were necessary. There followed a discussion on the Little Dargle and why it was left out of the DTM. GG advised that RPS would not be in a position to produce flood mapping without the DTM. MA said that it should be included in the topographical survey upstream to Marlay Park. It was agreed that it should be modelled and if it is shown to be a flood risk an appropriate DTM can be obtained by RPS to produce the flood mapping.</li> <li>➤ <b>Topographical Survey Budget</b> – MA advised that it was necessary for DCC to provide a more definite price to OPW for the completion of the overall topographical survey. This price needs to be supplied to the OPW as soon as possible for inclusion in their 2006 costings.</li> <li>➤ <b>Flood Mapping Formats</b> -- MA said the format is being finalised as part of the River Lee study with Halcrow and this format will become the national standard. MA advised OPW are looking for Flood Extent Maps with tables of flood levels in MapInfo format. The query is how the levels of confidence should be assigned to the flood risk maps and the OPW are awaiting Halcrow to provide a specification. The flood mapping formatting should be confirmed by the OPW in the near future.</li> <li>➤ MA confirmed that the <b>2005 FHRC's Multi-Coloured Manual</b> should be used for this study and GG confirmed this has no additional costs for RPS.</li> <li>➤ Item 1.4.3. of the minutes -- <i>Development of Flood Risk Management Options - Preferred design standards - Flood Risk Management Measures – assume review of options can rule out specific options on a general assessment of overall feasibility. E.g. too costly for benefit, land acquisition costs, environmentally not feasible etc.</i> MA confirmed that the ruling out of options needs to be justified by RPS. GG confirmed this would be done by RPS.</li> <li>➤ <b>Draft CFRMP</b> – MA advised that the OPW would be looking for 3 months (approx 60 working days) for consultation on the draft CFRMP which is a new request by the OPW. RPS have only allowed a Review Period of 20 days by the CA of the CFRMP in their programme. GG said that RPS can adjust their programme to allow for the increased review period and still</li> </ul>	<p>GG</p> <p>BH</p> <p>MA</p> <p>GG</p>
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<p>complete the study within the 18 months. GG confirmed as there would be no activity required by RPS during this extended review period there would be no additional charges by RPS.</p> <ul style="list-style-type: none"> <li>• BH reviewed some outstanding queries with RPS: <ul style="list-style-type: none"> <li>➤ BH queried GG if RPS had allowed for preparation of sufficient progress reports in their WBS. GG asked how many reports would be required as there is some confusion in the RFP on this issue. It was agreed that there would be monthly progress meetings between RPS and DCC and 6 meetings of the Steering Group. The Steering Group meetings would be arranged as the study required rather than a set time period.</li> <li>➤ RPS Insurances -- GG confirmed he had received e-mail from BH outlining 2 outstanding items required by DCC. GG said that he would forward confirmation once RPS brokers had arranged these 2 items even though their brokers felt they are onerous.</li> <li>➤ Appointment of PSDS -- GG said that he would prefer if this appointment were made before the new Health and Safety Legislation applied, as with the new Health and Safety Regulations, RPS would have a lot more onerous responsibility.</li> </ul> </li> <li>• BH queried with MA when would DCC be in a position to officially appoint RPS as the Consultants for the Study? MA outlined the 5 outstanding issues that RPS have to get back to DCC/OPW. These are Sediment Transport Model, MIKE FLOOD Licence, Hydrometric Equipment, Topographical Survey Management and Printing Costs/CD Booklet. When the costs for all these have been firmed up by RPS and sent to MA he can review it with the budget dept. of OPW. MA asked that GG come back to him with a final fee by Wednesday 15<sup>th</sup> November and then, when agreed, the OPW will issue a letter of approval for the funding for the study to DCC and the formal appointment of RPS can be proceeded with by DCC.</li> <li>• GG advised as follows on BH e-mail comments on the minutes of the Fee Negotiation Meeting 1: <ul style="list-style-type: none"> <li>➤ Historic Flood Data 1986 – DCC need to provide RPS with a copy of the book of photographs.</li> <li>➤ Design Scenario – Is it 50 years or 2031? This can be reviewed at the initial meeting once the study has commenced.</li> <li>➤ ERBD Data – RPS will advise on their requirements at initial meeting.</li> </ul> </li> <li>• GG said that a Private Developer had approached RPS and asked them to do a Flood Impact Assessment on an area in Milltown. He believed there could be a conflict of interest here. It was agreed by all parties that this would represent a conflict of interest and RPS are to advise the Developer accordingly and that they will not be in a position to carry out the assessment.</li> <li>• BH advised that DCC would be pushing for a December 2006 start date on the Study. DMcE said that it was important to get the appointment completed this year and to then agree on a start date. GG confirmed that the programme, WBS, RAM, etc would be all updated by RPS once a definite start date has been agreed.</li> <li>• MA mentioned that the EU Floods Directive will be adopted next summer</li> </ul>	<p><b>GG</b></p> <p><b>GG</b></p> <p><b>GG</b></p> <p><b>BH</b></p> <p><b>GG</b></p> <p><b>GG</b></p> <p><b>GG</b></p>
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<p>and that this project and its findings would have to take cognisance of the new directive.</p> <ul style="list-style-type: none"> <li>• BH queried with GG if the fees rates in the proposal still hold. GG said that he would have review with the finance section of RPS and find out if the rates would change for next year. He said he would provide confirmation on this issue to BH.</li> <li>• BH provided all attendees from RPS and OPW with a copy of working paper on the history of the River Dodder and Bohernabreena Waterworks. Michael Corcoran, DCC is updating this document as new historical information becomes available. It is a useful reference document on the development of the River Dodder Catchment.</li> </ul>	<p><b>GG</b></p>
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**Circulation:** All present.

**Plus:** John Martin, OPW,  
Grace Glasgow, RPS,  
Tom Leahy, Deputy City Engineer, DCC.