SITE-SPECIFIC FLOOD RISK ASSESSMENT

ST PAUL'S RESIDENTIAL DEVELOPMENT,
SYBIL HILL ROAD, RAHENY, DUBLIN 5

Crekav Trading GP Limited

Project No. N251
September 2019

SITE-SPECIFIC FLOOD

RISK ASSESSMENT

NOTICE

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CONTENTS

APPENDICES

1. INTRODUCTION

O'Connor Sutton Cronin (OCSC) has been instructed to prepare a Site Specific Flood Risk Assessment for the proposed development.

The development will consist of the construction of a residential development set out in 9 no. blocks, ranging in height from 5 to 9 storeys accommodating 657 no. apartments, residential tenant amenity spaces and a crèche. At basement level the site will accommodate car parking spaces, bicycle parking, storage, services and plant areas. Landscaping will include extensive communal amenity areas, and a proposed significant area of public open space. The proposed development also includes for the widening and realignment of an existing vehicular access onto Sybil Hill Road and the demolition of an existing pre-fab building to facilitate the construction of an access road with from Sybil Hill Road between Sybil Hill House (a Protected Structure) and St Paul's College incorporating upgraded accesses to Sybil Hill House and St Paul's College and a proposed pedestrian crossing on Sybil Hill Road. The proposed development also includes for the laying of a foul water sewer in Sybil Hill Road and the routing of surface water discharge from the site via St Anne's Park to the Naniken Stream and the demolition and reconstruction of existing pedestrian stream crossing in St Anne's Park with integral surface water discharge to Naniken Stream.

The subject lands are located at St Paul's College, Sybil Hill Road, Dublin 5. The site is bound to the north, east and south by St Anne's Park and to the west by Sybil Hill Road– see ***Figure 1***. The total development area is approximately 6.4 hectares (15.8 acres). The extent of redline works for the development is 6.7ha.

Figure 1: Site Location

1.1 The main entrance to the proposed development will be via Sybil Hill Road with the access to the basement car-park to be located off the main internal access road. Emergency egress will also be provided at ground level for fire tender vehicles.

1.2 The Flood Risk Assessment was conducted in accordance with:

- *The Planning System and Flood Risk Management Guidelines for Planning Authorities* (Department of Environment, Heritage and Local Government and the Office of Public Works);
- *C624 Development and Flood Risk* (Construction Industry Research and Information Association, CIRIA) and;
- *Dublin City Development Plan 2016-2022.*

1.3 The Flood Risk Assessment was based on the following information:

- Architectural drawings of the development proposals;
- OPW Floodmaps.ie;
- OPW National Preliminary Flood Risk Assessment;

- OPW Irish Coastal Protection Strategy Study;
- OPW Eastern CFRAM Study;
- SAFER Cities Flood Mapping;
- DCC Drainage Records;
- GDSDS Sewer Performance Records;
- Geological Survey of Ireland (GSI) Maps.

2.0 SITE CONTEXT

2.1 The Naniken Stream is approximately 100m to the north of the subject site and Dublin Bay is approximately 1.5km to the south of the site – see ***Figure 2***. The terms Naniken River and Naniken Stream are interchangeable and for the purpose of this planning application and all supporting reports and documentation both names refer to the same waterbody.

Figure 2: Site Context

2.2 The subject site is accessed from Sybil Hill Road. The site topography slopes away from a high point of 24.90m (Malin) AOD at the north-western boundary to a level of 21.28m (Malin) AOD at the south eastern boundary.

2.3 The Office of Public Works (OPW) collates available reports on flooding from all sources (e.g. fluvial, pluvial, coastal,

infrastructure) on a nationwide basis. The OPW's floodmaps.ie website was consulted to obtain reports of historical flooding within the vicinity of the subject site. The Map Report in ***Appendix A*** lists reports of historical flooding within 2.5km of the subject site. Flooding in the areas nearby is recorded in several locations, none of which directly impacted the subject site.

2.4 A tidal flooding event on the 1st of February 2002 is reported to have caused flooding in several areas in the east of Dublin City, including Clontarf road, but the area within and around the subject site was not affected by this flood event. There is also note of recurring flooding events in Donnycarney but again this does not affect the proposed site due to the natural topography of the land and location of the flood events which are over 2km away.

3.0 LEVEL OF SERVICE

3.1 The risk of a flood event is a function of the probability of occurrence in any given year. Traditionally, this has been expressed as a return period (e.g. 1-in-100-year return period). However, this has led to misconceptions about the likelihood of repeat occurrences. A less ambiguous expression of probability is the Annual Exceedance Probability (AEP), which may be defined as the probability of a flood event being exceeded in any given year. A 1-in-100-year return period flood event is therefore expressed as a 1% AEP flood event. Likewise, a 1-in-1-year return period flood event is expressed as a 100% AEP flood event.

3.2 The *Greater Dublin Strategic Drainage Study* (published by the Local Authorities in the Greater Dublin Region) and *The Planning System and Flood Risk Management Guidelines for Planning Authorities* (published by DOEHLG, November 2009) set out the best practice standards for flood risk in Ireland. These are summarised in ***Table 1***.

Table 1: Summary of Level of Service

Flooding Source	Drainage	Fluvial (River)	Tidal (Coastal)
Residential	1% AEP	0.1% AEP	0.1% AEP
Commercial	1% AEP	1% AEP	0.5% AEP
Water-compatible	–	>1% AEP	>0.5% AEP

3.3 In addition, the GDSDS requires that ground floor levels of houses be provided with a 500mm freeboard over the 1% AEP fluvial flood level.

3.4 Both the Greater Dublin Strategic Drainage Study and *The Planning System and Flood Risk Management Guidelines for Planning Authorities* require that account be taken of the effects of climate change over the design life of a development, normally 100 years. Design parameters to take account of climate change were established in the GDSDS and revised following later studies (as advised by Dublin City Council). These parameters are set out in ***Table 2***.

Table 2: Climate Change - Impact on Design Parameters

Design Category	Impact of Climate Change
Drainage	10% increase in rainfall
Fluvial (River)	20% increase in flood flow
Tidal/Coastal	Min FFL of 4.0mAOD

3.5 The Guidelines adopt a sequential approach to managing flood risk by reducing exposure to flooding through land-use planning. The approach adopted by the Guidelines establishes three zones (Guidelines paragraph 2.23) on a sliding scale of flood risk – see ***Table 3***.

Table 3: Flood Risk Zones

Zone A	**High Probability of Flooding** Where the annual probability of flooding is: greater than 1% for fluvial flooding or greater than 0.5% for coastal flooding
Zone B	**Moderate Probability of Flooding** Where the annual probability of flooding is: between 0.1% and 1% for fluvial flooding or between 0.1% and 0.5% for coastal flooding

Zone C	**Low Probability of Flooding** Where the annual probability of flooding is: less than 0.1% for fluvial flooding and less than 0.1% for coastal flooding

3.6 Flood risk zones are determined on the basis of the probability of river and coastal flooding only (Guidelines paragraph 2.24). Other sources of flooding (such as groundwater, infrastructure and pluvial) do not affect the delineation of flood risk zones. These other sources of flooding should be considered and mitigated in design. Flood risk zones are determined on the basis of the current flood risk, i.e. without the inclusion of climate change factors (Guidelines paragraph 2.24).

3.7 The Guidelines classify potential development in terms of its vulnerability to flooding. The types of development falling within each vulnerability class are described in Table 3.1 of the Guidelines, which is reproduced in ***Table 4***.

Table 4: Development Vulnerability Class

Vulnerability Class	Land uses and types of development which include:
Highly vulnerable development (including essential infrastructure)	Garda, ambulance and fire stations and command centres required to be operational during flooding; Hospitals; Emergency access and egress points; Schools; Dwelling houses, student halls of residence and hostels; Residential institutions such as residential care homes, children's homes and social services homes; Caravans and mobile home parks; Dwelling houses designed, constructed or adapted for the elderly or, other people with impaired mobility; and Essential infrastructure, such as primary transport and utilities distribution, including electricity generating power stations and sub-stations, water and sewage treatment, and potential significant sources of pollution

	(SEVESO sites, IPPC sites, etc.) in the event of flooding.
Less vulnerable development	Buildings used for: retail, leisure, warehousing, commercial, industrial and non-residential institutions; Land and buildings used for holiday or short-let caravans and camping, subject to specific warning and evacuation plans; Land and buildings used for agriculture and forestry; Waste treatment (except landfill and hazardous waste); Mineral working and processing; and Local transport infrastructure.
Water-compatible development	Flood control infrastructure; Docks, marinas and wharves; Navigation facilities; Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location; Water-based recreation and tourism (excluding sleeping accommodation); Lifeguard and coastguard stations; Amenity open space, outdoor sports and recreation and essential facilities such as changing rooms; and Essential ancillary sleeping or residential accommodation for staff required by uses in this category (subject to a specific warning and evacuation plan).

3.8 The Guidelines define the zones in which each class of development is appropriate – this is summarised in ***Table 5***. The Guidelines recognise that flood risks should not be the only deciding factor in zoning for development; the Guidelines recognise that circumstances will exist where development of a site in a floodplain is desirable in order to achieve compact and sustainable development of the core of urban settlements. In order to allow consideration of such development, the Guidelines provide a Justification Test, which establishes the criteria under which desirable development of a site in a floodplain may be warranted.

Table 5: "Appropriateness" Matrix

	Flood Zone A	**Flood Zone B**	**Flood Zone C**
Highly Vulnerable Development	Justification Test	Justification Test	Appropriate
Less Vulnerable Development	Justification Test	Appropriate	Appropriate
Water-compatible Development	Appropriate	Appropriate	Appropriate

3.9 The proposed development is mostly residential in nature and can therefore be classed as a "Highly vulnerable development" in accordance with Table 3.1 of the Guidelines.

4.0 FLOOD RISKS & MITIGATION MEASURES

4.1 Fluvial Flooding

4.1.1 The OPW's *Draft Preliminary Flood Risk Assessment* (DPFRA) includes an assessment of fluvial flood plains and produces the indicative national flood risk mapping – refer to OPW DPFRA drawing 2019/MAP/238/A in ***Appendix B***.

4.1.2 The MyPlan.ie website is managed by the Department of the Environment, Community and Local Government. The website includes the OPW's flood map data on fluvial flood risk in the vicinity. This map shows no indication of fluvial flooding on the subject site.

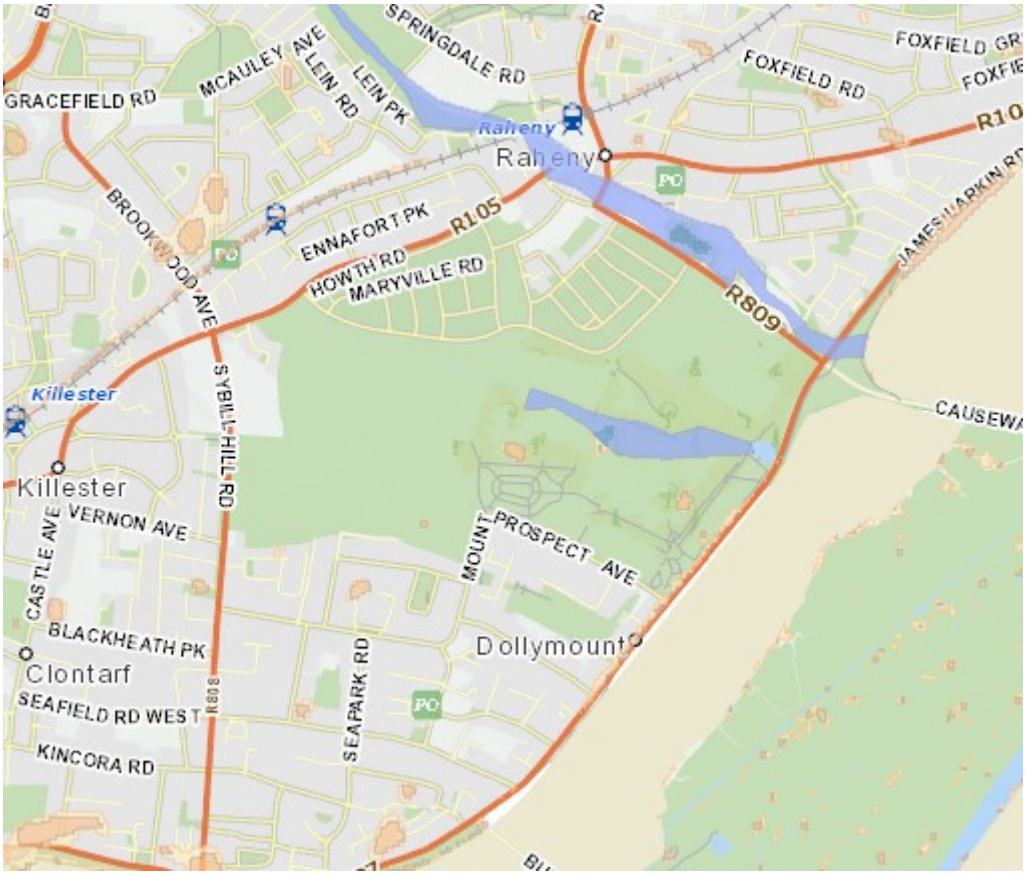


Figure 3: Extract from MyPlan.ie showing extent of fluvial flooding
1.0% AEP fluvial flooding is shown in dark blue
Extreme event fluvial flooding is shown in light blue

4.1.3 The DPFRA maps indicate that the site is not subject to fluvial flood risk.

4.1.4 Based on the above, it is concluded that the site of the proposed development is within Flood Zone C for fluvial flooding, in accordance with *The Planning System and Flood Risk Management Guidelines for Planning Authorities* and there is no significant risk of fluvial flooding.

4.2 Tidal Flooding

4.2.1 The proposed development site is located approximately 1.5km from the nearest tidal source at Dublin Bay. The Naniken Stream estuary is located approximately 1.41km to the east of the site.

4.2.2 The Eastern Catchment Flood Risk Assessment and Management (CFRAM) study is being carried out by the OPW and RPS. The study commenced in June 2011 and was completed at the end of 2016. It assesses the current and future flood extents within the eastern district of the country. The output drawings are shown in ***Appendix D***.

4.2.3 The OPW's *Draft Preliminary Flood Risk Assessment* (March 2012) includes coastal flood risk data. The data is based on the OPW's ongoing *Irish Coastal Protection Strategy Study* (ICPSS). Phase 3 of this Study, which covers the Irish North-east coast (including Dublin City), has been completed – see extracts in ***Appendix C***.

4.2.4 According to these maps the nearest predicted location of a coastal flooding occurrence is at a point inland along Clontarf Road approximately 1.0km south of the subject site.

4.2.5 The ICPSS used a statistical analysis of historic recorded sea levels and numerical modelling to establish design tide levels at selected points along the Irish Coast. The site at St. Pauls College, Sybil Hill Road is nearest to point 22 of the study.

Table 6: Design Tide Levels (m AOD)

Annual Exceedance Probability (AEP)	**0.5%**	**0.1%**
Return Period	**200 years**	**1000 years**
Point 22	**4.07**	**4.28**

The ground levels on the proposed site fall from a high point of approximately 24.90m (Malin) AOD at the north west of the development site to a level of approximately 21.28m AOD along the south eastern corner of St Anne's Park. The site is well above the 0.1% AEP event level at point 22 of 4.28m AOD.

Dublin City Council recommends a minimum floor level of 4.0m AOD to protect development against coastal flooding. The lowest proposed finished floor level is 22.900m AOD, which is well above the 0.1% AEP coastal flood level and recommended minimum floor level.

It is concluded that the site of the proposed development is within Flood Zone C for coastal flooding, in accordance with *The Planning System and Flood Risk Management Guidelines for Planning Authorities*. There is no significant risk of coastal flooding and therefore no mitigation is required.

4.3 Pluvial Flooding

The OPW's *Preliminary Flood Risk Assessment* (August 2011, Draft) includes pluvial flood risk data. Pluvial flooding is overland flow resulting from high intensity rainfall. The data is based on an OPW commissioned project by HR Wallingford. Pluvial flooding resulting in flood depths greater than 200mm for various return periods are indicated on the flood risk maps and are outlined in yellow. The PFRA flood risk map 2019/MAP/238/A, included in ***Appendix B,*** conveys that there is no pluvial flooding evident in close proximity to the subject site for the 1.0% AEP event flooding. It should also be noted that the OPW *www.floodmaps.ie* resource have not identified any reported flooding in this area (refer ***Appendix A***).

These maps along with a walkover of the site and an analysis of the topographical survey were carried out to determine if there was a potential risk to the site from pluvial flooding.

It is apparent that the proposed development site slopes from a level of 24.90m (Malin) down to a level of 21.28m AOD along the southern boundary. Should the proposed drainage infrastructure become overwhelmed in a storm event above the 1% AEP, the excess surface water will drain away from the subject lands as the existing topography suggests.

The existing topography of the site will be changed as part of the development to normalise gradients and accommodate the construction of the residential units and associated infrastructure. However, the natural directions of overland flow will remain unchanged. Overland flows will flow in a south western direction away from the proposed residential buildings to St Anne's Park.

The risk of pluvial flooding of the proposed development is considered negligible and no further mitigation is necessary.

4.4 Existing Drainage

The existing foul and surface water drainage infrastructure which runs along Sybil Hill Road adjacent to the proposed development shows signs of flooding of the system for the 1:30 return period for a short section of the piped network at the head of the run. From here the surface water ultimately flows further south downstream where the pipe network surcharges for 1-2 year return period events. The proposed development includes for attenuation for up to a 1:100 year return period event and limit the discharge rate from the site to pre-development levels which will have a positive effect in alleviating some of the previous over-ground flow during extreme storm events for that catchment area.

The sewer network within the immediate vicinity of the site is a separate network and remains so until it connects to the existing public surface water sewer along Sybil Hill Road.

Details of the proposed connections are shown on OCSC drawing no. ***N251-H01 & H02.***

As outlined previously, should the drainage infrastructure become overwhelmed, any excess surface water run-off will drain away from the site due to the natural fall of the topography of the subject lands. Hence, there is negligible flood risk to the subject site and the proposed development as any sewer flooding would result in overland flow as per the existing site topography. Therefore no further mitigation measures are required.

4.5 Proposed Drainage Infrastructure

There is potential for rainfall run-off from the development to cause flooding within the site. The risk to the development lies in the potential of a drainage system insufficient in capacity to accommodate the design storm rainfall event. The design of the proposed storm drains has been carried out using the *Micro Drainage* Program, which utilises the Modified Rational Method in accordance with EN752. In addition, the design adheres to the hydraulic performance criteria set out in the *Greater Dublin Strategic Drainage Study* and in the *Building Regulations Part H* in order to achieve self-cleansing velocity, minimising the potential for blockages leading to flooding.

A possible flood risk in the receiving drainage arises from the potential for the development to result in an increase in surface water runoff. The proposed drainage system incorporates Sustainable Drainage Systems (SuDs) that will control the discharge rate and reduce the volumetric runoff from the site.

The proposed development is designed to attenuate all surface water run-off from the site via attenuation storage facilities. The surface water run-off will be discharged at a limited rate of 9.6l/s for the combined catchment areas within the site to the Naniken Stream located north of the proposed development. This is as per the existing Naniken Stream storm water catchment. As the existing site provides no attenuation, the proposed development results in a reduction in the risk of flooding, on and off the site, for the rainfall runoff from the subject site.

The proposed attenuation facilities are located to the north east corner of the applicant site with the top water level of the attenuation system maintaining a minimum freeboard of 500mm to the lowest finished floor level within the catchment. Therefore the

risk of the site being flooded from attenuation facilities becoming overwhelmed is minimal.

The flood risks arising from the proposed drainage infrastructure are negligible and no further mitigation is required.

4.6 Groundwater Flooding

The OPW's *Draft Preliminary Flood Risk Assessment* (PFRA) includes an assessment of groundwater flood risk. The PFRA flood risk map included in ***Appendix B*** indicates no groundwater flood risk to the site or to the surrounding area.

According to maps obtained from the *Geological Survey of Ireland*, the subject site is located on made ground subsoil on top of Dinantian Upper Impure Limestone's. It is located on a locally important aquifer with bedrock which is moderately productive only in local zones. The groundwater vulnerability assessment of the site shows that the vulnerability of groundwater in the area is moderate. The sub soil permeability is low. There are no records of any karst features in the locality. Refer to ***Appendix D*** for GSI mapping information.

There is no record or evidence of groundwater flooding for the subject site.

Considering the geology and topography of the subject site, the possibility of groundwater rising above ground levels is considered extremely low. In any such event, water would follow overland flow routes and not collect at proposed buildings.

It is concluded therefore that the flood risk represented by ground water is negligible and no further mitigation is required.

5.0 CONCLUSIONS AND RECOMMENDATIONS

This report identifies the flood risks at the proposed development site adjacent to St. Pauls College, Sybil Hill Road, Dublin 5.

The proposed development is mostly residential in nature and is therefore considered to be a highly vulnerable development, in accordance with *The Planning System and Flood Risk Management Guidelines for Planning Authorities*.

The accompanying maps and drawings show that the site is outside the areas of potential risk for fluvial and coastal flooding. The site is therefore located within Flood Zone C and the proposed development is Appropriate in accordance with *The Planning System and Flood Risk Management Guidelines for Planning Authorities*.

Pluvial flooding and flooding arising from existing drainage infrastructure external to the site will not enter the site due to vertical constraints imposed by the existing and proposed topography. Pluvial flooding and flooding arising from failure of drainage systems within the site will result in overland flow towards the adjacent lands to the immediate south west of the site keeping with the original topography of the area.

As the drainage system is designed in accordance with the relevant standards and regulations, the flood risks arising from the proposed drainage infrastructure will be negligible and no further mitigation is required.

The flood risk represented by ground water is negligible and no further mitigation is required.

APPENDIX A

OPW floodmaps.ie MAP-REPORT

OPW National Flood Hazard Mapping

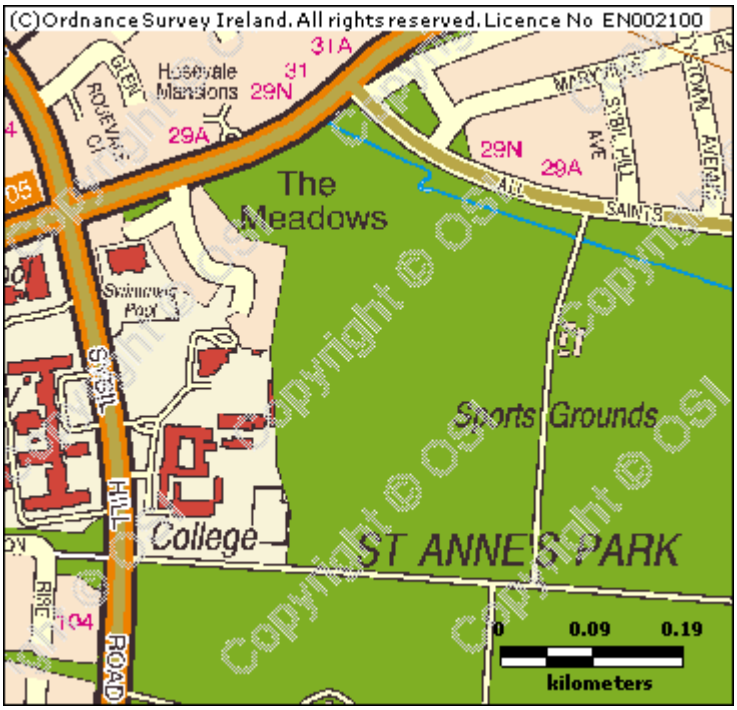
Summary Local Area Report

This Flood Report summarises all flood events within 2.5 kilometres of the map centre.

The map centre is in:

County: Dublin

NGR: O 205 374



Map Scale 1:7,849

Map Legend	
	Flood Points
	Multiple / Recurring Flood Points
	Areas Flooded
	Hydrometric Stations
	Rivers
	Lakes
	River Catchment Areas
	Land Commission *
	Drainage Districts *
	Benefiting Lands *

* Important: These maps do not indicate flood hazard or flood extent. Thier purpose and scope is explained in the Glossary.

17 Results

1. Flooding at Clanmoyle Road, Donnycarney, Dublin 5 on 24th Oct 2011
County: Dublin
Start Date: 24/Oct/2011
Flood Quality Code:3
Additional Information: Reports (1) More Mapped Information

2. Tolka December 1954
County: Dublin
Start Date: 08/Dec/1954
Flood Quality Code:1
Additional Information: Photos (2) Reports (13) Press Archive (9) More Mapped Information

3. Dublin City Tidal Feb 2002
County: Dublin
Start Date: 01/Feb/2002
Flood Quality Code:1
Additional Information: Photos (32) Reports (10) Press Archive (27) More Mapped Information

4. Howth Road Harmonstown June 1963
County: Dublin
Start Date: 11/Jun/1963
Flood Quality Code:3
Additional Information: Reports (3) Press Archive (2) More Mapped Information

5. Donnycarney Wad June 1963
County: Dublin
Start Date: 11/Jun/1963
Flood Quality Code:3

Additional Information: Reports (3) Press Archive (2) More Mapped Information

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6. Dublin Area 020709 — Start Date: 02/Jul/2009

County: Dublin — Flood Quality Code:3

Additional Information: Reports (1) More Mapped Information

7. Clontarf Tidal Flooding October 2004 — Start Date: 27/Oct/2004

County: Dublin — Flood Quality Code:3

Additional Information: Reports (2) More Mapped Information

8. Clontarf Rd Seaview Avenue August 2004 — Start Date: 23/Aug/2004

County: Dublin — Flood Quality Code:3

Additional Information: Reports (3) More Mapped Information

9. Kincora Court Conquer Hill Rd Aug 2004 — Start Date: 23/Aug/2004

County: Dublin — Flood Quality Code:3

Additional Information: Reports (3) More Mapped Information

10. Clontarf Oulton road area August 2004 — Start Date: 23/Aug/2004

County: Dublin — Flood Quality Code:3

Additional Information: Reports (1) More Mapped Information

11. Mount Prospect Ave Clontarf August 2004 — Start Date: 23/Aug/2004

County: Dublin — Flood Quality Code:3

Additional Information: Reports (3) More Mapped Information

12. Vernon Avenue Clontarf Road Aug 2004 — Start Date: 23/Aug/2004

County: Dublin — Flood Quality Code:3

Additional Information: Reports (2) More Mapped Information

13. Clontarf Kincora Park August 2004 — Start Date: 23/Aug/2004

County: Dublin — Flood Quality Code:3

Additional Information: Reports (2) More Mapped Information

14. Vernon Avenue Kincora Road Aug 2004 — Start Date: 23/Aug/2004

County: Dublin — Flood Quality Code:3

Additional Information: Reports (3) More Mapped Information

15. Seapark Drive Seafield Road Aug 2004 — Start Date: 23/Aug/2004

County: Dublin — Flood Quality Code:3

Additional Information: Reports (3) More Mapped Information

16. Naniken River Artane Dec 1954 — Start Date: 08/Dec/1954

County: Dublin — Flood Quality Code:3

Additional Information: Reports (2) More Mapped Information

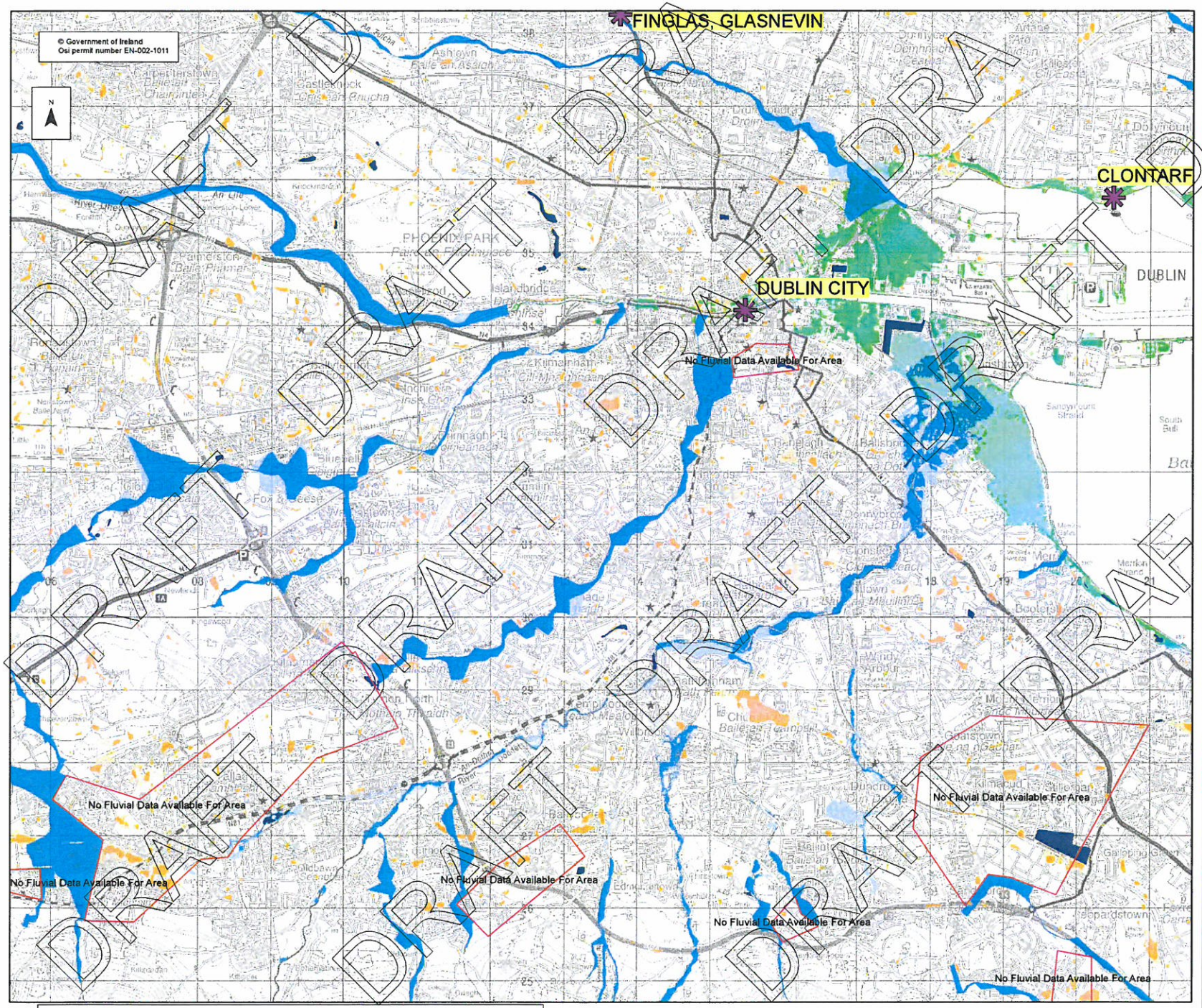
17. Donnycarney Dublin Recurring — Start Date:

County: Dublin — Flood Quality Code:1

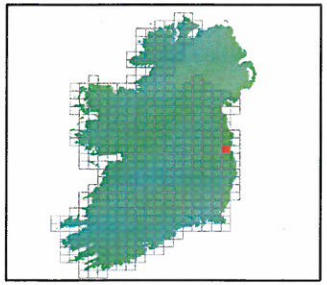
Additional Information: Reports (4) More Mapped Information

Appendix B

OPW Preliminary Flood Risk Assessment Maps



Location Plan :



Legend:

Flood Extents

- Fluvial - Indicative 1% AEP (100-yr) Event
- Fluvial - Extreme Event
- Coastal - Indicative 0.5% AEP (200-yr) Event
- Coastal - Extreme Event
- Pluvial - Indicative 1% AEP (100-yr) Event
- Pluvial - Extreme Event
- Groundwater Flood Extents
- Lakes / Turloughs

PFRA Outcomes

- Probable Area for Further Assesment
- Possible Area for Further Assesment

Important User Note:

The flood extents shown on these maps are based on broad-scale simple analysis and may not be accurate for a specific location. Information on the purpose, development and limitations of these maps is available in the relevant reports (see www.cfram.ie). Users should seek professional advice if they intend to rely on the maps in any way.

If you believe that the maps are inaccurate in some way please forward full details by contacting the OPW (refer to PFRA Information leaflets or 'Have Your Say' on www.cfram.ie).

Office of Public Works
Jonathon Swift Street
Trim
Co Meath
Ireland

OPW

Project :
PRELIMINARY FLOOD RISK ASSESMENT (PFRA)

Map :
PFRA Indicative extents and outcomes
- Draft for Consultation

Figure By :	PJW	Date :	July2011
Checked By :	MA	Date :	July 2011

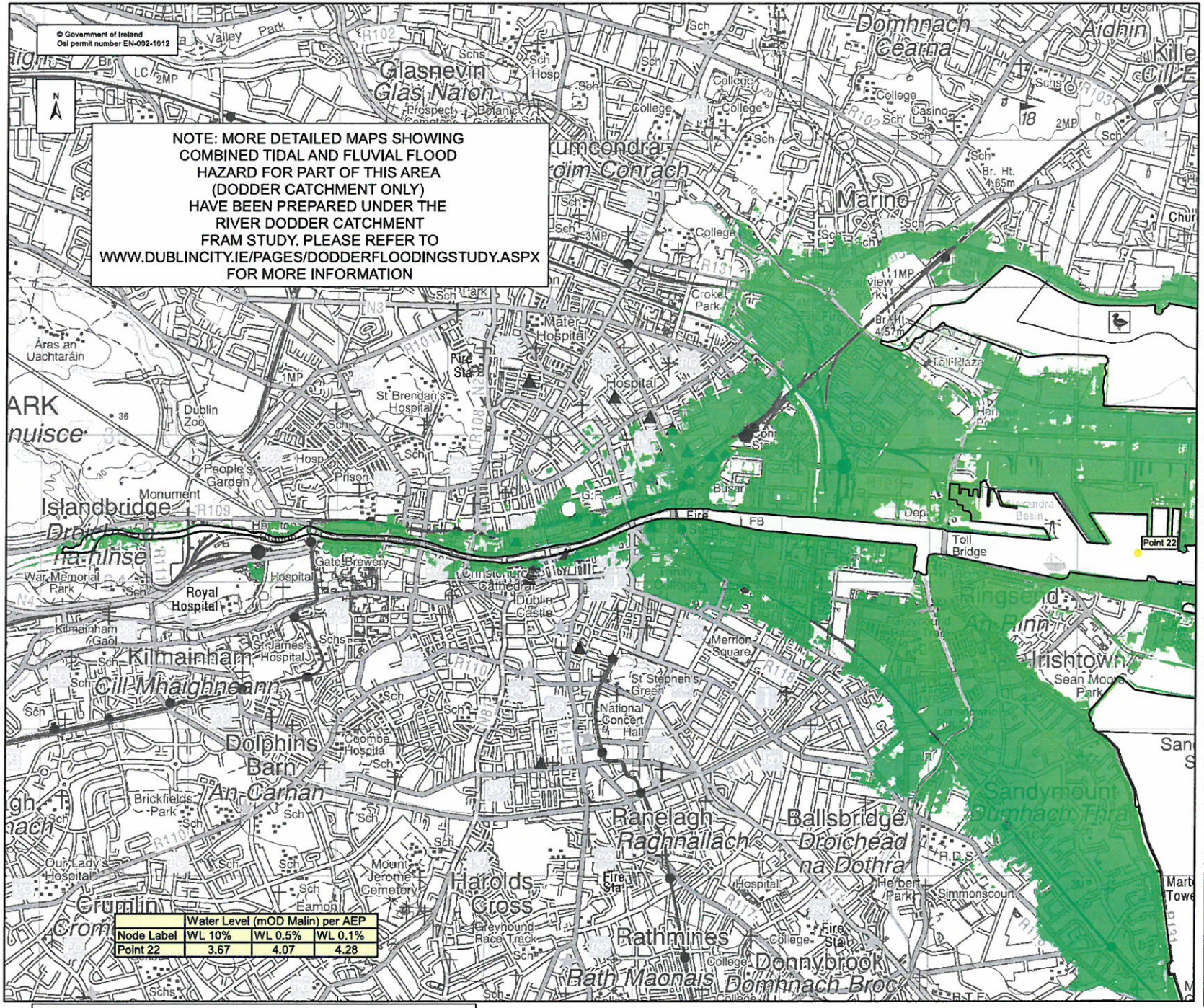
Figure No. 2019 / MAP / 238 / A

Revision 0

Drawing Scale : 1:50,000 Plot Scale : 1:1 @ A3

APPENDIX C

OPW Irish Coastal Protection Strategy Study



Location Plan :

EXTENT MAP

Legend:

- 0.5% AEP FLOOD EXTENT (1 in 200 chance in any given year)
- 0.1% AEP FLOOD EXTENT (1 in 1000 chance in any given year)
- High Water Mark (HWM)
- Node Point
- Point 34 Node Label (refer to table)

USER NOTE :

USERS OF THESE MAPS SHOULD REFER TO THE DETAILED DESCRIPTION OF THEIR DERIVATION, LIMITATIONS IN ACCURACY AND GUIDANCE AND CONDITIONS OF USE PROVIDED AT THE FRONT OF THIS BOUND VOLUME. IF THIS MAP DOES NOT FORM PART OF A BOUND VOLUME, IT SHOULD NOT BE USED FOR ANY PURPOSE.

RPS
Elmwood House
74 Boucher Road
Belfast
BT 12 6RZ
Northern Ireland

OPW
Office of Public Works
17-19 Lower Hatch Street
Dublin 2
Ireland

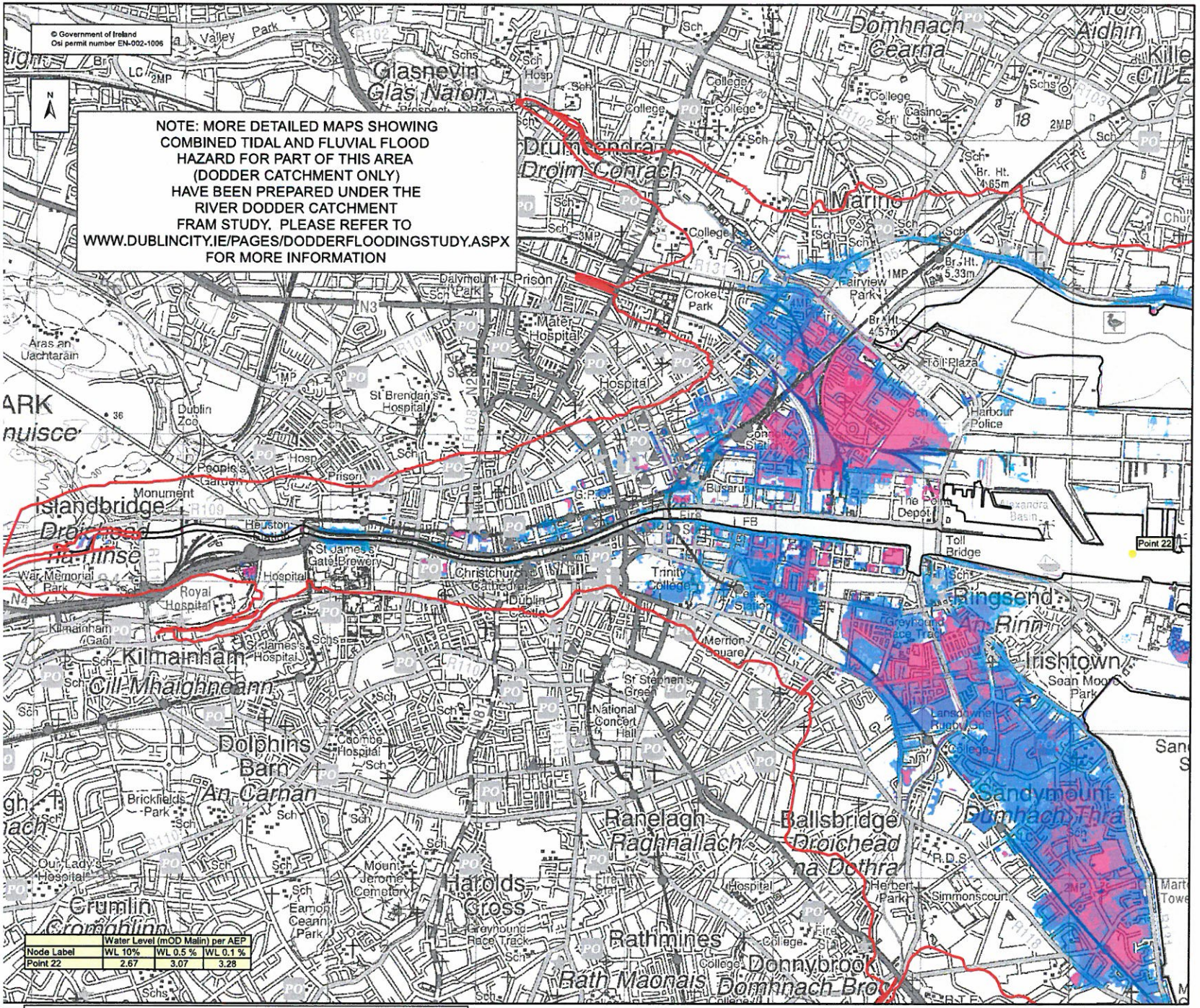
Project :
IRISH COASTAL PROTECTION STRATEGY STUDY - PHASE III

Map :
NORTH EAST COAST FLOOD EXTENT MAP

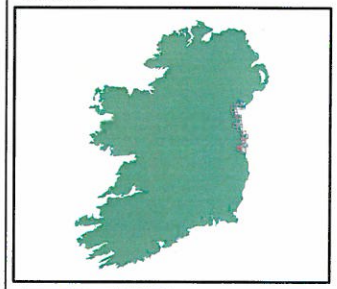
Map Type :	FLOOD EXTENT		
Source :	TIDAL FLOODING		
Map area :	RURAL AREA		
Scenario :	HIGH END FUTURE SCENARIO		
Figure By :	PJW	Date :	Sept 2012
Checked By :	JMC & JR	Date :	Sept 2012

Figure No. : NE / RA / EXT / HEFS / 19
Revision 0

Drawing Scale : 1:25,000 Plot Scale : 1:1 @ A3



Location Plan :



DEPTH MAP 0.5%AEP

Legend:

Depth Grid

- 0 -0.25 m
- 0.25 - 0.50 m
- 0.50 - 1 m
- 1.00 - 1.50 m
- 1.50 - 2.00 m
- > 2.00 m
- Inland DTM Extent
- High Water Mark (HWM)
- Node Point
- Point 34 Node Label (refer to table)

USER NOTE :

USERS OF THESE MAPS SHOULD REFER TO THE DETAILED DESCRIPTION OF THEIR DERIVATION, LIMITATIONS IN ACCURACY AND GUIDANCE AND CONDITIONS OF USE PROVIDED AT THE FRONT OF THIS BOUND VOLUME. IF THIS MAP DOES NOT FORM PART OF A BOUND VOLUME, IT SHOULD NOT BE USED FOR ANY PURPOSE.

RPS
Elmwood House
74 Boucher Road
Belfast
BT 12 6RZ
Northern Ireland

OPW
Office of Public Works
17-19 Lower Hatch Street
Dublin 2
Ireland

Project :
IRISH COASTAL PROTECTION STRATEGY STUDY - PHASE III

Map :
NORTH EAST COAST FLOOD DEPTH MAP

Map Type :	DEPTH		
Return Period	0.5% AEP EVENT		
Source :	TIDAL FLOODING		
Map area :	RURAL AREA		
Scenario :	CURRENT		
Figure By :	PJW	Date : Aug 2009	
Checked By :	JMC	Date : Aug 2009	

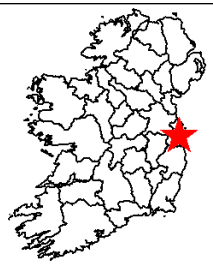
Figure No. : NE / RA / DEP / 19
Revision 1

Drawing Scale : 1:25,000 Plot Scale : 1:1 @ A3

APPENDIX D

GSI Geological Mapping

N251: St. Pauls College



Legend

National Draft Bedrock Aquifer Map

- Rf - Regionally Important Aquifer - Fissured bedrock
- Rk - Regionally Important Aquifer - Karstified
- Rkd - Regionally Important Aquifer - Karstified (diffuse)
- Rkc - Regionally Important Aquifer - Karstified (conduit)
- Lm - Locally Important Aquifer - Bedrock which is Generally Moderately Productive
- Lk - Locally Important Aquifer - Karstified
- Ll - Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones
- Pl - Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones
- Pu - Poor Aquifer - Bedrock which is Generally Unproductive
- Unclassified

Irish National Seabed Survey Zones (50m-5000m)

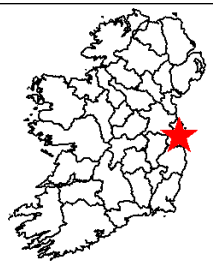
Irish Designated Seabed Zone

Bathymetry

ING:320611, 236868

Scale: 1:10,000

N251: St. Pauls College



Legend

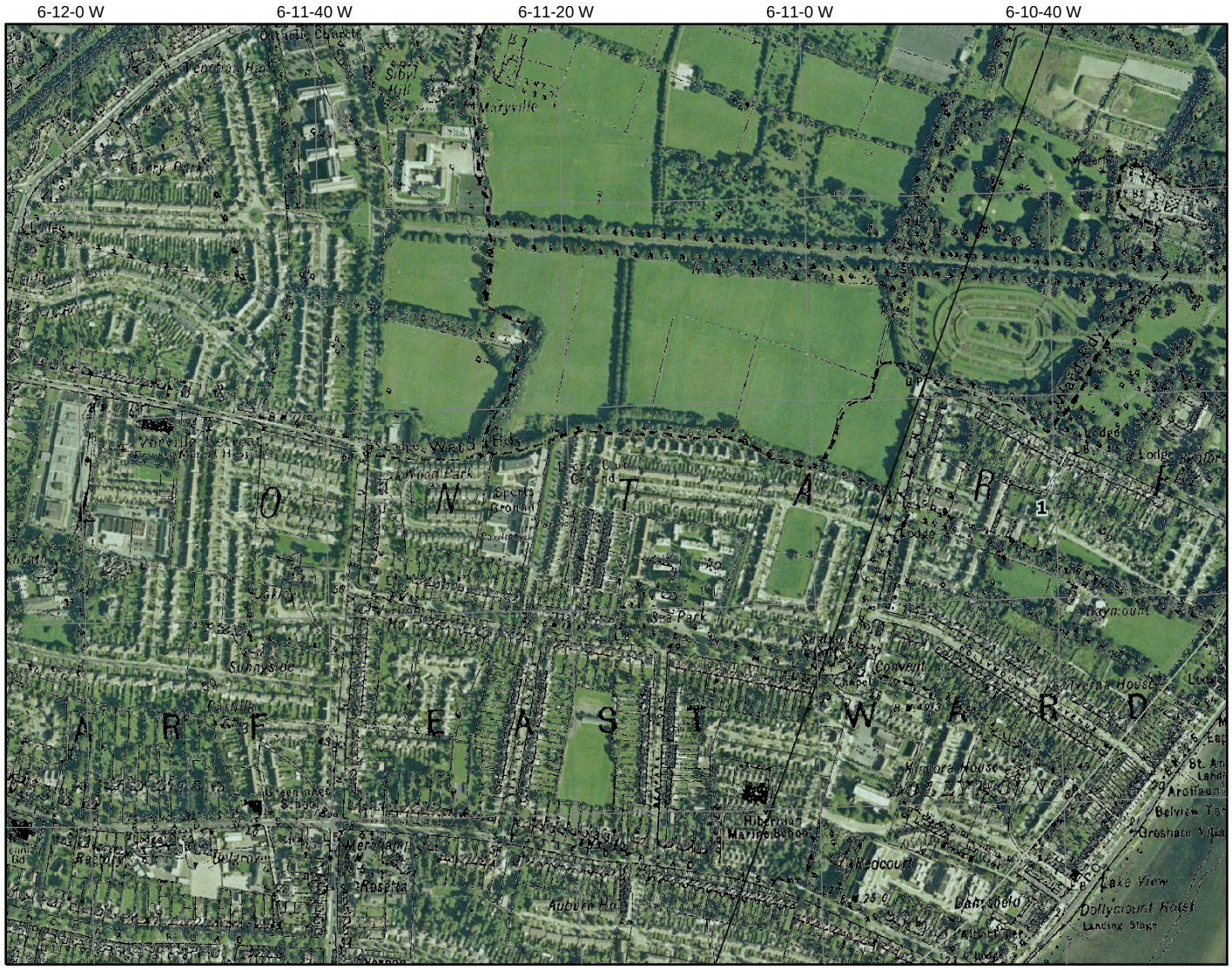
National Draft Generalised Bedrock Map

- BV - Basalts and other Volcanic rocks
- CM - Cambrian Metasediments
- DDL - Dinantian Dolomitised Limestones
- DESSL - Dinantian early Sandstones, Shales and Limestones
- DKS - Devonian Kiltorcan type Sandstones
- DLIL - Dinantian Lower Impure Limestones
- DMSC - Dinantian Mudstones and Sandstones Cork Group
- MSSL - Dinantian Mixed Sandstones, Shales and Limestones
- DORS - Devonian Old Red Sandstones
- DPBL - Dinantian Pure Bedded Limestones
- DPUL - Dinantian Pure Unbedded Limestones
- DS - Dinantian Sandstones
- DSL - Dinantian Shales and Limestones
- DUIL - Dinantian Upper Impure Limestones
- GII - Granites and other Igneous Intrusive rocks
- NSA - Namurian Sandstones
- NSH - Namurian Shales
- NU - Namurian Undifferentiated
- OM - Ordovician Metasediments
- OV - Ordovician Volcanics
- PM - Precambrian Marbles
- PQGS - Precambrian Quartzites, Gneisses and Schists
- PTMG - Permo Triassic Mudstones and Gypsum
- PTS - Permo Triassic Sandstones
- SMV - Silurian Metasediments and Volcanics

Scale: 1:10,000

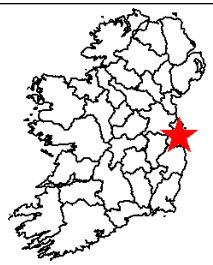
ING:320611, 236868

N251: St. Pauls College



0 300 600 900 m.

ING:320611, 236868



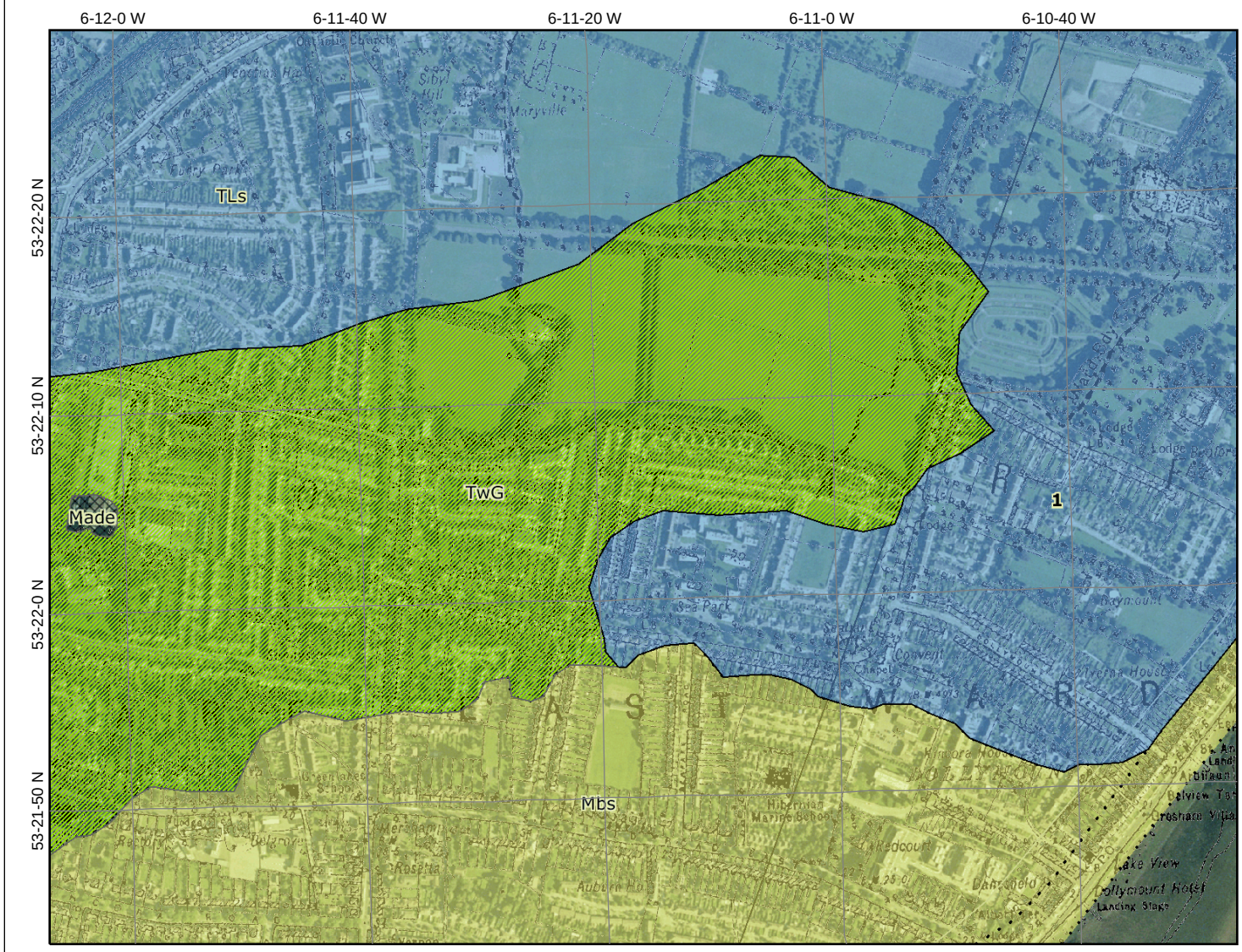
Legend

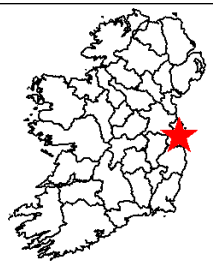
National Draft Gravel Aquifer Map

- Rg - Regionally important, extensive sand/gravels aquifers
- Lg - Locally important, sand/gravel aquifers
- Irish National Seabed Survey Zones (50m-5000m)
- Irish Designated Seabed Zone
- Bathymetry

Scale: 1:10,000

N251: St. Pauls College





Legend

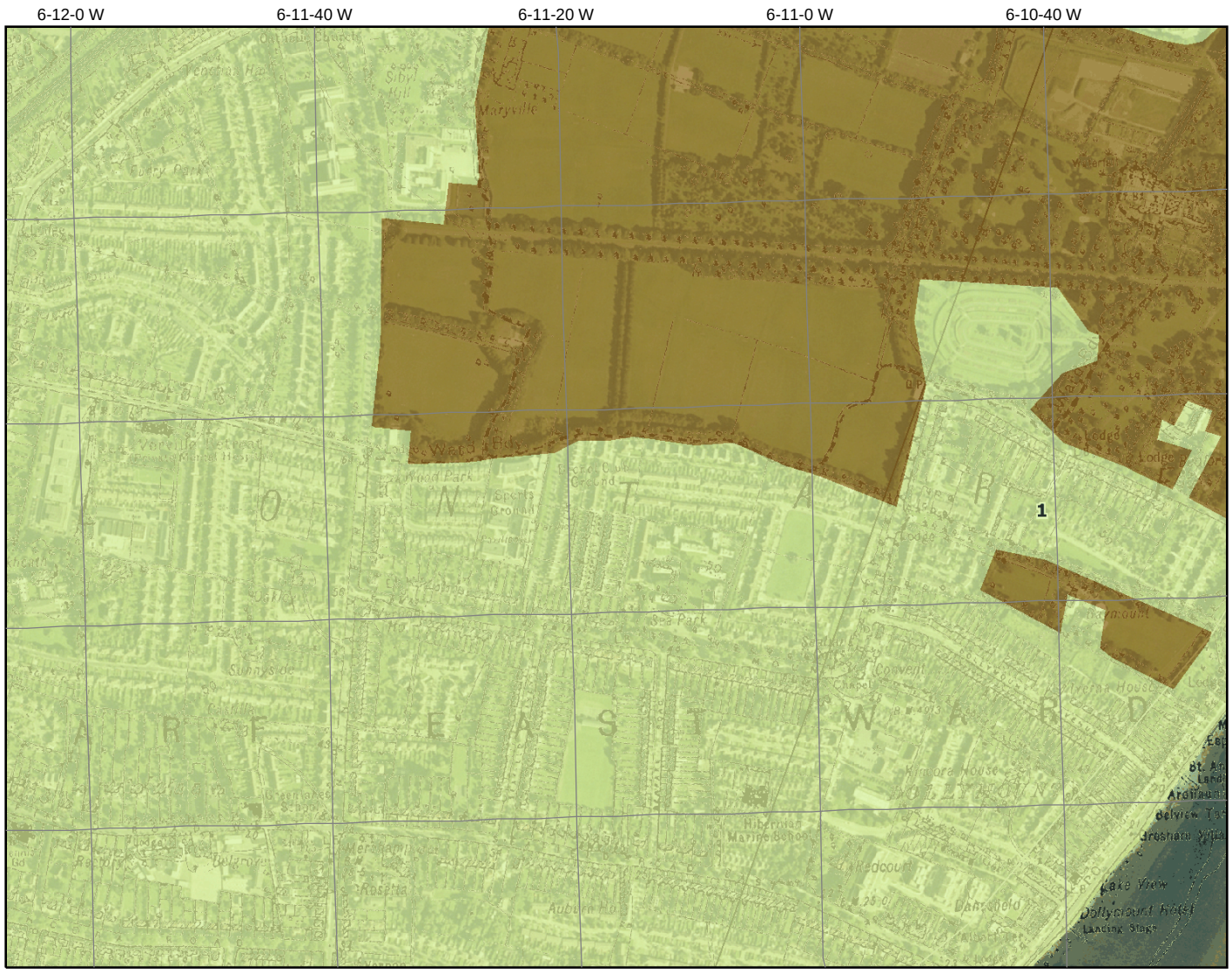
Quaternary

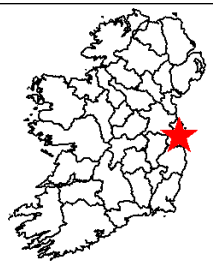
- A
- Ac
- Ag
- As
- Asi
- Clv
- D
- Esk
- G
- GCSsS
- GCh
- GDSs
- GGr
- GLP
- GLPS
- GLPSs
- GLs
- GNSSs
- IrST
- IrSTCSsS
- IrSTLPSs
- IrSTLPSsS
- IrSTLs
- It
- L
- Lake
- Lc
- Lg
- Lough
- Ls
- Lsi
- MEsc
- MGs
- Made
- Mbg
- Mbs
- Mas

Scale: 1:10,000

ING:320611, 236868

N251: St. Pauls College





Legend

National Groundwater Recharge Data

- 0
- 1-50
- 51-100
- 101-150
- 151-200
- 201-250
- 251-300
- 301-350
- 351-400
- 401-450
- 451-500
- 501-550
- 551-600
- 601-700
- 701-800
- 801-900
- 901-1000
- 1001-1400
- 1401-2000
- Water

Irish National Seabed Survey Zones (50m-5000m)

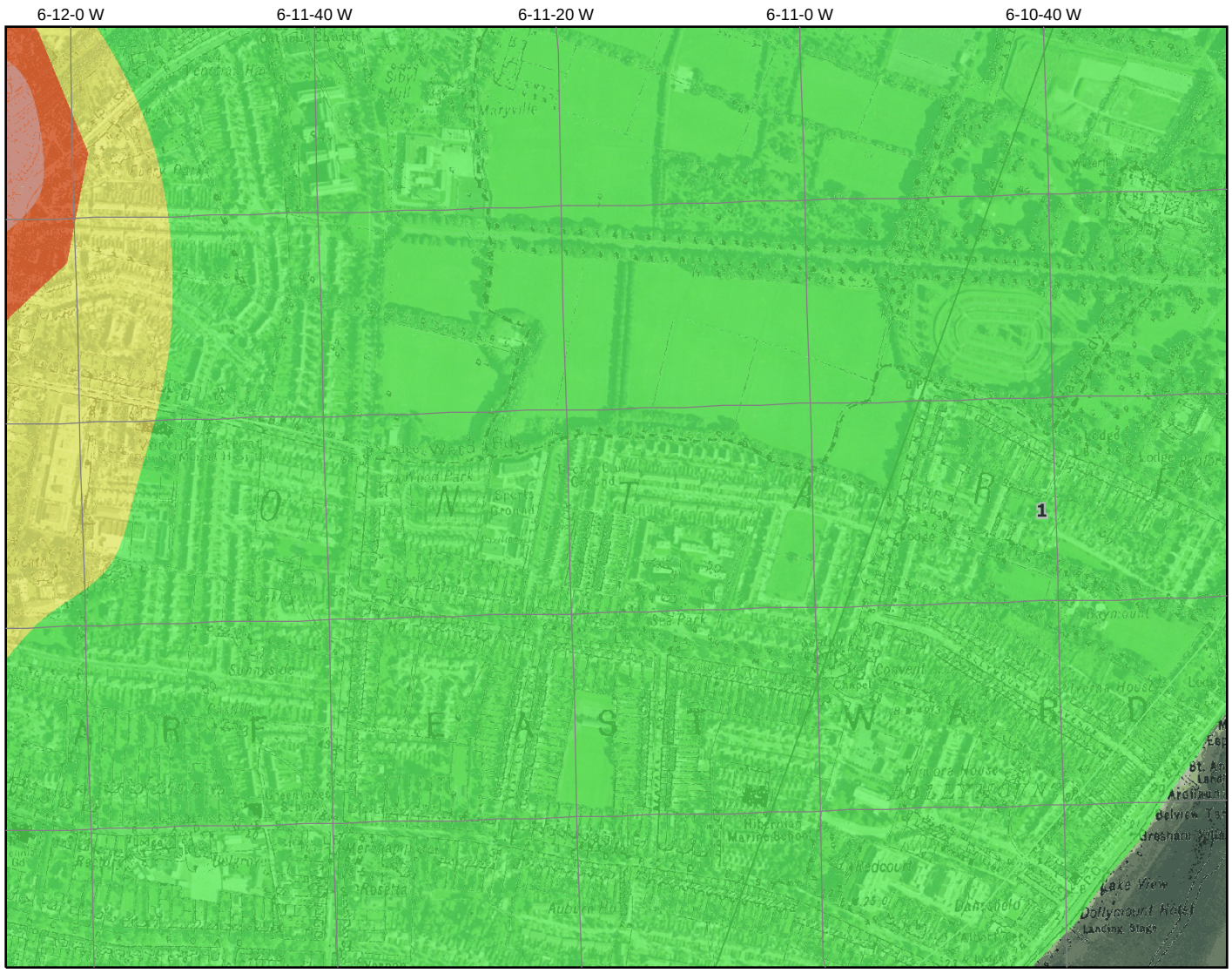
Irish Designated Seabed Zone

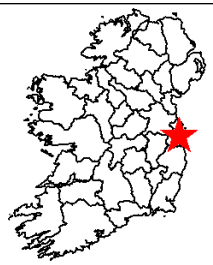
Bathymetry

ING:320611, 236868

Scale: 1:10,000

N251: St. Pauls College





Legend

Vulnerability

- X (Rock near Surface or Karst)
- E - Extreme
- H - High
- M - Moderate
- L - Low
- Water

Irish National Seabed Survey Zones (50m-5000m)

Irish Designated Seabed Zone

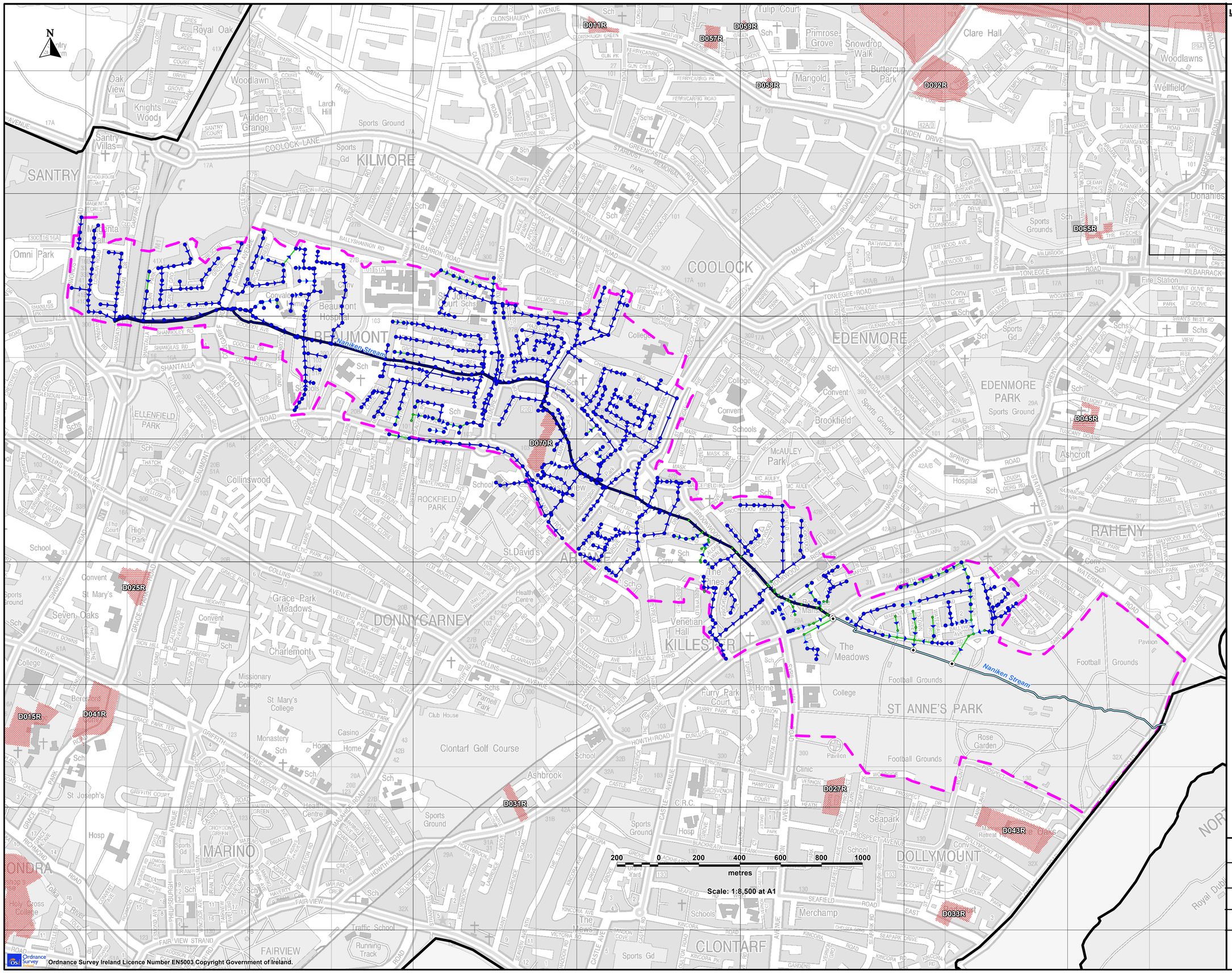
Bathymetry

Scale: 1:10,000

ING:320611, 236868

APPENDIX E

GDSDS Drainage Performance Assessment Drawings



Legend

- Wastewater Treatment Works
- County Council Boundary
- Catchment Boundary
- Rising Main (Coloured as sewer)
- Sewer not included in hydraulic model
- Direction of Flow (on sewer line)
- River/Watercourse
- Culverted River/Watercourse
- 1:1000 OS Grid Line Boundaries
- 1:5000 OS Grid Line Boundaries

- Storm Water Overflow to Foul/Combined
- Storm Water Pumping Station
- Storm Water Bifurcation
- Storm Water Apex Manhole
- Storm Water Flow Management Chamber

- Outfall
- Inlet

Flooding Performance Key

- Flooding greater than 25m3 Volume for 5yr Return Period Event (Volume m3)
- Flooding less than 25m3 Volume for 5yr Return Period Event
- Modelled Manhole does not flood for 5 year Return Period Event
- All Historically Reported Flooding Incidents caused by Hydraulic Overloading

Storm System Hydraulic Performance Key

- Storm Sewer surcharges for 1 or 2 year return period events
- Storm Sewer floods for 30 year return period or less.
- Storm Sewer does not surcharge for 1or 2 year return period events and does not flood for a 30 year return period event or below. (eg 1,2,5,10,20)

Important Hydraulic Considerations

- Location of Known Basements
- Assumed Location of Basements

- Zoned Residential Land
- Zoned Science / Technology Parks / Land
- Zoned Industrial Land
- Zoned Commercial Land
- Zoned Land for Mixed Development
- Recently Completed Developments

Structural Condition Assessment (Previously Reported/Graded Defects)

- Structural Condition - Grade 5
- Structural Condition - Grade 4

Catchment Deficiency Reference Key

HP 1	Hydraulic Deficiency Reference No.
SCD 1	Structural Deficiency Reference No.
CSO 1	CSO Deficiency Reference No. (Hydraulic or Environmental)
OP 1	Operational Deficiency Reference No.
GEN 1	General Deficiency Reference No.

Notes.

1. Levels referenced in meters to Ordnance Survey Datum, which is Mean Sea Level at Malin Head, Co. Donegal (1970 Adjustment).
2. All dimensions given in metric units.

GREATER DUBLIN STRATEGIC DRAINAGE STUDY

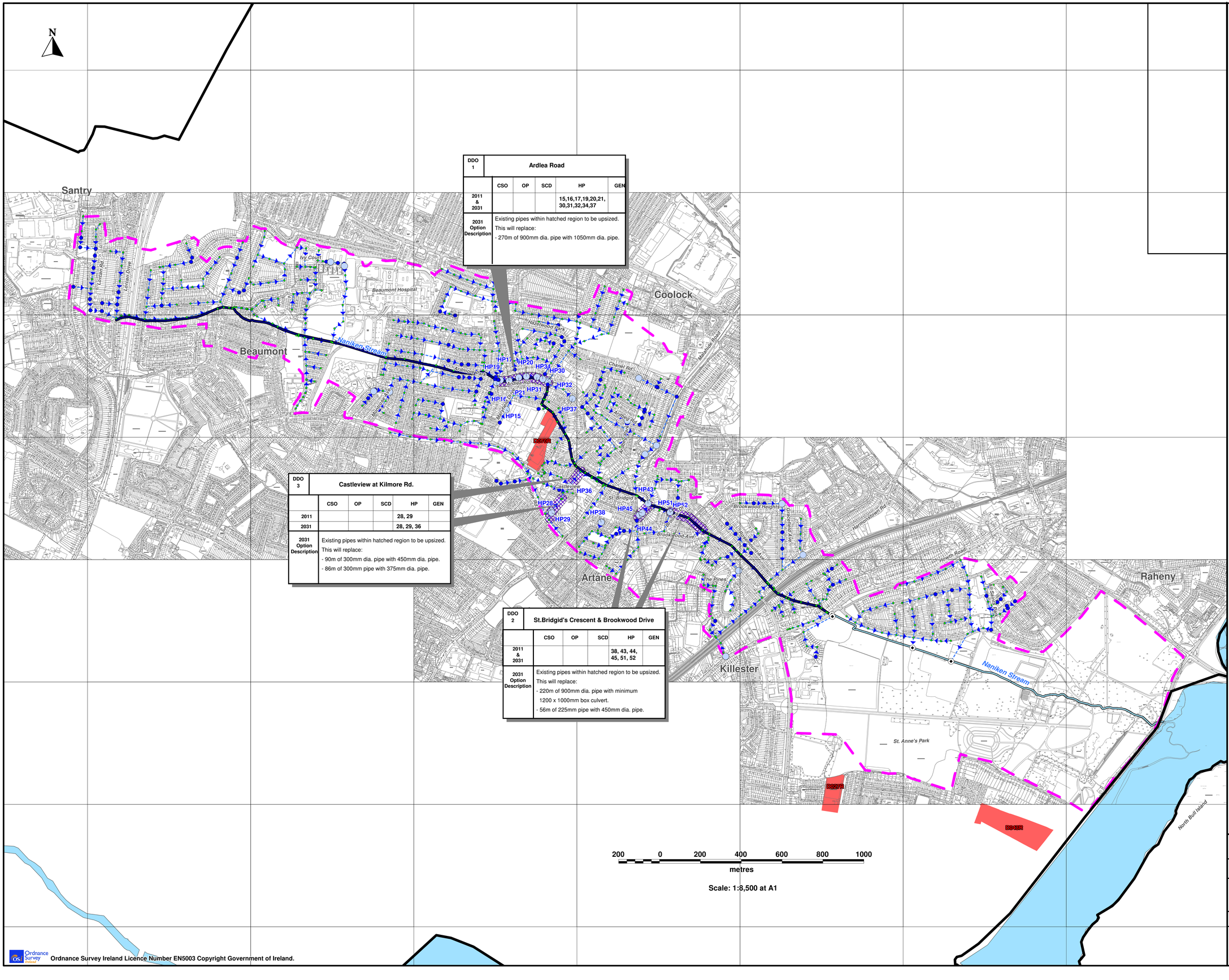
S2012 Naniken - Storm Level 2

Phase 2
Overview Existing Hydraulic Performance

GDSDS / S2012 / P2 - 006

Dublin Drainage
A Strategic Study For Greater Dublin

Drawn	HS	Chk'd	RL
Approved	RL		
Scale	1 : 8,500 at A1		
Date	24.11. 2003	Revision	D01



DDO 1	Ardlea Road				
	CSO	OP	SCD	HP	GEN
2011 & 2031				15,16,17,19,20,21, 30,31,32,34,37	
2031 Option Description	Existing pipes within hatched region to be upsized. This will replace: - 270m of 900mm dia. pipe with 1050mm dia. pipe.				

DDO 3	Castleview at Kilmore Rd.				
	CSO	OP	SCD	HP	GEN
2011				28, 29	
2031				28, 29, 36	
2031 Option Description	Existing pipes within hatched region to be upsized. This will replace: - 90m of 300mm dia. pipe with 450mm dia. pipe. - 86m of 300mm pipe with 375mm dia. pipe.				

DDO 2	St.Bridgid's Crescent & Brookwood Drive				
	CSO	OP	SCD	HP	GEN
2011 & 2031				38, 43, 44, 45, 51, 52	
2031 Option Description	Existing pipes within hatched region to be upsized. This will replace: - 220m of 900mm dia. pipe with minimum 1200 x 1000mm box culvert. - 56m of 225mm pipe with 450mm dia. pipe.				

200 0 200 400 600 800 1000

metres

Scale: 1:8,500 at A1

Legend

- Wastewater Treatment Works
- County Council Boundaries
- Catchment Boundary
- Foul Sewer
- Combined Sewer
- Storm Sewer
- Rising Main (Coloured as sewer)
- Direction of Flow (on sewer line)
- River/Watercourse
- Culverted River/Watercourse
- Inverted Syphon (Coloured as Sewer)
- 1:1000 OS Grid Line Boundaries
- 1:5000 OS Grid Line Boundaries
- Combined Sewer Overflow
- Foul/Combined Pumping Station
- Foul/Combined Bifurcation
- Foul/Combined Apex Manhole
- Foul/Combined Flow Management Chamber
- Storm Water Overflow to Foul/Combined
- Storm Water Pumping Station
- Storm Water Bifurcation
- Storm Water Apex Manhole
- Storm Water Flow Management Chamber
- Outfall
- Inlet
- All Historically Reported Flooding Incidents caused by Hydraulic Overloading

Development Key

- 2011 Zoned Residential Land
- 2011 Zoned Science/Technology Parks/Land
- 2011 Zoned Industrial Land
- 2011 Zoned Commercial Land
- 2011 Zoned Land for Mixed Development
- Recently Completed Developments
- 2031 Development Connection Point

Catchment Deficiency Reference Key

HP 1	Hydraulic Deficiency Reference No.
SCD 1	Structural Deficiency Reference No.
CSO 1	CSO Deficiency Reference No. (Hydraulic or Environmental)
OP 1	Operational Deficiency Reference No.
GEN 1	General Deficiency Reference No.

Options Key

- 2011 Option Location
- 2031 Option Location

Option Detail Box Key

DDO Ref	Area Name / Package Number				
	CSO	OP	SCD	HP	GEN
2011					
2031					
2011 Option Description	Deficiency Reference				
2031 Option Description					

Notes.

1. Levels referenced in metres to Ordnance Survey Datum, which is Mean Sea Level at Malin Head, Co. Donegal (1970 Adjustment).
2. All dimensions given in metric units.
3. All Options were developed for the most extreme scenario, i.e. 2031

GREATER DUBLIN STRATEGIC DRAINAGE STUDY

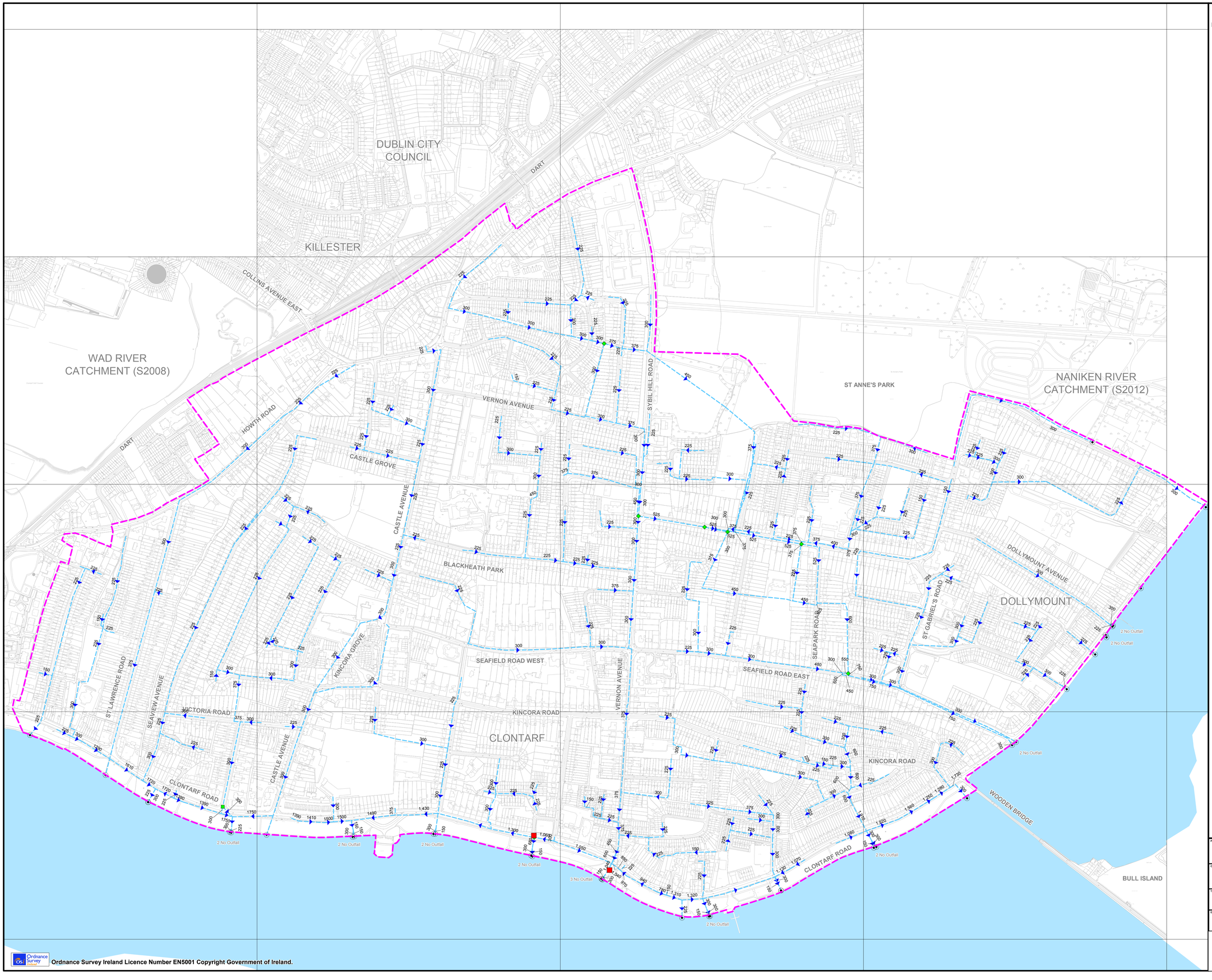
S2012 NANIKEN - STORM LEVEL 2

Phase 3
Preferred Options Summary

GDSDS / S2012 / P3 - 004

Dublin Drainage
A Strategic Study for Greater Dublin

Drawn	HS	Chk'd	EC
Approved	JF		
Scale	1 : 8,500 at A1	REVISION	D01
Date	18.03. 2004		



Legend

- Wastewater Treatment Works
- County Council Boundaries
- Catchment Boundary
- Foul Sewer (size mm)
- Combined Sewer (size mm)
- Storm Sewer (size mm)
- Rising Main (Coloured as sewer)
- Direction of Flow (on sewer line)
- River/Watercourse
- Culverted River/Watercourse
- Inverted Syphon (Coloured as Sewer)
- 1:1000 OS Grid Line Boundaries
- Combined Sewer Overflow
- Foul/Combined Pumping Station
- Foul/Combined Bifurcation
- Foul/Combined Apex Manhole
- Foul/Combined Flow Management Chamber
- Storm Water Overflow to Foul/Combined
- Storm Water Pumping Station
- Storm Water Bifurcation
- Storm Water Apex Manhole
- Storm Water Flow Management Chamber
- Unknown Type of Ancillary Structure
- All Historically Reported Flooding Incidents caused by Hydraulic Overloading
- Outfall
- Inlet

Notes.

1. Levels referenced in meters to Ordnance Survey Datum, which is Mean Sea Level at Malin Head, Co. Donegal (1970 Adjustment).
2. All dimensions given in metric units.

Project: GREATER DUBLIN STRATEGIC DRAINAGE STUDY

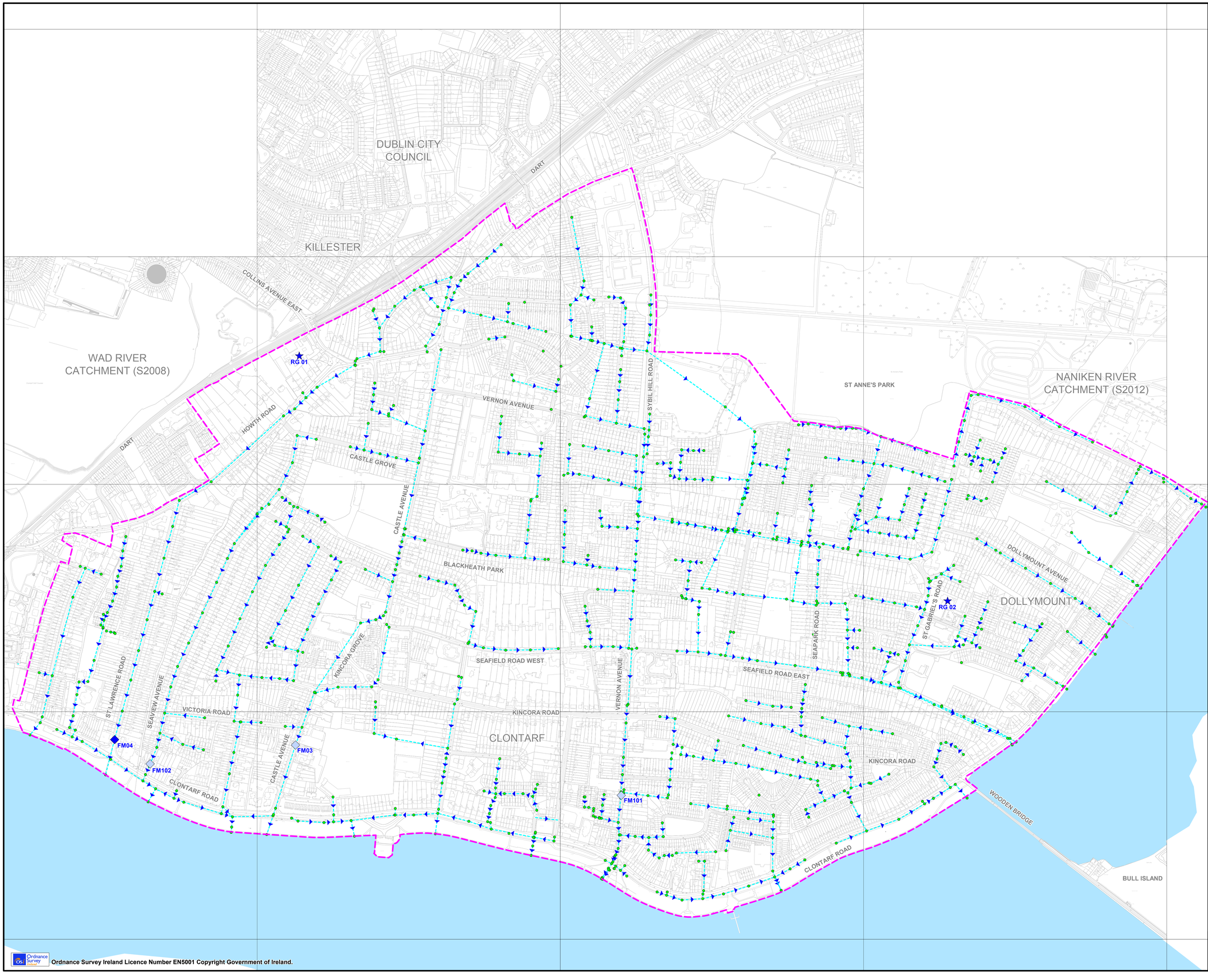
Catchment: CLONTARF CATCHMENT

Title: PHASE 2 - Catchment Schematic

Drg. No.: GDSDS/MAR3079/S2015/P2-001

Dublin Drainage — A Strategic Study for Fingal + Dublin

Drawn	KR	Chk'd	MCB
Approved	MCB		
Scale	N.T.S.	REVISION	B
Date	11.03.04		



Legend

- Wastewater Treatment Works
- County Council Boundaries
- Catchment Boundary
- Foul Sewer (size mm)
- Combined Sewer (size mm)
- Storm Sewer (size mm)
- Rising Main (Coloured as sewer)
- Direction of Flow (on sewer line)
- River/Watercourse
- Culverted River/Watercourse
- Inverted Syphon (Coloured as Sewer)
- 1:1000 OS Grid Line Boundaries

Asset Survey Key

- Existing Manhole Not Surveyed
- Full Survey Completed
- Unable to Survey - Surcharged
- Unable to Survey - Other
- Unable to Locate
- Unable to Raise
- Unable to Gain Access
- Data Digitised - Not Surveyed

Structural Condition Assessment (Previously Reported/Graded Defects)

- Structural Condition - Grade 5
- Structural Condition - Grade 4
- SCD 1 — Structural Deficiency Reference No.
- New CCTV Survey Length (GDSDS)

Flow and Rainfall Survey Key

- ADS Flow Monitor Location (& Ref.)
- Standard Flow Monitor (& Ref.)
- Rain Gauge Location (& Ref.)
- Depth Gauge Location (& Ref.)
- Permanent Flow Monitor Location (& Ref.)

Notes.

1. Levels referenced in meters to Ordnance Survey Datum, which is Mean Sea Level at Malin Head, Co. Donegal (1970 Adjustment).
2. All dimensions given in metric units.
3. SUS25 Data from draft EDS survey data.

Project: GREATER DUBLIN STRATEGIC DRAINAGE STUDY

Catchment: CLONTARF CATCHMENT

Title: PHASE 2 - Surveys Undertaken

Dtg. No.: GDSDS/MAR3079/S2015/P2-002

Dublin Drainage
A Strategic Study for Greater Dublin

Drawn	KR	Chk'd	MCB
Approved	MCB		
Scale	N.T.S.	REVISION	B
Date	11.03.04		

DUBLIN CITY COUNCIL

KILLESTER

DART

COLLINS AVENUE EAST

WAD RIVER CATCHMENT (S2008)

HOWTH ROAD

DART

D031R

D016R

VERNON AVENUE

CASTLE GROVE

CASTLE AVENUE

SYBIL HILL ROAD

ST ANNE'S PARK

NANIKEN RIVER CATCHMENT (S2012)

D027R

D043R

D033R

DOLLYMOUNT AVENUE

DOLLYMOUNT

ST GABRIEL'S ROAD

SEAPARK ROAD

BLACKHEATH PARK

KINCORA GROVE

SEAFIELD ROAD WEST

SEAFIELD ROAD EAST

VERNON AVENUE

ST LAWRENCE ROAD

SEAVIEW AVENUE

VICTORIA ROAD

KINCORA ROAD

CASTLE AVENUE

CLONTARF

CLONTARF ROAD

KINCORA ROAD

WOODEN BRIDGE

BULL ISLAND

2 No Outfall

3 No Outfall

Legend

- Wastewater Treatment Works
- County Council Boundaries
- Catchment Boundary
- Foul Sewer (size mm)
- Combined Sewer (size mm)
- Storm Sewer (size mm)
- Rising Main (Coloured as sewer)
- Direction of Flow (on sewer line)
- River/Watercourse
- Culverted River/Watercourse
- Inverted Syphon (Coloured as Sewer)
- 1:1000 OS Grid Line Boundaries
- Combined Sewer Overflow
- Foul/Combined Pumping Station
- Foul/Combined Bifurcation
- Foul/Combined Apex Manhole
- Foul/Combined Flow Management Chamber
- Storm Water Overflow to Foul/Combined
- Storm Water Pumping Station
- Storm Water Bifurcation
- Storm Water Apex Manhole
- Storm Water Flow Management Chamber
- Unknown Type of Ancillary Structure
- Zoned Residential Land
- Zoned Science/Technology Parks/Land
- Zoned Industrial Land
- Zoned Commercial Land
- Zoned Land for Mixed Development
- Recently Completed Developments

Project: GREATER DUBLIN STRATEGIC DRAINAGE STUDY

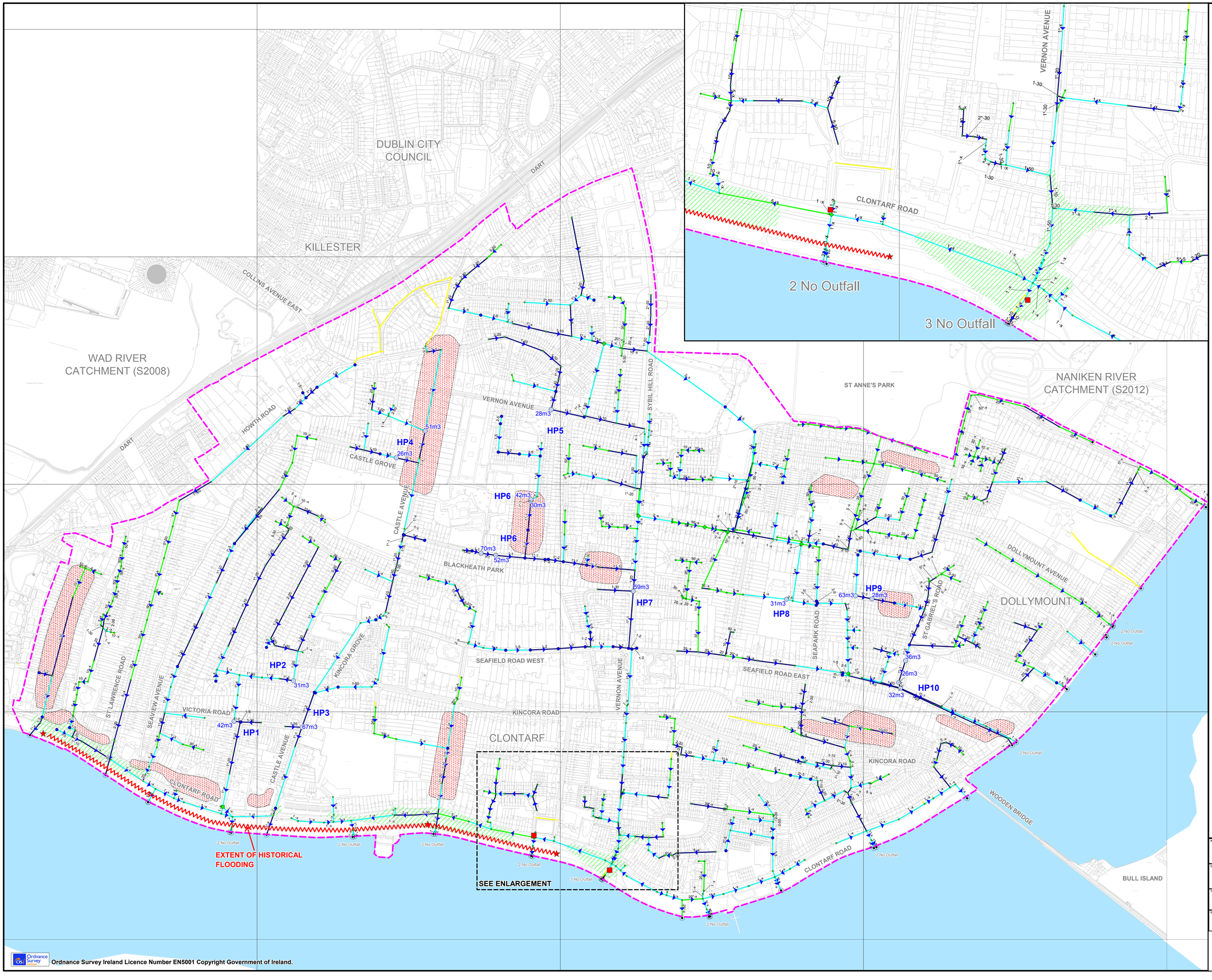
Catchment: CLONTARF CATCHMENT

Title: PHASE 2 - Zoned Development Land

Dig. No.: GDSDS/MAR3079/S2015/P2-003

Dublin Drainage
A Strategic Study for Greater Dublin

Drawn	KR	Chk'd	MCB
Approved	MCB		
Scale	N.T.S.	REVISION	B
Date	11.03.04		



Legend

- Wastewater Treatment Works
- County Council Boundaries
- Catchment Boundaries
- Rising Main (Coloured as sewer)
- Sewer not included in hydraulic model
- Direction of Flow (on sewer line)
- River/Watercourse
- Culverted River/Watercourse
- 1:1000 OS Grid Line Boundaries

- Combined Sewer Overflow
- Foul/Combined Pumping Station
- Foul/Combined Bifurcation
- Foul/Combined Apex Manhole
- Foul/Combined Flow Management Chamber
- Storm Water Overflow to Foul/Combined
- Storm Water Pumping Station
- Storm Water Bifurcation
- Storm Water Apex Manhole
- Storm Water Flow Management Chamber

Flooding Performance Key

- Flooding greater than 25m3 Volume for 5yr Return Period Event (Volume m3)
- Flooding less than 25m3 Volume for 5yr Return Period Event
- Modelled Manhole does not flood for 5 year Return Period Event
- All Historically Reported Flooding Incidents caused by Hydraulic Overloading

- Outfall
- Inlet

Storm System Hydraulic Performance Key

- x-x — Label for sewers showing (return period of surcharge (yrs) - return period of flooding (yrs)) Results based on constant tide level of 1.5m for 1-50 year storms and constant tide level of 1.7m for 100 year storms.
- 5-20 — Storm Sewer floods for 30 year return period or less.
- 2-50 — Storm Sewer surcharges for 1 or 2 year return period events
- 10-50 — Storm Sewer does not surcharge for 1or 2 year return period events and does not flood for a 30 year return period event or below. (eg 1,2,5,10,20)
- Area of predicted flooding for 2 year return period storm and tide of 2.7 m (HAT)

Important Hydraulic Considerations

- Location of Known Basements
- Assumed Location of Basements

Structural Condition Assessment (Previously Reported/Graded Defects)

- Structural Condition - Grade 5
- Structural Condition - Grade 4

Catchment Deficiency Reference Key

HP 1	Hydraulic Deficiency Reference No.
SCD 1	Structural Deficiency Reference No.
CSO 1	CSO Deficiency Reference No. (Hydraulic or Environmental)
OP 1	Operational Deficiency Reference No.
GEN 1	General Deficiency Reference No.

Notes

1. Results are based on assessment of sewer system under 1, 2, 5, 10, 20, 30, 50 and 100 year return period rainfall events.
2. For colour coding, flooding takes priority over surcharging.
3. Where pipe is not predicted to surcharge or flood for the return periods analysed, the pipe has not been labeled.
4. Levels referenced in meters to Ordnance Survey Datum, which is Mean Sea Level at Malin Head, Co. Donegal (1970 Adjustment).
5. All dimensions given in metric units.

Project: GREATER DUBLIN STRATEGIC DRAINAGE STUDY

Catchment: CLONTARF CATCHMENT

Title: PHASE 2 - Existing Hydraulic Performance

Dig. No.: GDSDS/MAR3079/S2015/P2-005

Dublin Drainage — A Strategic Study for Greater Dublin

Drawn	KR	Chk'd	MCB
Approved	MCB		
Scale	N.T.S.	REVISION	B
Date	11.03.04		