KILGALLEN & PARTNERS
CONSULTING ENGINEERS

Pinnacle Consulting Engineers Ltd.

Proposed Industrial Development, Profile Park, Grangecastle, Co. Dublin

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Report on Site-Specific Flood Risk Assessment

Pinnacle Consulting Engineers Ltd.	**Document Ref. No.**	**Kilgallen & Partners Consulting Engineers Well Road, Portlaoise Co. Laois**
	21054-R-SSFRA Issue PL1	

REVISION HISTORY

Client	Pinnacle Consulting Engineers Ltd.
Project	Proposed Industrial Development, Profile Park, Grangecastle, Co. Dublin
Title	Report on Site-Specific Flood Risk Assessment

Date	Detail of Issue	Issue No.	Origin	Checked	Approved
13.08.21	Initial issue	PL1	CP	PB	PB

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1. INTRODUCTION

Pinnacle Consulting Engineers Ltd. ['the Applicant'] intends to apply to South Dublin County Council for planning permission for an industrial development ['the proposed Development'] on an 8.72 hectare site at Profile Park, Grangecastle ['the Site'].

The Applicant has appointed Kilgallen and Partners Consulting Engineers to carry out a Site-Specific Flood Risk Assessment ['SSFRA'] for the proposed development in accordance with the 'Planning System and Flood Risk Management – Guidelines for Planning Authorities' ['the Guidelines'].

This report presents the findings of that SSFRA.

2. PROCESS FOR SITE-SPECIFIC FLOOD RISK ASSESSMENT

The initial stage of the SSFRA comprises an assessment of available flood risk data to identify flood risk indicators in the Study Area. If the Site is identified to be at risk of flooding, the SSFRA will proceed to a detailed assessment.

2.1 Potential Sources of Flood Risk

Potential flood risk mechanisms are summarised in Table 2-1.

Source	Mechanism
Fluvial:	Overtopping of Rivers and Streams
Pluvial:	The intensity of rainfall events is such that the ground cannot absorb rainfall run-off effectively or urban drainage systems cannot carry the run-off generated.
Groundwater:	Rising water table
Coastal:	Tidal levels and / or wave action
Infrastructure	Failure of flood protection or drainage infrastructure

Table 2-1 Flood Risk Mechanisms

As an inland site upstream of tidal influences and possible wave action, the Site is not subject to coastal flood risk and so this mechanism does not need to be considered further in this assessment.

The assessment will therefore consider the following mechanisms:

- Fluvial;
- Pluvial;
- Groundwater;
- Drainage Infrastructure *(considered under Section 9 – Residual Flood Risk)*

2.2 Flood Risk Indicators

Indicators of flood risk are identified using available data, most of which is historically derived. Typically, this data is not prescriptive in relation to flood return periods and neither predictive nor inclusive of climate change analysis.

Flood risk indicators include:

- Records available on the OPW's National Flood Risk Website. As part of the National Flood Risk Management Policy, the OPW developed the www.floodinfo.ie web-based data set, which contains information concerning historical flood data and displays related mapped information and provides tools to search for and display information about selected flood events;

- PFRA & CFRAM mapping produced under the CFRAM programme;
- The Strategic Flood Risk Assessment carried out to inform the making of the Local Area Plan;
- Geological Survey of Ireland (GSI) mapping - Hydrogeological mapping maintained by the GSI and made available through its website www.gsi.ie;
- Ordnance Survey mapping - Ordnance Survey maps include areas which are marked as being "Liable to Floods". Generally, these areas are only shown identified indicatively and suggest historical flooding, usually recurrent. In addition, the maps indicate areas of wet or hummocky ground, bog, marsh, springs, rises and wells as well as surface water features including rivers, streams, bridges, weirs and dams;
- Topographical survey information;
- Records of previous floods from other sources;
- Flood Studies, Reports and Flood Relief Schemes carried out in the vicinity of the Study Area;
- Site Walkover.

2.3 Identification of the Presence and Extent of Fluvial Flood Risk

Where the initial process of examining flood risk indicators demonstrates the existence of a risk of fluvial flooding, the study progresses to the next stage, which is a detailed flood risk assessment. This is based on field measurements and hydrological modelling and enables mapping of the zones of Flood Risk within the Site to be established.

In accordance with the Guidelines, flood risk zones are categorized as follows:

Flood Zone A where the probability of flooding in any year is greater than 1% (i.e. Flood Zone in respect of a flood with a return period of 100years);

Flood Zone B where the probability of flooding in any year is between 0.1% and 1% (i.e. Flood Zone in respect of a flood with a return period of between 100years and 1,000years);

Flood Zone C where the probability of flooding in any year is less than 0.1% (i.e. Flood Zone in respect of a flood with a return period of greater than 1,000years).

2.4 Identification of the Presence and Extent of Pluvial Flood Risk

Where the initial process of examining flood risk indicators demonstrates the existence of a risk of pluvial flooding, the study progresses to the next stage, which is a detailed assessment to establish the extent of pluvial flood risk at the Site.

2.5 Identification of the Presence and Extent of Groundwater Flood Risk

Where the initial process of examining flood risk indicators demonstrates the existence of a risk of flooding from groundwater, the assessment progresses to the next stage, which is a detailed assessment to establish the extent of groundwater flood risk at the Site.

2.6 Assessment of Proposed Development

As described in the previous paragraphs, the first stages of the assessment process are concerned with identifying whether the Site is at risk of pluvial, fluvial or groundwater flooding and establishing the extent of any such flood risks.

The next steps in the assessment process are:

- Determination of the impact that any of the identified flood risks will have on the proposed Development;

- Determination of any impact that the Development itself might have in terms of increasing the level of flood risk elsewhere outside the Site;
- Identification of mitigation measures in respect of any such impacts and identification of any residual risks after those mitigation measures are put in place;
- Applying the Development Management Justification Test if appropriate;
- Providing a conclusion as to the appropriateness of the proposed development in terms of flood risk.

3. SITE DESCRIPTION

Figure 3-1 shows the Site in the context of its immediate surroundings and Figure 3-2 shows the main drainage features and site topography indicatively.

The Site is located in Profile Park Business Park. It is bounded:

- to the north by the R134 New Nangor Roadl
- to the south by a distributor road through Profile Park;
- to the west by commercial / industrial development;
- to the east by undeveloped land within Profile Park.

The Site is undeveloped and does not seem to be used for any purpose.

Main Drainage Features

A small stream enters the Site at its eastern boundary corner, crosses through the Site and exits at the western boundary where it discharges to a twin-pipe culvert.

There is a 600mm dia. culvert on the stream midway through the Site.

There is no evidence of pluvial drainage entering the Site.

The vegetation is suggestive of poorly draining upper soils but there is no evidence of standing groundwater.

Topography

The Site can be described as relatively flat with no substantial changes in elevation and a general shallow fall towards the stream.

Figure 3-1 Site Context

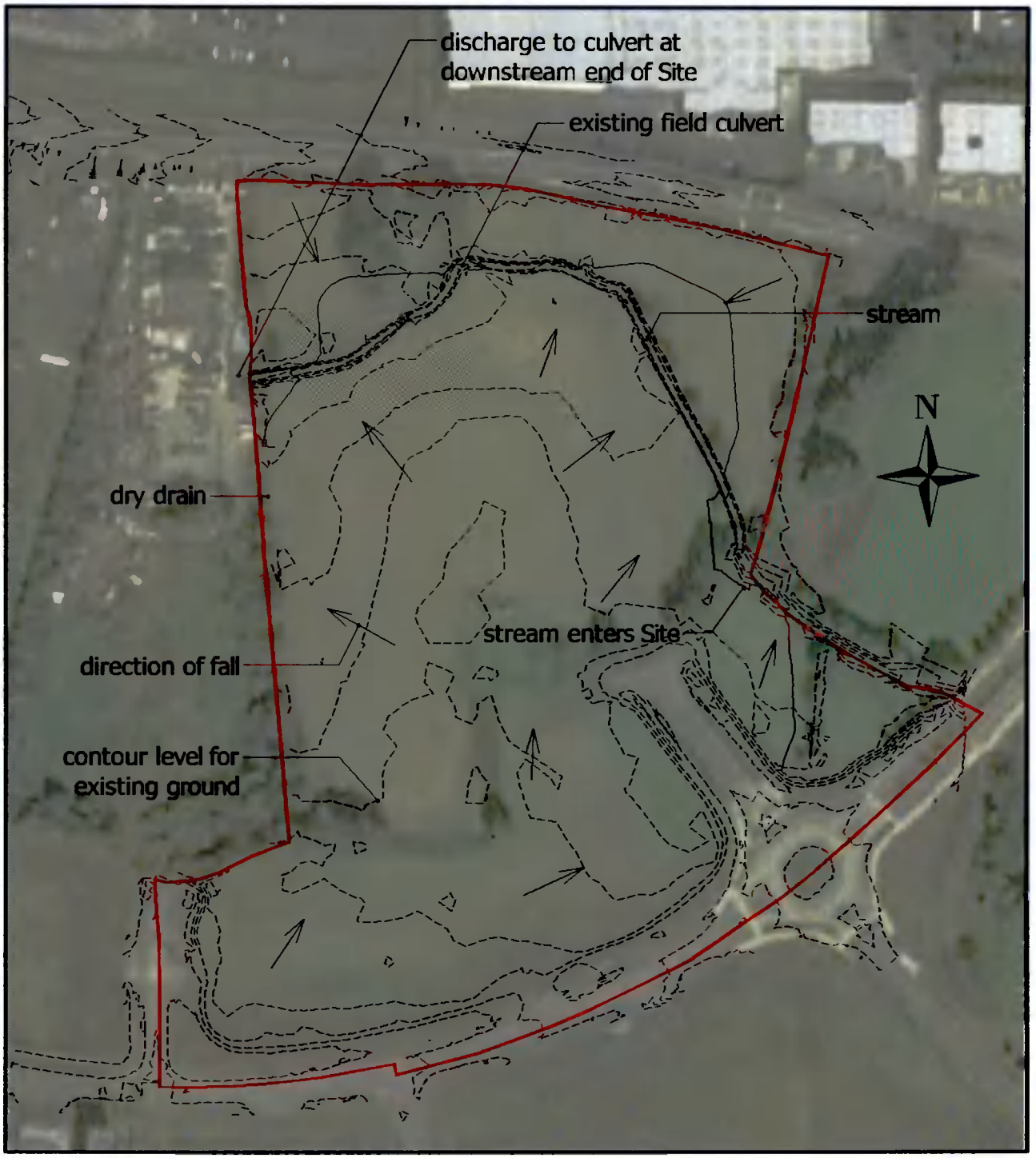


Figure 3-2 Site Topography / Main Drainage Features

4. PROPOSED DEVELOPMENT

4.1 Description

The development comprises industrial buildings, parking areas, circulation roads and ancillary landscaping. A schematic layout is shown in Figure 4-1.

A general layout showing surface water drainage for the proposed development is provided in Appendix A.

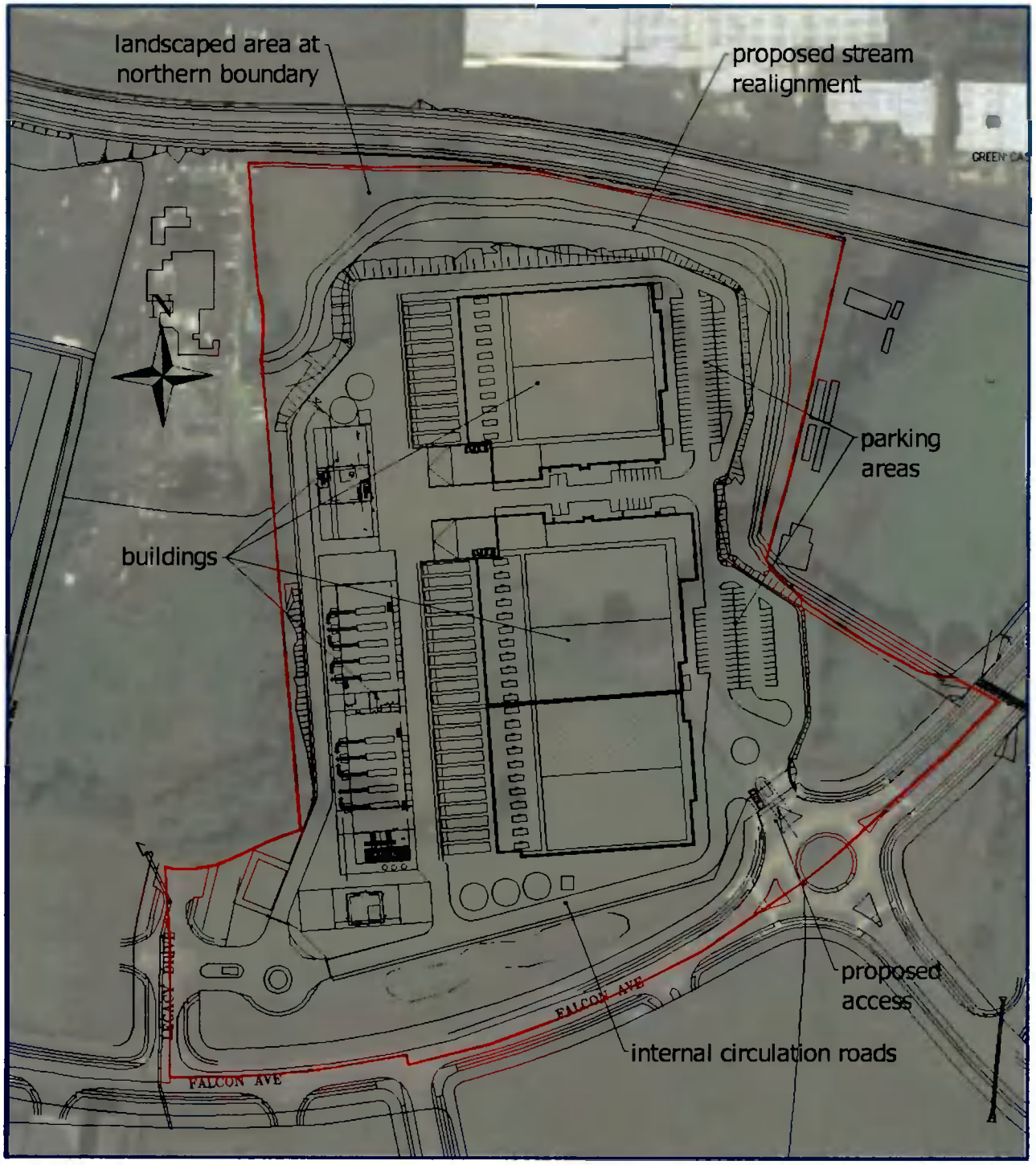


Figure 4-1 Schematic Layout of Proposed Development

4.2 Vulnerability

Table 3.1 of the Guidelines classifies different types of development in terms of their vulnerability to flooding. Figure 4-2 contains an extract from this table which shows industrial development classified as Less Vulnerable. The proposed development is an industrial development and so falls under this classification.

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.

Figure 4-2 Classification of development type by vulnerability to flooding

Table 3.2 of the Guidelines provides a matrix of development vulnerability versus Flood Zone which illustrates the appropriateness of a development type for each Flood Zone. This table is reproduced in Figure 4-3 and shows the Guidelines regards Less Vulnerable development as being appropriate for Sites in Flood Zone B and requiring the Justification Test for Sites in Flood Zone A

	Flood Zone A	Flood Zone B	Flood Zone C
Highly vulnerable development (including essential infrastructure)	Justification Test	Justification Test	Appropriate
Less vulnerable development	Justification Test	Appropriate	Appropriate
Water-compatible development	Appropriate	Appropriate	Appropriate

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Figure 6-4 Matrix of vulnerability versus Flood Zone

5. FLUVIAL FLOOD RISK – INITIAL ASSESSMENT

5.1 Flood Risk Indicators - Desktop

A number of datasets were interrogated for indicators of fluvial flood risk:

(i) SFRA

Mapping prepared as part of the Strategic Flood Risk Assessment for the South Dublin County Development Plan indicates the Site is affected by the 0.1% AEP and 1.0% AEP flood events. An extract from this mapping is shown in Figure 5-1.

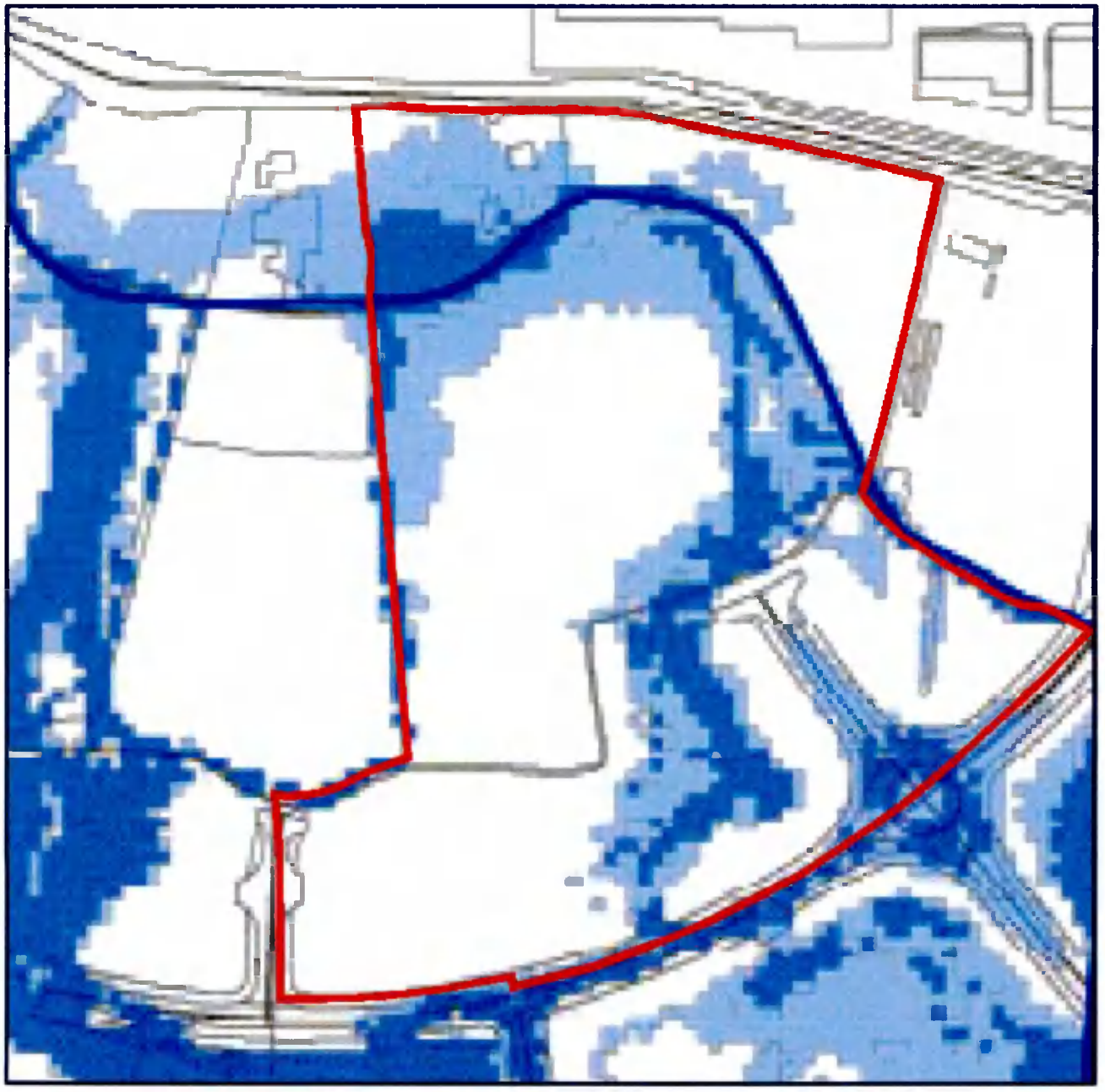


Figure 5-1 Extract from SFRA showing flood risk at the Site

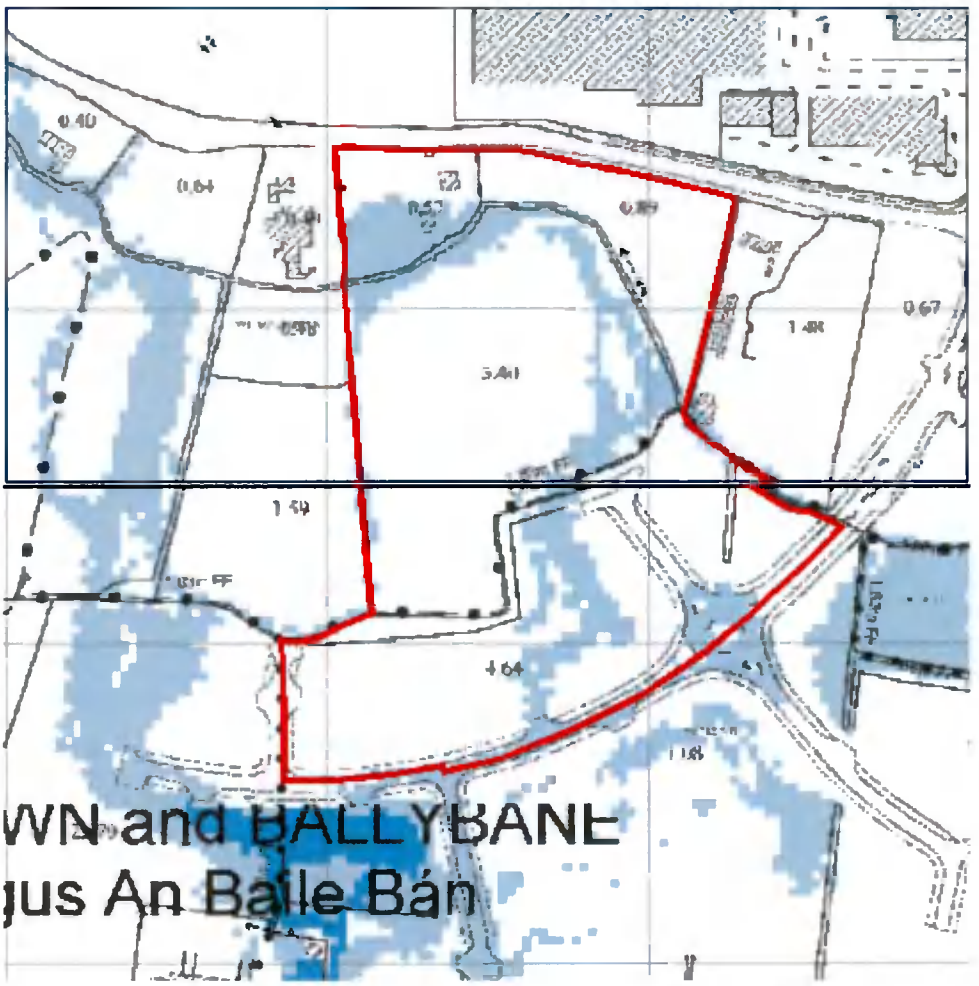
(ii) OPW National Flood Hazard Mapping Website

The OPW maintains the National Flood Hazard Mapping website (floodinfo.ie) which contains information about locations that may be at risk from flooding. The source of this information includes Local Authorities and other historic records such as newspaper articles and other documentation about reported floods.

The website does not have any records of flooding at this location.

(iii) CFRAM

Mapping prepared as part of the CFRAM programme indicates the Site is affected by the 0.1% AEP flood event but not the 1.0% AEP event.



(iv) Ordnance Survey Mapping

Figure 5-2 shows the historic 25" OS mapping for the Site and its immediate surroundings. There is no indication of flood risk at the Site.

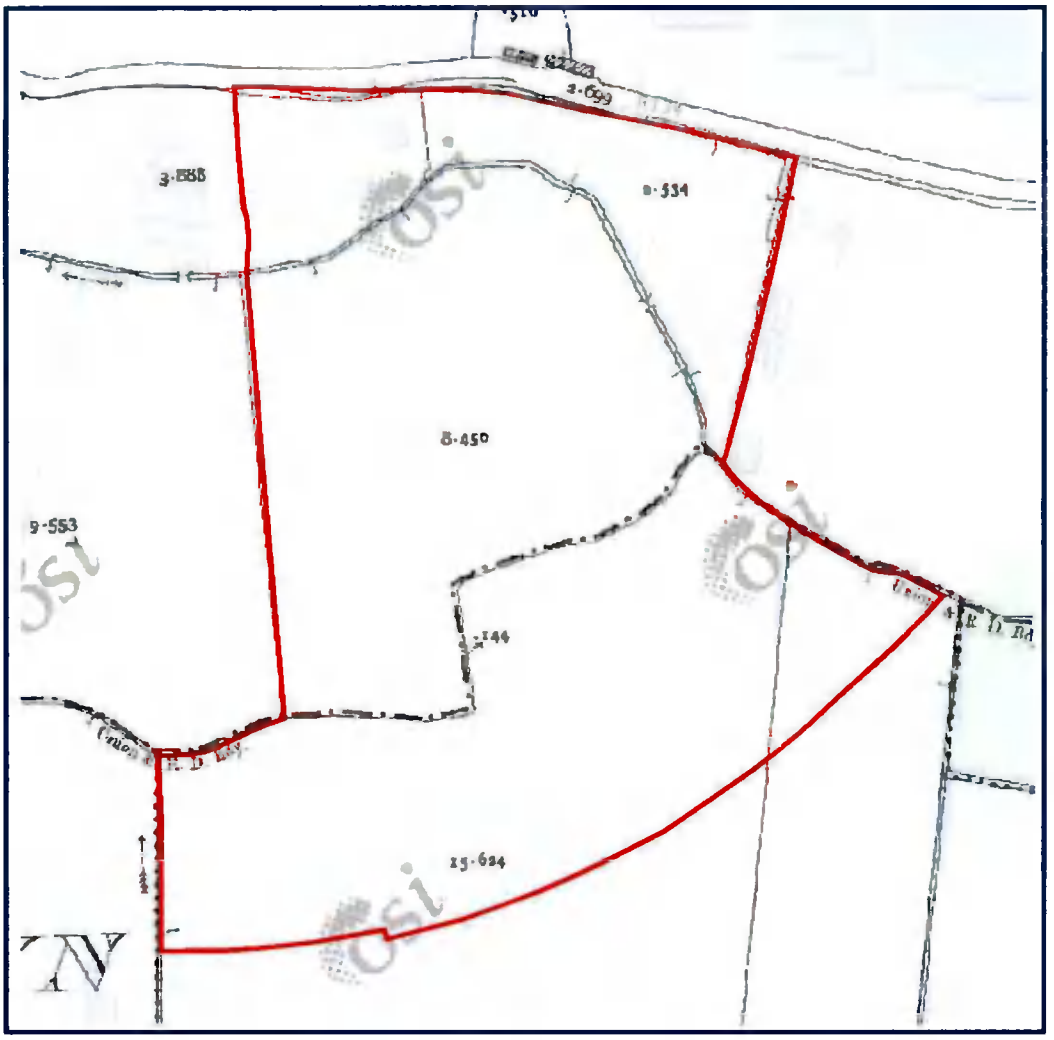


Figure 5-2 Historic OS Map

5.2 Flood Risk Indicators - Site Walkover

An unnamed stream enters the Site at its eastern boundary, crosses the Site and exits the Site via a twin-pipe culvert at its western boundary. The inlet to this culvert is poorly constructed and hydraulically inefficient; it was observed that in addition to the pipes, the gaps between the pipes also provides a flow path for the stream to discharge to.

There is a 600mm dia. culvert on the stream midway through the Site.

The vegetation is suggestive of poorly draining upper soils.

A visual assessment of the channel of the stream and the culverts suggests that the culverts will have a significantly lower hydraulic capacity than the channel.

Figure 5-3
Typical Section of Stream Channel and Site Vegetation

Figure 5-4
Inlet to culvert at downstream boundary

Figure 5-5
Inlet to culvert midway through the Site

5.3 Initial Assessment

The indicators described in Section 5.1 and the Site walkover described in Section 5.2 suggest that the Site is at risk from fluvial flooding. Accordingly, it is the conclusion of this SSFRA that detailed assessment of fluvial flood risk is appropriate.

6. FLUVIAL FLOOD RISK – DETAILED ASSESSMENT

6.1 Estimating Peak Flood Flows

The catchment area for the stream, shown on Figure 6-1, measures 1.0 km^2.

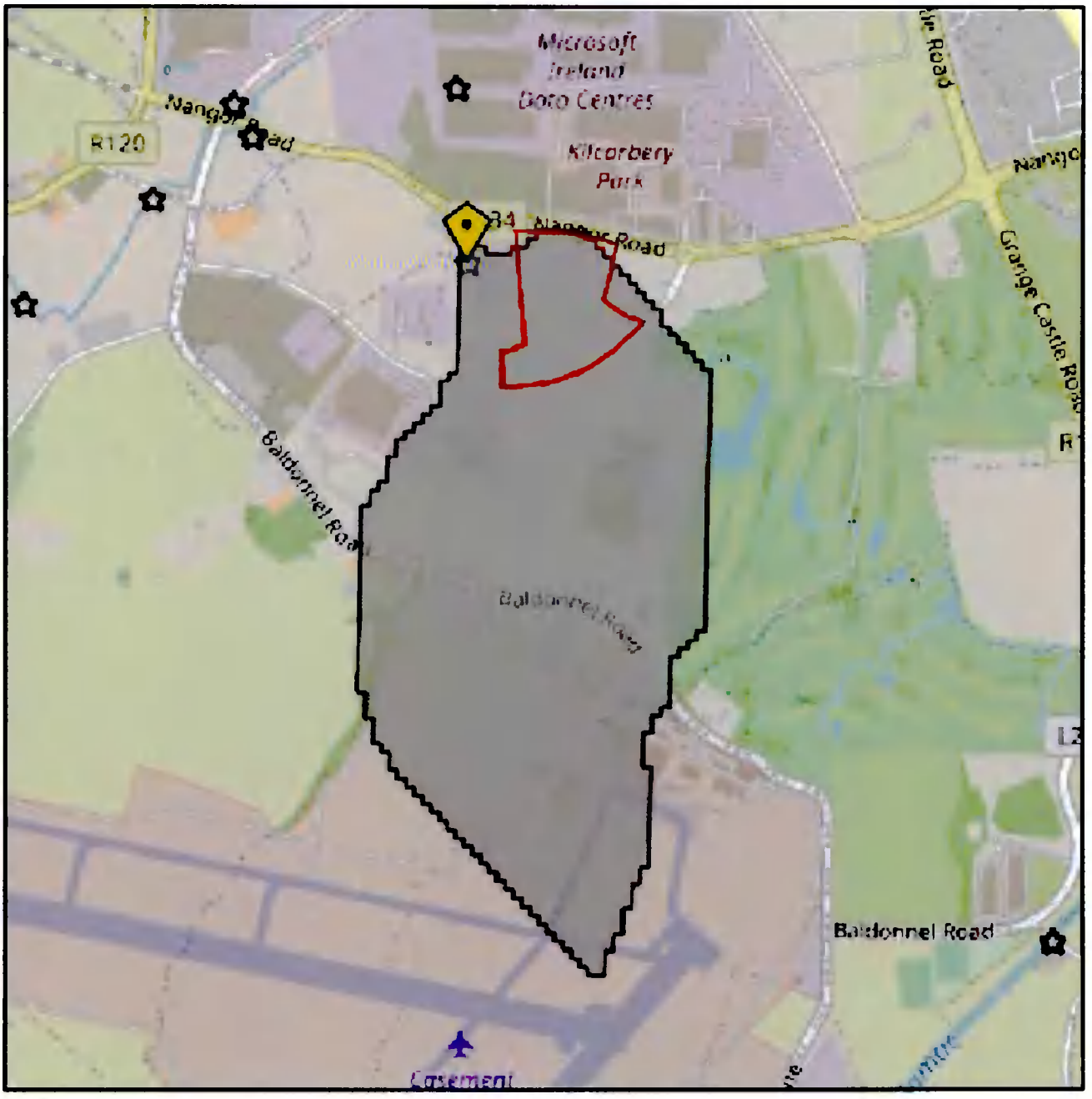


Figure 6-1 Catchment Area for Stream

The OPW provides a Web Portal for estimating peak flood flows in natural catchments (Flood Studies Update (FSU) Web Portal). While the use of this portal is generally considered best practice for the estimation of flood flows, the portal advises particular caution where peak flows are being estimated for catchments of less than 25km^2. Accordingly, peak flood flows were estimated using statistical methods for ungauged small catchments.

Table 6-1 shows a number of Physical Catchment Descriptors taken from the FSU portal that were used to estimate peak flood flows.

PCD	Value	
BFISOIL	0.5199	
SAAR	714.82	mm
FARL	1	
DRAIND	0.721	km/km^2
S1085	0.1	m/km
ARTDRAIN2	0	
ARTDRAIN2	0	
URBEXT	0.3589	

Table 6-1 Physical Catchment Descriptors from FSU Web Portal

Initially, a number of alternative statistical methods were used and the results of these are reproduced in Table 6-2 (details of these calculations are included in Appendix C). All flow estimates include a climate change factor of 20%.

Typically peak flow estimates for the 1% AEP flood event are are below 1.0m^3/s. The only exception is the flow estimate given by IH124 which is over three times the next greatest estimate and not consistent with the size of the catchment and the drainage infrastructure in the area. IH124 it generally considered to over-estimate peak flood flows *{WP4.2 Flood Estimation in Small and Urbanised Catchments – OPW 2012}*. Therefore the IH124 flow estimate will not be used and instead the flow estimates used will be the next greatest; i.e. those given by the FEH-Statistical method.

Method	1% AEP	0.1% AEP
	m^3/s	m^3/s
IH124	2.79	3.69
FSU Update	0.47	0.64
FSU-3V	0.14	0.18
FSU_7V	0.37	0.51
FEH-Statistical	0.89	1.20

Table 6-2 Estimates for Peak Flood Flows

6.2 Pre-development Hydrological Model

A hydrological model was prepared to simulate flow patterns during the 1% and 0.1% AEP rainfall events. This model was developed using the River and Flood Analysis module of the industry standard package Infrastructure Ultimate Design Suite produced by Autodesk. The hydrological modelling within this module is itself based on the HEC-RAS modelling software produced by the US Army Corps of Engineers.

The module calculates flood risk zones for the catchment based on the peak flood flows and the following:

- a terrain model created using topographical survey data;
- dimensions of culverts and other drainage structures;
- appropriate values for the roughness coefficient 'Manning's n' as determined from visual inspection of the Site.

Culvert downstream of SIte

As described above, the stream is culverted as it leaves the Site. This culvert comprises two 600mm diameter pipes at its inlet. A CCTV survey of the culvert revealed that one of these pipes changes to 450mm diameter approximately 20m from the inlet. Furthermore the both pipes show significant blockages that greatly reduce the capacity of the culvert; the extent of these blockages was such that the survey could not be completed for the full length of the culvert.

In regard to this culvert, the hydraulic models assumes:

- the culvert comprises a 600mm dia. pipe and 450mm dia. pipe for its entire length;
- the culvert will be cleared of all obstructions and maintained free of debris / deposition throughout the operational life of the proposed development;
- the maximum depth of deposition in the culvert will be 100mm.

Pre-Development Fluvial Flood Risk Zones at the Development Site

The map in Figure 6-2 shows the existing fluvial flood risk zones determined using the hydrological model described above. Peak water levels are as follows:

- 1.0% AEP Flood Event 72.07 m;
- 0.1% AEP Flood Event 72.53 m.

The Site was found to be affected by both 1% AEP flood risk and 0.1% AEP flood risk.

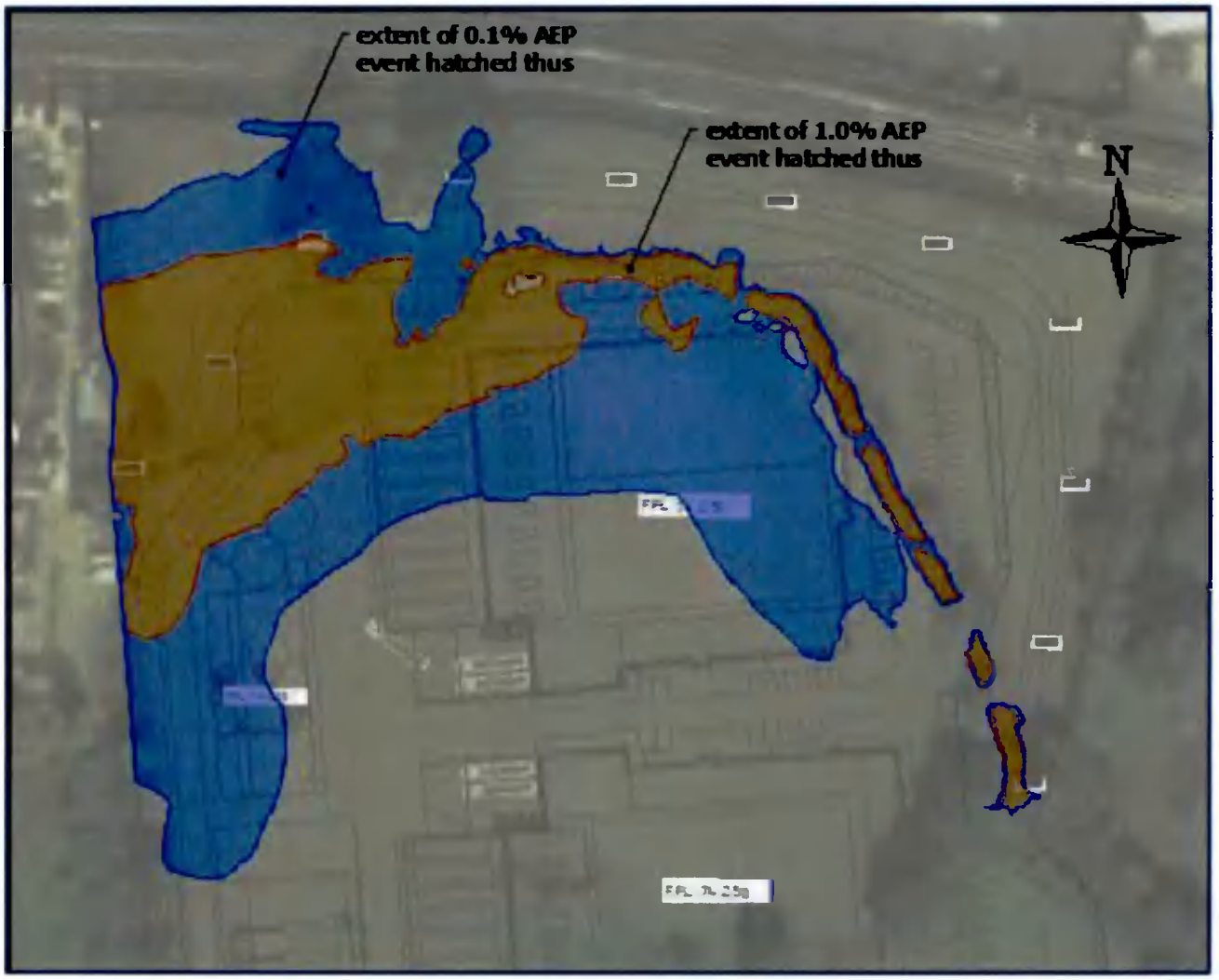


Figure 6-2 Fluvial Flood Risk Zones - Pre-Development

6.3 Development Proposals

Compensatory Storage

As described above, elements of the proposed development encroach on the flood risk zones. This creates the potential for the proposed development to displace floodplain storage and thereby increase flood risk elsewhere. To prevent this, it is necessary to provide compensatory storage within the Site.

Compensatory storage is provided by reducing the ground level in the landscape area adjoining the northern boundary. Figure 6-3 shows the location and extent of the basin and Figure 6-4 shows a typical cross-section through the basin.

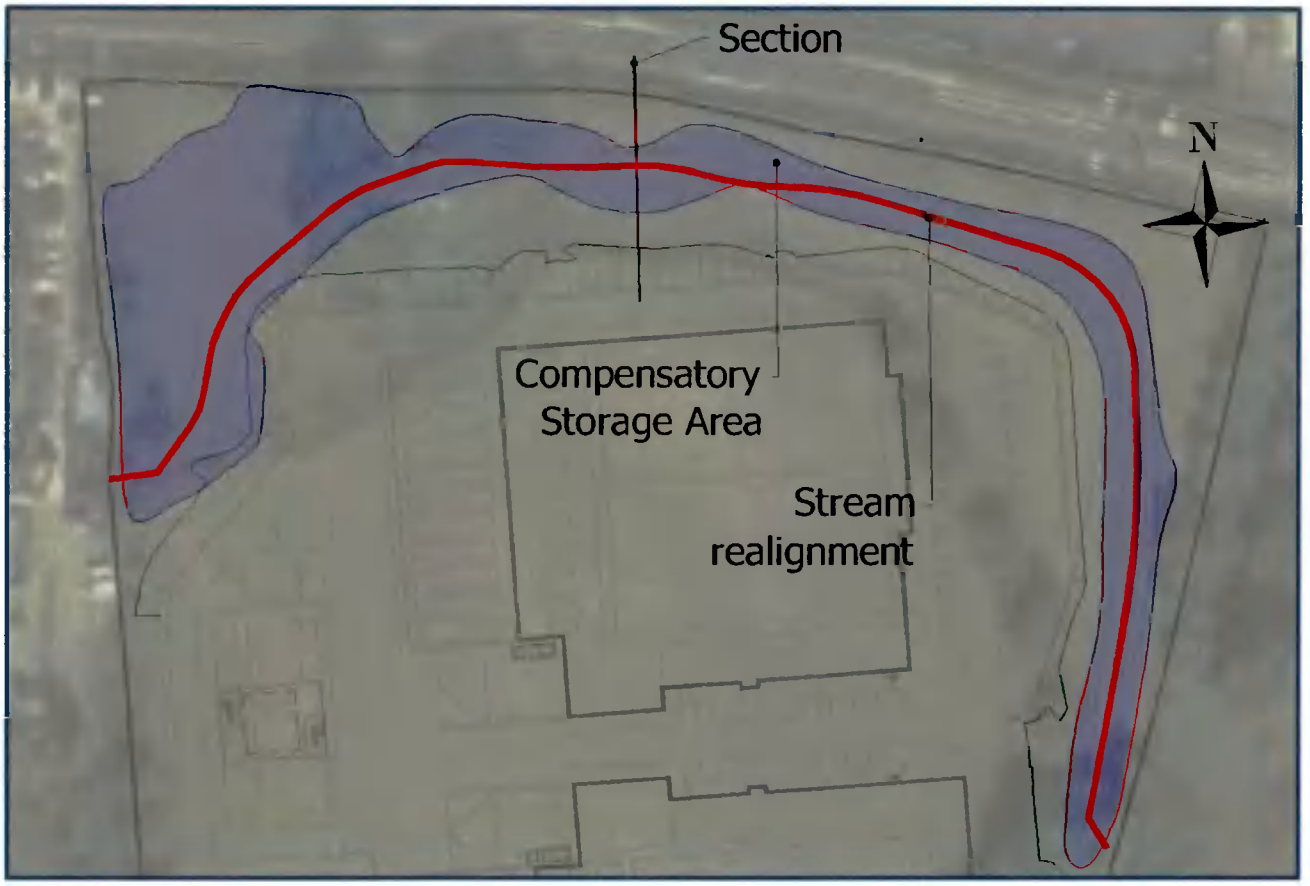


Figure 6-3 Compensatory Storage Basin and Stream Realignment

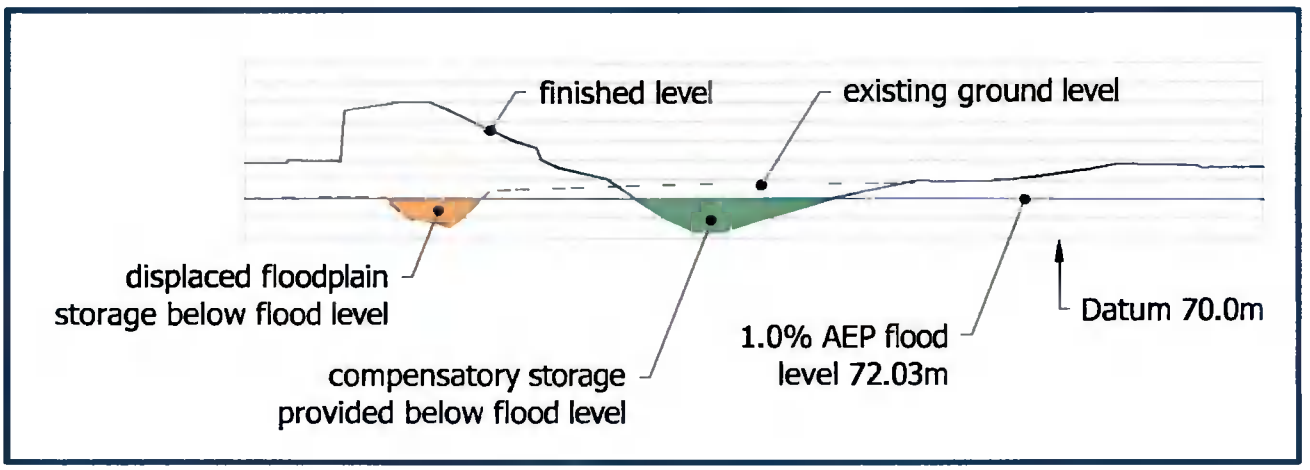


Figure 6-4
Typical Section showing displaced and compensatory floodplain storage at 1% AEP Flood Level

The Guidelines require 'level for level' compensation for floodplain storage in Flood Risk Zone A (i.e the 1% EP flood event). This means the same surface area is provided at the same elevation before and after development. This is be assessed using increments or slices of approximately 0.1m thickness.

Table 6-3 shows the volume of floodplain storage available in the pre-development and post-development scenarios between the lowest point of the Site and the peak water level during the 1% AEP flood event, broken

down to 100mm intervals in accordance with the Guidelines. At every interval the volume of compensatory storage provided is greater than the floodplain storage being displaced. Cumulatively, the proposed development will increase floodplain storage by 7,660 m^3 and so the proposed development will lead to a slight reduction in flood risk. The proposed development therefore meets the requirements of the Guidelines for Compensatory Storage.

Elevation		Floodplain Storage		
lower	upper	pre-development	post-development	change
m	m	m^3	m^3	m^3
70.2	70.3	86	508	422
70.3	70.4	111	539	428
70.4	70.5	136	572	435
70.5	70.6	159	605	446
70.6	70.7	184	644	460
70.7	70.8	209	671	463
70.8	70.9	234	699	466
70.9	71.0	260	733	473
71.0	71.1	288	767	479
71.1	71.2	314	800	486
71.2	71.3	345	828	482
71.3	71.4	394	856	461
71.4	71.5	448	889	440
71.5	71.6	528	934	405
71.6	71.7	611	974	363
71.7	71.8	694	1,012	318
71.8	71.9	790	1,067	277
71.9	72.0	907	1,124	217
72.0	72.1	1,062	1,199	137
			Cumulative	**7,660**

Table 6-3 Compensatory Storage Provision

Proposed Realignment of Stream

The current route of the stream crosses through the built area of the proposed development. Culverting the stream as it crosses through this area is not a sustainable solution on the grounds of environmental impact or future maintenance requirements. It is instead proposed to realign the stream towards the northern boundary of the Site through the proposed landscape area. The stream will be realigned across the full width of the Site, only tying into the existing stream as it enters and leaves the Site.

Figure 6-5 shows the minimum cross-section dimensions for the realigned stream. The gradient of the realigned stream will be 0.2%. Figure 6-5 shows the depth of water in the stream during then 1.0% flood event is 0.52m and the available freeboard will be 0.57m.

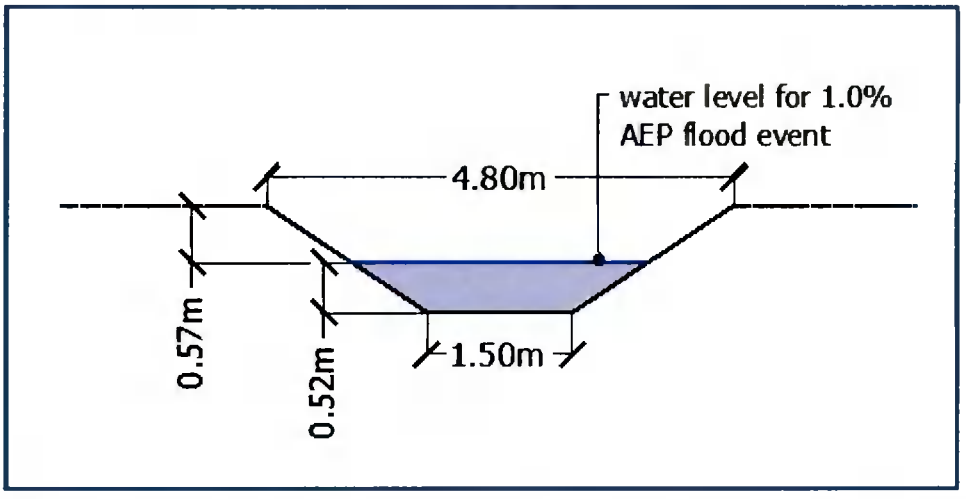


Figure 6-5 Typical Section through Relief Road and Realigned Stream

6.4 Post-development Hydrological Model

A model was prepared to simulate flow patterns during the 1% and 0.1% AEP rainfall events in the post-development scenario. This model is similar to that described in Section 6.2 but the terrain model was amended to include the finished levels for the proposed development and the realigned stream.

Peak Water Levels in the Post-Development Scenario

Figure 6-6 contains a map showing the post-development fluvial flood risk zones determined using the hydrological model described above. Peak water levels in the post-development scenario re as follows:

- 1.0% AEP Flood Event 72.02 m;
- 0.1% AEP Flood Event 72.51 m.

The proposed development will slightly reduce peak flood levels in both the 1% AEP and 0.1% AEP scenarios.

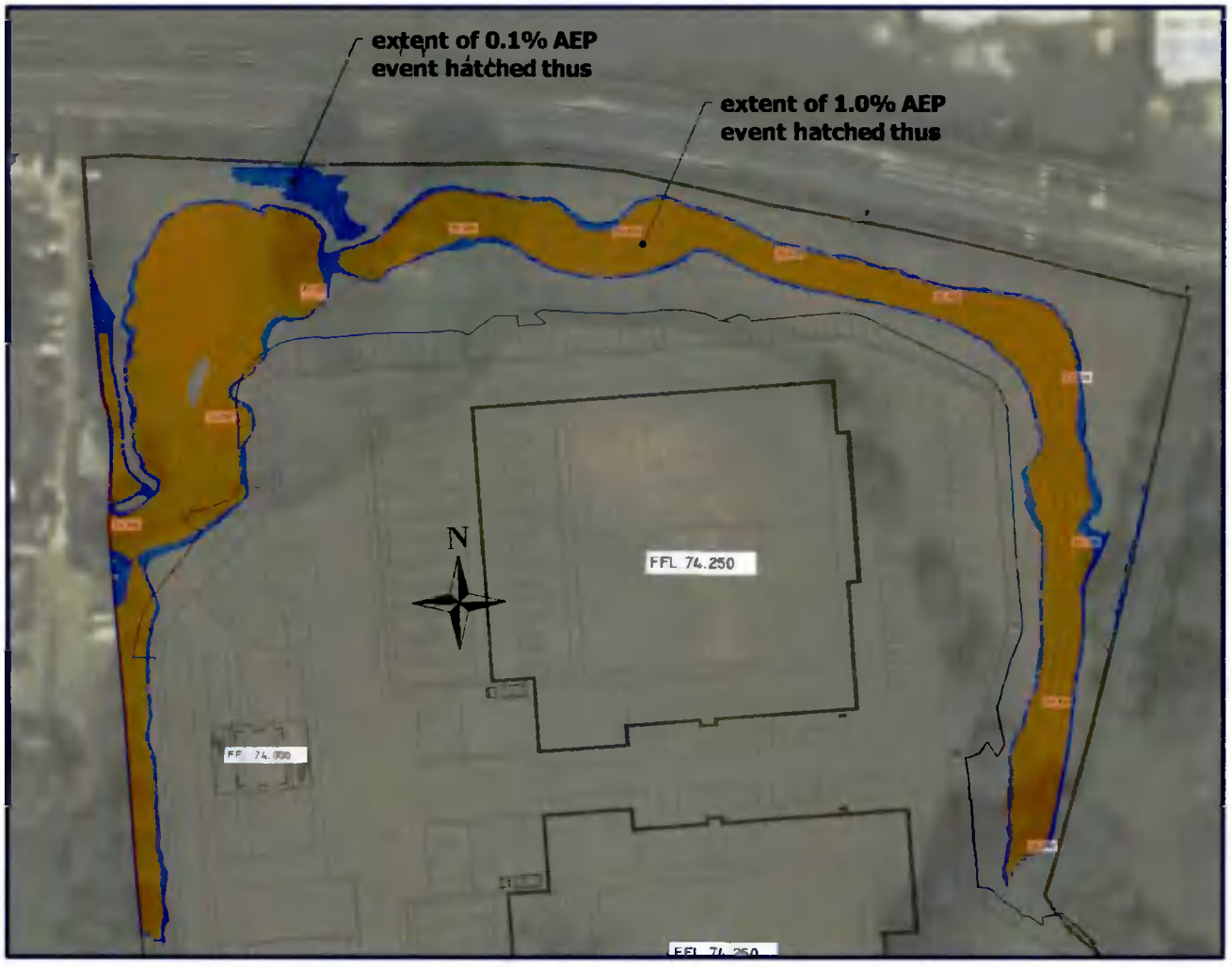


Figure 6-6 Flood Risk Zones Associated with Stream - Post-Development

6.5 Surface Water Drainage for Proposed Development

The surface water drainage system for the proposed development has been designed by Pinnacle Consulting Engineers who have provided confirmation that the design complies with the Greater Dublin Strategic Drainage Study.

Full compliance with GDSDS ensures the drainage system ensures the flood regime in the receiving stream will not be affected, thus not giving rise to flood risk elsewhere.

6.6 Conclusion of Detailed Assessment of Fluvial Flood Risk

The proposed development will not be at risk of flooding from fluvial sources and will not give rise to fluvial flood risk elsewhere.

7. FLOOD RISK FROM GROUNDWATER

7.1 Flood Risk Indicators - Desktop

Various datasets were interrogated for indicators of flood risk from Ground Water. These comprise:

(i) *OPW National Flood Hazard Mapping*

Records from the National Flood Hazard Mapping website maintained by the OPW do not contain any evidence of flood events at the Site associated with fluctuations in groundwater level;

(ii) *Geological Survey of Ireland (GSI)*

The GSI maintains a web portal that provides data for Groundwater (https://www.gsi.ie), including groundwater flooding data.

The portal does not show any groundwater flooding at or in the vicinity of the Site.

The portal indicates the Site to be in an area of high groundwater vulnerability with subsoils of low permeability.

(iii) *Historical Ordnance Survey Mapping*

Historical OS maps shows a well immediately northwest of the Site. No other information is available for this well. There is no indication of springs at the Site.

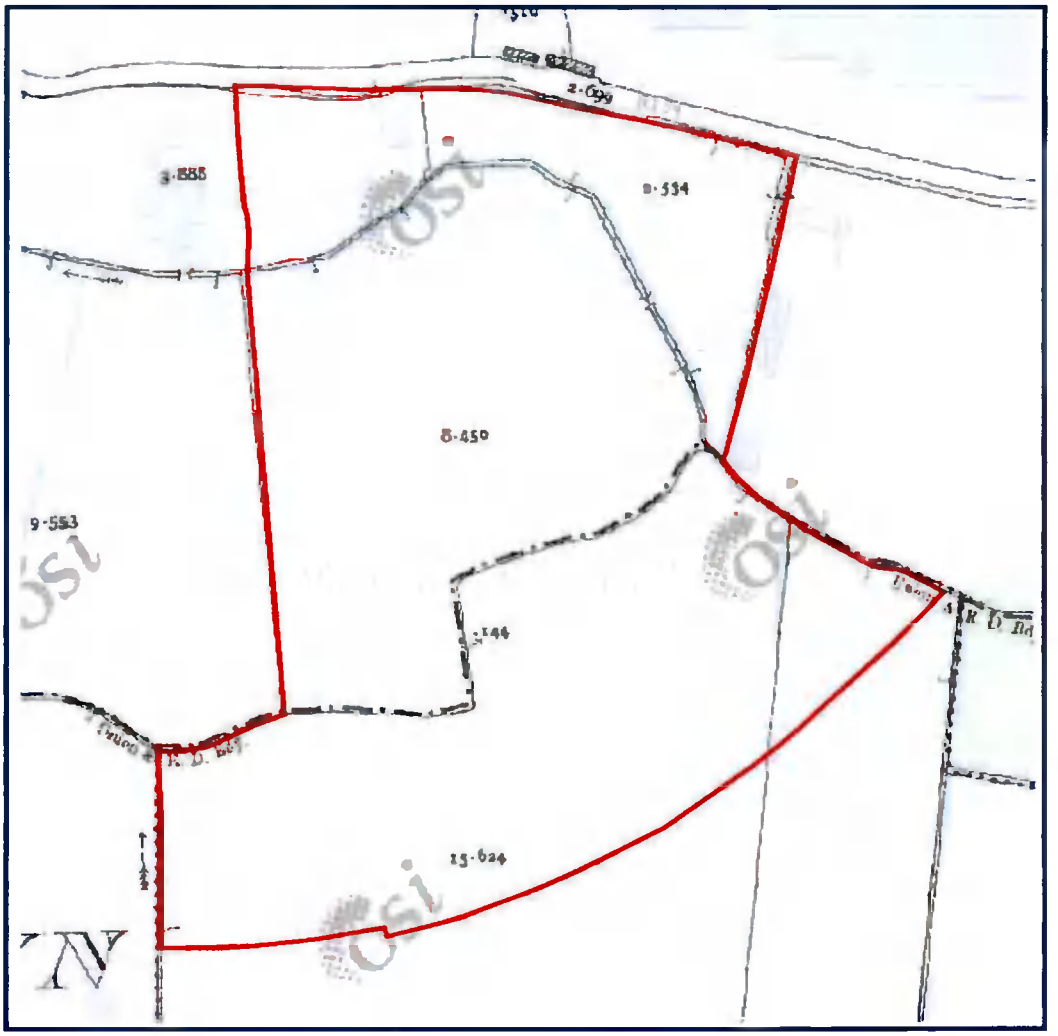


Figure 7-1 Historic OS Mapping

(iv) Ground Investigation
A ground investigation at the Site encountered groundwater generally between 1.0m and 2.0m blow existing ground level.

(v) Topography
The topography of the Site does not include localised low-lying areas that would give rise to groundwater ponding to a significant depth.

7.2 Flood Risk Indicators – Site Walkover

No evidence of flood risk from groundwater was observed during a Site walkover.

7.3 Initial Assessment

The ground investigation did encounter water-bearing strata relatively close to the surface however all indicators suggest the Site is not at risk from groundwater flooding. Detailed assessment of flood risk from this mechanism is not required.

8. PLUVIAL FLOOD RISK

8.1 Flood Risk Indicators - Desktop

A number of datasets were interrogated for indicators of pluvial flood risk:

(i) SFRA

The Strategic Flood Risk Assessment for the South Dublin County Council does not contain any information regarding pluvial flood risk at the Site.

(ii) OPW National Flood Hazard Mapping Website

The OPW maintains the National Flood Hazard Mapping website (floodinfo.ie) which contains information about locations that may be at risk from flooding. The source of this information includes Local Authorities and other historic records such as newspaper articles and other documentation about reported floods. This source does not register any previous flood events associated with pluvial flood risk at the Site.

(iii) CFRAM study programme undertaken by the OPW

Maps prepared for the CFRAM study programme do not show any pluvial flood risk at the Site.

(iv) Urban Drainage Systems

The Site is not affected by urban drainage systems that would give rise to overland flow across the Site.

8.2 Flood Risk Indicators – Site Walkover

No indicators of pluvial flood risk were observed during a site walkover

8.3 Surface water drainage system for the proposed development

The surface water drainage system for the proposed development has been designed by Pinnacle Consulting Engineers who have provided confirmation that the design complies with the Greater Dublin Strategic Drainage Study (Appendix .

Full compliance with GDSDS ensures the drainage system will have sufficient capacity to prevent surface water run-off from the proposed development causing flood risk within the proposed development and also ensures the flood regime in the receiving stream will not be affected, thus not giving rise to flood risk elsewhere.

8.4 Initial Assessment

Based on the indicators described in Section 8.1, on the site walkover described in Section 8.2 and the design of the surface water drainage system as described in Section 8.3, the initial assessment indicates the Site is not at risk from pluvial flooding and further assessment is not required.

9. RESIDUAL FLOOD RISK

Residual risk is the risk that remains after all mitigation measures to reduce the frequency of flooding have been taken.

9.1 Flood Risk Management Plan

The assessment to this point has found the proposed development is not at risk of flooding. However all developments include some element of residual flood risk that must be addressed during their operational life; for example the failure of building drainage due to lack of maintenance.

To address this residual risk it is recommended that a Site-Specific Flood Risk Mitigation Plan prepared in accordance with the Guidelines is implemented throughout the operational life of the proposed development.

9.2 Blockage in culvert immediately downstream of the Site

As described already, the stream is culverted as it leaves the Site. This culvert comprises two 600mm diameter pipes at its inlet. A CCTV survey of the culvert revealed that one of these pipes changes to 450mm diameter approximately 20m from the inlet. Furthermore the CCTV survey found both pipes to have significant blockages that greatly reduce the overall capacity of the culvert; the extent of these blockages was such that the survey could not be completed for the full length of the culvert.

Therefore the condition and size of the culvert downstream of the blockages is unknown and there is potential, for example in the event of culvert collapse, of the stream surcharging within the Site to a level in excess of that predicted by the models. To mitigate this risk, it is recommended that an overflow be constructed from the Site which would allow such excess to discharge to the stream immediately downstream of the Nangor Road. Subject to the capacity being available, this overflow could possibly discharge to existing surface water drainage in the Nangor Road but a dedicated surface water pipe might be required from the Site to a new outfall downstream of the Nangor Road.

The Flood Risk Mitigation Plan described in Section 9.1 must include should include a maintenance regime for all drainage features within the Site and for regular inspection of drainage features immediately upstream and downstream of the Site.

10. MINIMUM FINISHED LEVELS

In order to ensure that elements of development of the Site not compatible with water (i.e. roads, buildings etc.) are not at risk of flooding, the Guidelines recommend that floor levels and road levels be kept above the 1% AEP flood level with an appropriate allowance for freeboard.

A freeboard of 500mm is appropriate for floor levels and a freeboard of 250mm is appropriate for road levels.

The maximum water level during the 1% AEP flood event is 72.02m. The minimum floor level is 74.10m and the minimum parking level is 73.41m and so both meet the recommendations of the Guidelines.

11. DEVELOPMENT MANAGEMENT JUSTIFICATION TEST

A Development Management Justification Test was carried out in respect of the proposed development in accordance with Section 5.15 of the Flood Risk Management Guidelines and incorporating the findings of the subject FRA. Table 11.1 presents the results of this test which conclude that the proposed development satisfies the criteria of the Justification test.

5.1.1	*The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*	
	Yes	
5.1.2	*The proposal has been subject to an appropriate flood risk assessment which demonstrates that :*	
	(i)	*the proposed development will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
		The proposed development provides compensatory storage which exceeds the volume of existing floodplain storage that is being lost. Because of this the proposed development will lead to a slight reduction in flood risk elsewhere. The designer of the surface water drainage system has confirmed its compliance with the Greater Dublin Strategic Drainage Study and thus that it will will not increase flood risk elsewhere.
	(ii)	*the proposed development includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
		The proposed development includes proposals for treating and controlling surface water discharge which, will minimise flood risk to people, property, the economy and the environment as far as reasonably possible.
	(iii)	*the proposed development includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access;*
		The proposed development does not impact on any existing flood protection measures and will not prevent possible future flood risk management measures.
	(iv)	*the proposed development addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to development of good urban design and vibrant and active streetscapes.*
		Yes.

Table 11.1 Justification Test

12. SUMMARY AND CONCLUSION

12.1 Summary

This report presents the findings of a Site-specific flood risk assessment (SSFRA) carried out by Kilgallen and Partners in regard to a 8.7 hectare site in Profile Park, Grangecastle, Co. Dublin ['the Site']. The SSFRA was carried out in accordance with the document *'Planning System and Flood Risk Management – Guidelines for Planning Authorities'* ['the Guidelines'].

Initial assessment

For an inland Site of this nature and for which there are no existing flood defence mechanisms that could affect flood risk at the Site, the potential flood risk mechanisms are Fluvial, Pluvial, Groundwater and failure of drainage infrastructure (assessed as a residual risk).

Initial assessment of existing flood risk indicators indicate the Site is not at risk from either Pluvial or Groundwater flooding. The designers of the surface water drainage system have confirmed the surface water drainage system for the proposed development is designed in accordance with the Greater Dublin Strategic Drainage Study and so will be sufficient to ensure surface water run-off from the proposed development will cause flood risk within the proposed development and will not give rise to flood risk elsewhere.

Initial assessment of flood risk indicators suggest the Site could be at risk from Fluvial Flooding during the 1.0% AEP and 0.1% AEP events. Accordingly, a detailed assessment of fluvial flood risk was carried out.

Detailed assessment of fluvial flood risk

The detailed assessment of fluvial flood risk confirmed the Site is affected by Flood Risk Zone A (the 1% AEP flood event) and to a greater extent by Flood Risk Zone B (the 0.1% AEP flood event).

The proposed development will displace floodplain storage associated with the fluvial flood risk zones, potentially leading to an increase in flood risk elsewhere. To mitigate this, the proposed development includes compensatory storage to replace the displaced storage. The volume of compensatory storage exceeds the volume of existing floodplain storage that is being lost and so the proposed development will lead to a slight reduction in flood risk elsewhere.

Finished levels for buildings and roads in the proposed development provide an appropriate freeboard above the 1% AEP water level in accordance with the Guidelines.

Recommendations arising from assessment of residual flood risk

All developments include some element of residual flood risk that must be addressed during their operational life. To address this residual risk it is recommended that a Site-Specific Flood Risk Mitigation Plan prepared in accordance with the Guidelines is implemented throughout the operational life of the proposed development. This plan should include a maintenance regime for all drainage features within the Site and for regular inspection of drainage features immediately upstream and downstream of the Site.

The stream is culverted as it leaves the Site. A CCTV survey of this culvert revealed significant blockages that greatly reduce the capacity of the culvert. The detailed assessment described above assumed the culvert is cleared of all obstructions and maintained free of debris / deposition throughout the operational life of the proposed development. However, the condition and size of the culvert downstream of the blockages is unknown and there is potential, for example in the event of culvert collapse, of the stream surcharging within the Site to a level exceeding that predicted by the hydraulic model. To mitigate this risk, it is recommended that an overflow be constructed from the Site which would allow such excess to discharge to the stream immediately downstream of the Nangor Road. Subject to the capacity being available, this overflow could

possibly discharge to existing surface water drainage in the Nangor Road but a dedicated surface water pipe might be required from the Site to a new outfall downstream of the Nangor Road.

Justification Test

The proposed development was subject to and passed the Development Management Justification Test.

12.2 Conclusion

Assuming the implementation of the recommendations arising from this assessment, the proposed development is not at risk of flooding and will not increase flood risk elsewhere. The proposed development is therefore appropriate from a flood risk perspective.

Appendix A

Surface Water Drainage Layout for Proposed Development

Appendix B

Confirmation of Design Compliance

From: Shaun O'Reilly <shaun.oreilly@iepinnacle.com>
Sent: Friday 13 August 2021 16:16
To: Paul Bergin
Subject: RE: Grange FRA

Paul

Just to confirm that the sites drainage network has been designed in accordance with the GDSDS and that the parameters pertaining to the total outflow discharge off the site, meet the Qbar rate, as stipulated, in relation to greenfield run-off rates.

The drainage design also conforms to the Met Eireann Return Period Rainfall Depths, as well as the SAAR figure for this particular site.

Kind Regards

Shaun O'Reilly Pr Tech Dip CivEng
Associate

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Appendix C

Estimation of Run-off from Stream Catchment

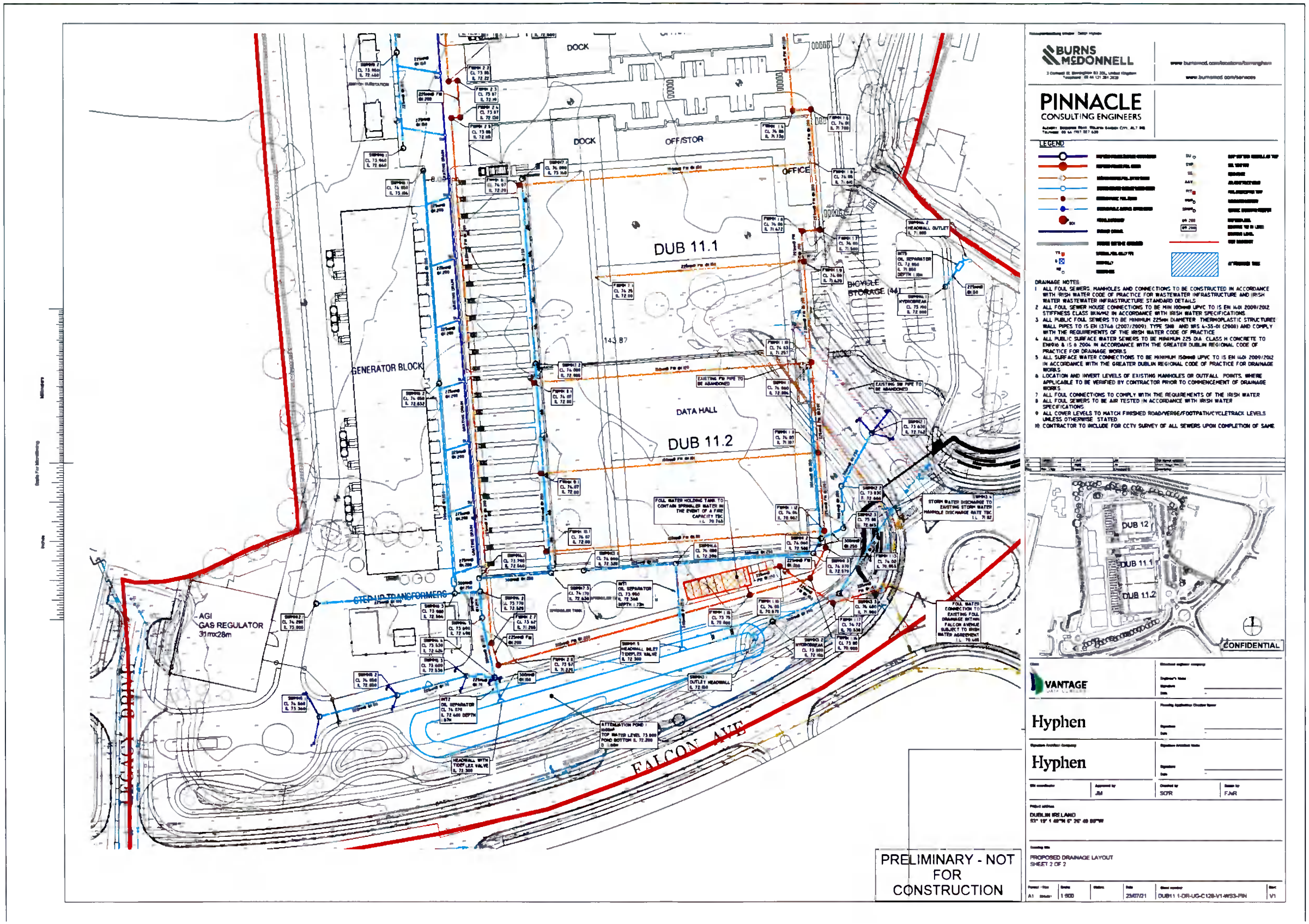
IH124 Estimation of Q_{100} and Q_{1000}			
$Q_{BAR\ RURAL} = 0.00108 \times AREA^{0.89} \times SAAR^{1.17} \times SOIL^{2.17}$			
Characteristic	**Value**	**Unit**	**Source**
Area (A)	1.0	km^2	FSU
Average Annual Rainfall (SAAR)	715	mm	FSU
G1 % =	0	%	Fig I 4.18
G2 % =	0	%	Fig I 4.18
G3 % =	0	%	Fig I 4.18
G4 % =	0	%	Fig I 4.18
G5 % =	100	%	Fig I 4.18
Soil index (G) =	0.50	%	
$Q_{BAR\ RURAL}$ =	0.52	m3/sec	
CWI =	106.3		Fig I 6.62
CIND =	45.96		Eqn 7.2
NC =	0.75		Eqn 7.3
URBAN =	0.4		FSU
$Q_{BAR\ URBAN} / Q_{BAR\ RURAL}$ =	1.367		Eqn 7.4
Q_{BAR} =	0.717	m3/sec	
Q_{100} / Q_{BAR} (Ireland)	1.96		FSR - Ireland
$Q_{1,000} / Q_{BAR}$ (Ireland)	2.6		FSR - Ireland
Q_{100} =	1.406	m3/sec	
$Q_{1,000}$ =	1.865	m3/sec	
Factorial Error Factor =	1.651		Page 37 IOH124
Climate Change Factor =	1.2		FRMG
Q_{100} =	**2.79**	**m3/sec**	
$Q_{1,000}$ =	**3.69**	**m3/sec**	

FSU Update estimation of Q_{100} & Q_{1000}			
Characteristic	**Value**	**Unit**	**Source**
Area	1.0	km^2	FSU Portal
SAAR	715	mm	FSU Portal
BFI_{soil}	0.520		FSU Portal
FARL	1.0		FSU Portal
S1085	0.10	m/km	FSU Portal
$QMED_{rural}$	0.09	m3/s	
URBEXT	0.36		FSU Portal
$QMED_{urban}$	0.14		
Climate Change Factor	1.2		OPW
Q_{100} / $QMED_{rural}$	2.77		FSU Portal
Q_{1000} / $QMED_{rural}$	3.74		FSU Portal
Q_{100}	**0.473**	**m3/sec**	
$Q_{1,000}$	**0.639**	**m3/sec**	

FSU-3V estimation of Q_{100} & Q_{1000}			
Characteristic	**Value**	**Unit**	**Source**
Area	1.0	km^2	FSU Portal
BFI_{soil}	0.520		FSU Portal
SAAR	715	mm	FSU Portal
QMED	0.041	m3/s	
Climate Change Factor	1.2		OPW
Q_{100} / QMED	2.77		
Q_{1000} / QMED	3.74		
Q_{100}	**0.136**	**m3/sec**	
$Q_{1,000}$	**0.183**	**m3/sec**	

FSU-7V estimation of Q_{100} & Q_{1000}			
Characteristic	**Value**	**Unit**	**Source**
Area	1.0	km^2	FSU Portal
BFI_{soil}	0.520		FSU Portal
SAAR	715	mm	FSU Portal
FARL	1.0		FSU Portal
DRAIND	0.72	km/km^2	
S1085	0.10	m/km	FSU Portal
ARTDRAIN	0.00		
$QMED_{rural}$	0.072	m3/s	
URBEXT	0.36		FSU Portal
$QMED_{urban}$	0.11		
Climate Change Factor	1.2		OPW
Q_{100} / $QMED_{rural}$	2.77		FSU Portal
Q_{1000} / $QMED_{rural}$	3.74		FSU Portal
Q_{100}	**0.375**	**m3/sec**	
$Q_{1,000}$	**0.506**	**m3/sec**	

FEH-Statistical estimation of Q_{100} & Q_{1000}			
Characteristic	**Value**	**Unit**	**Source**
Area	1.0	km^2	FSU Portal
SAAR	715	mm	FSU Portal
FARL	1.0		FSU Portal
BFI_{soil}	0.520		FSU Portal
QMED	0.27	m3/s	
Climate Change Factor	1.2		OPW
Q_{100} / QMED	2.77		FSU Portal
Q_{1000} / QMED	3.74		FSU Portal
Q_{100}	**0.885**	**m3/sec**	
$Q_{1,000}$	**1.195**	**m3/sec**	



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LEGEND

DRAINAGE NOTES:

1. ALL FOUL SEWERS, MANHOLES AND CONNECTIONS TO BE CONSTRUCTED IN ACCORDANCE WITH IRISH WATER CODE OF PRACTICE FOR WASTEWATER INFRASTRUCTURE AND IRISH WATER WASTEWATER INFRASTRUCTURE STANDARD DETAILS.
2. ALL FOUL SEWER HOUSE CONNECTIONS TO BE MIN 100mmØ UPVC TO IS EN 1401 2009/2012 STIFFNESS CLASS 8KN/M2 IN ACCORDANCE WITH IRISH WATER SPECIFICATIONS.
3. ALL PUBLIC FOUL SEWERS TO BE MINIMUM 225MM DIAMETER THERMOPLASTIC STRUCTURED WALL PIPES TO IS EN 13476 (2007/2009) TYPE SN8 AND BRS 4-35-01 (2008) AND COMPLY WITH THE REQUIREMENTS OF THE IRISH WATER CODE OF PRACTICE.
4. ALL PUBLIC SURFACE WATER SEWERS TO BE MINIMUM 225 DIA. CLASS H CONCRETE TO EN966 & IS 6 2004 IN ACCORDANCE WITH THE GREATER DUBLIN REGIONAL CODE OF PRACTICE FOR DRAINAGE WORKS.
5. ALL SURFACE WATER CONNECTIONS TO BE MINIMUM 150mmØ UPVC TO IS EN 1401 2009/2012 IN ACCORDANCE WITH THE GREATER DUBLIN REGIONAL CODE OF PRACTICE FOR DRAINAGE WORKS.
6. LOCATION AND INVERT LEVELS OF EXISTING MANHOLES OR OUTFALL POINTS, WHERE APPLICABLE TO BE VERIFIED BY CONTRACTOR PRIOR TO COMMENCEMENT OF DRAINAGE WORKS.
7. ALL FOUL CONNECTIONS TO COMPLY WITH THE REQUIREMENTS OF THE IRISH WATER.
8. ALL FOUL SEWERS TO BE AIR TESTED IN ACCORDANCE WITH IRISH WATER SPECIFICATIONS.
9. ALL COVER LEVELS TO MATCH FINISHED ROAD/VERGE/FOOTPATH/CYCLETRACK LEVELS UNLESS OTHERWISE STATED.
10. CONTRACTOR TO INCLUDE FOR CCTV SURVEY OF ALL SEWERS UPON COMPLETION OF SAME.

CONFIDENTIAL

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DUBLIN IRELAND

PROPOSED DRAINAGE LAYOUT
SHEET 2 OF 2

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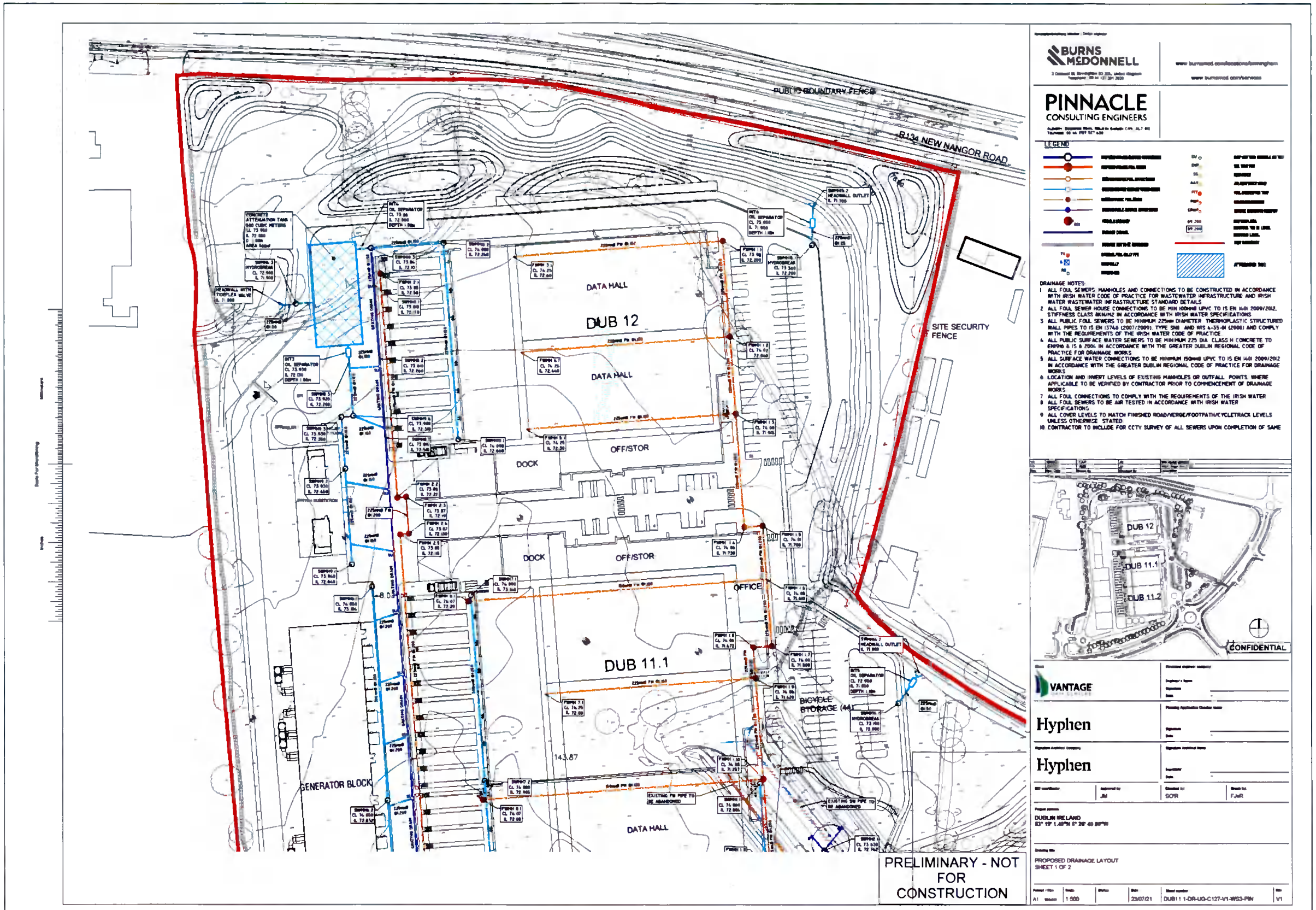
PUBLIC BOUNDARY FENCE
R134 NEW NANGOR ROAD
SITE SECURITY FENCE
DATA HALL
DUB 12
DATA HALL
OFF/STOR
DOCK
DOCK
OFF/STOR
OFFICE
DUB 11.1
BICYCLE STORAGE (44)
GENERATOR BLOCK
DATA HALL
143.87
DRAINAGE NOTES
1 ALL FOUL SEWERS, MANHOLES AND CONNECTIONS TO BE CONSTRUCTED IN ACCORDANCE WITH IRISH WATER CODE OF PRACTICE FOR WASTEWATER INFRASTRUCTURE AND IRISH WATER WASTEWATER INFRASTRUCTURE STANDARD DETAILS
2 ALL FOUL SEWER HOUSE CONNECTIONS TO BE MIN 100mmØ UPVC TO IS EN 1401 2009/2012, STIFFNESS CLASS 8KN/M2 IN ACCORDANCE WITH IRISH WATER SPECIFICATIONS
3 ALL PUBLIC FOUL SEWERS TO BE MINIMUM 225mm DIAMETER THERMOPLASTIC STRUCTURED WALL PIPES TO IS EN 13476 (2007/2009), TYPE SN8 AND WIS 4-35-01 (2016) AND COMPLY WITH THE REQUIREMENTS OF THE IRISH WATER CODE OF PRACTICE
4 ALL PUBLIC SURFACE WATER SEWERS TO BE MINIMUM 225 DIA CLASS H CONCRETE TO ENR490 & IS 6 200L IN ACCORDANCE WITH THE GREATER DUBLIN REGIONAL CODE OF PRACTICE FOR DRAINAGE WORKS
5 ALL SURFACE WATER CONNECTIONS TO BE MINIMUM 150mmØ UPVC TO IS EN 1401 2009/2012 IN ACCORDANCE WITH THE GREATER DUBLIN REGIONAL CODE OF PRACTICE FOR DRAINAGE WORKS
6 LOCATION AND INVERT LEVELS OF EXISTING MANHOLES OR OUTFALL POINTS, WHERE APPLICABLE TO BE VERIFIED BY CONTRACTOR PRIOR TO COMMENCEMENT OF DRAINAGE WORKS
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9 ALL COVER LEVELS TO MATCH FINISHED ROAD/VERGE/FOOTPATH/CYCLETRACK LEVELS UNLESS OTHERWISE STATED
10 CONTRACTOR TO INCLUDE FOR CCTV SURVEY OF ALL SEWERS UPON COMPLETION OF SAME
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