KILGALLEN & PARTNERS
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Kelland Homes / Durkan Estates Ireland

Residential Development, Boherboy, Saggart, Co. Dublin

Report on Site-Specific Flood Risk Assessment

Kelland Homes / Durkan Estates Ireland	**Document Ref. No.**	**Kilgallen & Partners Consulting Engineers Well Road, Portlaoise Co. Laois**
	17025-R-21-SSFRA Issue PL2	

REVISION HISTORY

Client	Kelland Homes / Durkan Estates Ireland
Project	Residential Development, Boherboy, Saggart, Co. Dublin
Title	Report on Site-Specific Flood Risk Assessment

Date	Detail of Issue	Issue No.	Origin	Checked	Approved
01/03/22	Draft issue	PL1	PB	MK	PB
07/03/22	Initial issue	PL2	PB	MK	PB

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Glossary of frequently used terms

OPW Office of Public Works

FMRG 'The Planning System and Flood Risk Management Guidelines – Guidelines for Planning Authorities' published by OPW

SFRA Strategic Flood Risk Assessment

SSFRA Site-specific Flood Risk Assessment

EXECUTIVE SUMMARY

This report presents the findings of a Site-specific flood risk assessment (SSFRA) carried out by Kilgallen and Partners in regard to a proposed residential development at Boherboy, Saggart, Co. Dublin.

Kilgallen and Partners is a professional consulting engineering firm with experience in the design of flood relief and flood defence schemes, the preparation of Strategic Flood Risk Assessments for Planning Authorities and in carrying out Site-Specific Flood Risk Assessments for developments.

Kilgallen and Partners has provided professional advice to the applicants for this development since 2017 and has complete knowledge of flood related issues pertaining to these lands.

The SSFRA was carried out in accordance with the document 'Planning System and Flood Risk Management – Guidelines for Planning Authorities 2009' (the Guidelines). In accordance with Section 28 Ministerial Guidelines, this document serves as the statutory method for assessing flood risk and justification testing for proposed developments in Ireland. The subject residential development passes the parameters set out in the Guidelines and is therefore deemed appropriate from a flood risk perspective

The SSFRA identified the various flood risk mechanisms that could affect the Site and searched for evidence of flood risk arising from each mechanism. This search was based on:
(i) interrogation of available datasets for evidence of flood risk arising;
(ii) examination of relevant details of the proposed development;
(iii) inspection of the Site.

This process found evidence of flood risk at the Site from fluvial sources (i.e. from the overtopping of rivers and streams). No evidence of flood risk at the Site was found for other flood risk mechanisms.

For a site affected by fluvial flood risk, there are the following concerns:
- development of that site might give rise to flood risk elsewhere.
- development of that site might be at risk of flooding;

Regarding the first concern, the proposed development was found to have the potential to displace fluvial floodplain storage, thereby increasing flood-risk elsewhere. To prevent this, the proposed development includes compensatory storage, designed in accordance with the Guidelines, to offset the displaced floodplain storage. The SSFRA found the compensatory storage exceeds the potential floodplain storage being displaced and so the proposed development will lead to a slight reduction in flood risk elsewhere.

Regarding the second concern, the finished levels of the proposed development that are considered to be water-vulnerable, i.e. buildings, roads, parking areas, footways cycleways and other paved areas were found to lie outside flood risk zones in the post-development scenario and so the proposed development is not considered to be at risk of flooding. The freeboard between the potential top water level of the 1% AEP flood event and the lowest proposed site road or floor level far exceeds the minimum recommended dimensions as set out in the Guidelines. Furthermore, the freeboard above the highest potential top water level and the vehicle/pedestrian access points into Carrigmore/Carrigmore Park is significantly greater than those recommended in the Guidelines and therefore there will be no impact on the ability to enter/leave the site during the extreme 1% AEP event (i.e. 1 in 100 year event).

The assessment carried out by Kilgallen and Partners informed the design of the proposed development so as to avoid any potential of flooding. In addition, the layout of the open space to the northern end of the development has been designed to cater for potential extreme rainfall events and then revert to usable open space during normal weather conditions.

The SSFRA included appropriate factors to allow for the potential impact of climate change.

The Flood Risk Management Guidelines require the appropriateness of proposals to develop lands at risk of flooding to be assessed using the Development Management Justification Test. Accordingly, the proposed development was subject to and was found to satisfy the various criteria of this test.

The SSFRA concluded that the proposed development is not at risk of flooding and will not increase flood risk elsewhere. In accordance with the Flood Risk Management Guidelines, the proposed development is therefore appropriate from a flood risk perspective.

1. INTRODUCTION

Durkan Estates & Kelland Homes [together known as 'the Applicant'] intend to apply for planning permission for residential development at Boherboy, Saggart, Co. Dublin ['the Site'].

The Applicant has appointed Kilgallen and Partners Consulting Engineers to carry out a Site-Specific Flood Risk Assessment ['SSFRA'] in accordance with the 'Planning System and Flood Risk Management – Guidelines for Planning Authorities (2009) to support its application to the Planning Authority.

This report presents the findings of the SSFRA. It has been prepared for planning purposes only. It is not to be used for any other purpose.

2. PROCESS FOR SITE SPECIFIC FLOOD RISK ASSESSMENT

In September 2008 "The Planning System and Flood Risk Management Guidelines for Planning Authorities" (The 2009 Guidelines) were published by the Department of Environment, Heritage and Local Government in Draft format. In November 2009, the adopted version of the document was published.

The 2009 Guidelines provide guidance on flood risk and development. A precautionary approach is recommended when considering flood risk management in the planning system. The core principle of the guidelines is to adopt a risk based sequential approach to managing flood risk and to avoid development in areas that are at risk.

The objective of as SSFRA is to assess all types of flood risk to a development. It investigates potential sources of flood risk and includes for the effects of climate change. The assessment is required to examine the impact of the development and the effectiveness of flood mitigation and management procedures proposed. It also presents the residual risks that remain after those measures are put in place.

The initial stage of the SSFRA comprises an assessment of available flood risk data to identify flood risk indicators that might affect the Site; 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, in many cases being historical, 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 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 FRM 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). Throughout this report this is referred to as the 1% AEP flood, where AEP stands for Annual Exceedance Probability.

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). Throughout this report this is referred to as the 0.1% AEP flood.

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 stage of the assessment process is concerned with the following:

- 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.

Table 3.1 of the FRMG classifies different types of development in terms of their vulnerability to flooding. Figure 2-1 contains an extract from this table which shows residential development classified as Highly Vulnerable.

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.

Figure 2-1 Classification of development type by vulnerability to flooding

Table 3.2 of the FRMG 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 2-2 and shows the FRMG regards Highly Vulnerable development 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 2-2 Matrix of vulnerability versus Flood Zone

2.7 Climate Change Adaption

This assessment's consideration of the effects of climate change is guided by the climate change adaption plan published by OPW (`*Flood Risk Management - Climate Change Sectoral Adaptation Plan*' Sep 2019).

For the purposes of the CFRAM Programme, the OPW adopted two indicative potential futures for flood risk assessment; the Mid-Range Future Scenario (MRFS) and the High-End Future Scenario (HEFS). These were selected to reflect, based on information available at the time, a future in the latter part of the century that would be:

(i). typical or near to the general average of the future climate projections (MRFS), and,

(ii). a more extreme future based on the upper end of the range of projections of future climatic conditions and the impacts such changes would have on the drivers of flood risk (HEFS).

Table 2-2 reproduces climate change adaption factors for each of these scenarios from Table 5-5 of the OPW plan. The OPW plan considers these factors acceptable as plausible futures for use in assessing potential requirements for climate adaption.

Parameter	**MRFS**	**HEFS**
Extreme Rainfall Depths	+ 20%	+ 30%
Peak Flood Flows	+ 20%	+ 30%
Land Movement	-0.5mm / year	-0.5mm / year
Urbanisation	No general allowance – review on a case-by-case basis	No general allowance – review on a case-by-case basis

Table 2-2 OPW climate adaption allowances in flood parameters for the Mid-Range and High-End Future Scenarios

This assessment will apply the MRFS factors in its general consideration of flood risk. The potential effects of the HRFS will be considered in terms of residual risk (Section 9).

3. SITE DESCRIPTION AND PROPOSED DEVELOPMENT

3.1. Site Description

The Site measures 18.3 hectares and is located on the northern side of the Boherboy Road and is currently used as agricultural land. Figure 3.1 provides a map showing the Site location. The Site is bounded to the north by residential development, to the west by agricultural lands and to the east by residential development. The Boherboy Road forms the southern boundary.

A prominent characteristic of the Site is the steep gradient downwards from the south boundary to the north boundary. Overall, there is a difference of approximately 33.0m in elevation between the south and north boundaries.

A stream flows along the eastern boundary, turning west at the northern boundary before exiting the Site at its northwest corner. This stream is a tributary of the Camac River and is named by the EPA as the Corbally Stream, designation code 09C10, on the EPA website (https://gis/epa.ie/EPAMaps/Water). The Corbally Stream outfalls to the Camac River approximately 2.1km north of the Site.

The Site comprises two rectangular fields in parallel stretching from the southern boundary to the northern boundary, both under agricultural use. The boundary between the fields is defined by a hedgerow and local field ditch (EPA Designation Code 09C60); this ditch inside the Site, close to the south boundary, and outfalls to the Corbally Stream at the north boundary. A similar local field ditch (EPA Designation Code 09C62) adjoins the western boundary of the Site; this ditch starts at the south boundary and also discharges to the Corbally Stream.

3.2. Land-Use Classification

Under the South Dublin County Council (SDCC) Development Plan, the Site is classified as follows:

- Objective RES-N To provide for new residential communities in accordance with approved area plans.

3.3. Proposed Development

The proposed development comprises a mixture of detached, semi-detached and terraced houses, duplex units and apartments, 655 residential units in total, a wastewater pumping station and a crèche.

The proposed development includes:

- ancillary streets, footways, cycleways and other paved areas which, in combination with roof areas, will increase the impermeability of the Site;
- four crossings over the stream (two vehicular, two pedestrian / cyclist).

The surface water drainage system for the proposed development was designed by Roger Mullarkey & Associates Consulting Structural & Civil Engineers in accordance with the Greater Dublin Regional Code of Practice, the GDSDS and CIRIA Report c753 "The SuDS Manual" 2015.

A full SuDS treatment train is proposed in accordance with the CIRIA SuDS Manual. The train comprises:

- filter drains to the rear of houses;
- permeable paving to all private parking areas;
- rainwater butts to the rear downpipes of the houses;
- filter swales and tree pits where practicable;
- use of the existing central dry-ditch as a drainage swale
- a bio-retention area;
- silt-trap/catchpit manholes;

- hydrobrake flow control valves limiting discharge flow to the Qbar greenfield rate;
- petrol interceptors upstream of all outfall points;
- stone lined voided arch retention storage devices.

Figure 3.2 shows the general layout superimposed on the Site background.

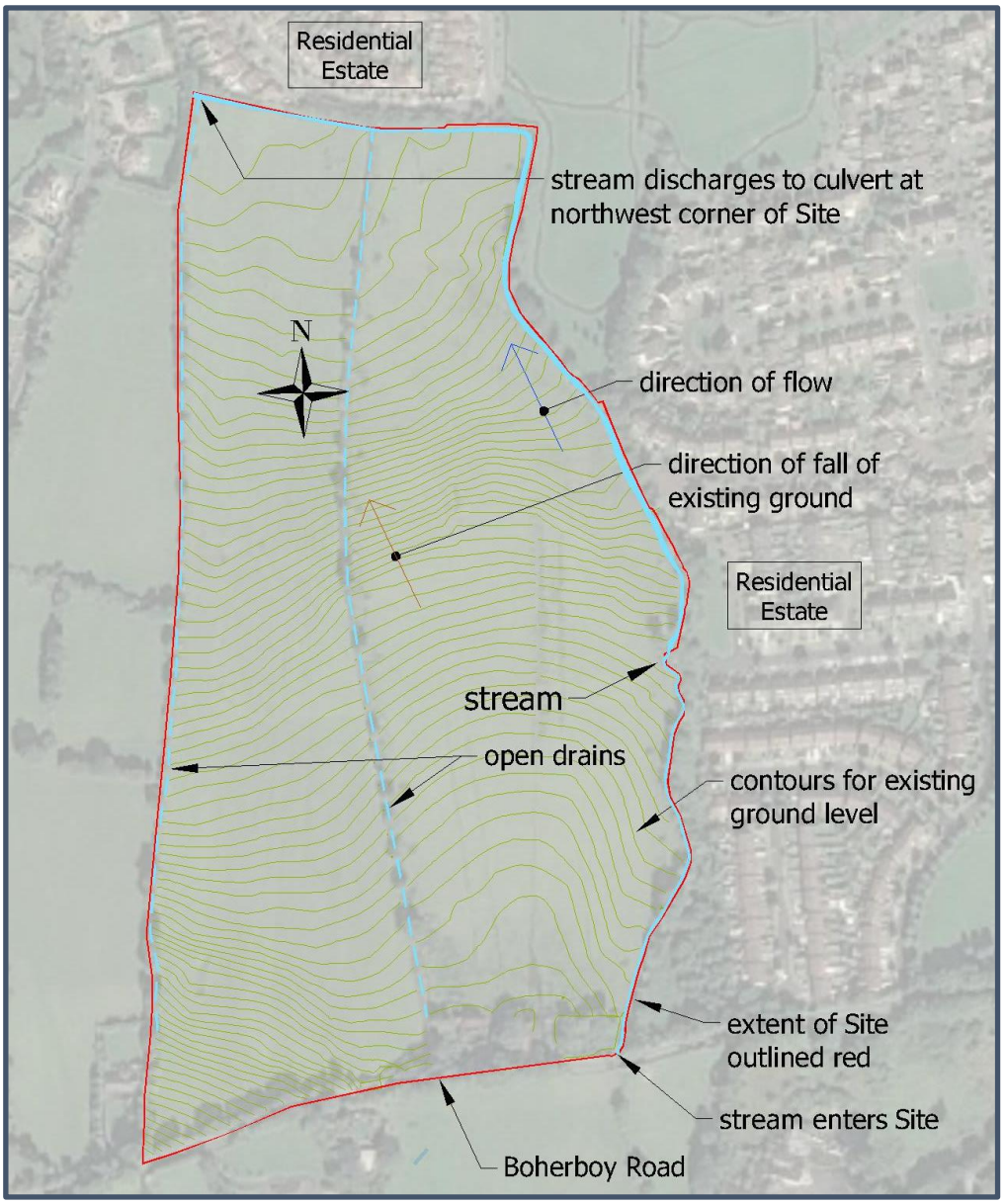


Figure 3.1 Site Details

Figure 3.2 Proposed Development

4. FLUVIAL FLOOD RISK – INITIAL ASSESMENT

4.1 Flood Risk Indicators - Desktop

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

(i) SFRA for South Dublin Development Plan 2016 – 2022

The Strategic Flood Risk Assessment for the South Dublin Development Plan 2016 – 2022 found the Site to be impacted by both the 1% AEP and 0.1% AEP flood risk zones.

Figure 4-1 Extract from SFRA for County Development 2016 - 2022

(ii) SFRA for Draft South Dublin Development Plan 2022 – 2028

The Strategic Flood Risk Assessment for the draft South Dublin Development Plan 2016 – 2022 also found the Site to be impacted by both the 1% AEP and 0.1% AEP flood risk zones.

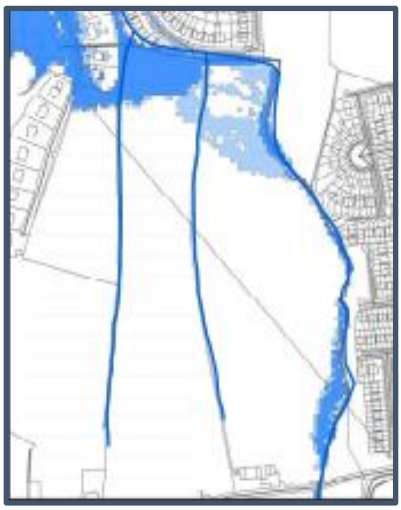


Figure 4-2 Extract from SFRA for County Development 2022 – 2028

(iii) 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 the stream at the Site. However, as the stream is located away from the public road as it flows through the Site, the absence of historic flood records is not a strong indicator that there is no flood risk. A site-specific report in this regard is provided in Appendix C.

(iv) CFRAM

CFRAM maps prepared for the CFRAM study programme indicate the Site to be impacted by both the 1% AEP and 0.1% AEP flood risk zones. The pattern and extent of flood risk is consistent with that found by the SFRA.

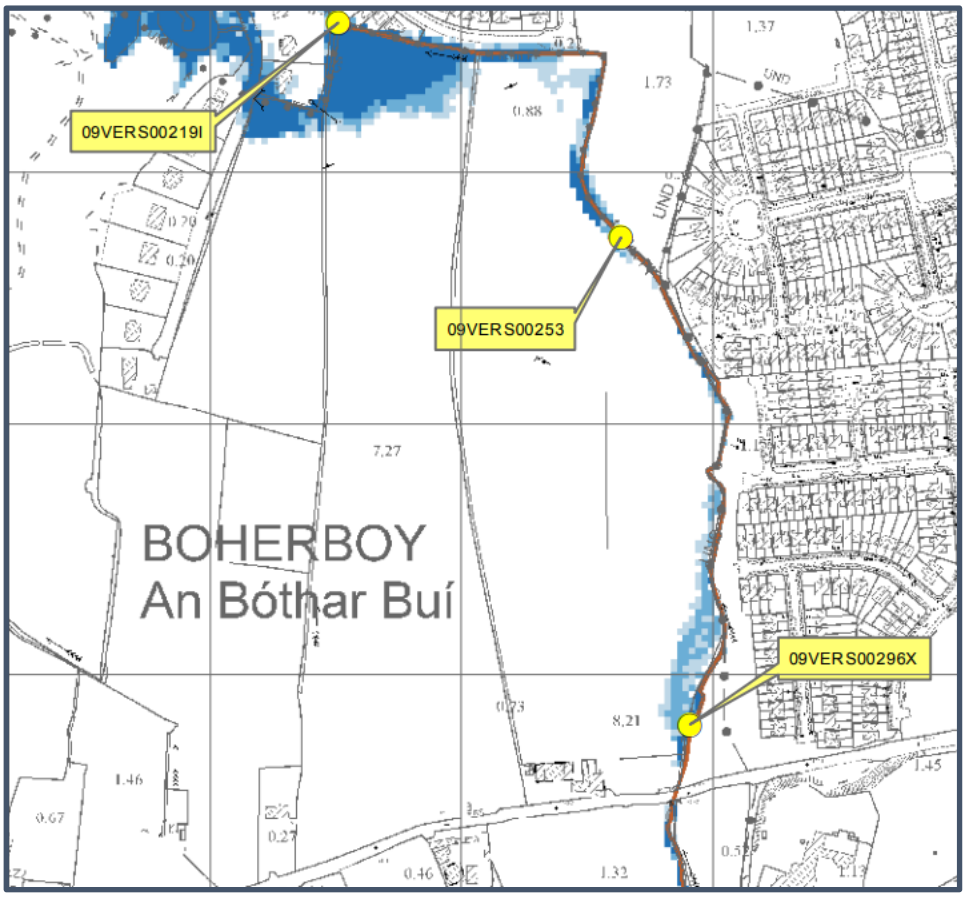


Figure 4-3 Extract from CFRAM Mapping

(v) Ordnance Survey Mapping

Historic OS mapping for the Site and its immediate surroundings does not contain any indicators of fluvial flood risk.

(vi) SFRA for Fortunestown Local Area Plan May 2012

Figure 4-3 shows an extract from flood-risk mapping prepared for the Fortunestown Local Area Plan May 2012. This mapping suggests the extent of flood risk at the Site to be far greater than that predicted by subsequent CFRAM and SFRA studies. Furthermore, the flood-risk pattern is not consistent with the Site topography. Finally, the assessment is from 2012 and has been superseded by more recent SFRAs.

Thus, other than noting the presence of flood-risk, this map is not considered to be a reliable indicator of the extent of flood risk.

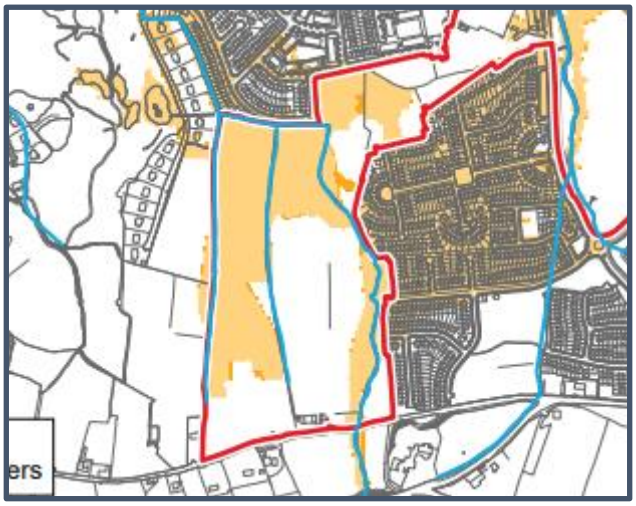


Figure 4-4 Extract from SFRA for County Development

4.2 Flood Risk Indicators - Site Walkover

A Site walkover was carried out by the author of this report to allow a direct inspection of drainage features.

Fluvial drainage features are consistent with those shown on OS mapping, suggesting there have be no significant changes to the drainage regime in recent times.

The Corbally stream enters the Site at its southeast boundary via a culvert under the Boherboy Road. This stream flows along the eastern boundary of the Site until it meets the northern boundary, whereupon it turns towards the west and flows along the northern boundary before discharging to a culvert at the northwest corner of the Site. The outfall culvert comprises 4no. 450mm dia. pipes.

As expected, the Corbally Stream follows the Site topography and its gradient is steep, particularly so along the eastern boundary.

Figure 4-5 Stream at eastern boundary

Figure 4-6 Stream at northern boundary

Figure 4-7 Culvert immediately downstream of Site

4.3 Initial Assessment

Based on the indicators described in Section 4.1 and on the Site walkover described in Section 4.2, the initial assessment indicates the Site may at risk from fluvial flooding during extreme rainfall events.

The principal flood risk area is at the northwest corner of the Site. The indicators also suggest a risk of shallow overland flow at the northeast corner of the Site.

5. FLUVIAL FLOOD RISK – DETAILED ASSESMENT

5.1 Flood Risk Zones – Pre-Development

Estimating Peak Flood Flows

The Site is in the catchment of a tributary stream of the Camac River. It is this stream which flows along the eastern and northern boundary of the Site.

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 flood flows are being estimated for catchments of less than 25km^2.

Accordingly, alternative statistical methods were used and the results of these are reproduced in Table 5-1. All flow estimates include a climate change factor of 20%.

The largest flood flow estimates are given by IH124. This is unsurprising as IH124 is generally considered to over-estimate peak flood flows (WP4.2 Flood Estimation in Small and Urbanised Catchments – OPW 2012). In accordance with the precautionary principle, the IH124 flow estimates will be used for the purposes of this assessment, thus leading to a conservative assessment (details of the IH124 calculations are provided in Appendix B).

Method	1% AEP	0.1% AEP
	m^3/s	m^3/s
IH124	4.03	5.35
FSU Update	3.31	4.46
FSU-3V	0.39	0.52
FSU_7V	2.38	3.21
FEH-Statistical	1.90	2.57

Table 5-1 Peak fluvial flood flows from statistical methods

By way of comparison, the OPW CFRAM estimates peak flood flows immediately upstream of the Site as being 2.25 m^3/s for the 1.0% AEP event and 3.99 m^3/s for the 0.1% AEP event, considerably less than the estimates given by IH124.

Hydrological Model

A topographical survey was carried out for the study area by a third-party land surveyor. The results of this survey were imported into the industry standard software package Infrastructure Ultimate Design Suite to create a 3D digital terrain model for the study area.

A hydrological model was prepared to simulate flow patterns during the 1.0% and 0.1% AEP flood 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:

- the terrain model;
- cross-sectional data for the river channel;
- dimensions of culverts and other drainage structures;
- appropriate values for the roughness coefficient 'Manning's n' as determined from visual inspection of the Site.

The stream leaves the Site by discharging to a culvert at the northwest corner of the Site. For the purposes of this assessment and in accordance with good practice, the hydrological model assumes that blockages have reduced the culvert capacity by 35.0%.

Existing Fluvial Flood Risk Zones at the Site

Figure 5-1 shows the existing fluvial flood risk zones determined using the hydrological model described above. These are consistent with the extent of flood risk predicted by both SFRA and CFRAM mapping (Figures 4-1 and 4-2).

The Site is largely free from flood risk except at the north boundary. Figure 5-2 shows flood risk at this Site to a greater scale.

The flood risk arises when the capacity of the culvert immediately downstream of the Site is exceeded and water begins to surcharge the culvert. This surcharging has two effects; the first is to increase the hydraulic gradient across the culvert and thus increase the volume of water it can convey. The second is to cause water to back up in the stream channel to the point where it overtops the channel bank. The extent to which the flood level rises is a function of the flow in the stream but is it rises will begin to overtop the western boundary and continue downstream.

Figure 5.1 shows the layout of the proposed development with existing flood risk zones, established using the model described above, superimposed thereon.

Pre-development peak water levels in the existing flood risk zone are as follows:

- 1.0% AEP Flood Event 118.02m
- 0.1% AEP Flood Event 118.05m

While the layout of the development is broadly cognisant of fluvial flood risk, elements of the proposed development at the northern boundary 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 in accordance with the Flood Risk Management Guidelines (Section 5.2).

The stream was found to overtop its western bank at the northeast corner of the Site. Because the Site is steeply sloping at this location, this overflow continues downstream as overland flow and flows back into the stream channel slightly further downstream at the north boundary (refer to Section 5.4).

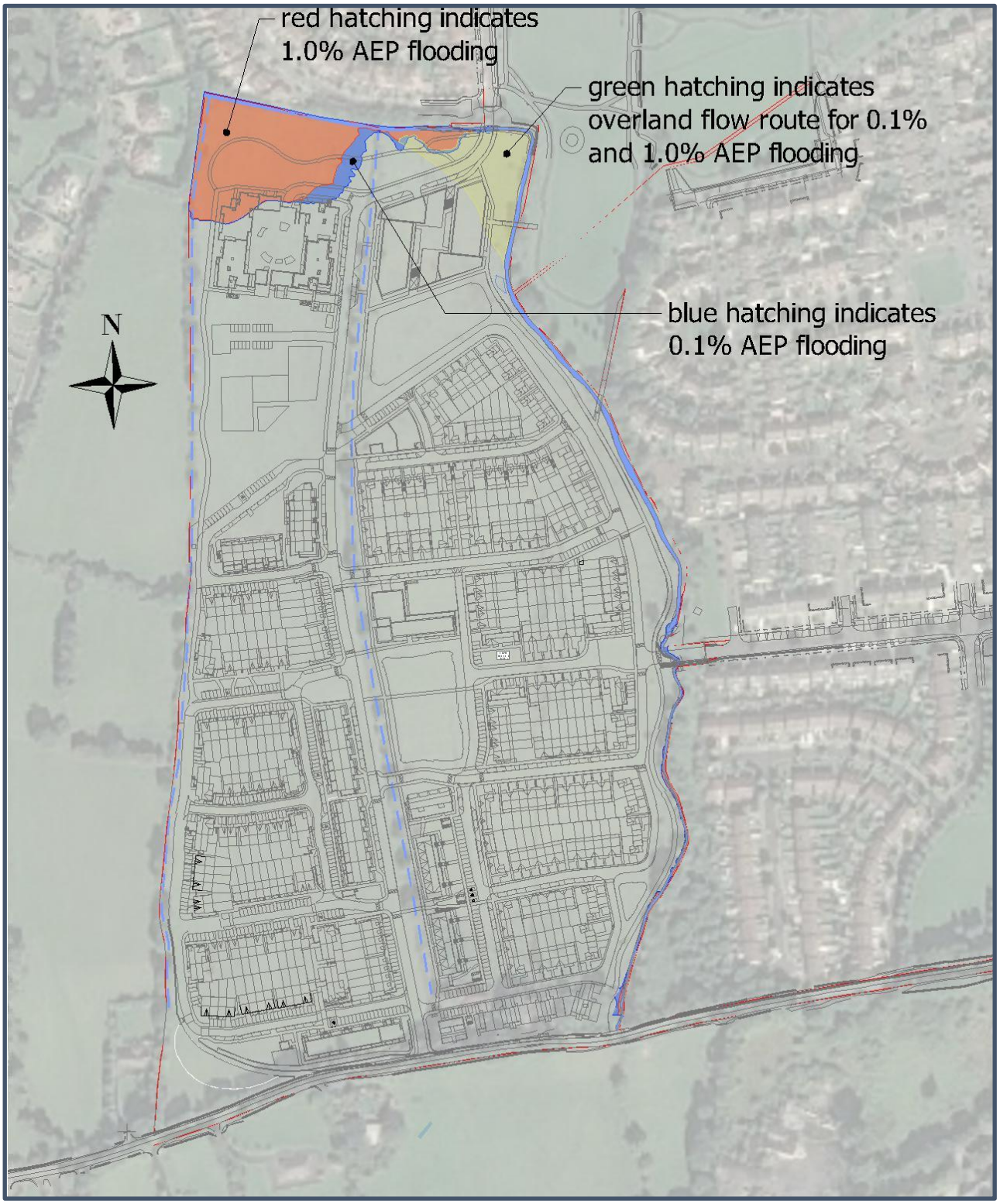


Figure 5.1
Pre-development flood-risk zones established by hydraulic model superimposed on proposed development

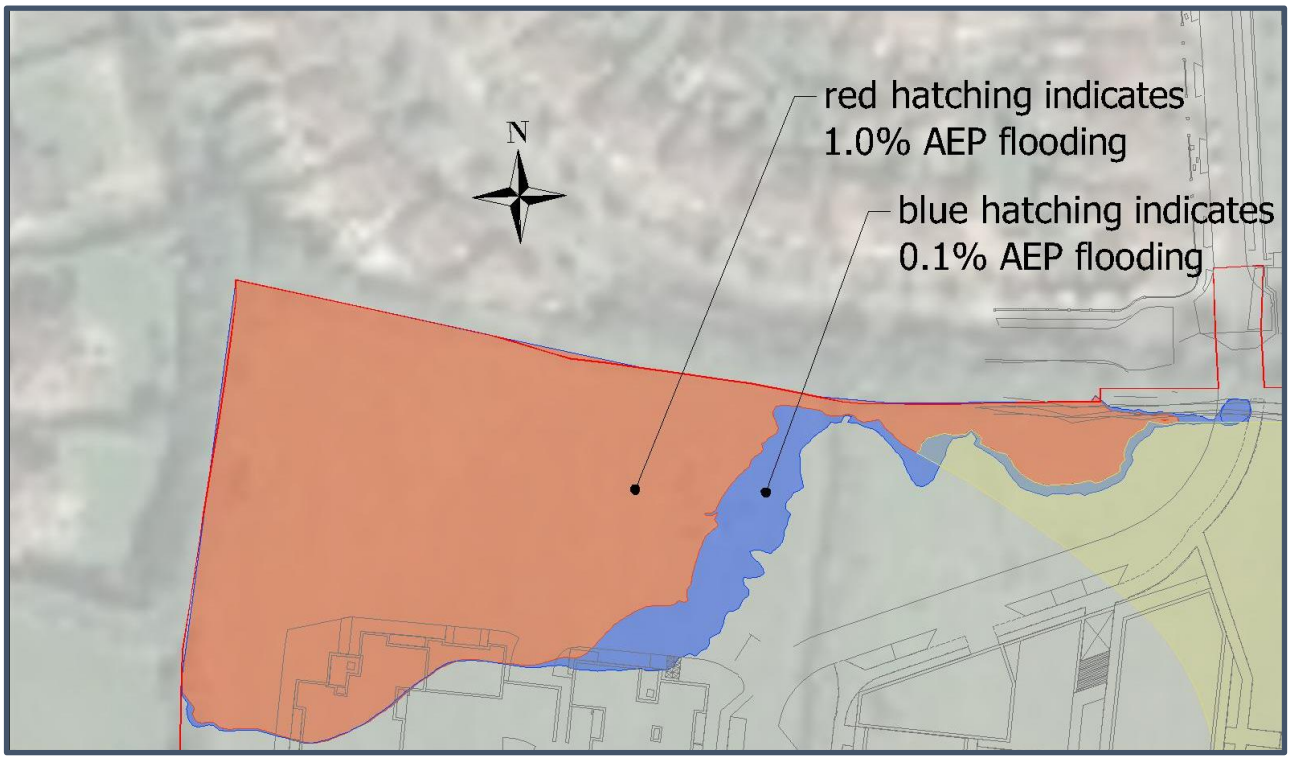


Figure 5.2
Pre-development flood-risk zones established by hydraulic model at northwest boundary superimposed on proposed development

5.2 Compensatory Storage

Where a proposed development encroaches into a flood-risk zone, it displaces floodplain storage and so has the potential to increases flood-risk. Appendix B of the FMRG requires that where such displacement occurs, the proposed development must provide storage (Compensatory Storage) to offset the displaced floodplain storage.

Compensatory Storage can be provided in two ways; direct and indirect.

- direct methods (also known as 'level for level') re-grade land and provide a direct replacement for the lost storage volume. Level-for-level compensation provides the same surface area at the same elevation before and after development. This is assessed using increments or slices approximately 100mm thick.
- indirect methods rely on water entering a defined storage area which then releases it at a slower rate, similar to a surface water attenuation scheme.

Indirect methods are complicated to design and construct and may require a more intensive maintenance regime, which must be continued indefinitely. Accordingly, the FMRG recommends direct level-for-level compensation as the default method.

The proposed development includes a basin at the northwest corner of the Site which is designed to provide direct compensatory storage. The inclusion of this basin means that while the proposed development will impact on existing flood risk zones at some locations (as noted in Section 5.1) and thus displace floodplain storage, it reduces the ground level at other locations, thereby providing compensatory storage. Figure 5.2 shows a typical section through the compensatory storage area.

The requirements for providing compensatory storage are set out in the Appendix to the Flood Risk Management Guidelines. The basic criterion for compensatory flood plain storage is that, calculated at

elevation intervals of 100mm, the compensatory storage provided must not be less than the volume of floodplain storage displaced by the proposed development. To determine if this criterion was met, the volumes of flood plain storage available under the pre- and post-development scenarios was calculated for each 100mm interval between the lowest elevation of the Site, 117.20m, and the peak flood level for the 0.1% AEP flood event, 118.05m (the Assessment Range).

These volumes were calculated using the following methodology and Autodesk Civil 3D:

(i) 3D models (surfaces) were created for the pre-development (i.e. existing ground level) and post-development (i.e. proposed finished level) scenarios;

(ii) comparison volume models were then created for both pre- and post-development scenarios at 100mm intervals between. These volume models established the volume of floodplain storage available at each 100mm elevation within the Assessment Range;

(iii) The volumes of flood plain storage available in any given 100mm interval was calculated by subtracting the volume available at the next lowest interval (e.g. the volume available between elevations 117.30m and 117.40m was calculated by subtracting the volume available at 117.30m from the volume available at 117.40m.

Table 5.1 presents the results of this assessment and shows that for all elevation intervals between the lowest point of the Site and the 0.1% AEP flood level, the volume of compensatory storage provided is greater than the volume of floodplain storage displaced in every interval bar one. Cumulatively the proposed development will increase floodplain storage by 870 cu.m and thus will slightly reduce flood risk elsewhere.

The proposed development therefore meets the requirements of the Flood Risk Management Guidelines for Compensatory Storage.

Elevation		Available Storage		Change in Storage	
lower	upper	pre-development	post-development	interval	cumulative
m	m	m^3	m^3	m^3	m^3
117.2	117.3	0	0	0	0
117.3	117.4	79	247	168	168
117.4	117.5	149	409	261	429
117.5	117.6	205	428	223	652
117.6	117.7	291	444	154	806
117.7	117.8	386	460	74	880
117.8	117.9	451	476	25	905
117.9	118.0	515	515	0	905
118.0	118.05	290	256	-34	870

Table 5.1 Available Floodplain Storage: Pre- and Post-Development

Figure 5.2 shows a plan and typical cross-sections for the compensatory storage area.

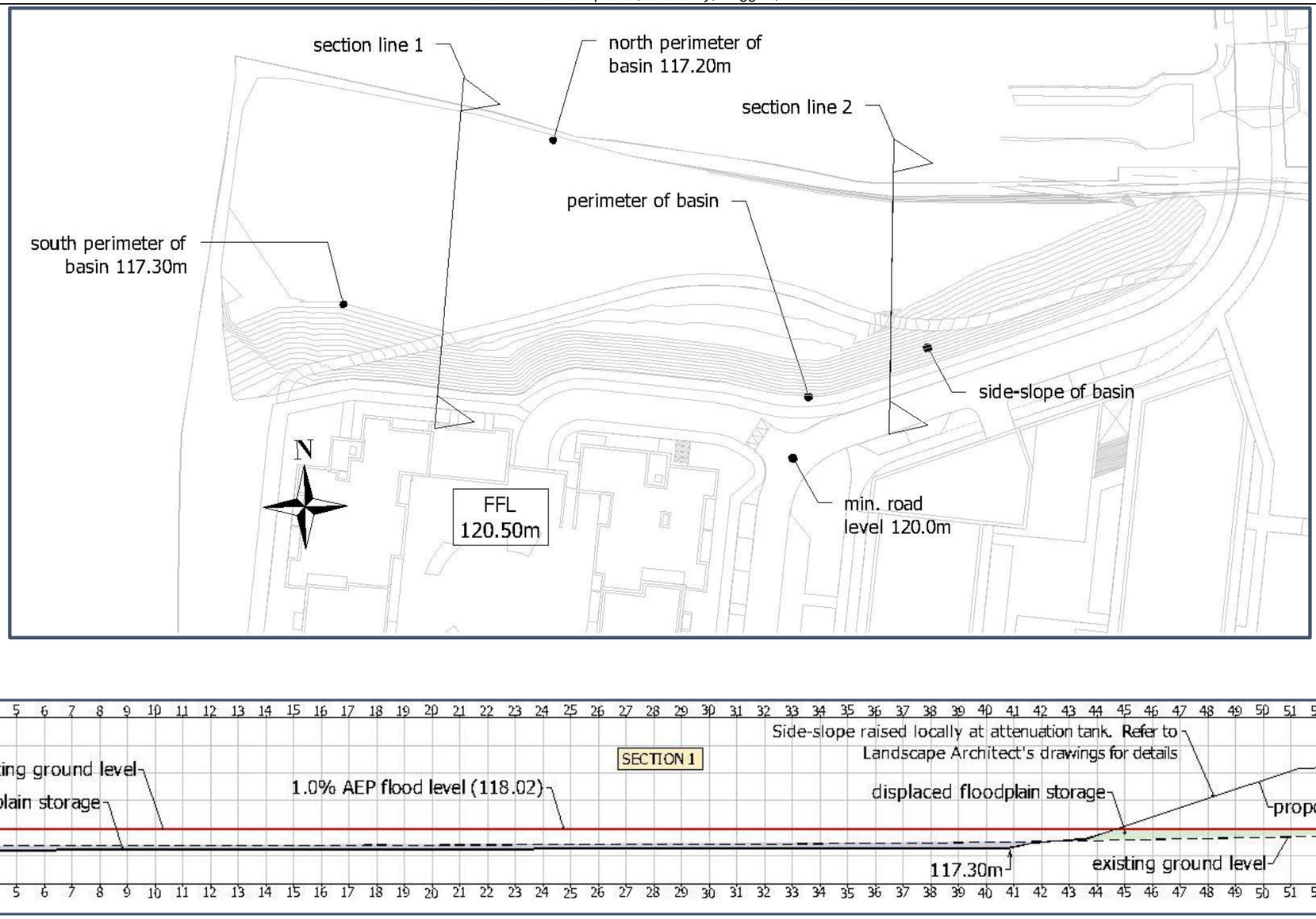


Figure 5.2 Plan and Typical Sections for Compensatory Storage Basin

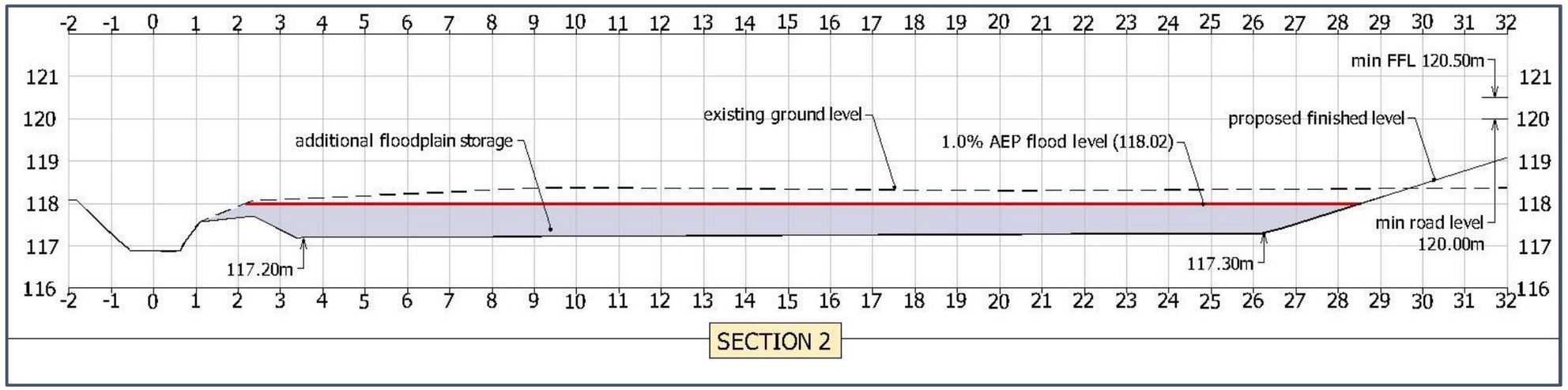


Figure 5.2 Plan and Typical Sections for Compensatory Storage Basin *(continued)*

5.3 Flood Risk Zones – Post-Development

Post-development flood risk zones were established using the hydrological model described in Section 5.1 but using the finished levels of the proposed development rather than the existing ground levels. Figure 5.3 shows the extent of the post-development flood risk zone superimposed on the proposed development; Figure 5.3 also shows the outlines of pre-development flood risk zones.

Post-development peak water levels flood-risk zones are as follows:

- 1.0% AEP Flood Event 118.02m
- 0.1% AEP Flood Event 118.05m

The levels are significantly below the minimum proposed road and floor levels (See Section 8). Within the Site the post-development flood risk zones occupy the compensatory storage basin and do not encroach on water-vulnerable areas of the proposed development.

The proposed development increases available flood plain storage and so will lead to a slight reduction in flood risk elsewhere.

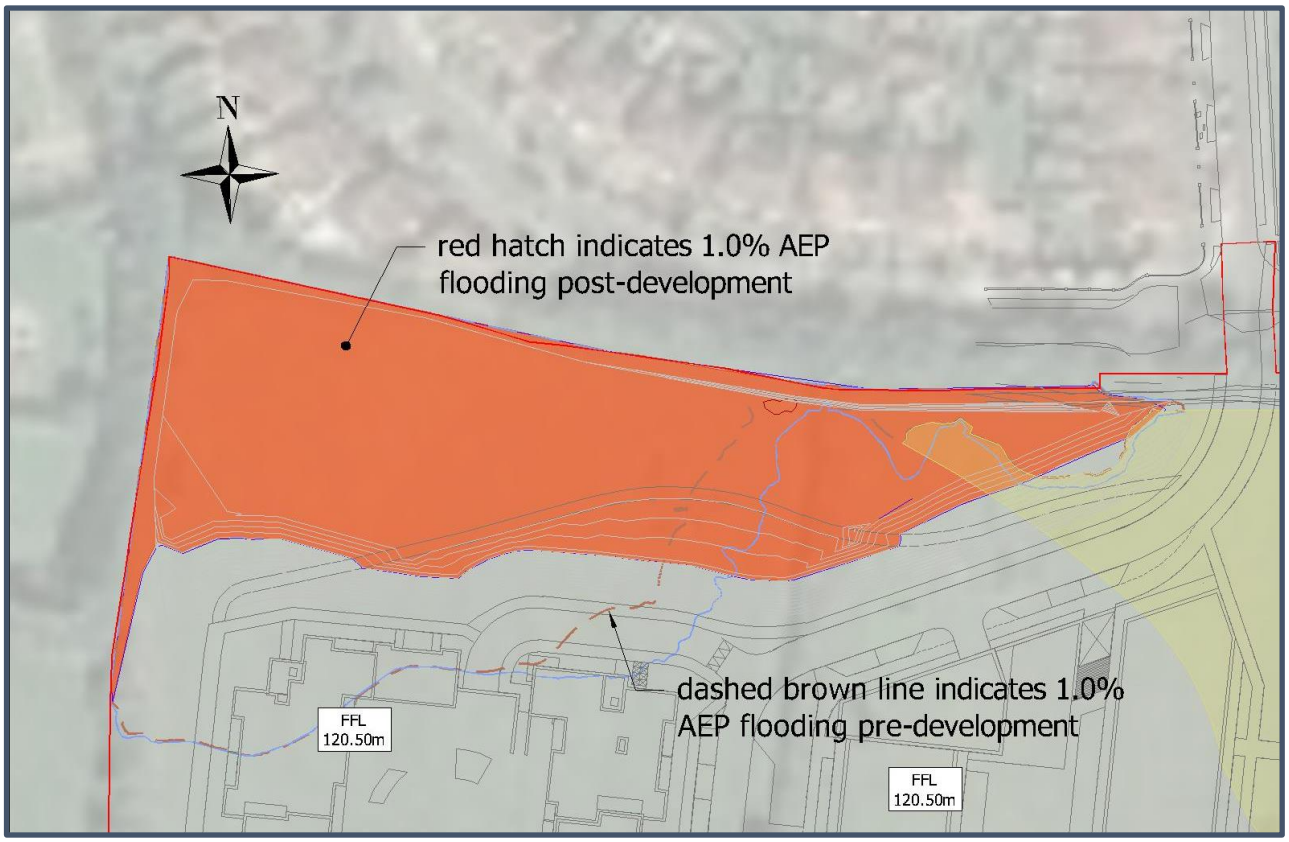


Figure 5.3 Post-Development Flood Risk Zones

5.4 Freeboard to stream channel

The stream was found to overtop its western bank at the northeast corner of the Site, with the resulting overflow continuing downhill as sheet flow (i.e. shallow overland flow) and flowing back into the stream channel slightly further downstream.

Further upstream, peak water levels were found to be close to the bank levels to the point where appropriate freeboard was not being provided.

To provide this freeboard generally the finished level of the open space adjacent to the stream has been raised along the eastern boundary as shown in Figure 5.4 to provide a minimum 750mm freeboard above the 1% AEP water level in the stream.

This measure also eliminates the risk of overland flow at the northeast corner, ensuring that flow remains within the channel through this area. Sections showing the 1% AEP flow levels at the east boundary are provided in Figure 5-6.

The existing topography does not provide any storage for the sheet flow and so compensatory storage is not required.

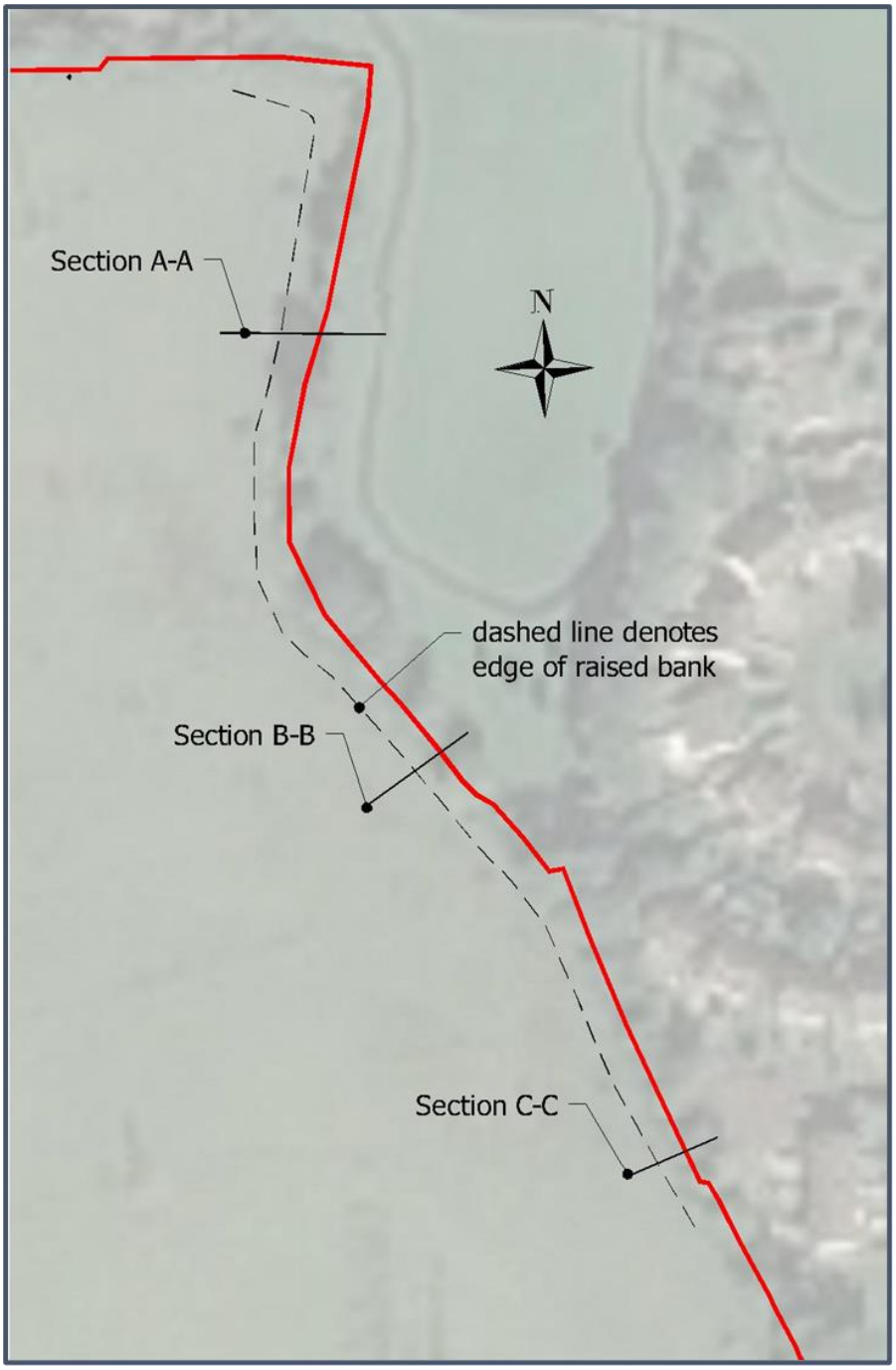


Figure 5.4 Raised Bank at East Boundary

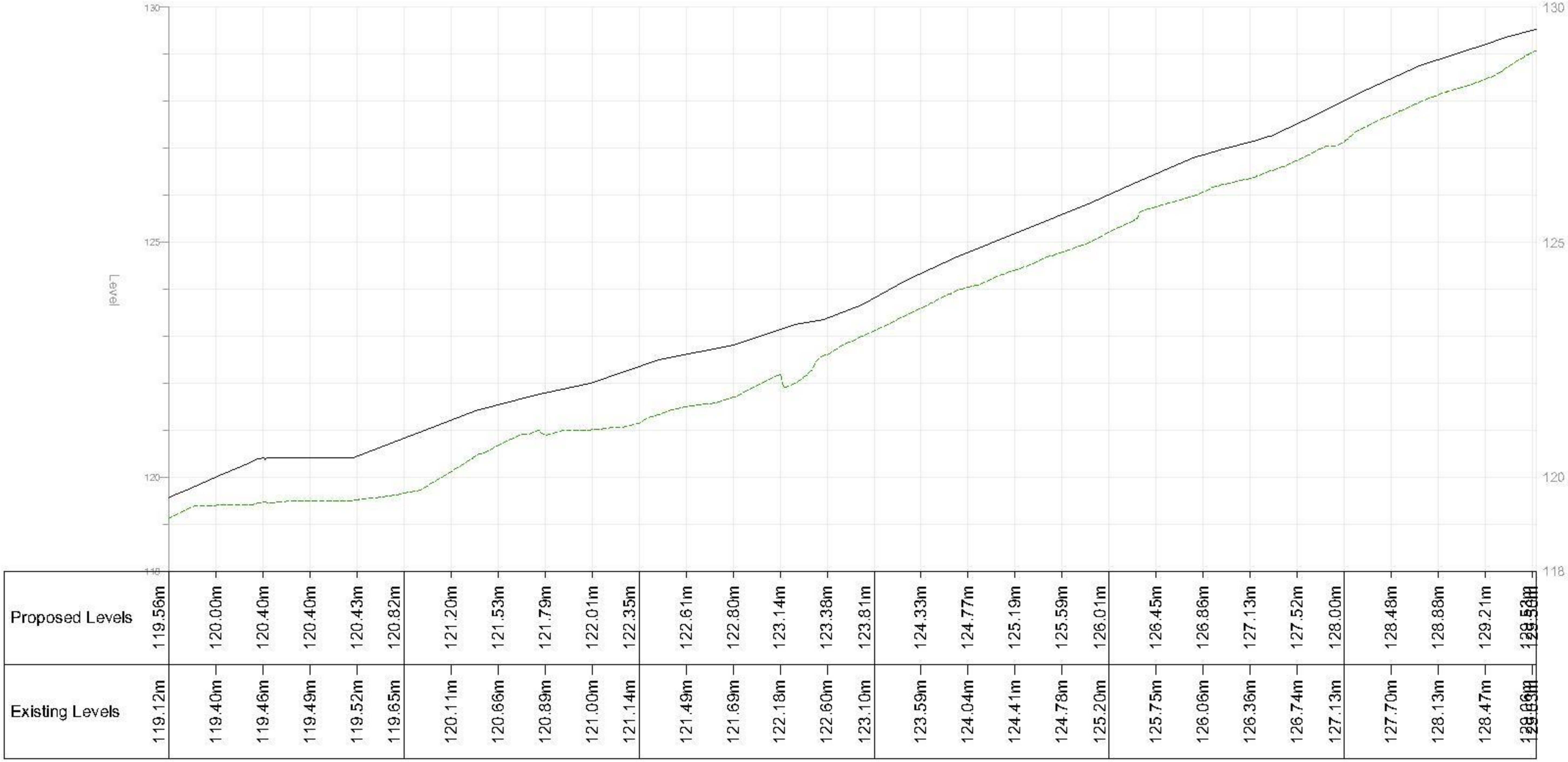


Figure 5.5 Profile through top of Raised Bank at East Boundary (Scale 1Horizontal:10 Vertical)

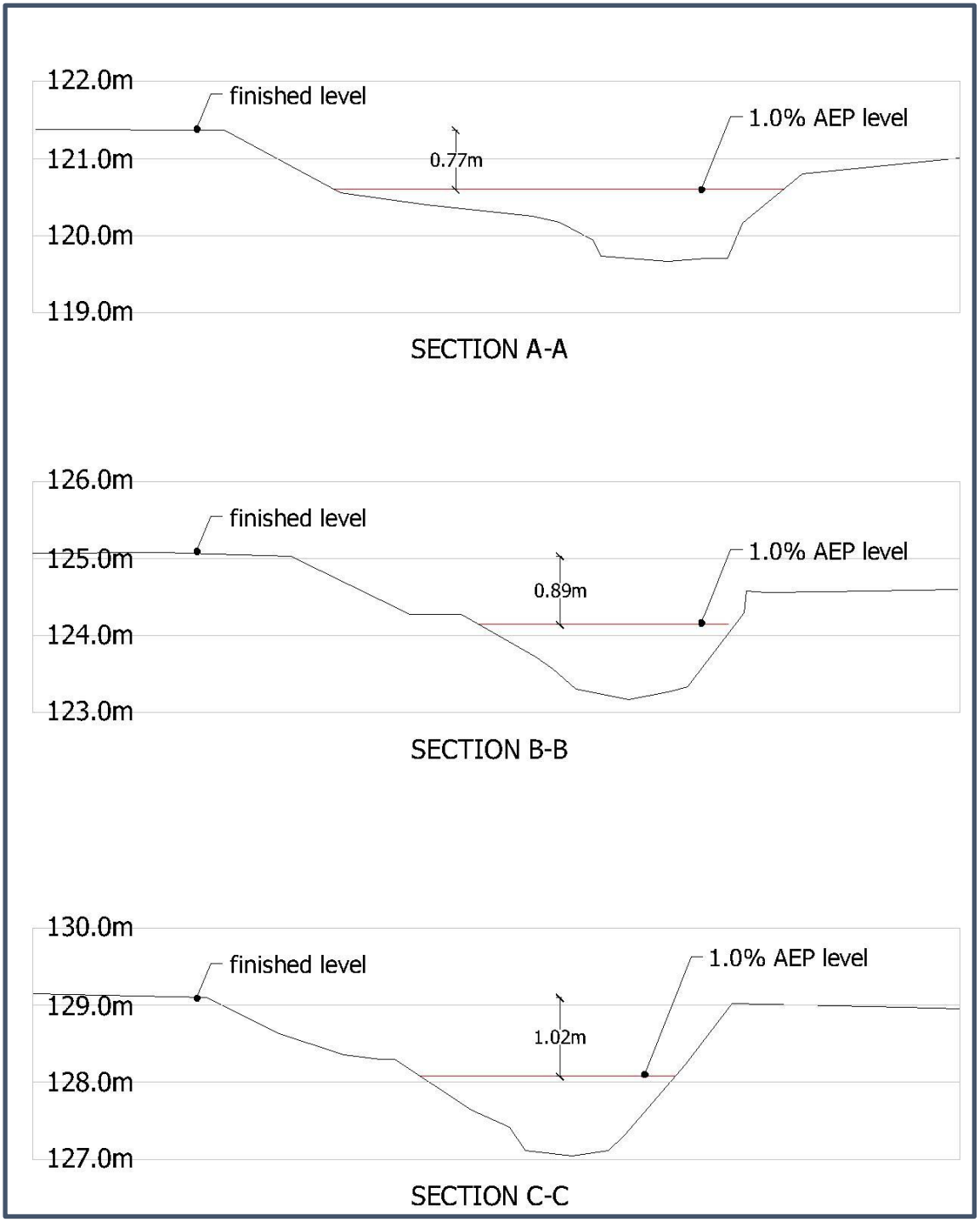


Figure 5.6 Sections showing 1.0% AEP flood level at Raised Bank

5.5 Proposed Stream Crossings

The proposed development includes four stream crossings at the locations shown on Figure 5.7. The crossings structures can be either bridge-type, comprising a simply-supported slab across the stream, or a culvert.

A preliminary design for each structure has been carried out in accordance with OPW requirements. The OPW requires design solution to convey the 1% AEP flood event with a minimum freeboard of 300mm between the top water level at the inlet and the soffit of the culvert.

Table 5.2 shows the 1.0% AEP water level and minimum soffit level at each crossing culvert. Soffit levels are at least 500mm above the 1% AEP level and so comfortably exceeds OPW requirements. Finished levels are thus more than 500mm above the 1% flood level and thus comply with the FRMG recommendations (Section 8).

Figure 5.8 shows a typical section at a stream crossing.

Two of the crossings are vehicular and crossing levels are constrained by the requirement to tie-in to existing road levels. OPW Section 50 consent have been obtained for these crossings; a copy of the consents is included in Appendix E.

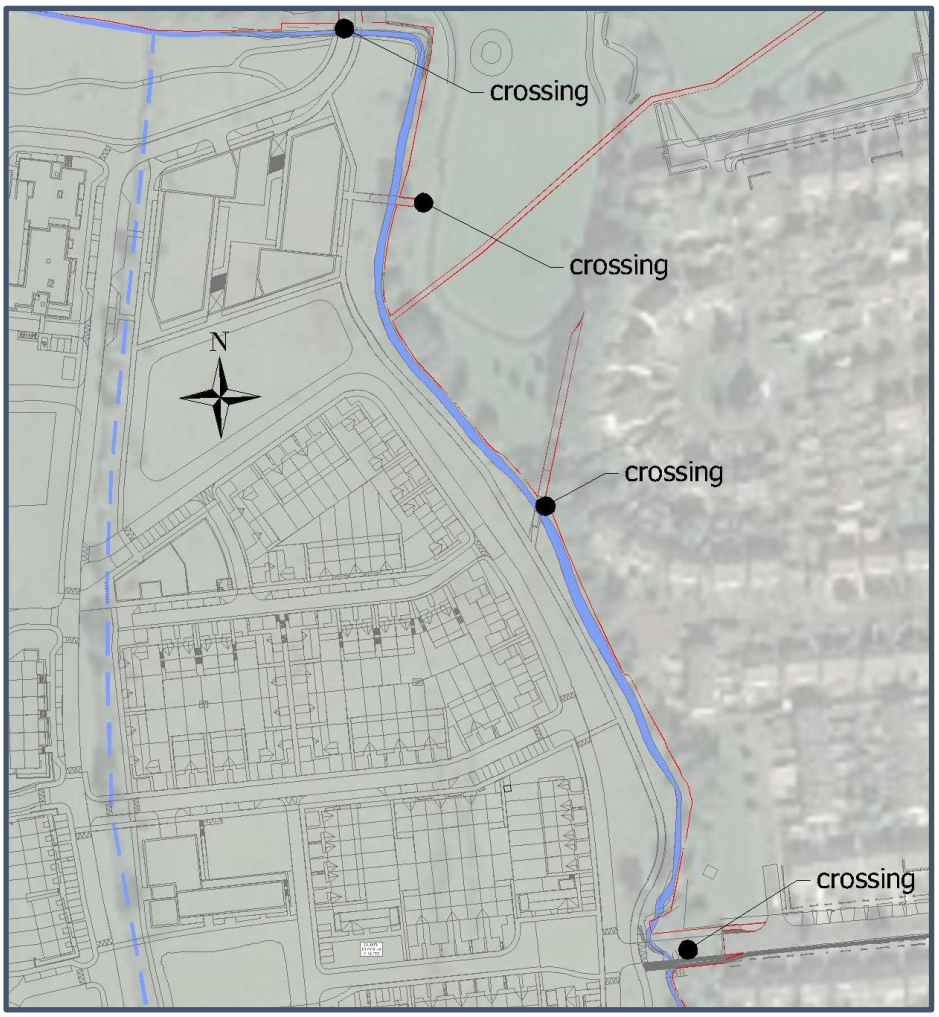


Figure 5.7 Stream Crossings

Crossing	1.0% AEP water level (m OD)	min. soffit Level m OD
1	118.84m	119.44m
2	120.29m	120.79m
3	124.64m	125.14m
4	132.88m	133.38m

Table 5-2 Crossing Details

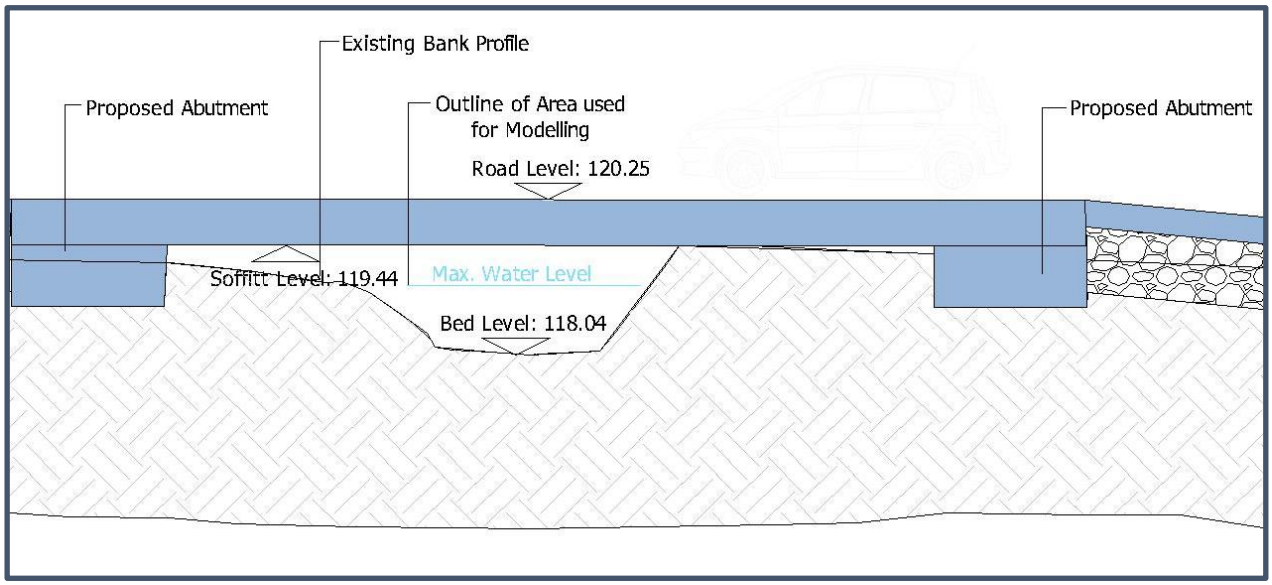


Figure 5.8 Typical Section at Stream Crossing (Carrigmore)

6. FLOOD RISK FROM GROUNDWATER

6.1 Flood Risk Indicators - Desktop

A number of datasets were interrogated for indicators of flood risk from Ground Water. These comprised:

(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. A site-specific report in this regard is provided in Appendix C.

(ii) Geological Survey of Ireland (GSI)

The GSI maintains a web portal which contains information on groundwater flooding. (https://www.gsi.ie). The portal does not show any groundwater flooding at the Site or its environs. The northern half of the Site is in an area of low vulnerability and the southern half is in an area of moderate vulnerability.

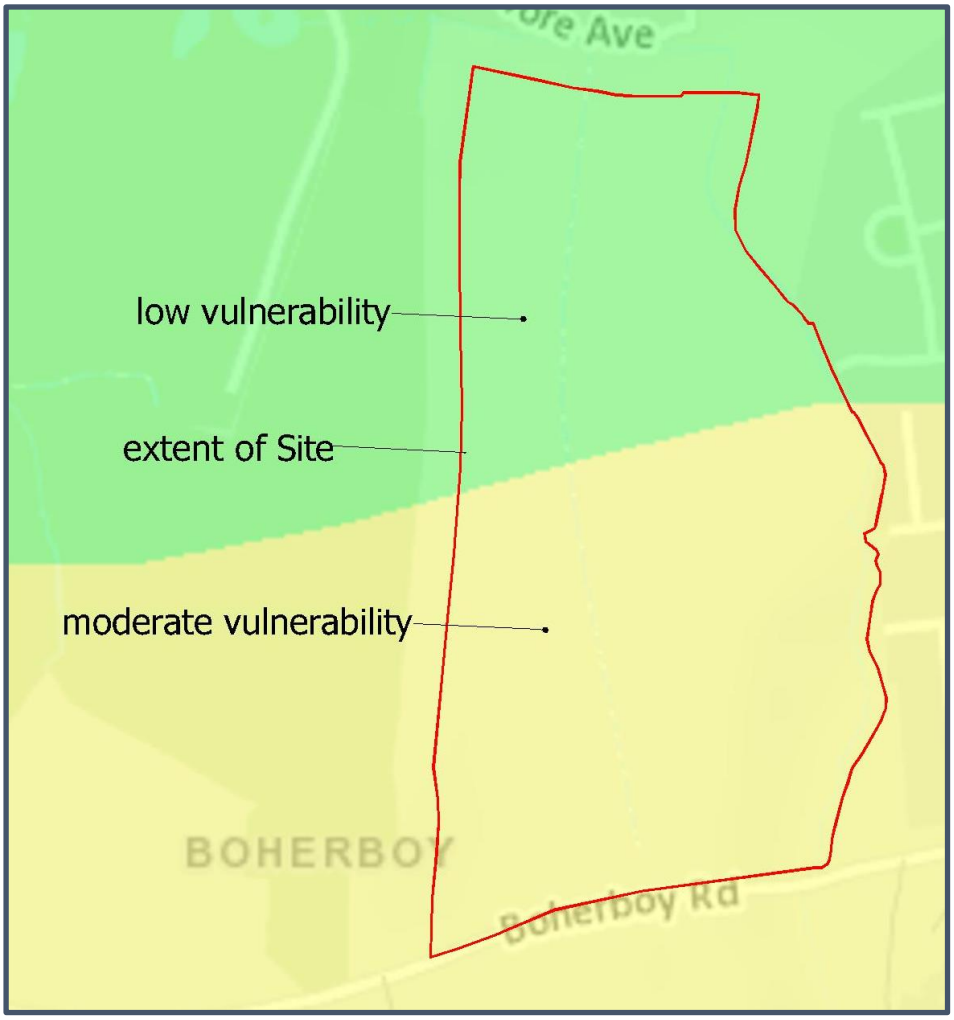


Figure 6.1 Groundwater Vulnerability from GSI

(iii) Historical Ordnance Survey Mapping

Historical OS maps do not contain any indicator of flood risk from ground water.

(iv) Topographical Survey

The Site slopes steeply from the Boherboy Road to the northern boundary. This sloping topography eliminates the potential for significant localised groundwater ponding within the Site.

(v) Ground Investigation

Trial holes were excavated as part of a ground investigation at the Site. Groundwater was not encountered within 2.0m of existing ground level. A copy of the ground investigation records is provided in Appendix D.

6.2 Flood Risk Indicators – Site Walkover

No indicators of groundwater flood risk were observed during a Site walkover.

6.3 Initial Assessment

The indicators described above do not provide any indication of flood risk from groundwater and so further detailed assessment of flood risk from this mechanism is not required.

7. PLUVIAL FLOOD RISK

7.1 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 Development Plan 2016 – 2022 does not show any indicators of pluvial flood risk at the Site.

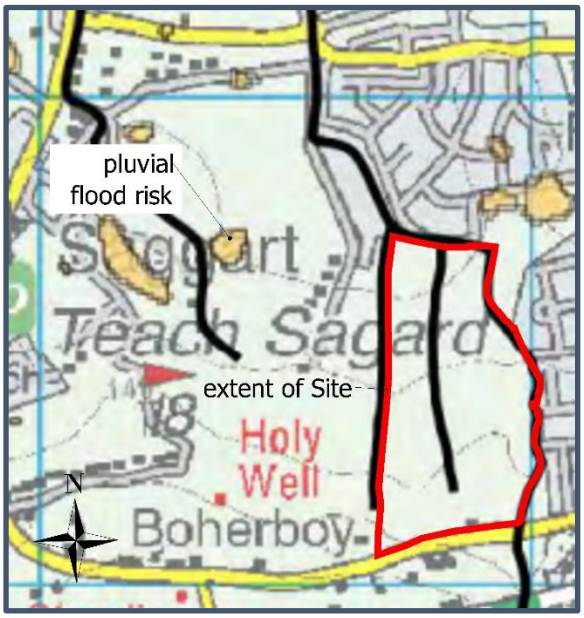


Figure 7.1 Extract from SFRA

(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. However, as much of the Site is away from the public road, the absence of historic flood records is not a strong indicator that there is no flood risk. A site-specific report in this regard is provided in Appendix C

(iii) CFRAM study programme undertaken by the OPW

Maps prepared for the CFRAM study programme do not show and indicators of pluvial flood risk at the Site. A copy of the relevant flood risk map is provided in Appendix A.

(iv) *Surface Water Drainage for the Proposed Development*

The surface water drainage system for the proposed development is designed in accordance with the recommendations of GDSDS (refer to Section 3.2). Compliance with GDSDS ensures the surface water drainage system for the development will not lead to pluvial flood risk within the development and will not cause an increase in pluvial flood risk elsewhere.

A small underground attenuation storage tank is proposed at the northern margins of the compensatory storage basin. This storage tank should be sealed so that there can be no ingress of water from the compensatory storage basin to the attenuation storage; a non-return valve is to be installed on the outfall.

These measures ensure there will be no connectivity between fluvial flow and the surface water drainage system for the proposed development.

7.2 Flood Risk Indicators – Site Walkover

As described in Section 3, the Site includes two local field ditches running in a south to north direction.

The Site comprises two rectangular fields in parallel stretching from the southern boundary to the northern boundary, both under agricultural use. The boundary between the fields is defined by a hedgerow and local field ditch (EPA Designation Code 09C60); this ditch inside the Site, close to the south boundary, and outfalls to the Corbally Stream at the north boundary. A similar local field ditch (EPA Designation Code 09C62) adjoins the western boundary of the Site; this ditch starts at the south boundary and also discharges to the Corbally Stream.

Figure 7.1 Local field ditch rain through centre of Site

Figure 7.2 Local field ditch at west boundary

Both ditches are to remain open post-development. The ditch at the west boundary will remain largely unchanged; the ditch through the middle of the Site will become a swale with a filter drain installed below its bed (Ref Detail 8 of RMA Dwg 1324B/317). The drainage paths established by these field ditches will therefore be preserved post-development.

No evidence of drainage pipes entering the Site which could lead to pluvial flow entering the Site was observed.

7.3 Initial Assessment

Neither desktop indicators nor the Site walkover revealed evidence of flood risk from pluvial sources and accordingly detailed assessment of this flooding mechanism is not required.

8. FINISHED LEVELS OF PROPOSED DEVELOPMENT

In order to ensure that elements of the development not compatible with water (i.e. roads and houses) are not at risk of flooding, it is recommended that proposed floor and road levels be raised above peak flood levels. The Flood Risk Management Guidelines recommend that floor levels be kept above the 1.0% AEP flood level with an appropriate allowance for freeboard, typically 500mm. The SSFRA also recommends that road levels should be kept a minimum 250mm above the 100year flood level.

The maximum post-development 1% AEP water level in the basin at the north boundary is 118.02m. Accordingly, the minimum ground floor level for buildings adjacent to the Compensatory Storage Area should be 119.52m (i.e. 118.02m + 0.5m). Proposed buildings adjacent to the Compensatory Storage Area have a minimum floor level of 120.50m, 2.48m above the 1% AEP level.

Similarly, the minimum recommended road level immediately in the vicinity of the Compensatory Storage Area is 118.27m (i.e. 118.02m + 0.25m). The proposed road connecting to lands north has a minimum level of 120.00m, 1.98m above the 1% AEP level and 1.73m above the recommended minimum.

As described in Section 5.4, the finished level of the open space adjacent to the Corbally stream has been raised where required to provide a minimum 750mm freeboard above the 1% AEP water level in the stream.

9. SOUTH DUBLIN COUNTY COUNCIL – WATER SERVICES REPORT

Table 9.1 presents the comments relating to flood risk in the SDCC Water Services Report of 21st October 2020 and the SSFRA responses thereto.

SDCC Comment of Flood Risk	SSFRA
The applicant is required to clarify whether or not there are existing land drains traversing the site which drain lands outside of the subject site boundaries. If this is the case, then the applicant is required to demonstrate how the existing overland surface water flows will be maintained across the site after the site has been developed.	The drainage system for the proposed development preserves the drainage paths established by existing field ditches. Refer to Section 7.2. No evidence was found of either drainage pipes entering the Site which could lead to pluvial flow or of land drainage pipes within the Site.
The applicant is required to obtain consent from the Office of Public Works (OPW) through a Section 50: Arterial Drainage Act 1945 licence for the proposed construction of all stream crossings as part of the development. The applicant is required to submit with their planning application written confirmation of a Section 50 licence agreement with the OPW for the above works.	A preliminary design for each structure has been carried out in accordance with OPW requirements. Soffit levels are at least 500mm above the 1% AEP level at all crossings and so comfortably exceed OPW requirements. Two of the crossings are vehicular and crossing levels are constrained by the requirement to tie-in to existing road levels. OPW Section 50 consent have been obtained for these crossings; a copy of the consents is included in Appendix E. Refer to Section 5.5 for additional detail.
Side slopes of proposed swales, detention basins and flood compensation storage areas should be graded to be as shallow as possible to allow for maintenance and terracing of side slopes should be considered. All swales, detention basins and flood compensation storage areas details must be agreed with South Dublin County Councils Public Realm Department to ensure maintenance of same can be carried out.	Side slopes on the basin at the northern boundary do not exceed 1H:3V.

Table 9.1 SDCC Report and Responses

10. RESIDUAL FLOOD RISK

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

10.1 Climate Change

As described in Section 2.7, the assessment considered flood risk associated with the Mid-Range Future Scenario (MRFS).

The OPW has adopted a second indicative potential futures for flood risk assessment; the High-End Future Scenario (HEFS). The HEFS is based on a more extreme future based on the upper end of the range of projections of future climatic conditions. It is considered as a residual flood risk.

As described in Section 5.1, flood risk at the northwest corner of the Site arises when the capacity of the culvert immediately downstream of the Site is exceeded and water ultimately overtops the west boundary and continues downstream. In the HEFS, this same overtopping mechanism limits the extent to which water will rise. As described in Section 8, freeboard between peak water levels and floor levels and road levels significantly exceeds the recommended minimum and so even in the HEFS, appropriate freeboard remains.

Section 5.4 describes the finished level of the open space adjacent to the stream being raised along the eastern boundary to provide a minimum 750mm freeboard above the 1% AEP water level in the stream. To assess flood risk along the eastern boundary in the HEFS, the performance of the stream at the east boundary was analysed for peak flows in the 1% scenario based on a 30% climate change factor. This analysis found that even in the HEFS, the freeboard available between the 1% AEP water level and the top of bank exceeds 500mm; refer to Figure 10-1, and thus complies with the recommendations of the Flood Risk Management Guidelines.

10.2 Blockage downstream of the Site

In the event of flow in the watercourse downstream becoming obstructed during a significant rainfall event, for example if the culvert immediately downstream of the Site becomes blocked, water will back up in the stream channel to the point where it overtops the channel bank at the northwest corner of the Site. If the water level continues to rise it will overtop the western boundary. Once water has reached this elevation, the effective flow channel becomes far larger than the natural channel and water levels will therefore not increase significantly above the existing ground level at the western boundary.

From Section 8, the minimum floor level is 120.50m, significantly above ground levels at the western boundary and therefore no buildings in the proposed development are at risk in this scenario.

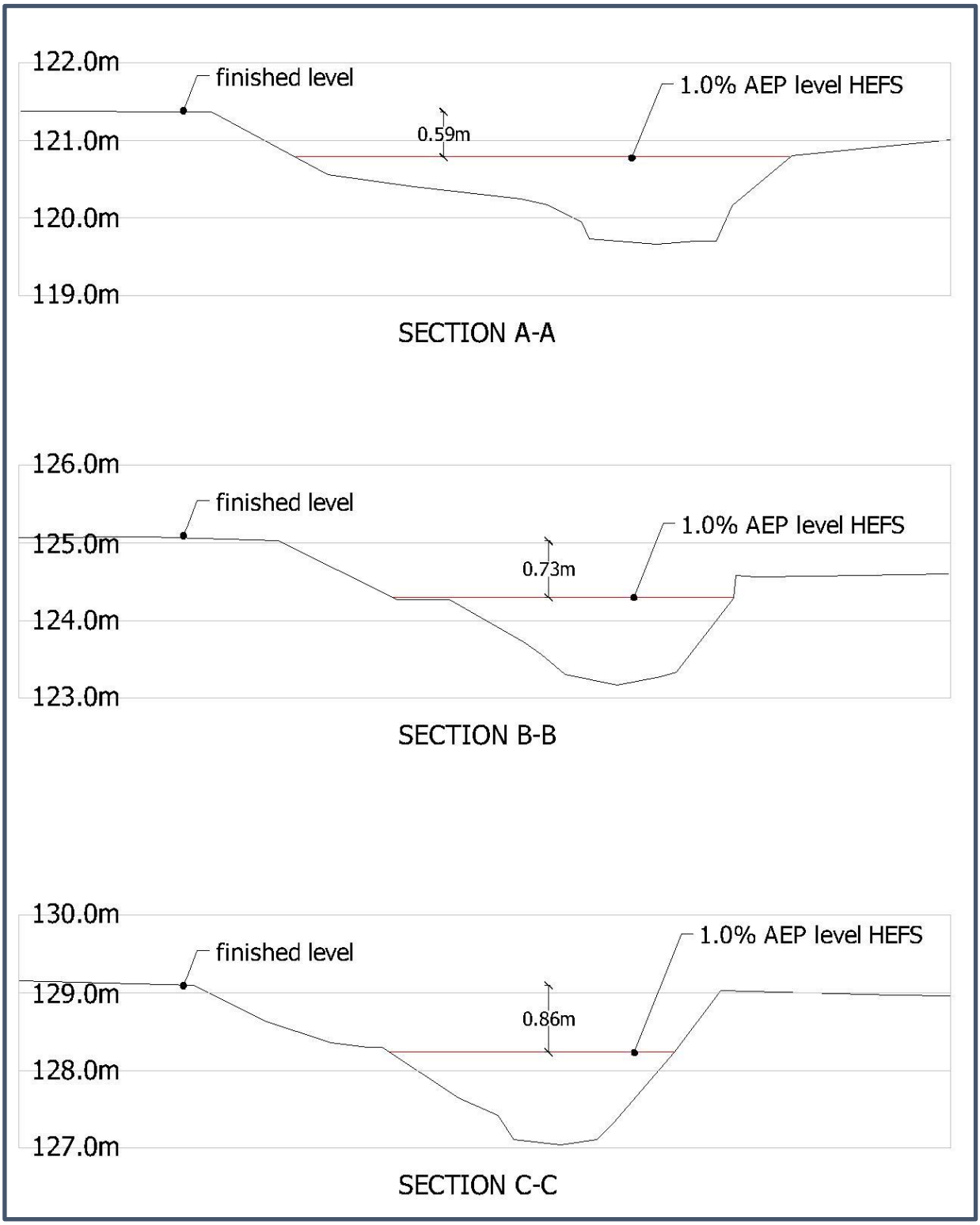


Figure 10-1 Sections at East Boundary in HEFS

10.3 Failure of surface water drainage system

The surface water drainage system has been designed to capture, store and discharge surface water run-off from rainfall events for all return periods up to and including 100 years (with an allowance for climate change).

Notwithstanding this, a blockage could occur in the surface water drainage system, leading to the risk of water rising in upstream manholes to the point where the manhole overtops and water overflows on to the surrounding ground.

The proposed development provides routes for the conveyance of such overflows which ensure that buildings would not be at risk of flooding in this event. Refer to Drg No 1324B/315 Exceedance Overflow Route prepared as part of the surface water drainage design.

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.*	
	Under the South Dublin County Council (SDCC) Development Plan, the Site is classified for the following land use (Objective RES-N) To provide for new residential communities in accordance with approved area plans.	
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 in excess of the floodplain storage being displaced and so will lead to a slight decrease in flood risk elsewhere. The surface water drainage system for the proposed development has been designed in accordance with the Greater Dublin Strategic Drainage Study and thus 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 proposed residential development at Boherboy, Saggart, Co. Dublin. The SSFRA was carried out in accordance with the document *'Planning System and Flood Risk Management – Guidelines for Planning Authorities (2009)'.*

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 and Groundwater.

Initial assessment of existing flood risk indicators indicate the Site is not at risk from either Pluvial or Groundwater flooding.

Initial assessment of flood risk indicators suggest the Site could be at risk from Fluvial Flooding. Accordingly, a detailed assessment of fluvial flood risk was carried out. This detailed assessment confirmed that the Site is affected by flood risk zones A & B at its northern boundary.

The proposed development includes a basin at the northwest corner of the Site which is designed to provide direct compensatory storage. The inclusion of this basin means that while the proposed development will impact on existing flood risk zones at some locations (Section 5.1) and thus displace floodplain storage, it reduces the ground level at other locations, thereby providing compensatory storage. Cumulatively, more floodplain storage will be available upon completion of the proposed development than is currently available, leading to a slight reduction on flood risk elsewhere.

The proposed development includes four stream crossings at the locations shown on Figure 5.7. A preliminary design for each structure has been carried out in accordance with OPW requirements. Soffit levels are at least 500mm above the 1% AEP level at all crossings and so comfortably exceed OPW requirements. Two of the crossings are vehicular and crossing levels are constrained by the requirement to tie-in to existing road levels. OPW Section 50 consent have been obtained for these crossings; a copy of the consents is included in Appendix E.

The Flood Risk Management Guidelines recommend that floor levels be kept above the 1.0% AEP flood level with an appropriate allowance for freeboard, typically 0.5m. The maximum post-development 1% AEP water level in the basin at the north boundary is 118.02m. The minimum proposed floor level is 120.50m, 2.48m above the 1% AEP level and 1.98m above the recommended minimum. This SSFRA also recommends that road levels should be kept a minimum 250mm above the 100year flood level. The minimum proposed road level is 120.00m, 1.98m above the 1% AEP level and 1.73m above the recommended minimum.

As described in Section 5.4, the finished level of the open space adjacent to the Corbally stream has been raised where required to provide a minimum 750mm freeboard above the 1% AEP water level in the stream.

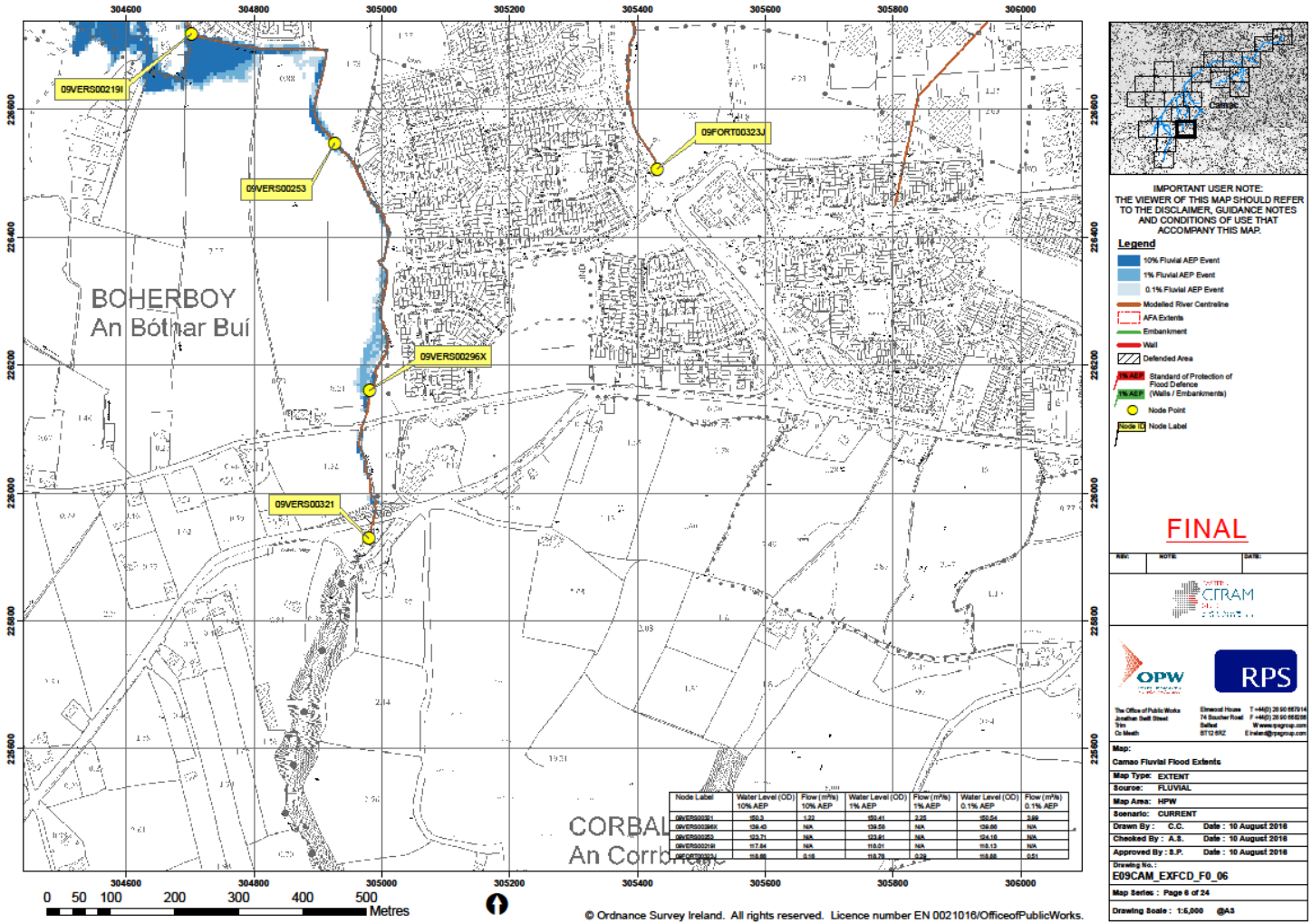
The proposed development was subject to and passed the Development Management Justification Test.

12.2 Conclusion

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

Flood Risk Maps


09VERS00219I
09VERS00253
09FORT00323J
09VERS00296X
09VERS00321
BOHERBOY
An Bóthar Buí
CORBAL
An Corrbhéal
0 50 100 200 300 400 500 Metres
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IMPORTANT USER NOTE:
THE VIEWER OF THIS MAP SHOULD REFER TO THE DISCLAIMER, GUIDANCE NOTES AND CONDITIONS OF USE THAT ACCOMPANY THIS MAP.
Legend
10% Fluvial AEP Event
1% Fluvial AEP Event
0.1% Fluvial AEP Event
Modelled River Centreline
AFA Extents
Embankment
Wall
Defended Area
Standard of Protection of Flood Defence (Walls / Embankments)
Node Point
Node Label
FINAL
OPW
RPS
Map: Camao Fluvial Flood Extents
Map Type: EXTENT
Source: FLUVIAL
Map Area: HPW
Scenario: CURRENT
Drawn By : C.C. Date : 10 August 2016
Checked By : A.B. Date : 10 August 2016
Approved By : S.P. Date : 10 August 2016
Drawing No. : E09CAM_EXFCD_F0_06
Map Series : Page 6 of 24
Drawing Scale : 1:5,000 @A3

Appendix B

Estimation of Run-off from 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)	2.05	km^2	FSU
Average Annual Rainfall (SAAR)	889	mm	FSU
G1 % =	0	%	Fig I 4.18
G2 % =	0	%	Fig I 4.18
G3 % =	0%	%	Fig I 4.18
G4 % =	100%	%	Fig I 4.18
G5 % =	0%	%	Fig I 4.18
Soil index (G) =	0.45	%	
$Q_{BAR\ RURAL}$ =	1.02	m3/sec	
CWI =	121		Fig I 6.62
CIND =	44.96		Eqn 7.2
NC =	0.71		Eqn 7.3
URBAN =	1%		FSU
$Q_{BAR\ URBAN}$ / $Q_{BAR\ RURAL}$ =	1.018		Eqn 7.4
Q_{BAR} =	1.038	m3/sec	
Q_{100} / Q_{BAR} (Ireland)	1.96		FSR - Ireland
$Q_{1,000}$ / Q_{BAR} (Ireland)	2.6		FSR - Ireland
Q_{100} =	2.034	m3/sec	
$Q_{1,000}$ =	2.699	m3/sec	
Factorial Error Factor =	1.651		Page 37 IOH124
Climate Change Factor =	1.2		FRMG
Q_{100} =	**4.03**	**m3/sec**	
$Q_{1,000}$ =	**5.35**	**m3/sec**	

FSU Update estimation of Q_{100} & Q_{1000}			
Characteristic	**Value**	**Unit**	**Source**
Area	2.0	km^2	FSU Portal
SAAR	889	mm	FSU Portal
BFI_{soil}	0.619		FSU Portal
FARL	1.0		FSU Portal
S1085	65.48	m/km	FSU Portal
$QMED_{rural}$	0.99	m3/s	
URBEXT	0.00		FSU Portal
$QMED_{urban}$	0.99		
Climate Change Factor	1.2		OPW
Q_{100} / $QMED_{rural}$	2.77		FSU Portal
Q_{1000} / $QMED_{rural}$	3.74		FSU Portal
Q_{100}	**3.305**	**m3/sec**	
$Q_{1,000}$	**4.463**	**m3/sec**	

FSU-3V estimation of Q_{100} & Q_{1000}			
Characteristic	**Value**	**Unit**	**Source**
Area	2.0	km^2	FSU Portal
BFI_{soil}	0.619		FSU Portal
SAAR	889	mm	FSU Portal
QMED	0.116	m3/s	
Climate Change Factor	1.2		OPW
Q_{100} / QMED	2.77		
Q_{1000} / QMED	3.74		
Q_{100}	**0.386**	**m3/sec**	
$Q_{1,000}$	**0.522**	**m3/sec**	

FSU-7V estimation of Q_{100} & Q_{1000}			
Characteristic	**Value**	**Unit**	**Source**
Area	2.0	km^2	FSU Portal
BFI_{soil}	0.619		FSU Portal
SAAR	889	mm	FSU Portal
FARL	1.0		FSU Portal
DRAIND	1.85	km/km^2	
S1085	65.48	m/km	FSU Portal
ARTDRAIN	0.00		
$QMED_{rural}$	0.716	m3/s	
URBEXT	0.00		FSU Portal
$QMED_{urban}$	0.72		
Climate Change Factor	1.2		OPW
Q_{100} / $QMED_{rural}$	2.77		FSU Portal
Q_{1000} / $QMED_{rural}$	3.74		FSU Portal
Q_{100}	**2.379**	**m3/sec**	
$Q_{1,000}$	**3.213**	**m3/sec**	

FEH-Statistical estimation of Q_{100} & Q_{1000}			
Characteristic	**Value**	**Unit**	**Source**
Area	2.0	km^2	FSU Portal
SAAR	889	mm	FSU Portal
FARL	1.0		FSU Portal
BFI_{soil}	0.619		FSU Portal
QMED	0.57	m3/s	
Climate Change Factor	1.2		OPW
Q_{100} / QMED	2.77		FSU Portal
Q_{1000} / QMED	3.74		FSU Portal
Q_{100}	**1.902**	**m3/sec**	
$Q_{1,000}$	**2.567**	**m3/sec**	

Appendix C

Summary Report from OPW Flood Hazard Website

OPW National Flood Hazard Mapping

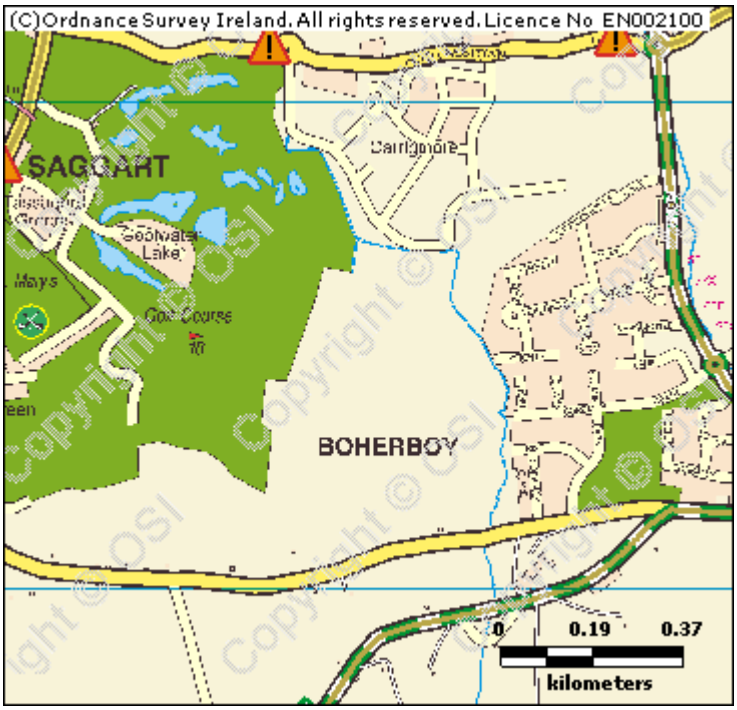
Summary Local Area Report

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

The map centre is in:

County: Dublin

NGR: O 047 264



Map Scale 1:15,532

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.

11 Results

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

2. Flooding at Garter Lane, Saggart, Co. Dublin on 24th Oct 2011
County: Dublin
Start Date: 24/Oct/2011
Flood Quality Code:3
Additional Information: Reports (1) More Mapped Information

3. Flooding at Fortunestown Lane, Citywest, Co. Dublin on 24th Oct 2011
County: Dublin
Start Date: 24/Oct/2011
Flood Quality Code:3
Additional Information: Reports (1) More Mapped Information

4. Flooding at Blessington Road, Tallaght, Dublin 24 on 1st May 2012
County: Dublin
Start Date: 05/Jan/2012
Flood Quality Code:2
Additional Information: Reports (1) More Mapped Information

5. Flooding at Avoca Road, Saggart on 24th Oct 2011
County: Dublin
Start Date: 24/Oct/2011
Flood Quality Code:2

Appendix D

Ground Investigation Records

GROUND INVESTIGATIONS IRELAND

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Catherinestown House,
Hazelhatch Road,
Newcastle, Co Dublin,
Tel: 01 601 5175 / 5176 | Fax: 01 601 5173
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GROUND INVESTIGATIONS IRELAND LTD

BOHERBOY SAGGART

GROUND INVESTIGATION REPORT

DOCUMENT CONTROL SHEET

Engineer	Roger Mularkey
Project Title	Boherboy Saggart
Project No	4019-11-13
Document Title	Ground Investigation Report

Rev.	Status	Author(s)	Reviewed By	Approved By	Office of Origin	Issue Date
A	Final	C Finnerty	F McNamara	F McNamara	Dublin	3rd February 2014

Saggart, Boherboy - Ground Investigation Report

Contents

Appendices

1.0 Preamble

On the instructions of Roger Mularkey Consulting Engineers, a site investigation was carried out by Ground Investigations Ireland Ltd., between the 9th and the 12th of December 2013 on a site in Boherboy, Saggart, Co. Dublin.

2.0 Overview

2.1 Background

The site consists of two greenfield sites which have been combined for the purpose of the proposed development. The site is located on the outskirts of Saggart as shown in the location plan in Appendix 1. It is proposed to develop a portion of the site closest to the road and to construct two and three story residential dwellings. The site slopes from the southern boundary along the road towards the north with the highest point at the south west corner. Earthworks and a retaining wall are proposed along the highest portion of the site to make it more accessible and suitable for construction. There are a series of two large diameter water mains passing through the centre of the site from east to west and a second series of three large diameter water mains along the same axis in the northern portion of the site.

2.2 Purpose and Scope

The purpose of the site investigation was to investigate subsurface soil conditions by means of trial pitting, dynamic probing and slit trenching. The scope of the work undertaken for this project included the following:

- Visit project site to observe existing conditions
- Carry out 8 No. Trial Pit to a maximum depth of 3.5m BGL
- Carry out 6 No. Slit Trenches to a maximum depth of 2.5m BGL
- Carry out 9 No. Dynamic Probes to a maximum depth of 3.3m BGL
- Carry out 4 No. Soakaway tests to BRE Digest 365
- Geotechnical and Environmental Laboratory testing

3.0 Desk Study

3.1 Sources of Information

A desk study has been carried out for the site and the surrounding area to determine the nature of the underlying bedrock geology and overburden materials, relevant geomorphological features, previous land use for the site and to identify any other geotechnical considerations for the area. This study comprised a search of relevant geotechnical, geological and hydrogeological information. The Geological Survey of Ireland (GSI) was consulted for this purpose and the following sources of information were reviewed:

GSI Publications:

- Geology of Kildare Wicklow, GSI, 1994, B. McConnell, M.E. Philcox,

- Bedrock Geology 1:100,000 Scale Map Series, Sheet 16: Kildare - Wicklow.

GSI Online Mapping:

- GSI Drift Geology Maps
- GSI Hydrogeological Mapping
- GSI Groundwater Well Database
- GSI Karst Database
- GSI Quarries Database

In addition, the Ordnance Survey of Ireland (OSI) was also consulted and the following sources of information reviewed.

OSI Online Mapping:

- Historical Mapping – 6 Inch Sheets
- Historical Mapping – 25 Inch Sheets
- Ortho Mapping
- Historical Land Use Mapping Database

3.2 Land Use

The OSI mapping indicates that the site has historically been used as agricultural land. A number of agricultural and/or accommodation buildings are shown on the 6" and 25" Historic Mapping close to the road, with little change from the current site layout. A drain or watercourse is shown on the 25" Mapping feeding into the current watercourse from the west between the two field boundaries. Based on the current

Orthophotographs this section of the drain or watercourse has been in-filled. Caution should be exercised with foundations in area of this in-filled stream. The 1995, 200 and 2005 Orthophotographs show little or no discernable change to the land use in the recent past.

3.3 Superficial Geology

The GSI publications and mapping indicate that the estate and surrounding area is underlain primarily by glacial till derived from Sandstone and Shale. The soils mapping indicates that glacial till derived from Limestone are present to the north of the site and rock outcrops or is very near to the surface to the north and north west of the site, coinciding with areas of extreme groundwater vulnerability and the locations of historic quarries on the historic mapping.

3.4 Regional Bedrock Geology

The site is mapped as being underlain by coarse greywacke & shale of the Pollaphuca Formation. The Calp or Lucan formation is present to the north of the site.

3.5 Hydrogeology

GSI mapping indicates that the bedrock underlying the site (Pollaphuca Formation) is classified as a Poor Aquifer (P) - bedrock which is generally unproductive except only in local zones.

The aquifer vulnerability for the area ranges from Low to Extreme. At the site location, the area is classified as having a Low Vulnerability. An area of Moderate and High Vulnerability is present surrounding the area of the site area. Generally, the High/Extreme Vulnerability areas are close to areas where bedrock is shallow or where sand and gravel deposits are expected and/or there is a thin cover of cohesive material above the bedrock. The Moderate/Low Vulnerability areas are likely to coincide with areas where sufficient thicknesses of cohesive glacial deposits are present above the bedrock or where deeper bedrock is expected.

The GSI Karst database mapping confirms that no karst features are present on or around the site location.

There are no recorded mineral or aggregate extractive licences sites in the immediate vicinity of the site as shown in the GSI Quarries Database, however there are a number of metallic and non-metallic mineral locations in Belgard to the east and in Lugmore to the south east of the site.

4.0 Subsurface Exploration

4.1 General

During the ground investigation in December 2013 a programme of trial pitting, dynamic probing and slit trenching was undertaken to determine the sub surface conditions at the proposed site. Soakway testing was carried out in accordance with BRE Digest 365 to determine the infiltration characteristics of the site. Regular sampling and in-situ testing was undertaken in the trial pits to facilitate the geotechnical descriptions and to enable laboratory testing to be carried out on the soil samples recovered during excavation.

4.2 Trial Pits

Eight trial pits were excavated using a JCB 3 CX at the locations shown in the exploratory hole location plan in Appendix 1. The locations were checked using a CAT scan to minimise the potential for encountering services during the excavation. The trial pits were logged and photographed by a Geotechnical Engineer prior to backfilling with arisings.

The trial pit logs are provided in Appendix 2 of this Report.

4.3 Dynamic Probes

The dynamic probe tests (DPH) were carried out beside the trial pits using Terrier 2000 rig in accordance with B.S. 1377: Part 9 1990. The test consists of mechanically driving a cone with a 50kg weight in 100mm intervals and monitoring the number of blows required. An equivalent Standard Penetration Test (SPT) 'N' value may be calculated by dividing the total number of blows over a 300mm drive length by 2. The probes DP1 to DP8 were undertaken adjacent to the trial pits locations while DP9 was carried out beside SP4.

The dynamic probe logs are provided in Appendix 3 of this Report.

4.4 Soakaway Testing

The soakaway pits were excavated to a maximum depth of 2.2m BGL and filled with water to assess the infiltration characteristics of the proposed site. The pits were allowed to drain and the drop in water level recorded over time as required by BRE Digest 365. The pits were logged and photographed prior to completing the soakaway test and were backfilled with arisings and reinstated upon completion.

The soakaway test results are provided in Appendix 4 of this Report.

4.5 Slit Trenching

A number of slit trenches were excavated to determine the line and location of the large diameter water services which cross the site. Some of the trenches were

completed as separate excavations to locate the services with minimum disturbance to the ground surface. Each of the services shown on the local authority plans were identified and logged. The services were marked using 6 foot posts and were surveyed by the project topographical surveyors. The line, depth and location of the services located are shown on the plan in Appendix 1.

The slit trench logs are provided in Appendix 5 of this Report.

The above notes outline the procedures used in this site investigation and are in accordance with Eurocode 7 Part 2: Ground Investigation and testing (ISEN 1997 – 2:2007) and B.S. 5930:1999 + A2:2010.

4.6 Laboratory Testing

Samples were selected from the trial pits for a range of geotechnical and chemical testing to assist in the classification of soils and to provide information for the proposed design. Testing consisting of Particle Size Distribution (PSD), moisture content, atterberg limits, CBR and compaction testing were sent to NTML's Geotechnical Laboratory for analysis. Environmental laboratory testing was carried out on samples of soil by Jones Environmental Laboratory in the UK. The results of the laboratory testing is included in Appendix 6 of this Report.

5.0 Ground Conditions

5.1 General

The recommendations given and opinions expressed in this report are based on the findings as detailed in the borehole and trial pit records. Where an opinion is expressed on the material between exploratory hole locations, this is for guidance only and no liability can be accepted for its accuracy. No responsibility can be accepted for conditions which have not been revealed by the exploratory holes.

5.2 Ground Conditions

The ground conditions encountered during the investigation are summarised below with reference to insitu and laboratory test results. The full details of the strata encountered during the ground investigation are provided in the trial pit and dynamic probe records included in the appendices of this report. The sequence of strata encountered are generally consistent across the site and are generally consisted of;

- Topsoil
- Cohesive Deposits
- Granular Deposits

Topsoil: Topsoil was encountered in the majority of exploratory holes and was present to a maximum depth of 0.3m BGL.

Cohesive Deposits: Cohesive deposits were encountered beneath the Topsoil and were quite variable, described typically as brown, grey brown or occasionally as black *slightly sandy slightly gravelly CLAY, slightly gravelly sandy CLAY/SILT, Laminated sandy SILT* and *sandy gravelly slightly organic CLAY*. The strength of the cohesive deposits generally increased with depth and was typically soft or soft to firm at shallow depths increasing to stiff or stiff to very stiff at the base of the majority of the trial pits. These deposits had occasional cobble and rare boulder content where noted on the trial pit logs.

Granular Deposits: Granular deposits were encountered in the trial pits in the south of the site either as lenses within the cohesive deposits or as strata underlying upper cohesive deposits to the base of the trial pits. These deposits were typically described as brown or dark grey *gravelly fine to coarse SAND and clayey sandy sub angular to sub rounded fine to coarse GRAVEL*. These deposits had occasional cobble and rare boulder content where noted on the trial pit logs.

5.3 **Groundwater**

The groundwater strikes were noted during the investigation and were generally encountered as slow seepage at depths between 2.0m and 3.0m BGL. We would point out that these exploratory holes did not remain open for sufficiently long periods of time to establish the hydrogeological regime and groundwater levels would be expected to vary with the time of year, rainfall nearby construction and other factors.

5.4 Soakaway Testing

At the test locations a trial pit was excavated and filled with water to a nominal invert level. The pits were allowed to drain and the rate of fall in water level was monitored to determine the time for the water level to drop from 75% to 25% the pit volume.

Based on the soakaway test results we would recommend that the soakaway design be based on a soil infiltration rate of $f = 1.38 \times 10^{-5}$ m/s in the vicinity of SP1.

The remaining test locations SP2 to SP4, indicate that the ground conditions are not favourable for soakaway design.

5.5 Laboratory Testing

A series of tests were completed on samples collected from the trial pits and were sent to GSTL's geotechnical laboratory in the UK.

The classification test results generally confirm the descriptions on the logs with the primary constituent for the cohesive deposits plotting as a CLAY of low to intermediate plasticity. The Particle Size Distribution tests confirm that generally the cohesive overburden strata have variable clay, silt, sand and gravel content. The granular deposits were generally well graded and had high fines content, typical of the granular glacial till deposits in the region.

Four samples were selected from the boreholes and trial pits and sent to Jones Environmental Laboratories in the UK for a range of contamination testing.

The results were assessed in accordance with European Council Directive 1999 131/EC Article 16 Annex II 'Criteria and procedures for the acceptance of waste at landfills which lays down guidelines for the classification of waste as "Inert' 'Non Hazardous' and 'Hazardous'. The results classify the material tested as below the limits for inert waste at Murphy Environmental Landfill in Co. Dublin. Any material removed off site should be disposed of at a suitable licenced facility. The results of this testing can be found at the rear of this report.

6.0 Recommendations and Conclusions

6.1 General

The recommendations given and opinions expressed in this report are based on the findings as detailed in the trial pit records. Where an opinion is expressed on the material between exploratory hole locations, this is for guidance only and no liability can be accepted for its accuracy. No responsibility can be accepted for conditions which have not been revealed by the exploratory holes.

Earthworks are proposed in the south west corner of the site and a retaining wall is proposed to be constructed. The material excavated in this area, based on TP1 and TP2, will be suitable for re-use as landscaping fill within the proposed development. The material has a high fines content and the optimum moisture content is close to or above the natural moisture content. The CBR test results indicate that material reused from excavations will have a CBR value of 2% or below.

The retaining wall should be designed using the approach advocated in BS8002: Code of Practice for Earth Retaining Structures or Eurocode 7: Geotechnical Design. The appropriate design parameters should be determined from the trial pit logs for the depths retained.

Due to the presence of loose granular deposits and/or soft cohesive deposits foundations in the vicinity of TP1, TP2 & TP5 foundations are recommended to be taken to the firm to stiff cohesive deposits, or the medium dense granular deposits at a depth of 2.0m BGL. An allowable bearing capacity of 70kN/m^2 is recommended at this depth based on the dynamic probe records in Appendix 5. Vibro compaction or other forms of ground improvement may be more economical than deep excavations for foundations, however depending on the proposed development levels and the earthworks proposed in the south west corner of the site, the proposed foundation levels may be more achievable.

An allowable bearing capacity of 70kN/m^2 is recommended for the foundations at 1.0m BGL on the firm to stiff cohesive deposits in the vicinity of TP3, TP4 & TP6. An increased value of 100kN/m^2 is recommended at 1.0m BGL for TP7 & TP8. Any soft spots encountered at this depth should be excavated and replaced with lean mix concrete.

Excavations for services which are required to be installed in the water bearing granular deposits may require temporary support and dewatering. Note should be taken of the stability of the trial pits recorded on the logs in Appendix 2.

The recommendations provided in this report should be verified in the design of the proposed buildings, using the full details of the loading conditions and taking into consideration the allowable tolerable settlements/movements that the building can accommodate. The founding strata should be inspected and verified by a suitably qualified engineer prior to construction of the building foundations.

****


TP 1
TP 2
TP 3
TP 4
TP 5
TP 6
TP 7
TP 8
SP 1
SP 2
SP 3
SP 4
LAYOUT T
Corbally R
Background unavailable
304830, 226365

TRIAL PIT RECORD

Project Name: Saggart, Boherboy — **Hole ID: TP1**

Client: Pinnacle
Consultant: Roger Mullarkey & Associates
Location: Saggart
Date: 09/12/2013
Excavator used: JCB 3CX

Co-ordinates: 304720.00, 226091.00
Elevation: 149.930
Project no. 4040-11-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL								
		0.30	149.63					
Soft dark brown slightly sandy slightly gravelly CLAY								
		0.60	149.33					
Firm laminated brown and light brown slightly sandy slightly gravelly CLAY/SILT								
		0.90	149.03	T	0.90			
		1		B	1.00			
Loose brown slightly gravelly fine to medium SAND with lenses of slightly clayey slightly gravelly SAND				T	1.00			
		2		B	2.00			
		2.70	147.23	B	2.70			
Stiff dark brown sandy gravelly CLAY with occasional cobbles and rare boulders								
		3		B	3.00			
		3.20	146.73					
End of Trial pit at 3.20 m								
		4						

Remarks:
Stability: Stable
Water: Slow seepage at 3.1m bgl
Remarks:

KEY
B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 3.00
Depth: 0.70
3.20

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TRIAL PIT RECORD

Project Name: Saggart, Boherboy — **Hole ID: TP2**

Client: Pinnacle
Consultant: Roger Mullarkey & Associates
Location: Saggart
Date: 09/12/2013
Excavator used: JCB 3CX

Co-ordinates: 304727.00 226146.00
Elevation: 144.800
Project no. 4040-11-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL								
		0.30	144.50					
Soft to firm grey brown slightly sandy slightly gravelly CLAY		0.50	144.30	T	0.50			
Firm grey sandy gravelly slightly organic CLAY		0.90	143.90					
Firm brown sandy gravelly CLAY with occasional cobbles and rare boulders		1		B	1.00			
		2		B	2.00			
		2.20	142.60					
Dark grey slightly gravelly fine to coarse SAND (wet)		2.50	142.30	B	2.50			
Stiff black slightly sandy gravelly CLAY with occasional cobbles and rare boulders		2.70	142.10					
End of Trial pit at 2.70 m		3						
		4						

Remarks:

Stability: Collapsing below 1.5m bgl
Water: Slow seepage at 2.0m bgl
Remarks:

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 3.00
Depth: 2.70
0.70

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TRIAL PIT RECORD

Project Name: Saggart, Boherboy — **Hole ID: TP3**

Client: Pinnacle
Consultant: Roger Mullarkey & Associates
Location: Saggart
Date: 09/12/2013
Excavator used: JCB 3CX

Co-ordinates: 304802.00 226242.00
Elevation: 137.700
Project no. 4040-11-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL								
		0.30	137.40					
Soft to firm brown slightly sandy slightly gravelly CLAY with occasional cobbles and rare boulders				T B LB	1.00 1.00 1.00			
		1.50	136.20					
Firm to stiff brown sligthly sandy gravelly CLAY with occasional cobbles and rare boulders				B	2.00			
		2.20	135.50					
Stiff to very stiff dark brown slightly sandy gravelly CLAY								
		3.00	134.70	B	3.00			
End of Trial pit at 3.00 m								

Remarks:
Stability: Stable
Water: No groundwater encountered
Remarks:

KEY
B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 3.00
Depth: 3.00
0.70

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TRIAL PIT RECORD

Project Name: Saggart, Boherboy — **Hole ID: TP4**

Client: Pinnacle
Consultant: Roger Mullarkey & Associates
Location: Saggart
Date: 09/12/2013
Excavator used: JCB 3CX

Co-ordinates: 304714.00 226270.00
Elevation: 134.700
Project no. 4040-11-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL								
		0.20	134.50					
Soft orange brown sandy slightly gravelly CLAY		0.30	134.40					
Soft to firm brown slightly sandy slightly gravelly CLAY with occasional cobbles and rare boulders								
		0.90	133.80					
Firm brown slightly sandy slightly gravelly CLAY with occasional cobbles and rare boulders		1		T B	1.00 1.00			
Medium dense brown clayey sandy sub rounded to sub angular fine to coarse GRAVEL with occasional cobbles and rare boulders		1.50	133.20	LB	1.50			
		2						
		2.70	132.00					
Medium dense to dense brown sligthly sandy clayey sub angular to sub rounded fine to coarse GRAVEL with frequent cobbles (wet)		3.00	131.70	LB	3.00			
End of Trial pit at 3.00 m								
		4						

Remarks:

Stability: Stable
Water: No groundwater encountered
Remarks:

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 3.00
Depth: 3.00
0.70

GROUND INVESTIGATIONS IRELAND
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TRIAL PIT RECORD

Project Name: Saggart, Boherboy — **Hole ID: TP5**

Client: Pinnacle
Consultant: Roger Mullarkey & Associates
Location: Saggart
Date: 09/12/2013
Excavator used: JCB 3CX

Co-ordinates: 304883.00, 226244.00
Elevation: 141.630
Project no. 4040-11-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL								
		0.30	141.33					
Soft orange brown sandy slightly gravelly CLAY				B	0.70			
		0.80	140.83					
Soft grey brown slightly sandy slightly gravelly CLAY		1						
		1.20	140.43					
Soft laminated grey brown sandy CLAY/SILT				B	1.50			
		1.70	139.93					
Soft to firm grey brown slightly gravelly sub fine to medium SAND with occasional lenses of sandy SILT		2		LB	2.00			
		2.30	139.33					
Medium dense grey brown sandy sub angular to sub rounded fine to coarse GRAVEL with occasional cobbles		3		LB	3.00			
		3.50	138.13					
End of Trial pit at 3.50 m		4						

Remarks:
Stability: Stable
Water: No groundwater encountered
Remarks:

KEY
B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 3.00
Depth: 3.50
0.70

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TRIAL PIT RECORD

Project Name: Saggart, Boherboy — **Hole ID: TP6**

Client: Pinnacle
Consultant: Roger Mullarkey & Associates
Location: Saggart
Date: 09/12/2013
Excavator used: JCB 3CX

Co-ordinates: 304963.00, 226248.00
Elevation: 139.000
Project no. 4040-11-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL								
		0.30	138.70					
Soft to firm brown sandy slightly gravelly CLAY with occasional cobbles and rare boulders				B	0.70			
		1.10	137.90					
Firm to stiff brown sandy slightly gravelly CLAY with occasional cobbles and rare boulders				B	1.50			
		2.00	137.00	LB	2.00			
End of Trial pit at 2.00 m								

Remarks:
Stability: Stable
Water: No groundwater encountered
Remarks:

KEY
B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 3.00
Depth: 0.70
2.00

GROUND INVESTIGATIONS IRELAND
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TRIAL PIT RECORD

Project Name: Saggart, Boherboy — **Hole ID: TP7**

Client: Pinnacle
Consultant: Roger Mullarkey & Associates
Location: Saggart
Date: 09/12/2013
Excavator used: JCB 3CX

Co-ordinates: 304883.00 226244.00
Elevation: 139.390
Project no. 4040-11-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL								
		0.30	139.09					
Soft to firm brown sandy slightly gravelly CLAY with occasional cobbles and rare boulders								
		0.70	138.69					
Stiff brown sandy slightly gravelly CLAY with occasional cobbles and rare boulders								
		1		B	1.00			
				T	1.50			
				LB	1.50			
		2		B	2.00			
End of Trial pit at 2.60 m		2.60	136.79	B	2.60			
		3						
		4						

Remarks:

Stability: Stable
Water: No groundwater encountered
Remarks:

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 3.00
Depth: 0.70
2.60

GROUND INVESTIGATIONS IRELAND
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TRIAL PIT RECORD

Project Name: Saggart, Boherboy — **Hole ID: TP8**

Client: Pinnacle
Consultant: Roger Mullarkey & Associates
Location: Saggart
Date: 09/12/2013
Excavator used: JCB 3CX

Co-ordinates: 304957.00, 226309.00
Elevation: 137.000
Project no. 4040-11-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL								
Soft to firm brown sandy slightly gravelly CLAY with occasional cobbles and rare boulders		0.30	136.70					
Stiff brown sandy slightly gravelly CLAY with occasional cobbles and rare boulders		0.70	136.30	LB	0.70			
		1		T	1.00			
End of Trial pit at 2.00 m		1.50	135.50					
		2						
		3						
		4						

Remarks:

Stability: Stable
Water: No groundwater encountered
Remarks:

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 3.00
Depth: 2.00
0.70

GROUND INVESTIGATIONS IRELAND
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TRIAL PIT RECORD

Project Name: Saggart, Boherboy — **Hole ID: SP1**

Client: Pinnacle
Consultant: Roger Mullarkey & Associates
Location: Saggart
Date: 09/12/2013
Excavator used: JCB 3CX

Co-ordinates: 304814.00, 226147.00
Elevation: 141.000
Project no. 4040-11-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL								
Soft to firm orange brown slightly sandy gravelly CLAY		0.30	140.70					
Soft brown slightly sandy slightly gravelly CLAY		0.70	140.30					
		1						
Brown gravelly fine to coarse SAND		1.50	139.50					
Brown sandy sub angular to sub rounded fine to coarse GRAVEL with occasional cobbles		2.00	139.00					
End of Trial pit at 2.20 m		2.20	138.80					
		3						
		4						

Remarks:

Stability: Stable
Water: No groundwater encountered
Remarks: Soakaway test completed in accordance with BRE365.

KEY

B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 2.50
Depth: 0.70
2.20

GROUND INVESTIGATIONS IRELAND
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TRIAL PIT RECORD

Project Name: Saggart, Boherboy — **Hole ID: SP2**

Client: Pinnacle
Consultant: Roger Mullarkey & Associates
Location: Saggart
Date: 09/12/2013
Excavator used: JCB 3CX

Co-ordinates: 304714.00, 262220.00
Elevation: 137.000
Project no. 4040-11-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL								
		0.30	136.70					
Soft to firm orange brown slightly sandy gravelly CLAY								
		0.50	136.50					
Soft brown sandy gravelly CLAY with occasinal cobbles and boulders (damp)								
		1.50	135.50					
Brown clayey sandy sub angular to sub rounded fine to coarse GRAVEL with occasional cobbles and rare boulders (wet)								
		1.90	135.10					
End of Trial pit at 1.90 m								

Remarks:

Stability: Collapsing beow 0.5m BGL
Water: Slow groundwater seepage encountered below 2.0m BGL
Remarks: Soakaway test completed in accordance with BRE365.

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample

Dimensions: 2.30 × 0.70
Depth: 1.90

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TRIAL PIT RECORD

Project Name: Saggart, Boherboy — **Hole ID: SP3**

Client: Pinnacle
Consultant: Roger Mullarkey & Associates
Location: Saggart
Date: 09/12/2013
Excavator used: JCB 3CX

Co-ordinates: 304939.00, 226195.00
Elevation: 141.500
Project no. 4040-11-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL								
		0.30	141.20					
Soft to firm brown sandy slightly gravelly CLAY with occasional cobbles and rare boulders								
		1.00	140.50					
Firm to stiff grey brown sandy slightly gravelly CLAY with occasional cobbles and rare boulders								
		2.00	139.50					
End of Trial pit at 2.00 m								
		3						
		4						

Remarks:

Stability: Stable
Water: No groundwater encountered
Remarks: Soakaway test completed in accordance with BRE365.

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample

Dimensions: 2.20
Depth: 2.00
0.70

GROUND INVESTIGATIONS IRELAND
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TRIAL PIT RECORD

Project Name: Saggart, Boherboy — **Hole ID: SP4**

Client: Pinnacle
Consultant: Roger Mullarkey & Associates
Location: Saggart
Date: 09/12/2013
Excavator used: JCB 3CX

Co-ordinates: 304886.00, 226304.00
Elevation: 138.000
Project no. 4040-11-13
Logged by: C Finnerty

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL								
Soft to firm brown sandy slightly gravelly CLAY with occasional cobbles and rare boulders		0.30	137.70					
Firm to stiff grey brown sandy slightly gravelly CLAY with occasional cobbles and rare boulders		1.20	136.80					
End of Trial pit at 2.10 m		2.10	135.90					

Remarks:
Stability: Stable
Water: No groundwater encountered
Remarks: Soakaway test completed in accordance with BRE365.

KEY
B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample

Dimensions: 2.30
Depth: 2.10
0.70

GROUND INVESTIGATIONS IRELAND
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Appendix E

OPW Consents

OPW Oifigeacht na nOibreacha Poiblí Office of Public Works

[illegible]
An Bóthar Nua
Sráid Átha Trasna
Co. na Mí
C15 K8W0
Telephone: (046) 9431484
[illegible]
Fax: (046) 9431451
East Region Drainage Maintenance
Newtown
[illegible]
Co. Meath
C15 K8W0
Telephone: (046) 9431484
(046) 9431352
Fax: (046) 9431451

Ref: 249-2021

Mr. Eugene Keyes
Kilgallen and Partners Consulting Engineers,
Kylekiproe,
Well Road,
Portlaoise,
Co. Laoise.

e.keyes@kilgallen.ie

Re: Section 50 applications for a three bridges in Dutherboy, Saggart, Co. Dublin.

Dear Mr. Keyes,

I refer to your above named recent Section 50 Application

The documentation submitted has been examined and I am to confirm that the consent of the Commissioners of Public Works under Section 50 of the Arterial Drainage Act, 1945 is given to the proposed bridges as follows as per that detailed in the attached report
This office is recommending Section 50 consent for;

Structure 1; A bridge with 10m of clear span, 7.5m wide with a 1.9m clearance of soffit to channel bed level, as per that detailed on the attached drawing;
Dwg No 17025-002 Rev P1

Structure 2; A bridge with a 9.5m of clear span, 7.5m wide with a 1.4m clearance of soffit to channel bed level, as per that detailed on the attached drawing;
Dwg No 17025-003 Rev P1

Structure 3; A footbridge with a 4.8m of clear span, 2.5m wide with a 1.92m clearance of soffit to channel bed level, as per that detailed on the attached drawing;
Dwg No 17025-004 Rev P1

It should be noted that the consent is given only for the purpose of Section 50 and does not absolve the recipient of responsibility for any adverse effects caused by this installation to any third party.