DUBLIN SIMON COMMUNITY

PROPOSED DEVELOPMENT SITE, OLD NANGOR ROAD, DUBLIN 22

PROPOSED CULVERT HYDRAULIC DESIGN REPORT

IE CONSULTING
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1 Introduction

IE Consulting was requested by Hayes Higgins Partnership, on behalf of the Dublin Simon Community, to assess the hydraulic capacity of an existing culvert located beneath a site to be developed for social housing at Old Nangor Road, Dublin 22. The proposed development was granted planning permission by South Dublin County Council on the 17th of May 2017 for a three-storey apartment building and all associated works.

It is proposed to rebuild the existing culvert along the existing culvert alignment underneath the foundation of the proposed social housing development using three 900mm pipe culverts laid side by side within the boundary of the site.

The purpose of this report is to summarise the Hydrological and Hydraulic Assessment for the construction of the three 900mm culverts within the site.

Quoted ground levels and estimated flood levels relate to Ordnance Datum Malin.

The following information is enclosed herein:

- Appendix A Site Investigation Photographs
- Appendix B Culvert Condition Inspection Report & Topographical Survey
- Appendix C Drainage Records
- Appendix D Micro Drainage Output
- Appendix E Drawing Number IE1978-001-A Proposed Culverts Plan and Sections

2 Site Description

2.1 General

The site is located within Clondalkin Village in Dublin 22. A stone arch culvert drains through the site and provides a hydrological discharge point for the Mill Pond located to the south of the site into the Camac River located to the north of the site as shown in *Figure 1* below.

The stone arch culvert was constructed as part of a paper mill that is no longer in operation. It is approximately 2.47m wide and 1.56m high. Waters spill from the Camac River into the Mill Pond located upstream of the culvert. These waters discharge to a concrete tank, which in turn discharges to a stone channel located on Mill Lane and into the culvert inlet via a large sump. The location of the culvert is shown on *Figure 1* below.

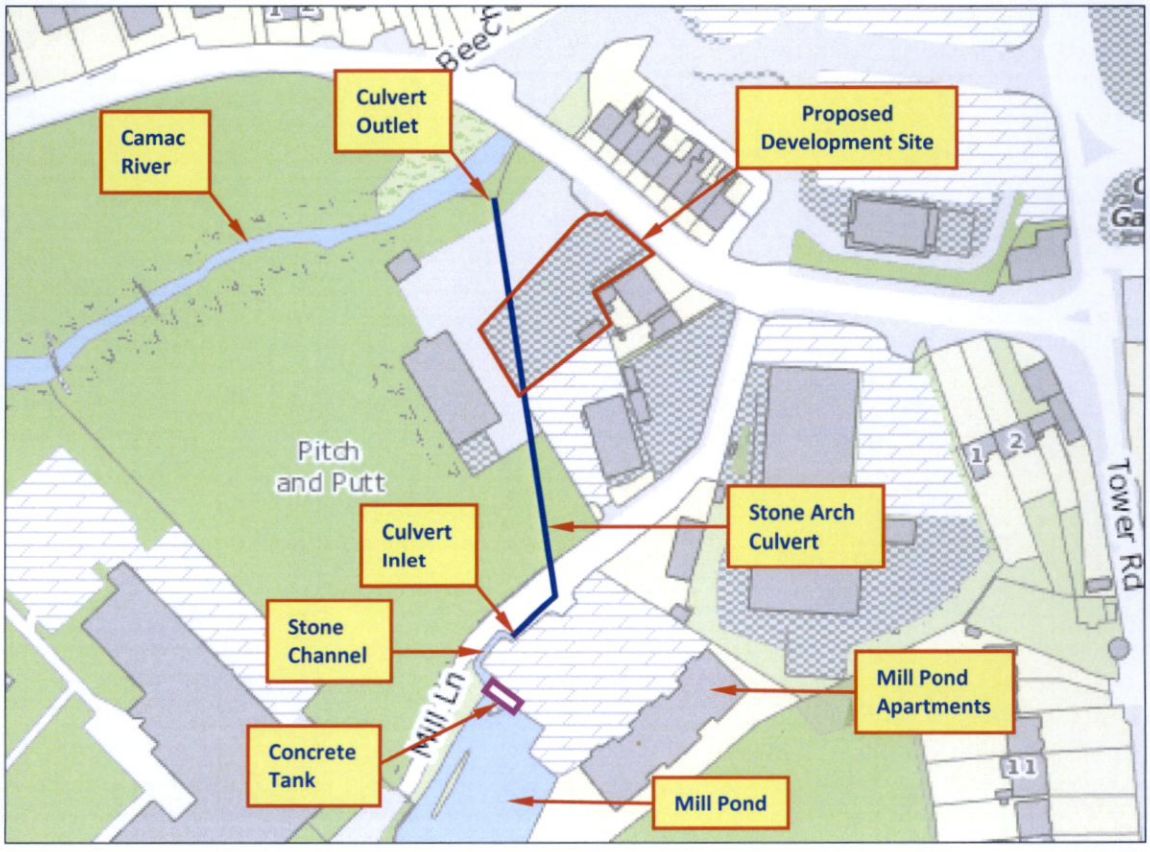

Figure 1 - Culvert Layout Plan

2.2 Existing Structures

The existing stone arch culvert is approximately 125m in length from the inlet adjacent to the Mill Pond apartments to outlet where is discharges to the Camac River. The culvert outlet is shown in *Figure 2* below.

Figure 2 - Culvert Outlet to Camac River

There are a number of hydraulic structures located upstream of the culvert which convey the flow from the Mill Pond into the culvert including a concrete tank, stone channel and inlet sump. These structures are shown in *Figure 3, Figure 4* and *Figure 5* below. Please refer to *Appendix A* for additional photographs of the culvert and its surrounding features.

Figure 3 – Concrete Tank Outlet

Figure 4 – Stone Channel

Figure 5 – Inlet Sump

2.3 Site Investigation Works

A site walkover survey was carried out by an Engineer from IE Consulting on the 31st of January 2020. This included meeting with the Area Engineer Graham Murphy from South Dublin County Council (SDCC). A visual inspection was carried out of the culvert inlet and culvert outlet as well as the lake feeding the culvert, upstream concrete tank and stone channel. Refer to *Appendix A* for photographs of the visual inspection carried out.

A topographical survey and culvert inspection survey was carried out by Murphy Surveys on the 6th of March 2020, an Engineer from IE Consulting and Graham Murphy from SDCC were also present on site. The culvert inspection was carried out at the culvert inlet which included man-entry. Access into the culvert was however not possible as the culvert was almost completely full of stone. It was noted by the surveyor that a manhole chamber/wall structure was constructed with the culvert aperture a short distance (estimated by the surveyor to be approximately 8m) downstream of the culvert inlet.

There was no evidence of a manhole from the road surface in this location and therefore the manhole was likely to have been paved over. The SDCC Area Engineer subsequently located the manhole from the

surface with a metal detector and had the cover exposed and raised to road level. A further inspection of the culvert was carried out in this location by SDCC in May 2020. This identified a pipe connection emanating from the direction of the Mill Pond Apartments. The existing culvert in this location appears to have been rebuilt with concrete blocks, which has substantially reduced the aperture of the existing stone arch culvert. It is estimated that this opening has reduced the existing culvert capacity by more than 50%. This is believed to be the reason for the substantial blockage at the culvert inlet.

No further access to the culvert was possible and no attempt to access the culvert from the outlet was carried out due to the risk of collapse identified during a previous inspection survey carried out in 2019. The topographical survey of the culvert inlet and outlet was completed with no issue. Refer to *Appendix B* for the culvert inspection report and topographical survey prepared by Murphy Surveys. Refer to *Appendix A* for photographs taken by SDCC during the May 2020 Inspection.

3 Hydraulic Assessment

3.1 Existing Culvert Peak Flow Estimation

3.1.1 Contributing Flow from Mill Pond

The culvert was originally constructed as part of a paper mill, which is no longer in existence. It does however provide a hydraulic conveyance function to allow waters that spill into the Mill Pond from the Camac River to flow back into the river downstream. The rate of discharge from the pond is limited by an opening in the side of the concrete tank located upstream of the culvert inlet as shown in *Figure 2* above.

In order to determine the peak flow discharging from the Mill Pond a hydraulic model was developed using HEC RAS software of the outlet from the concrete tank, the stone channel and the inlet into the sump at the culvert inlet. The existing stone arch culvert has not been included in the hydraulic assessment. It is currently significantly blocked with stone, however if it was free from blockage the capacity of the culvert would be significantly greater than the rate of discharge from the Mill Pond. The extent of the model is shown in *Figure 6* below:

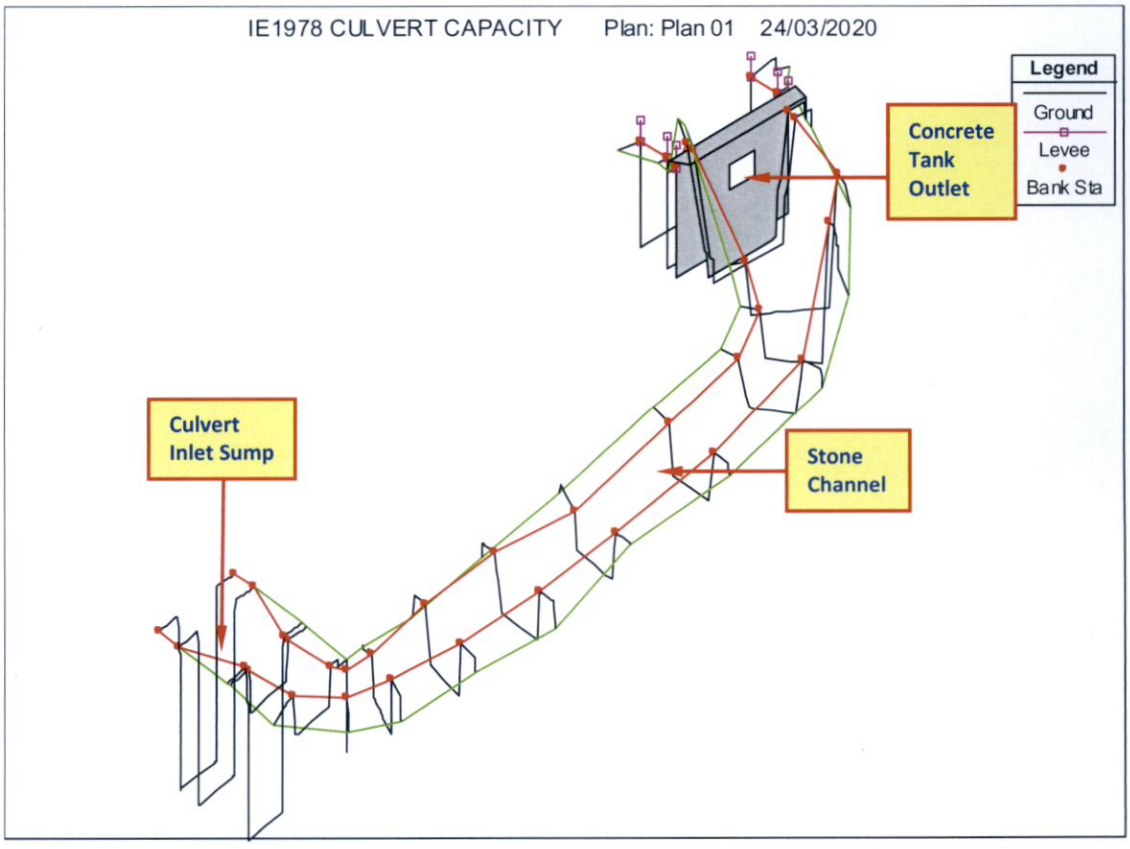

Figure 6 – Hydraulic Model

The flow limiting factor into the culvert is the concrete tank outlet, which was assessed by increasing the flow into the hydraulic model until such time that the water levels surcharge above the top of the concrete tank roof level.

A peak flow of 0.695m^3/s was determined to be the peak flow that may discharge from the outlet of the concrete tank.

The model simulation is represented by a longitudinal profile through the modelled reach as shown in *Figure 7* below.

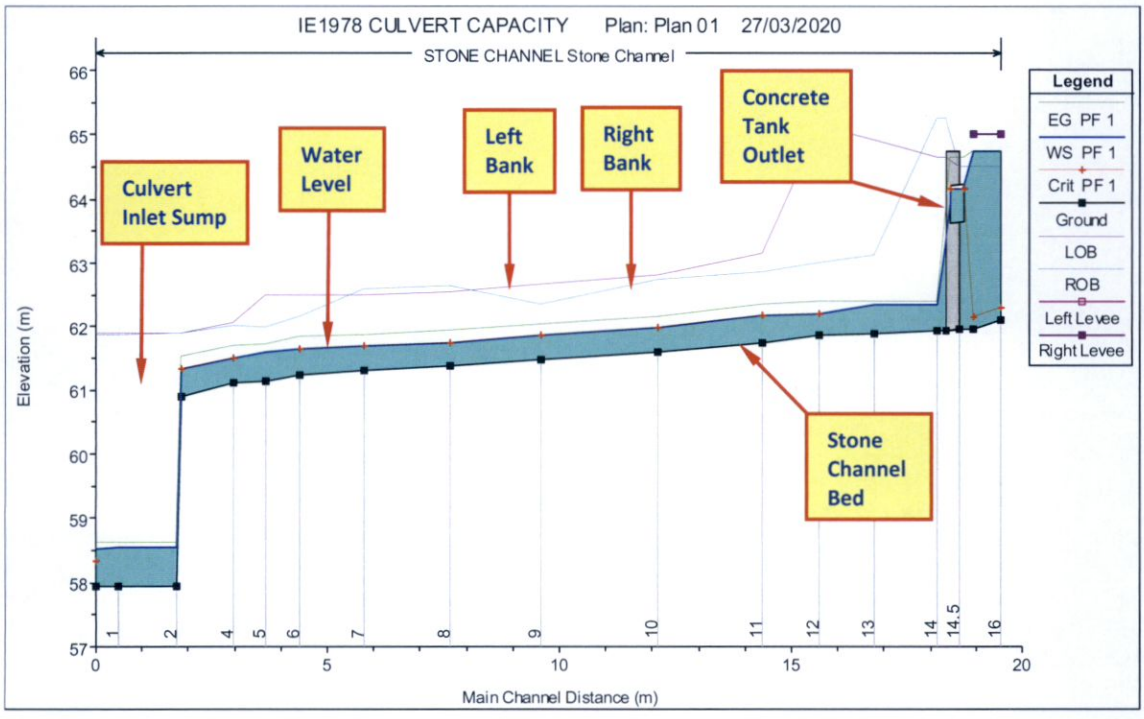

Figure 7 – Model Longitudinal Profile

3.1.2 Contributing Flow from Stormwater Connections

Drainage records were obtained from South Dublin County and Irish Water to determine the location of any stormwater connections to the culvert. These records do not show the presence of any connections to the culvert. The SDCC online planning system was utilised to review planning applications in the vicinity of the culvert. There was no information available that showed any stormwater connections to the culvert. Refer to *Appendix C* for details of the drainage records obtained.

A culvert inspection survey carried out in March 2020 which showed a substantial blockage was not able to determine the location of any stormwater connections discharging to the culvert from adjacent properties due to significant blockage at the culvert inlet. However, a further inspection by South Dublin County

Council identifies a pipe connection emanating from the direction of the Mill Pond apartments and therefore it is likely the surface water runoff from this development discharges to the stone arch culvert. It is also likely that the Pitch and Putt facility may have a stormwater connection to the culvert. The manhole identified within the culvert is likely to be the connection point from the Mill Pond apartments. There are also two stormwater gullies located within the car park of the Pitch and Putt. It is possible given their location that these are connected to the stone arch culvert. The anticipated location of these connections is shown in *Figure 8* below. Although the stormwater connection from the Pitch and Putt is likely to be located downstream of the proposed development site for the purposes of this assessment it is assumed to be located upstream of the site as a possible manhole was identified upstream of the site as shown in *Figure 8* below.

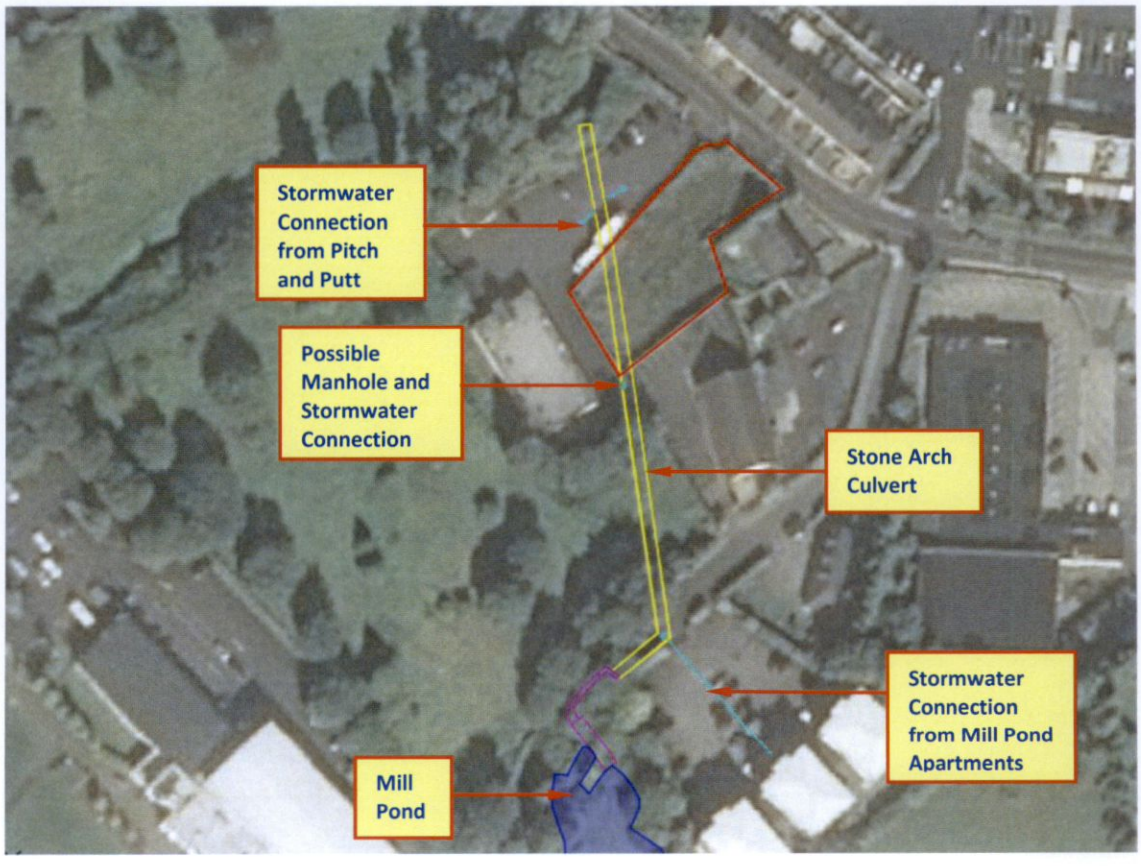

Figure 8 – Potential Stormwater Connections

Hard standing and paved areas have been divided into two categories of surface areas which can drain into the existing stormwater drainage system from the Mill Pond apartments and the Pitch and Putt. The contributing catchment areas from each area are as follows:

Mill Pond Apartments

Roof Area = 801m^2

Paved Area = 1180m^2

Total Area = 1981m^2

Pitch and Putt

Roof Area = 423m^2

Paved Area = 1455m^2

Total Area = 1878m^2

Typical rainfall runoff co-efficents are applied to hard standing areas of 90% for roofs and 85% for roads and paved areas. However, for the purposes of this assessment it is assumed that 100% rainfall runoff drains from these surfaces to the existing stormwater drainage system.

3.2 *Hydraulic Analysis of Existing Stone Arch Culvert*

A hydraulic model was developed of the existing stone arch culvert using Micro Drainage software from the culvert inlet to the discharge point to the Camac River along a channel reach length of approximately 125m. This model also includes stormwater connections from the existing developments of the Mill Pond apartments and the Pitch and Putt. This allows the rainfall runoff from the roof and paved areas to be routed from their source into the stone arch culvert and analysed.

The purpose of developing the hydraulic model is to estimate the peak flow that may enter the culvert from the Mill Pond and the stormwater connections as well as determining the peak water levels during a 1 in 100 year rainfall event including 20% climate change.

The extent of modelled reach length is illustrated in *Figure 9* below:

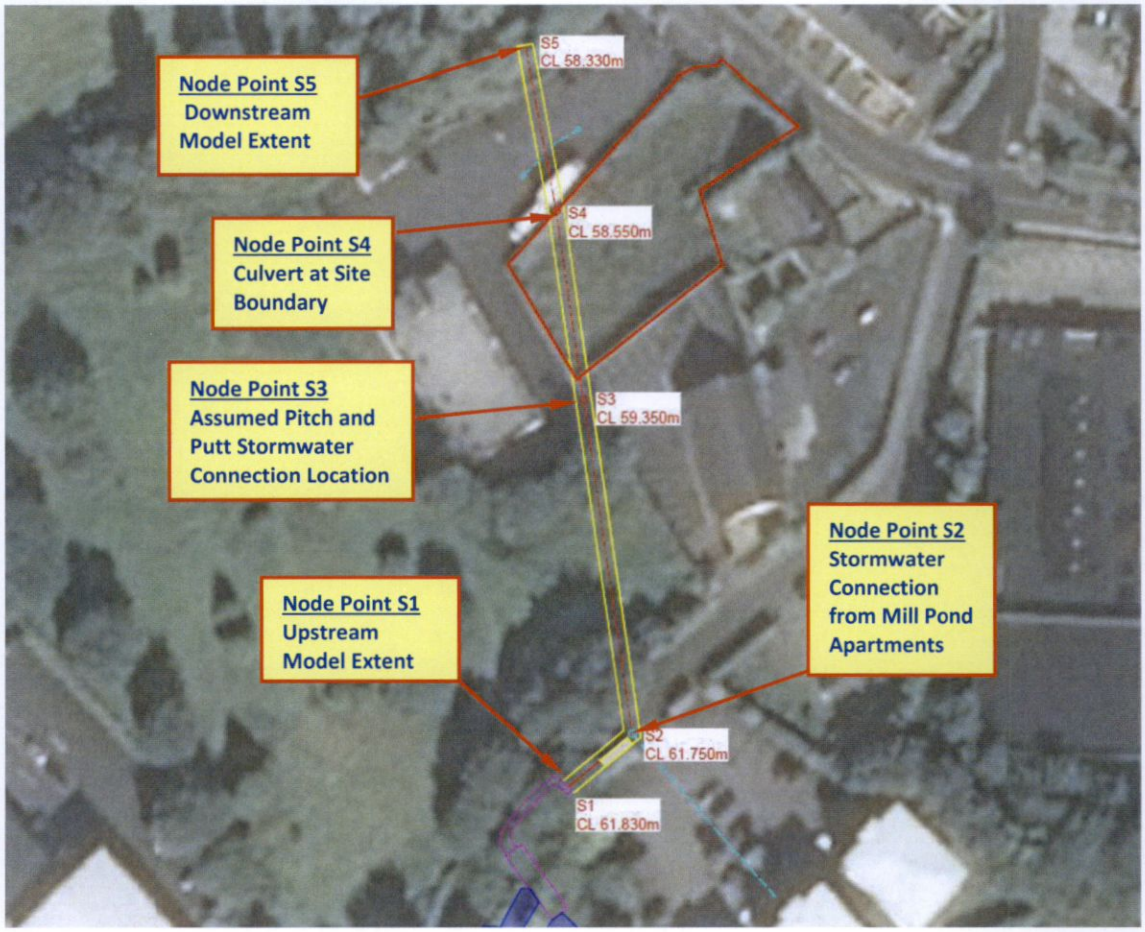

Figure 9 – Micro Drainage Hydraulic Model Extents

The model length of culvert includes five node points as shown in *Figure 9* above to represent various locations or manholes/connections along its length.

3.2.1 Hydraulic Model Assumptions

The following assumptions have been made in the hydraulic model assessment:

- 100% rainfall runoff from paved and roof areas;
- Rainfall return period simulations included 5, 30, and 100 year event for durations ranging from 15 minutes to 6 hours;
- The stormwater connections pipes have not been modelled and therefore there is no restriction on the rate of rainfall runoff as a result of the stormwater pipe capacity.
- 20% increase in rainfall depths to allow for future climate change;

- 20% factor of safety applied to flow discharging from Mill Pond;
- Existing culvert dimensions are 2.5m wide and 1.5m high arch culvert;
- The culvert is free from obstructions, blockages or collapse;
- The outfall to the Camac River is not restricted or impeded by high river levels.

The restriction identified during the site investigation works between Node Point S1 and Node Point S2 has been excluded from the hydraulic assessment as this is located upstream of the proposed development site. It is likely to restrict flows downstream and therefore excluding this will only provide a more conservative assessment of the extreme water levels in the culvert downstream of this location.

3.2.2 *Existing Scenario Simulation Results*

The model simulation is represented by a longitudinal profile through the reach modelled. *Table 1* below summarises the predicted 1 in 100 Year + 20% flood levels along the modelled reach of the stone arch culvert for the existing scenario.

Node Point	1 in 100 Years (1% AEP) + 20% Water Level (m OD)
S1	57.128
S2	57.090
S3	56.976
S4	56.888

Table 1 – Existing Scenario: Predicted 1 in 100 Year + Climate Change Flood Levels

Figure 10 below illustrates the longitudinal profile of the predicted 1 in 100 year + 20% flood levels along the existing stone arch culvert.

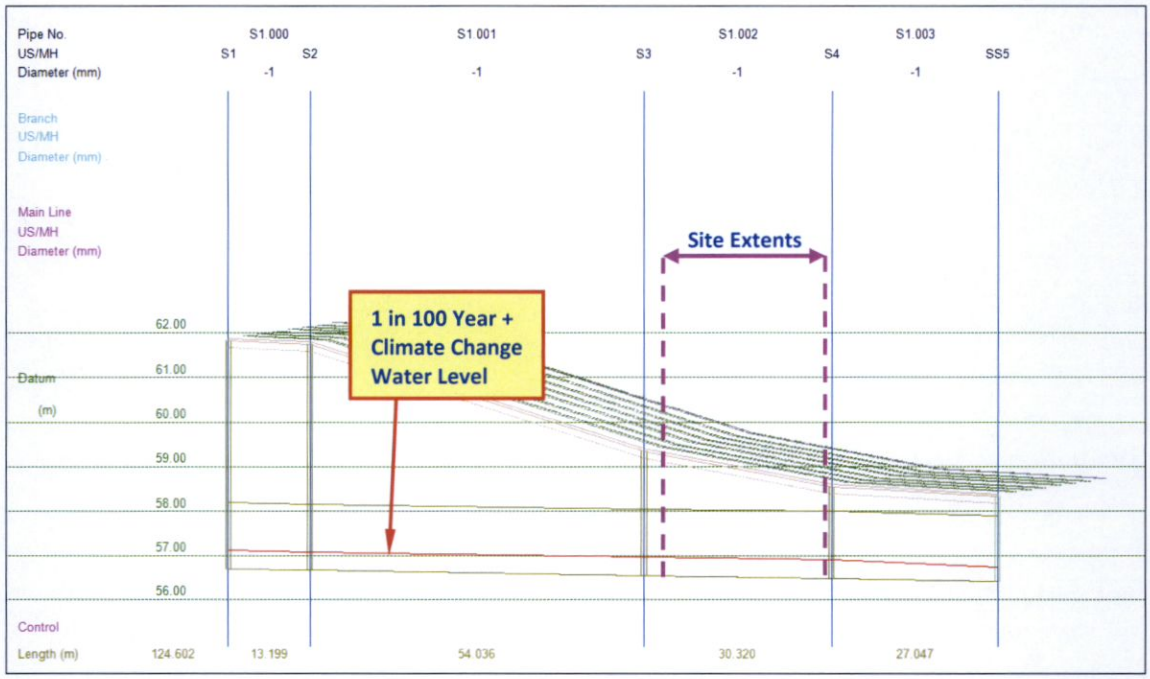

Figure 10 – Existing Scenario: 1 in 100 Year + 20% Longitudinal Profile

The peak 1 in 100 year + climate change flow rate that may discharge from the culvert into the Camac River is 1.02m^3/s.

Refer to the Micro Drainage output sheets enclosed in *Appendix D* for further details.

3.3 Hydraulic Analysis of Proposed Culvert

It is proposed to replace the existing stone arch culvert within the boundary of the proposed development site with three 900mm pipe culverts laid side by side along the same alignment as the existing culvert. This is to allow a housing development to be constructed within the boundary of the site above the line of these culverts. Although it is not preferable to construct a building above a culvert there is no room available within the site boundary to divert the culvert around the building.

The original capacity of the existing 2.5m wide and 1.5m high stone arch culvert is no longer required as it no longer provides the same hydraulic function for which it was built in the operation of a paper mill. The actual capacity required is 1.02m^3/s.

The hydraulic model was updated to include three 900mm pipes within the boundary of the site. The model simulation is represented by a longitudinal profile through the reach modelled. *Table 2* below summarises the predicted 1 in 100 Year + 20% flood levels along the modelled reach of the existing stone arch culvert and compares it to the proposed three 900mm pipes within the boundary of the site.

Node Point	1 in 100 Years (1% AEP) + 20% Water Level (m OD)
S1	57.138
S2	57.101
S3	56.992
S4	56.890

Table 2 – Proposed Scenario: Predicted 1 in 100 Year + Climate Change Flood Levels

Figure 11 below illustrates the longitudinal profile of the predicted 1 in 100 year + 20% flood levels along the existing stone arch culvert.

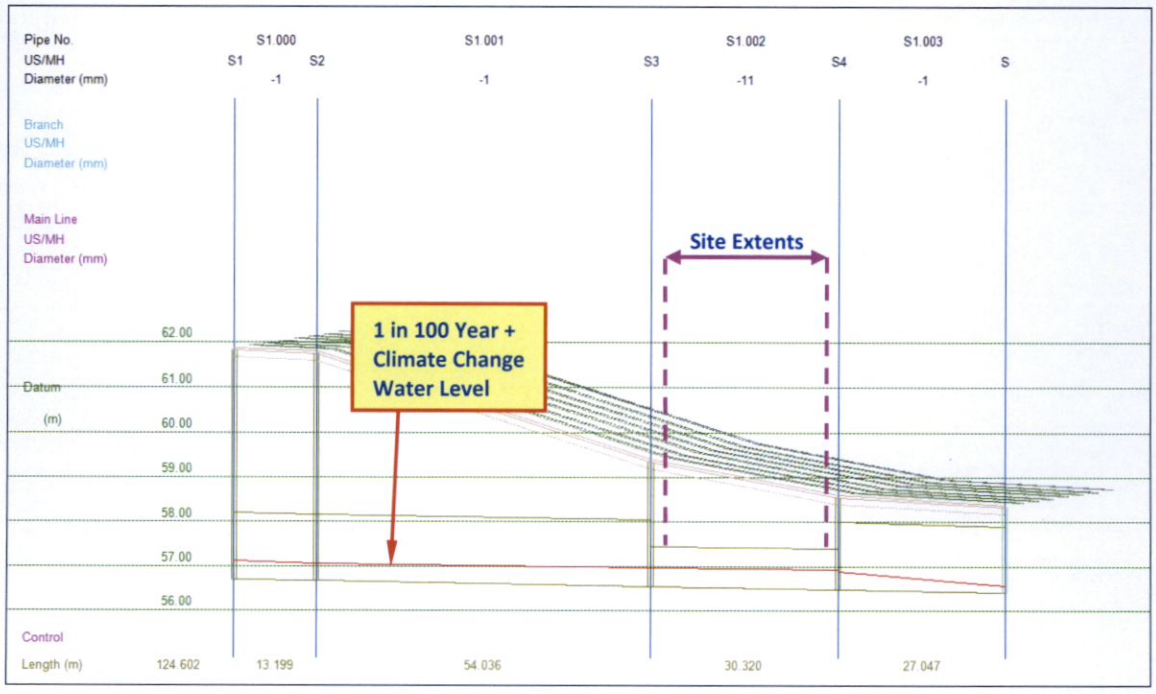

Figure 11 – Proposed Scenario: 1 in 100 Year + 20% Longitudinal Profile

The proposed three 900mm pipe culverts have sufficient hydraulic capacity to convey the 1 in 100 year + 20% climate change flow. The depth of freeboard is 445mm at the upstream end and 411mm at the downstream end of the culverts respectively. The proposed culvert plan and section details are shown on drawing number *IE1978-001-A, Appendix E*.

Refer to the Micro Drainage output sheets enclosed in *Appendix D* for further details.

4 Conclusions

The estimated 1 in 100 year + 20% climate flow rate in the stone arch culvert is 1.02m^3/s. This flow rate is conservative as it assumes the following:

- 100% rainfall runoff from paved and roof areas;
- The stormwater connections pipes have not been modelled and therefore there is no restriction on the rate of rainfall runoff as a result of the stormwater pipe capacity.
- 20% increase in rainfall depths to allow for future climate change;
- 20% factor of safety applied to flow discharging from Mill Pond;
- The culvert is free from obstructions, blockages or collapse;
- The restriction identified during the site investigation works has been excluded from the hydraulic assessment

The existing full bore capacity of the stone arch is no longer required or appropriate as the paper mill is no longer in existence. There is also a substantial in the reduction of the culvert aperture location at the culvert inlet in front of the Mill Pond Apartments. The existing culvert in this location appears to have been rebuilt with concrete blocks, which has substantially reduced the existing culvert capacity by more than 50%.

It is proposed to replace the existing culvert within the boundary of the proposed development site with three 900mm pipe culverts laid side by side. The hydraulic assessment shows the proposed culverts have sufficient hydraulic capacity to convey the predicted 1 in100 year + 20% flow ratee of 1.02m^3/s. The depth of freeboard is 445mm at the upstream end and 411mm at the downstream end of the culverts respectively.

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APPENDIX A

Site Investigation Photographs

Photo 1: Mill Pond

Photo 2: Pond Outlet into Concrete Tank

Photo 3: Concrete Tank Outlet

Photo 4: Stone Channel Upstream End

Photo 5: Stone Channel Downstream End

Photo 6: Sump Inlet & Grill

Photo 7: Culvert Outlet to Camac River

Photo 8: Rebuilt Culvert Outside Mill Pond Apartments Looking Upstream

Photo 9: Stormwater Connection from Mill Pond Apartments

Photo 10: Culvert Looking Downstream from Rebuilt Section

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APPENDIX B

Culvert Condition Inspection Report & Topographical Survey

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Confined Space Inspection Survey Report

Old Nangor Road, Clondalkin, Dublin 22

murphy
SURVEYS
GLOBAL CONSULTING SURVEYORS

Submitted: March 2020

TABLE OF CONTENTS

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1.0 PROJECT DETAILS

Project Name: 35588 Old Nangor Road, Clondalkin

Project Description: Confined Space Survey of Culvert

Project Number: 35588

Project Date: 6/03/2020

Standard: Sewer Rehabilitation Manual, 5th Edition

2.0 PROJECT DESCRIPTION

A confined space inspection was carried out on a surface water culvert connecting a landscaped lake with the River Camac in Clondalkin. The culvert is approximately 110 m in length. The upstream end is accessed via a steel grate while the downstream end is an open-ended culvert discharging into the River Camac. A previous sewer survey carried out by McBreen Environmental in February 2019 commenced at the downstream end and detected a blockage approximately 8 m from the downstream end that could not be passed.

Murphy Surveys accessed the culvert from the upstream end via the steel grate that was opened by representatives from South Dublin County Council.

3.0 CULVERT LOCATION MAP

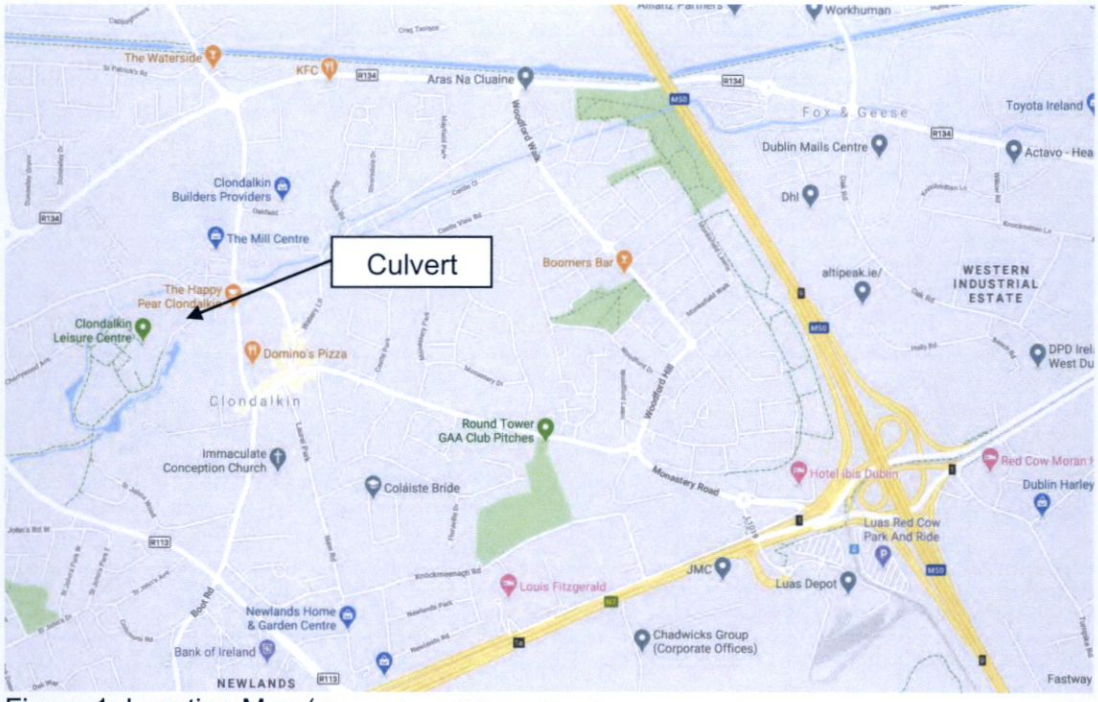

Figure 1: Location Map (Map courtesy of Google Maps)

The culvert is located between a storm attenuation tank and the river Camac. It crosses under the The Mill Pond Road, off the Old Nangor Road in Clondakin, Dublin 22.

4.0 INSPECTION FINDINGS

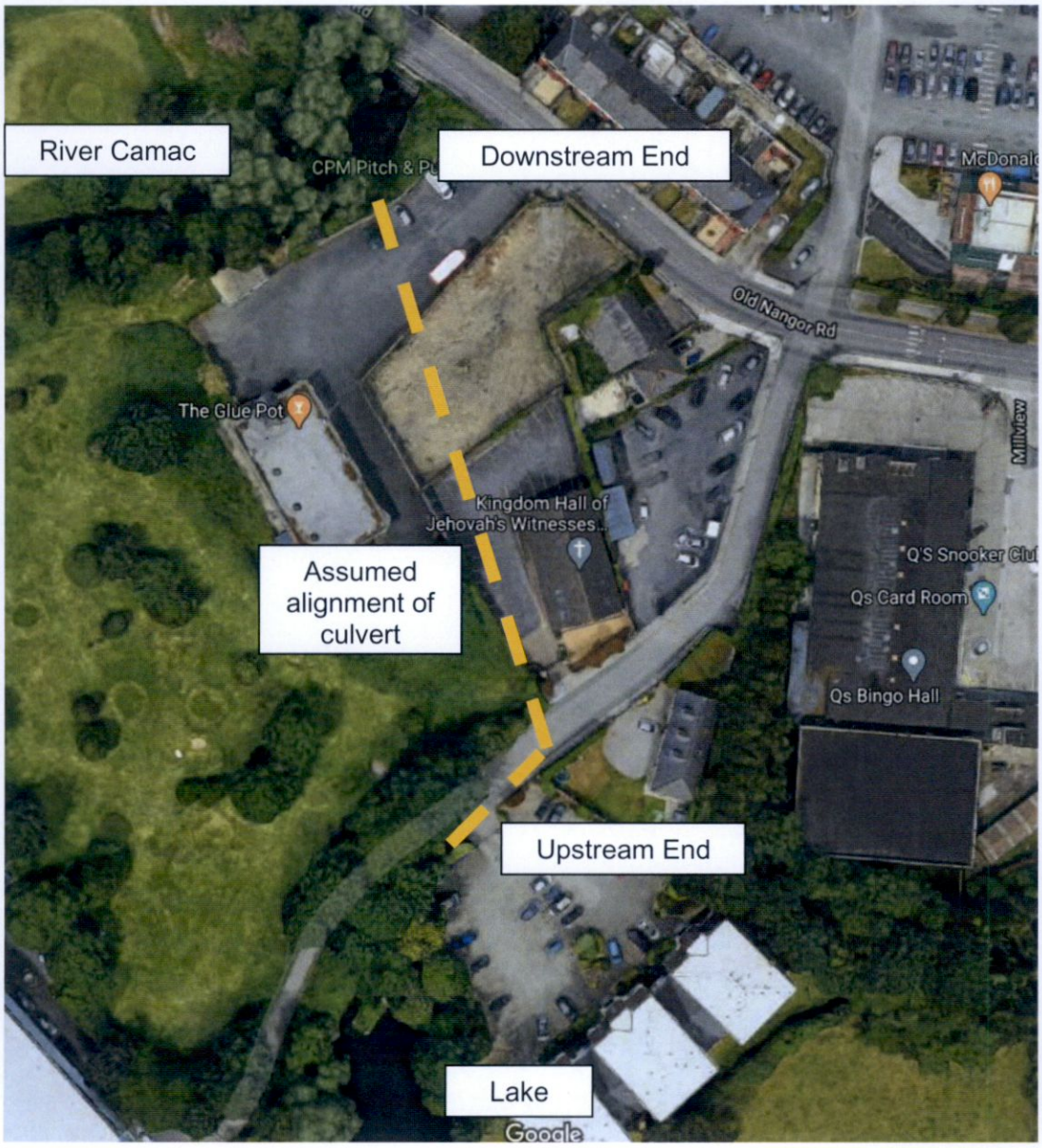

Figure 2: Location Plan

The inspection commenced at the upstream end via a steel grate. Confined space operatives attempted to walk down the culvert but were unable to proceed beyond a blockage in the culvert at the upstream end.

There is a small sized chamber between the steel grate and what appears to be the fascia of an old masonry arch bridge. The water level is up to approximately 300 mm of the arch barrel soffit. A build up of coarse gravel material and debris is present at the old bridge fascia. This blockage, and high-water level prevented progress further downstream. There is a block chamber approximately 8m downstream from the

upstream fascia of the culvert. The chamber can been seen in photograph number three below. South Dublin County Council stated they were going to go back and scan the road, to see if they can find a manhole lid under the road carriageway.

Appendix A: Photographs

Photograph No. 1 Upstream end. Old bridge fascia.

Photograph No. 2 Upstream End @ 2 m. Blockage in Arch Barrel

Photograph No. 3 Upstream End @ 2 m. Arch Barrel

Photograph No. 4 Upstream End @ 2 m. Arch Barrel