URBAN RIVER MANAGEMENT

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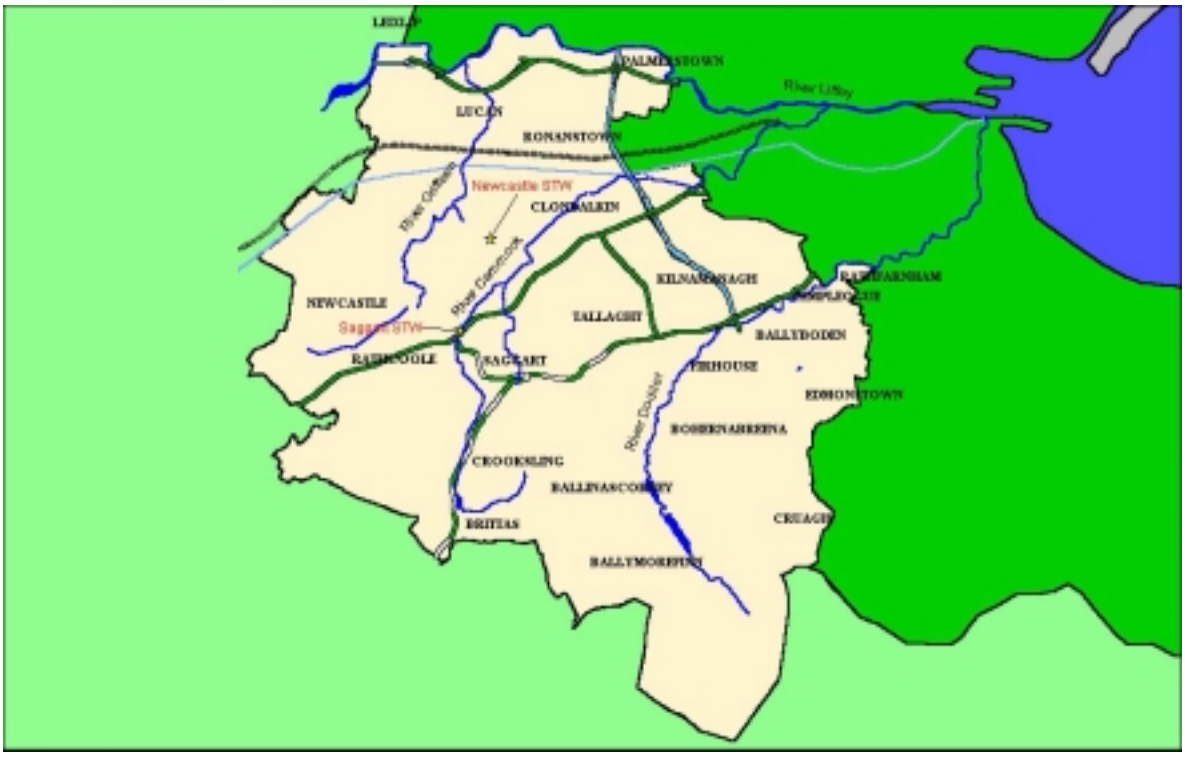

ABSTRACT

The current population of South Dublin County Council is 240,000 and continues to grow. The rivers to which we discharge surface water have a limited capacity to accept further peak-flow discharge. Stormwater management and control of urban surface water run-off is essential. River flow management is illustrated by a case study of the River Camac, a tributary of the River Liffey, rising near Brittas Village and discharging at Heuston Station. Corkagh Park lies approximately midway along its reach. Upstream of the Park is mostly rural with high permeability while downstream is developed with low permeability and rapid run-offs. A flood event in June 1993 caused considerable damage to houses in the Clondalkin area downstream of Corkagh Park. SDCC subsequently devised the River Camac Improvement Scheme Phases 1 & 2 to minimise the future risk of flooding to the area.

Phase 1 provided flood protection and flood alleviation for specific areas affected by the 1993 flood event. These works involved the construction of flood relief culverts and embankments, weir improvements, upgrading of surface water disposal systems and the removal of an old factory weir. The Phase 1 works were completed in 1995 at a cost of £215,000.

Phase 2 provided a mechanism for the control of surface water volumes by means of attenuation ponds within Corkagh Park. The volume required was determined to be 55,000m^3 from computer simulation models using 'RBM-DOGGS' output to provide input for a 'Hydroworks' analysis. The works will go for tender in 2001 at an estimated cost of £560,000.

CASE STUDY: RIVER CAMAC

The River Camac is a tributary of the River Liffey. It rises in the Dublin Mountains at Mount Seskin near the village of Brittas and passes through Saggart, Clondalkin and Inchicore before entering the River Liffey immediately downstream of Heuston Station. The main reach of the river measures 22.7 km in length from its source to its point of discharge. Approximately 16.2 km of that length is in South Dublin County Council and the remainder is in the Dublin Corporation area. There are a number of streams discharging to the Camac River the most important of which are the Coolmine, Boherboy, Brownsbarn and Fettercairn streams.

The River Camac flows through Corkagh Park, which South Dublin County Council maintains as a public park and amenity area. The Park, which measures approximately 120 hectares in area, lies roughly midway between the source of the River Camac and its point of discharge at Heuston Station. Downstream of the Park the Camac catchment can be described as being developed and urban in character with low permeability and rapid run-off of surface waters. Upstream of the Park the catchment is less developed and for the most part rural in character where higher permeability and longer times of concentration for surface water flows are characteristics.

Historically the Camac played a role in serving industry by providing either power or water supply to industries such as the Clondalkin Paper Mills, the Metropolitan Laundry and Guinness Brewery. The legacy of the river's industrial past is to be seen in the many control structures, such as weirs and small ponds that still exist on the river. The Camac does not now serve industry as it did in the past and it now functions both as an important surface water channel and amenity resource.

Certain reaches of the river are flat and have been subject to periodic flooding. A flood event in June 1993 caused considerable material damage to houses in the Clondalkin area of Leinster Terrace, Beech Row and Cherrywood Estate, which are downstream of Corkagh Park. The flooding raised obvious concerns and South Dublin County Councils Environmental Section responded by devising a strategy known as the River Camac Improvement Scheme Phases 1 and 2 in order to minimise the future risk of flooding to the area.

Phase 1 made provision for interim measures to provide flood protection and flood alleviation for areas affected by the 1993 flood event.
Phase 2 provided a design for the attenuation of floodwaters at Corkagh Park.

RIVER CAMAC IMPROVEMENT SCHEME PHASE 1

Flood Event of June 1993

During a period of prolonged rainfall beginning on Friday 11th June 1993 and continuing through Saturday, the River Camac burst its banks in a number of locations resulting in flooding of private property at two separate locations in the Clondalkin area as follows:

(a) Leinster Terrace and Old Nangor Road where the Camac enters the former site of the Clondalkin Paper Mills;
(b) Cherrywood Estate, immediately upstream of the Newlands / Fonthill Road bridge.

Preliminary information obtained from the Meteorological Service indicated that the rainfall for the 24hour period amounted to 100mm which is equivalent to a storm of a return period of 100 years. The catchment was practically saturated due to the heavy rainfall at the end of May in 1993 and the subsequent showery weather and this antecedent wetness undoubtedly resulted in faster run-off to watercourses than would otherwise have been the case.

The flooding in the vicinity of the former Clondalkin Paper Mills was extensive affecting houses on Leinster Terrace and Beech Row, some houses on the Old Nangor Road and the road itself, which became impassable. The flooding of the houses in Cherrywood Estate occurred when the river level rose above the retaining bank level approximately 200m upstream of the Newlands/Fonthill Road Bridge. The river section from the Old Masonry Arch Bridge in Corkagh Park, which was badly damage, downstream to the weir at Moyle Park Mills falls at a slack gradient yielding sluggish and tranquil flow. The Newlands/Fonthill Road Bridge lies 300m upstream of the Moyle Park weir.

Description of Phase 1 Works

The River Camac Improvement Scheme Phase 1 was designed with the objective of alleviating possible future flooding at Cherrywood and the Mill area and was prompted by the events of June 1993. There are four distinct parts undertaken in the Phase 1 Works as follows:

1) *Flood relief culvert and earth embankment in Corkagh Park designed to eliminate any risk of flooding to houses in Cherrywood.*

   An emergency overflow mechanism was constructed upstream of the Newlands/Fonthill bridge, which comes into operation when the water level reaches the level of the Newlands/Fonthill Road. A further overflow mechanism was constructed downstream of the Newlands/Fonthill bridge, the level being 300mm lower that the soffit of the bridge. This was installed to cater for the backwater effects of the Moyle Park weir.

2) *Improvement to the Moyle Park Weir*

   This work involved the raising and widening of the weir to facilitate a greater flow and to reduce backwater effects upstream, i.e. at the Newlands/Fonthill bridge.

3) *An upgrading and enhancement of the surface water disposal system at Leinster Terrace, Clondalkin to eliminate the danger of houses being flooded at that location.*

4) *Removal of the factory weir at the Clondalkin Paper Mills to alleviate future flooding in the Leinster Terrace/Beech Row vicinity.*

The River Camac Improvement Scheme Phase 1 was completed in 1995 at a cost of £215,000.

RIVER CAMAC IMPROVEMENT SCHEME PHASE 2

The Phase 1 works addressed the risk of flooding to those areas that suffered flooding in June 1993. The effect of the works was to contain the course of the floodwaters and to remove obstacles that impeded discharge from the areas at risk. This however increased the risk areas downstream of the Phase 1 works. The flooding of the Cherrywood/Leinster Terrace areas actually provided a form of stormwater attenuation that benefited those areas downstream. As a result of the Phase 1 works this unintended attenuation area was reduced in capacity. The Phase 1 works could be described as a surface water containment project that benefited a specific area at risk. It did not provide a mechanism for the control of surface water volume for the area at risk nor to areas downstream of it.

It was clear that some mechanism would have to be provided within Corkagh Park in order to control the Camac River floodwater flows before it reached the urbanised areas downstream of the Park. The obvious solution was to provide a flood storage area in the form of a flood attenuation pond within Corkagh Park. In order to determine the volume of attenuation required it was necessary to create a model of the Camac catchment.

Modelling the Catchment

The RBM-DOGGS Model

A computer-modelling package was employed in the development of a hydraulic model of the River Camac Catchment. The product used was 'Ribaman' produced by Hydraulics Research Ltd., Wallingford, U.K. Ribaman is an integrated set of component software packages for the analysis and design of surface water in natural or partly developed catchments. The component of particular relevance to this study is RBM-DOGGS.

The RBM-DOGGS computer simulation model can generate run-off from a number of sub-catchments and then route the resulting flow hydrograph through a stream network to the outfall. RBM-DOGGS enables design or observed rainfall events to be modelled. This program was chosen because of its ready availability and robustness.

The model is made up of an arbitrary branched network of major streams which has no loops and which converges to a single outfall. The streams are fed by run-offs from sub-catchments. The inflow to the initial reach consists of run-off from the catchment upstream of this point. Flow into subsequent reaches consists of flow from upstream reaches together with run-off from any catchment that enters the system at this point.

The physical characteristics for each reach/sub-catchment are input, as is the time to peak for the unit hydrograph for a specified time period. The time to peak is calculated in accordance with the Flood Studies Report (FSR), Natural Environmental Research Council, London 1975.

RBM-DOGGS is a suitable computer simulation tool if the catchment is mainly rural with open channel drainage following a tree network as is case in the Camac River catchment.

The Hydroworks Model

The Hydroworks software package was used to model the 2km reach through Corkagh Park down to Moyle Park weir. The Hydroworks model begins where the RBM-DOGGS model terminates – the output hydrograph from the RBM-DOGGS model was used as the input hydrograph for the Hydroworks model. The model assists in the evaluation and monitoring of the river characteristics with differing flow conditions. Hydroworks, unlike RBM-DOGGS, can estimate the depth and flow at any point along the route. This is particularly useful along the section of river downstream of Corkagh Park where a number of potentially important structures exist e.g. Moyle Park weir and the Newlands/Fonthill bridge. The latter structures are the principal structures of influence in this reach and are described in more detail below.

The Moyle Park Weir is of major importance as it controls water levels upstream through backwater effect. It is the output point for the Hydroworks model. It consists of an 18m long side weir. It is the rise in the water level at this weir that has caused previous breaches in the Camac riverbanks upstream.

The Newlands/Fonthill Road Bridge limits the level to which the river can rise. It therefore constricts the quantity of flow that can pass forward to the Moyle Park Weir. Phase 1 works allowed for emergency overflow both upstream and downstream of the Newlands/Fonthill Road Bridge. The emergency overflow upstream comes into operation when the water level is at road level at the bridge, clearly not an ideal solution. The downstream emergency overflow is set at 300mm below the soffit of the bridge and is largely governed by backwater effects from the Moyle Park Weir.

Data Parameters

The principal input parameters for each reach of the main channel of the River Camac and for each tributary or stream discharging to the main channel consisted of: -

SAAR = Annual average rainfall (as indicated by the FSR, Vol. 5), measured in mm.

URBAN = Existing urban fraction by area.

TP_T = Time to peak of the T_{hour} unit hydrograph, measured in hours.

Length = Length of reach or tributaries, measured in km.

Area = Area of catchment, measured in km^2.

The analysis yielded:-

TP_T = 4.39 hours
D = 9.19 hours (the design storm duration)

A range of hydrographs relating to different rainfall duration, from twice to seven times TP_T, was used to determine the storm that poses the maximum storage requirement (Ref. Design of Flood Storage Reservoirs, B14, CIRIA)

Summary of Analysis
The model was calibrated against known flood flows recorded on the River Camac for the years 1979 to 1981 and the following criteria were determined: -

- The allowable peak flow of the river channel downstream was determined to be 12.5 m^3/s. Restrictions downstream and the critical capacity of the channel determined this.

- A storm of 25-year return period was selected as the appropriate basis for a cost-effective design. The risk of a storm of this magnitude being exceeded in any one year is on average 4%.

- A storm duration of 7.5 hours for a 25-year return period was identified as generating the greatest flood. This was found to be the case when models were created for various degrees of urbanisation of the upper part of the catchment which at present is largely undeveloped.

It was assumed when modelling the catchment that all areas of the catchment up to the 122m (400ft) contour would be developed. The following table shows the peak flows and storage required for a storm event of 25-year return period for varying duration assuming development up to the 122m contour and assuming that the maximum allowable peak flow for the River Camac is limited to 12.5 m^3/s.

Duration (hr)	5	7.5	10	13	15	18
Peak Flow (m^3/s)	18.15	18.29	17.56	16.27	16.06	14.54
Req. Storage Vol. (m^3)	44,775	**54,450**	49,950	36,225	33,750	15,975

It was recommended that off-line emergency storage ponds, controlled by weirs, be constructed on the River Camac within the South Dublin County Council owned Corkagh Park. The storage volume was to be 55,000m^3. The estimated cost of the works is £560,000.

Stormwater Attenuation Works

South Dublin County Council prepared a preliminary report for the River Camac Improvement Scheme Phase 2. The Council retained J.B. Barry & Partners Consulting Engineers to prepare detailed drawings and contract documents for the provision of the off-line attenuation ponds within Corkagh Park. The Council will be in a position to go for tender in early 2001.

The Council was fortunate to own a 120-hectare public park and amenity area through which the River Camac flowed. It did away with the need for expensive and time-consuming land acquisition. The

Council is mindful of the need to preserve and if possible enhance the amenity value of Corkagh Park and the proposed works will involve careful contouring of the existing land and landscaping in order to produce a surface water attenuation area that is both functional and aesthetically pleasing.

'Put and Take' Fishery

The Councils Parks Department devised an amenity scheme known as a 'Put and Take' fishery. This involved the creation of an off-line lake adjacent to the Camac River. The objective is to stock the lake with fish in order to create a commercially viable recreation facility where members of the public could catch fish and use the surrounding amenity area. The lake is to be 2.7 hectares in area, 34,000 m^3 in volume and 3.0m deep (maximum). At first it was considered that the 'Put and Take' fishery could also serve the flood attenuation requirement for 55,000m^3 water storage. However, the 'Put and Take' fishery requires a volume of 34,000m^3 at all times to operate successfully. When the flood attenuation requirement of 55,000m3 is added to that it was found that the resulting area required to accommodate up to 90,000m3 of water storage was not physically feasible at one single location. However, the 'Put and Take' fishery has been designed to accommodate a water level some 0.5m above normal working level and this yields some 13,500 m3 of off-line storage which is almost 25% of the overall 55,000m3 storage requirement.

Attenuation Ponds

A location downstream of the 'Put and Take' fishery was identified as the location for the main flood attenuation lakes. When in full operation the attenuation ponds will cover a combined area of 3.54 hectares and have a maximum water depth of 1.2m. When not in operation the flood attenuation ponds will act as wetland meadows.

STORMWATER MANAGEMENT POLICY FOR DEVELOPMENTS

Fifty years ago the administrative area of South Dublin County Council was for the most part rural with some eight or nine villages scattered throughout its area. Today the area has a population of 240,000 and continues to grow at a rapid rate.

The streams and rivers to which we discharge our surface waters; the Camac, Griffeen and Dodder have a limited capacity to accept further peak-flow discharges. It is necessary therefore to think in terms of stormwater management and the control of urban surface water runoff.

South Dublin County Council now requires that all future developments, within certain areas, provide on-site surface water attenuation facilities in order to limit the maximum discharge of surface water to 6 litres/sec/hectare. The attenuation facilities should be in the form of either: -

- Oversized sewers
- On-line tanks
- Off-line tanks
- Surface Ponds

The discharge of surface water from the site should be fitted with a flow control mechanism such as a vortex flow control, orifice, reduced pipe or similar subject to approval. As a general rule the Council requires that surface water storage volume be provided based on a storm event of 2-hour duration with a 20-year return period. The 2-hour duration seems from experience to be the most critical duration for most cases encountered. The 20-year return period is regarded as a minimum requirement.

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