



#### Presentation to Cork Chamber of Commerce and Cork Business Association

March 2017



**The Problem** 

## Fluvial (2009)/ Tidal(2014)





#### Flood Extents and Benefitting Lands (Central Island)



1% AEP Fluvial (River Lee) / 0.5% AEP Tidal Flood Extent (1 in 100 year fluvial / 1 in 200 year tidal flood extent) Benefitting Lands (Defended against River Lee events up to the 1% AEP Fluvial / 0.5% AEP Tidal)

Watercourse



# Developing a Solution

### **Objectives and Overview**

Develop a viable, cost effective and Sustainable Flood Relief Scheme for the Study Area, building upon the findings of the Lee CFRAM Study

#### Standard of Protection (SOP)\* is:

- **1% AEP Fluvial** (1% chance of occurrence in any given year or often known as a 1 in 100 year event)
- 0.5% AEP Tidal
- Most Onerous Combination

\*In line with international Standards and other OPW schemes.





#### **Key Issues**

Key Issues to be considered included:

- Build on findings of Lee CFRAM Study
- Maximising Potential Benefit of Carrigadrohid and Inniscarra Dams
- Flood Forecasting System
- Optimisation of Flow between North and South Channels
- Remediation and utilisation of Historic Quays as Defences
- Environmental Considerations (including Heritage and Landscape and Visual)
- Minimise flood gates in tidal reach and avoid in fluvial reach
- Consideration of Climate Change Adaptability
- Importance of Stakeholder and Landowner Consultation





### **Public Consultation**

Description of Event	Consultation dates
Constraints Stage	17 July 2013
Emerging Preferred Option	29 July 2014
Statutory Exhibition of Scheme	Dec 2016/Jan 2017 (submissions by 7 April 2017)



Lower Lee (Cork City) Flood Relief Scheme the Lower Lee (Colk Oly) Disinage Scheme and the River Snite (Sankpool) Certified Disinage Scheme) Project Information-Colk City Project Information-Biackpool News Downloads Litris Corract



LowerLee Public Exhibition



In accordance with the Artenal Drainage acts 1945 and 1995, the Office of Public Works is bringing forward a proposed Drainage Scheme (Flood Relef Scheme) in respect of part of the Lower Lee, which is down stream of innacema. Co Cork and through Ballincollo, Co Cork and through Cork City and its tributaries for the purpose of preventing or substantially reducing the periodical localised fooding of lands in the area of that wetercourse.





#### Four Manned Statutory Exhibition Dates

Date	Displays at:
Monday, 12th December 2016	<ul> <li>The Foyer, City Hall</li> <li>The Foyer, County Hall</li> <li>Public Library</li> </ul>
Tuesday, 13th December 2016	
Tuesday, 20th December 2016	Ballincollig
Thursday, 19th January 2017	<ul> <li>Central Library, Grand Parade</li> </ul>

- Individual Consultation Meetings with over 100 landowners directly affected by the works in advance of Statutory Exhibition
- Previous Briefings with Cork Chamber and CBA as well ٠ as local Elected Representatives
- Ongoing Stakeholder Consultation Planned for Upcoming Stages of the Project





**Project Website:** www.lowerleefrs.ie



### Long List of Options Considered (in Lee CFRAMS and/or in Lower Lee FRS)

- Modified Operation of Inniscarra and Carrigadrohid Dams
- Flood Forecasting and Flood Early Warning System
- Planning Control and Building Regulations
- Public Awareness Campaign
- Upstream Flood Storage and Land Use Management
- Washlands
- Direct Flood Defences
- Channel Widening
- In-channel Flow Regulation
- Bridge/Weir Modifications
- Local Conveyance Improvements
- Property Occupier Relocation
- Individual Property Protection
- Pumping
- Tidal Barrage





Proposed Solution

### **The Solution for Lower Lee**

- Flood Forecasting System and Flood Warning Service
- Revised Dam Operating Procedures for Extreme Events
- **Designation of Upstream Washlands** to facilitate greater advance discharges (up to 300m3/s) from the dams.
- Direct Defences downstream of Inniscarra Dam and through the City
- Flow Regulation Structure on South Channel to reduce flood risk in South Channel)
- Small number of Flood Gates at some footbridges and boardwalk locations
- Localised Surface Water Pumps to deal with 'back of wall drainage'





### **Benefitting Properties**

#### **Properties Defended**

## Circa 2100 properties which are currently at risk, will be defended to 1% AEP Fluvial / 0.5% AEP Tidal SOP

- 1227 commercial properties
- 878 residential

#### Further Properties benefitting from reduced flood risk

A further 1079 properties currently not at risk from events up to the Scheme SOP, but which are within the current 0.1% AEP, will also benefit from a significant reduction of flood risk.

- 613 commercial
- 466 residential



#### **Cost Benefit Analysis**

ltem	Amount (€)
Present Value Costs (PVc)*	€128m
Present Value Benefit (PVb)**	€185m
Net Present Value (NPVb) (4% DR)	€57m
Benefit Cost Ratio (BCR)***	1.44

\* Excludes VAT and Inflation

\*\* Conservative Estimate

\*\*\* Reduces to 1.21 in worst case sensitivity case



Flood Forecasting System

## **Flood Forecasting System**

- Uses forecasted rainfall as well as real time rainfall and river flow
- Provides an alarm for a predicted significant event
- Allows Dam levels to be lowered at predefined spill rates which won't flood property
- Allow management of discharges in real time taking account of inflow from the Shournagh/Western Bride and Tide Levels
- Trigger levels set conservatively low to ensure that large events are caught (some false alarms)
- System will be dynamic and will grow with the scheme
- Significant redundancy and fail safes.



#### **Flood Forecasting System**



- Proposed River Gauges
  - Existing Rain Gauges
  - Proposed Rain Gauges



## Revised Dam Operating Procedures (During flood periods)

#### **Revised Dam Operating Procedures**

#### Operation

#### In advance of Predicted Extreme Event

The new procedures will involve increased advance discharges (with graduated increases) to create storage in advance of the flood.

#### **During Fluvial Event**

During the rising flood, continued increased discharges, not exceeding the threshold of flooding, will ensure that dam storage is retained until it is needed at the peak of the event

#### **During Tidal Event**

The New Rules will also allow dam discharges to be managed effectively in conjunction with the tidal cycle





#### **Change in Flood Frequency Curve**





Washlands

#### **Example of Washlands (Ballincollig)**



#### Legend:



Flood Extents for current maximum Inniscarra pre-flood discharge of 150m<sup>3</sup>/s (assuming median annual flood on downstream tributaries)

Proposed Washlands: Flood Extents for proposed maximum Inniscarra pre-flood discharge of 300m<sup>3</sup>/s (assuming median annual flood on downstream tributaries)

Post-scheme 1% AEP Fluvial Flood Extents

Watercourse





#### **Heritage Benefit**



- 393 protected structures and 20 RMPs in city protected by scheme
- Circa €20m being invested to repair circa 4 kilometres of historic Quay Walls





#### Key to Plan

Existing quay walls to be strengthened and repaired where necessary (2899m - 54%)

New sheet pile wall (371m - 7%)

Retaining existing quay wall (2055m - 39%)





#### Key to Plan

17711) (1444-144) Existing historic cut limestone parapet wall to be replaced with new limestone-clad flood defence parapet (10%)

Historic railing being replaced by new flood defence parapet/railing (9%)

New sheet pile wall (9%)

Existing modern wall/railing being replaced by new flood defence parapet/railing (51%)

Wall unchanged (21%)

#### ARUP









#### North Mall – Exhibition Section



Existing

Section as exhibited





#### North Mall – Alternative - Railing stays in situ



Existing

Alternative 1 - retain railing and existing footpath







# **River Amenity**



#### Key to Plan

- 1200mm high parapet wall (27%)
- 600mm (or less) high parapet wall and 600mm railing (53%)
- Existing parapet walls to be maintained. Strengthening and repair works where necessary (18%)

#### 1100mm = Existing parapet height

ARUP

Glass Flood Panels (2%)

## Bachelor's Quay – Typical Cross Section





# What will it look like?























































Lower Lee (Cork City) Drainage Scheme

































Phasing of Works

## **Phasing of the Works**

Contraction - Standing



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	Phase 0	Morrison's Island – Commence 2017	
-	Phase 1	West of City Element– Commence 2018	Projected that Phases 0 – 2 likely to be completed by circa 2020
	Phase 2	Wellington Bridge to Grenville Place	providing majority of protection
	Phase 3	High Priority Tidal Reaches	
	Phase 4	Remainder of North Channel	
	Phase 5	Remainder of South Channel	

Was there a multidisciplinary design team who investigated all facets?

- Yes. Design team included engineers, hydrologists, geomorphologists, environmental scientists, ecologists, archaeologists, L & V specialists, heritage experts.
- A landscape architect was commissioned to look at sensitive areas such as Fitzgerald's Park
- Extensive consultation with key stakeholders
- Cork City Council's Architects, Parks, Environmental, Heritage, and other directorates all involved in development of finishes etc.



Why not deal with the problem by implementing natural flood risk management measures upstream?

- Available Research indicates that such measures may be effective at small local scale in upstream headwaters but have limited benefit at larger scales such as in Cork City and at high return periods
- In Lee catchment, the reservoirs perform the key attenuation function and so negate any potential benefit
- Requires extensive change of use of large tracts of private lands which is not easily achieved.
- In summary, the approach has merits in some catchments for low return period floods, but is unsuitable for Cork









Why not just dredge the river?

- Only hydraulically beneficial upstream of the tidal reach (Doesn't work for tidally dominated areas and so won't reduce required defence heights in the city)
- Potentially significant negative ecological and archaeological impact
- May require significant future maintenance



Why not isolate the south channel to avoid the need for defences?

- This option was investigated in detail and was ruled out as it would require diversion of the Curraheen River and Glasheen River and unacceptably high defence walls on the Curraheen
- Would also have significant ecological impact on the Curraheen



Is the proposed Scheme going to have a significant negative impact on the cultural heritage of the city?

- We believe that the scheme will provide a positive impact in terms of cultural heritage
- 393 protected structure and 412 RMPs in city will be protected from flooding by scheme
- Circa €20m being invested to repair/restore circa 4 kilometers of historic Quay Walls that are in very poor condition
- Solutions, finishes and public realm improvements have been carefully developed in conjunction with CCC Architects and Heritage department to ensure they respect the historic setting



Why are concrete finishes proposed? Can we use more glass?

- The finishes displayed at Exhibition were chosen with the agreement of CCC.
- The Public Exhibition process is an opportunity for the public to provide feedback which will be considered before finalising finishes.
- The finishes will likely include a suitable mix of salvaged cut limestone, new cut limestone, concrete, glass defences and/or other finishes, taking cognisance of the setting.
- Some glass flood defence barriers are proposed where deemed appropriate. However, extensive use is not proposed due to increased risk of vandalism, maintenance requirements, costs and inappropriateness in historical settings





Will views and access to the river be lost?

- No. To the west of the city, defences are set back from the river walks to maintain the amenity value of the river
- On the south channel, solid wall heights are generally less than 600mm high (except for Union Quay)
- On the north channel, solid wall heights are less than 600mm in many locations to the east and maximum of guarding height further west
- Other than redundant access points which are being extinguished, existing access points are being retained
- Glass panels also being used
- New walkways and public realm spaces being constructed to increase interaction with the River





Are there alternatives in key areas like North Mall, Sullivan's Quay and Fitzgerald's Park

- Yes. There is an option to set back the defence wall on both Sullivan's Quay and North Mall to the back of the footpath, thus retaining the historic railings in situ. This was considered but the inadequacy of existing open railing and public safety considerations meant that the exhibited solution was favoured on balance.
- There is an option to not protect Fitzgerald's Park, but instead defend along Mardyke Walk to the south. This along with many other options were considered by CCC and its landscape architect before choosing the exhibited solution
- The above will be considered in the context of the views of the public, CCC and safety considerations



Could direct defences be avoided entirely if the dams are managed differently?

- No. Unfortunately the reservoirs are very small in volume terms relative to the design flood.
- They therefore cannot on their own provide a solution and thus direct defences are also required
- Their operation is being optimised to reduce the peak flow during the design event by 40% which allows wall heights in the city centre to be kept at or below guarding height.



Are the construction works going to have a detrimental affect on business in the city?

- Whilst there will be some disruption during construction, this will be minimised by careful phasing of the Works and inclusion of contractual provisions in relation to working times, traffic management, noise and dust management, maintaining critical infrastructure etc.
- Significant consultation has already taken place with the various business organisations and this will continue throughout the project.
- The permanent benefit of the scheme in protecting existing businesses and attracting new business far outweighs any short term impacts



Will the proposed scheme increase flood risk in some locations, i.e. Docklands

- No. The revised operation of the dams will reduce the peak flow by circa 40%, thus reducing the fluvial flood risk.
- Whilst a greater proportion of the flow will be directed down the North Channel, the flow in the North Channel will still be significantly less than at present for the design event
- Downstream of the works, (Docklands, Blackrock etc.) the risk is tidal and is not impacted by flow. The risk here is unchanged.
- It is not currently feasible or cost beneficial to defend docklands. Instead, flood defence in this area will be addressed through development and planning control.



Has Climate Change being considered?

- Yes. A comprehensive assessment of the potential affects of climate change has been undertaken.
- The climate change strategy incorporates the following:
  - Limiting CC increases in flows reaching the city through further alterations to dam operations, allowing even greater advance discharges as forecast accuracy improves
  - Constructing the fluvial direct defences to be extendable in the future by up to one metre (demountable or permanent)
  - Constructing the tidal defences to be extendable in the future by up to 0.6m (max. 1.2m high walls in city)
  - Increased tidal defences are likely to be a necessary precursor to any future tidal barrier which may become viable if sea level rise exceeds circa 1m







Project Website: <u>www.lowerleefrs.ie</u>

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