# **CALGARY DOWNTOWN FLOOD BARRIER & JAIPUR BRIDGE REPLACEMENT**





# **INTRODUCTION & OBJECTIVES**

The following project consists of two sections of study and analysis. <u>Section 1</u> focuses on the City of Calgary's newly designed and built Downtown Flood Barrier, with objectives to conduct modeling of three flood scenarios to help gain insight on the effects of the Flood Barrier, a cost-benefit analysis on the City of Calgary's chosen design and alternatives, an engineering and geotechnical analysis of the barrier design, an investigation into the environmental impacts of the barrier, and a review of stakeholder engagement and regulatory involvement. Section 2 contains detailed design engineering of the Jaipur Bridge pier supports, including a discussion of design considerations, selection of optimal design components and development of a final design. A preliminary computational fluid dynamics simulation of flow around the designed bridge supports is also completed to provide insight on the flow-infrastructure interaction.

# FLOOD SCENARIOS WITH/WITHOUT FLOOD BARRIER – HEC-RAS FLOOD MODEL



# JAIPUR BRIDGE FOUNDATION DESIGN

The Jaipur Bridge foundation was designed to withstand full structural loading on the bridge including dead load, emergency vehicle live loads, and loads from flooding and extreme winds.

![](_page_0_Figure_10.jpeg)

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# **CURRENT FLOOD BARRIER**

![](_page_0_Picture_14.jpeg)

Figure 3. 0.5% Chance Flood (1:200), Maximum Inundation Figure 4. 0.2% Chance Flood (1:500), Maximum Inundation

## **COMPUTATIONAL FLUID DYNAMICS: BRIDGE SUPPORT**

**CFD modelling can help with Understanding the effects of these** the estimation of: phenomena can help inform engineering design decisions such as:

- Wave loads on engineered
- structures Shear forces acting on
- river/lagoon beds

• Extent and patterns of scour resulting from shear forces • Hydraulic losses of water flowing through engineered

structures

### WHY THIS MATTERS?

#### Calgary's June 2013 Flood led to:

- 5 lives lost
- \$5 billion+ in financial losses and property damage
- \$400 million+ in damage to City of Calgary infrastructure [2]

Calgary is at risk of more severe and frequent flood events in the future due to climate change [3]. We need to invest in our city's resilience to extreme disasters.

 Bridge support geometry Choice of materials • Rip rap extent, size, and placement Lagoon bed material

![](_page_0_Picture_36.jpeg)

Figure 7. CFD model showing Prince's Island lagoon bed shear stress during a 1:100 flood event

**UN Sustainable Development Goal #11** encourages cities to implement strategies for "mitigation and adaptation to climate change, and resilience to disasters"[4].

As climate changes, Alberta is at risk of more severe and frequent flood events [3]. By completing studies and analysis on the Calgary Downtown Flood Barrier and Jaipur Bridge Support, the project works towards strengthening the resilience of the city, with focus on the integrated relationship between environment, society, and economy.

![](_page_0_Picture_41.jpeg)

![](_page_0_Picture_42.jpeg)

Figure 8. UN Sustainability Goal 11

CONTACT

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#### CONCLUSION

• The Flood Barrier:

 Prevents significant flood damage downtown • A net positive long-term investment that contributes to city resiliency, with focus on sustainable parameters

• Pile cap design optimizes cost and use of materials while maximizing strength • The design and construction process consider wildlife and environmental impacts and is seamlessly integrated with the environment

### **BARRIER COST-BENEFIT ANALYSIS**

### SUSTAINABILITY