Quebrada El Leon Flood Control Project

2024 Canadian Consulting Engineering Awards

International Category

Project Information

Name:	Quebrada El Leon Flood Control Project
Location of Project:	Trujillo, La Libertad, Peru
Completed by:	September 2023
Category:	International
Entering firm:	Hatch Ltd.
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Role in Project:	Design Engineer

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Project Outline

Project Summary

The Quebrada El Leon flood control project was part of a Peruvian government program to reduce recurring flood risks and damages. Hatch was engaged to develop the project's conceptual design, cost-benefit analyses, environmental permitting, and the detailed engineering for construction. The project was completed on schedule and on budget, and successfully navigated a fast-tracked schedule and a challenging setting that accounted for climate change impacts, public safety, flash floods and high seismicity.

Location of the Project and layout of structures

View of the headworks

Project Highlights

Q.11 Social and Economic Impact

Flash floods occur on average every five years along the Pacific coast of Peru and are generated by intense rainfalls on the slopes of the Andes mountains during El Niño events. These floods have a significant impact on the Peruvian economy and public safety, damaging residential areas and infrastructure, and often resulting in casualties. The Government of Peru planned to develop flood control infrastructure on select watersheds to mitigate these damages and mandated the ARCC (Autoridad para la Reconstrucción con Cambios) to manage a nation-wide investment program to design and build these structures.

The Quebrada El Leon, located north of the City of Trujillo (Peru's third largest city), is one of the targeted watersheds. The last event occurred in 2017 and destroyed large residential areas, portions of the Pan-American highway and affected the Trujillo airport, resulting in hundreds of millions of dollars in damages.

Flooding in the streets of Trujillo, Peru

The main objective of the project and the retained solution was to reduce the impact on the population and economy of the region. Several important infrastructures, population centers, archeological sites and agricultural zones were identified. At the end, the retained solution minimized the impact in all these areas, reduced the project cost.

The project included:

- Headworks consisting of a 1,200-m-long basin to collect flows and accumulate sediments, with two intake canals, two dikes and a concrete overflow spillway structure.
- A 20-km-long canal to collect and transfer flows from the headworks to the ocean.
- Outlet works including a stepped canal dissipation structure with stilling basin, and a concrete discharge overflow crest at the coast.

The completion of this project not only brings economic benefits to the region, by avoiding recurring flood events and the resulting damages in this important Peruvian area, it also ensures a secure environment to the local population and allows for better land development in the surrounding sectors.

Intake canal structure near poultry farms – all structures were optimized to avoid impact on local industries

Q.12 Capacity Building

The success of this project is due to a judicious combination of Canadian expertise in flood control project design and the use of local Peruvian engineering support to deliver a challenging mandate.

In order to be cost-efficient during the design phase, Hatch hired several local engineers, specialists and subconsultants to leverage Peruvian knowledge of standards and processes, such as the environmental permitting, architectural and archeological aspects, road design and even for BIM tasks. A project of this scale provided opportunities for the local engineering community to skill build and be trained on international design standards.

Because Hatch provided the engineering services on this EPCM fast-track contract, it was necessary to build a strong engineering-construction management team that would work closely to deliver the project while meeting strict budget and schedule targets. Engineering was prepared in parallel with the other activities, which allowed the client to improve their procurement and construction strategy and processes. Hatch and the client team developed a strong relationship from the start of the project, which has continued after the end of Hatch's mandate.

The design proposed for this project is unique in Peru and has already set precedence for other similar projects. Following the success of this project, Hatch was awarded the engineering, procurement and construction management of the Chavimochic irrigation project in the same region.

Hatch and client integrated team on an initial project site visit

Q.13 Environmental Impact

materias The project design included interesting features with a focus on environmental protection and sustainability. Highlighted features include the following:

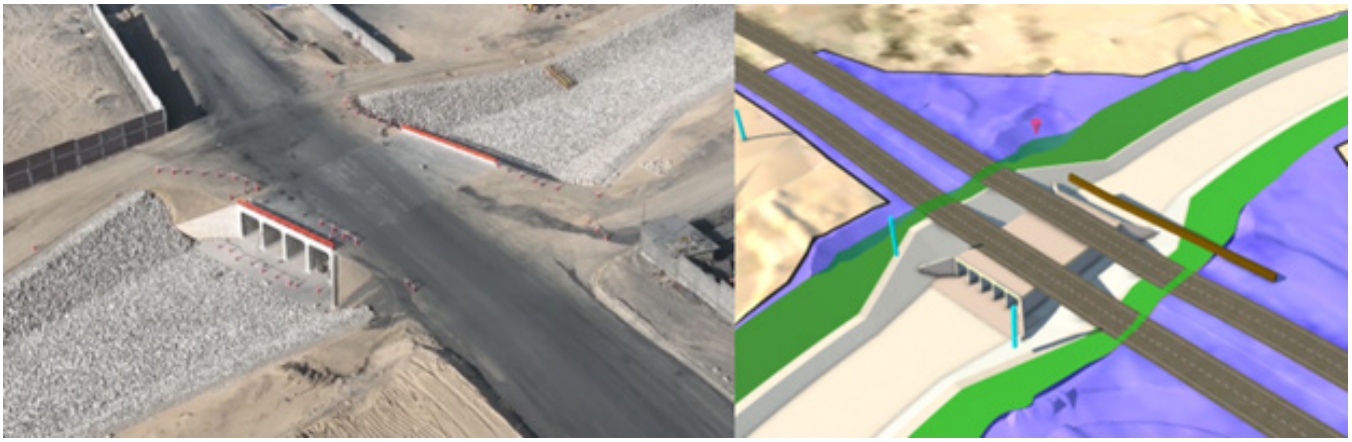
- All structures were designed to account for climate change to ensure the safety and sustainability of the designed system. More specifically, the design hydrology was adjusted based on future climate scenarios.
- Flash floods in Peru generally carry large volumes of sediments, mud and debris into urban areas, causing significant damage. The proposed flood control structures include headworks designed to capture most of the sediments and debris carried with the flows, leaving cleaner water to be confined in the canal and released to the ocean on the seacoast.
- In current conditions, and with the concept proposed at feasibility stage, the flood flows to the sea in a tourist area whereas the proposed design deviates the flows to the north in a quieter area with less environmental impact.
- Erosion protection for most of the structures was designed using local materials such as stones found in large quantities at the construction site. Cyclopean concrete was also recommended for several structures when possible. All these measures aim to reduce the overall carbon footprint of the structures.
- Peru has a rich cultural heritage, and a local expert was hired as part of the Hatch team to help identify archeological areas and avoid any impact on these sensitive areas in the design.
- Finally, local populations were consulted in all areas affected by the project. Strong support for this project was expressed by the regional communities and industry.

View of the discharge structures at the seacoast

Q.14 Meeting and Exceeding Owner's /Client's Needs

The owner and client's expectations were to deliver a design that would be safe for the local population, environment-friendly, and meet the cost-benefit target and the fast-track schedule for construction to be functional for the next flood season. The terms of reference included a concept for the flood control works that was developed at the feasibility stage.

Hatch proposed a completely different concept that, although initially received with skepticism due to lack of precedence in the region, proved to be a major success.



Concrete culvert after construction (left) and as designed in 3D (right)

Through the value engineering proposed by Hatch, the proposed design proved to exceed all expectations:

Safety: A passive design not requiring human intervention during operations, a 20-km-long canal avoiding industrial, residential and agricultural areas with low maintenance requirements.

Environment: Structures were placed to avoid environmentally and archeologically sensitive areas and proved to be better for the environment.

Cost: With a focus on cost control, the design was optimized and made efficient use of local materials. Hatch's design was half the cost of the alternative developed at a previous stage.

Fast-track schedule: This design also focused on simple structures, local materials, and constructability aimed at a shorter construction schedule. The project was delivered successfully on a fast-track schedule with the ARCC approval of a Hatch design that was considered unconventional in Peru. The project is planned to be commissioned in March 2024, and will be the first ARCC flood control project to be completed for the current flood season.

Deviation for construction of the canal crossing of the national highway (Pan-American)

Photo Appendix

View of the headworks from downstream of the spillway

Canal crossing quarries in operation

Canal across the plain near transmission lines

Downstream view of a concrete culvert for road crossing the canal

Downstream section of the canal, before junction with the discharge structures

Canal crossing quarries in operation

Downstream view of the discharge structures, photo taken from the beach

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