

DHI CASE STORY

REAL-TIME IRRIGATION CANAL OPERATION

Using hydraulic modelling to optimise the Rangitata Diversion Race

The Rangitata Diversion Race (RDR)—New Zealand's largest irrigation system—supplies water that irrigates 64,000 hectares of land. Previously, operation of the irrigation scheme was straightforward. After the Barrhill Chertsey Irrigation Limited Group was granted permission to swap water at the bottom end of the Rangitata Diversion Race, water delivery became more complex. To help river operators, we developed a system that uses a hydraulic model to forecast system response and recommend control gate setpoints. This enables operators to balance supply with demand priorities using real-time data.

OPERATING NEW ZEALAND'S LARGEST IRRIGATION SYSTEM

The RDR is New Zealand's largest irrigation system, diverting water to 64,000 hectares of prime agricultural pasture. The RDR consists of a contour canal measuring 10 m wide and 3 m deep. The canal structures include siphons, checkgates, radial gates and spillways. Completed in 1941, the RDR draws water from the Rangitata River and discharges it 67 km downstream to the Rakaia River via the Highbank hydro power station. Along the way, additional water is extracted from the South Ashburton River and offtakes deliver water to irrigators.

A variable license allows up to 30.8 m³/s of water to be taken from the Rangitata River and up to 7 m³/s from the South Ashburton River. The water is delivered to a number of stockwater offtakes, as well as four irrigation schemes: Mayfield Hinds, Valetta, Ashburton Lyndhurst and Barrhill Chertsey.



The Rangitata Diversion Race © DHI - Greg Whyte

SUMMARY

CLIENT

JV Electricity Ashburton & Barrhill Chertsey Irrigation Limited

CHALLENGE

Managing canal gate operations to balance irrigation supply with demand

SOLUTION

Real-time MIKE 11 hydraulic model of the canal in order to calculate gate operations

VALUE

- Allows for real-time irrigation management
- Optimises canal operations with model simulations of less than an hour
- Enables operators to handle emergency situations

LOCATION / COUNTRY

Canterbury, New Zealand

Once the water leaves the RDR, the owner of each scheme is responsible for the internal distribution for irrigation within their area. Until recently, irrigation scheme operations have been relatively straightforward. Experienced operators balanced the variable license conditions and irrigation demands with supplies from the offtakes.

This changed after the formation of the Barrhill Chertsey Irrigation Limited (BCI) Group in 1998. In 2001, BCI received permission to extract 17 m³/s of water from the bottom Rakaia River. The additional water, gained by pumping water back up into the canal via the Highbank hydropower penstock, allowed for the irrigation of an additional 40,000 hectares. The BCI scheme also included small scale storage ponds as well as offtake and control structures. This allowed for more flexible, but also more complex, water delivery. With water now entering the canal from both ends, operation became less intuitive. As such, operators could no longer rely on past experience.

REAL-TIME CANAL OPERATION SYSTEM

To address this problem, we developed a real-time canal operation and optimisation system for the RDR that takes daily irrigation demands and river restrictions into consideration. It allows all four irrigation schemes to submit a two-day water order and the RDR operator to submit two-day river inflows.



The Rangitata Diversion Race Inlet © DHI - Greg Whyte

Using a hydraulic model to forecast system response and recommend control gate setpoints, the system includes:

- MIKE 11 calibrated model that represents the pre-BCI RDR canal
- MIKE 11 calibrated model representing the current RDR canal – that optimises storage and minimises spills back into the river
- Connection to the RDR Supervisory Control and Data

Acquisition (SCADA) system that allows for the model to be updated using real-time flows and levels

- A MIKE CUSTOMISED Dashboard Manager – an interface that allows for system inputs and forecast displays

Our system permits operators to define:

- time varying storage pond water levels
- manually controlled structure settings not controlled by telemetry, such as maintenance gate openings

It takes canal constraints and the variable extraction license conditions into account. It then supplies the offtake and canal gate settings, providing optimum balance between supply and demand. In addition, our system allows for emergency-type situations that can be input by the RDR operator.

Future expansions to the project could include additional large-scale storage and tributary inflow forecasting.



The Rangitata Diversion Race sits on the Canterbury plains © DHI - Greg Whyte

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