

BACKGROUND

The Pukaki Canal Intake is a reinforced concrete culvert and transition basin owned by Meridian Energy that controls the discharge from Lake Pukaki and is the primary feed to the chain of six hydro power stations, with a generating capacity of 1550MW, on the upper and mid Waitaki Valley.

A risk assessment in late 2009 identified a previously unrecognised trigger for potential failure of the transition stilling basin structure. Principally, gravel erosion could lead to failure of water stops in the slab joints potentially leading to slab uplift, foundation erosion and ultimately catastrophic failure of the Pukaki Dam.

The objectives for the project were to safely dewater and refill a major earth lined hydro canal, prepare designs of options for implementation and to be prepared to carry out immediate repairs if necessary on dewatering.

PROJECT OBJECTIVE

The client was able to take advantage of a transmission network outage, scheduled for just six days after the risk was identified, to plan, safely dewater, inspect and rewater 22km of hydro canal. Such was the co-ordination that the team managed to not just inspect the Pukaki Canal Inlet structure but also to implement repairs to the stilling basin slab which have successfully mitigated the structure safety and operational risks. This huge undertaking involved mobilising an army of people, plant and materials and cost over NZ\$1.8m excluding the cost of lost power production. From identifying the problem to completing repairs took just 13 very busy days.

THE SERVICE

The unique aspect of this project is that all repairs were successfully completed during '62 hours on the slab'. It was dependant on excellent pre-planning and cooperation, involving competing electricity generating companies, a number of contractors, client staff and consultants who all pitched in on site. Any delay, due to further damage discovered during repair or any other failure to adhere to the timeline, would have involved major disruption to the national power generators.

CLIENT

Meridian Energy Limited

DAMWATCH SERVICES

PROJECT MANAGEMENT FROM MERIDIAN Mobilised the project to successfully carry out a dewatered repair of the canal from beginning to end in just 13 days. Over 225 client staff, 23 contractors and subcontractors, working 24/7 across a number of worksites, including the confined area of the transition basin, with no lost time injuries.

DAMWATCH DAM SAFETY SPECIALISTS Led the risk assessment, planning and management of the safe dewatering and rewatering of the 22km of the Pukaki/Ohau Canal.

DAMWATCH SURVEILLANCE TEAM

Damwatch managed the site team who provided 24/7 intensive surveillance on the canal from before the start of dewatering to one week after. This included resources from Meridian, Mighty River Power and other consultants.

DAMWATCH STRUCTURAL ENGINEERS Developed remedial repair options that could be implemented in the available time frame and worked with contractors Downer NZ Ltd, concrete expert Sigi Keis and the client to select and optimise a repair method that suited the timeframe and available skills and resources. Damwatch also modified the design of repairs according to conditions revealed by the dewatering.

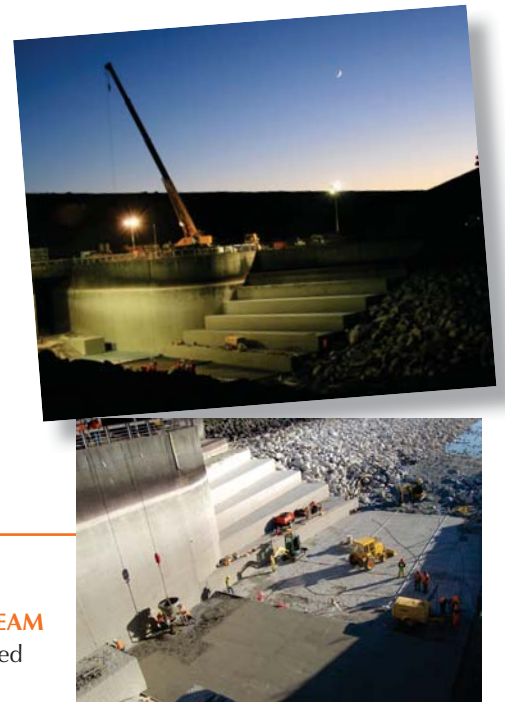
CONCRETE MATERIALS SPECIALIST Sigi Keis and Central Testing Services technicians worked with the two local (uncertified) batch plants to design a concrete mix, prepare trial mixes and then deliver over 290m³ of high quality high strength silica fume concrete to the site within first 36 hours of the 62 hour window.

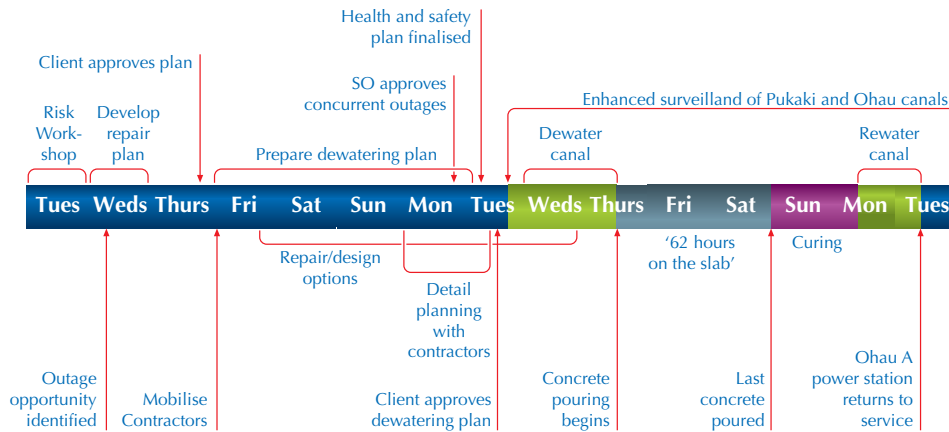
ENVIRONMENTAL SOLUTIONS

Failure of the Pukaki Canal would have had significant environmental impacts and taken 688 MW of electricity capacity out of generation. Making use of a planned transmission outage had obvious financial advantages for Meridian. Meridian's emergency management structures were very effective in the planning and management of the repairs.

Being able to align the repair work with a planned transmission outage meant that the interruption to sustainable hydro generation (likely to have to be made up by use of fossil fuels) to the country was minimised.

Adopting a concrete repair maximised the use of local contractors and materials, giving a lower environmental impact





than other potential solutions such as steel plating, which would require use of imported steel plate and contractors from other regions.

DoC, Fish and Game, and the local community were involved in recovering and relocating fish from the canals to Lake Ruataniwha.

MANAGEMENT SKILLS

Engaging appropriate expertise, undertaking robust risk assessment and developing an optimal solution with client involvement from the start, resulted in the ambitious remediation plan being approved at short notice to take advantage of the planned transmission outage. Effective communication ensured management and all participants were fully engaged in the early opportunity to dewater the canal, assess the stilling basin and repair it.

The business, maintenance and operation systems were sufficiently embedded and flexible that they enabled the team to mobilise and implement these unusual works quickly, safely and effectively. These systems included dam safety surveillance and monitoring systems, standing agreement contracts, procurement systems, work control, site health and safety management systems, plant operation and commissioning.

Strong relationships between the client, consultant, contractors, suppliers and other organisations meant that the project teams could be set up and resources mobilised very rapidly. Work for a number of other clients was put on hold by both consultants and contractors, on the understanding that a problem needed their urgent help. Similarly, on the strength of a single phone call, Mighty River Power provided surveillance support for a two week period.

Strong relationships between the parties created the environment where the risk to the stilling basin was treated as a challenge which was successfully addressed through concerted action by the whole team. It also provided the confidence in the client's senior management that the project team could deliver on the plan.

Immediate resource mobilisation, exceptional planning, contractor commitment of plant and staff to cover eventualities and commitment to maintain '62 hours on the slab'.

THE OUTCOME

A critical component of New Zealand's hydro power generation



was removed from service, repaired and reinstated in 6 days, with no impact on consumers. The canal was safely dewatered, reinforced and silica fume concrete placed over the damaged slab and shotcrete on the sloping faces. The canal was recommissioned after 62 hours work with no impact on electricity consumers.

Meridian were exceptionally pleased with the outcome of the project, the requirements to repair the structure within the transmission outage window was achieved, the relationships with Damwatch, and Meridian's contractors, suppliers and local community were enhanced and the works were carried out at a cost of \$1.8m, which Meridian found to be very reasonable given the business cost of a separate outage for later repair works.

Follow-up dive inspections and new instrumentation demonstrate that the repairs have performed well for more than 12 months, and are expected to last for many years to come.

