update
NIWA
Taihoro Nukurangi
Instrument Systems
collecting data, delivering solutions

Monitoring water quality at Lake Forsyth

Recent anecdotal reports about the deterioration in water quality in Lake Forsyth, on Banks Peninsula near Christchurch, have highlighted the need for ongoing water quality monitoring. The Canterbury Health Board routinely advises when people and animals should not drink the lake water or swim in the lake because of the consistently high levels of blue-green algae, which produce liver-damaging toxins.

A century ago the area was a brackish lagoon open to the sea. Wave action has gradually closed the outlet, and as it fills up with water delivered by inflows, the lake level has to be controlled by regularly opening it to the sea.

Why the water quality problem?

The causes for the water quality deterioration are thought to be:

- erosion sediment entering the lake from the surrounding hillsides, making it shallower
- nutrients entering the lake, such as the phosphorus that naturally occurs in the surrounding volcanic soil
- fertiliser runoff from surrounding farms and excrement from wild swans, geese, ducks, and stock.

The regular opening of the lake allows some water flow-through, but this only refreshes the surface of the lake; not the lower parts.

Monitoring water level & quality

Ten years ago we added water quality monitoring instrumentation to the existing lake water-level station which is operated by Environment Canterbury. The water quality data collected over the past 10 years for ECan has provided a baseline, against which future comparisons can be made. The monitoring system has taken readings, at 30-minute intervals, of five important parameters: water temperature, electrical conductivity (a broad indicator of the concentration of some nutrients), turbidity (an indicator of the amount of sediment suspended in the water), wind speed (which affects the amount of sediment stirred up from the lake bed), and pH.

We recently upgraded the site and now are also monitoring dissolved oxygen content, which affects the amount of fish and other life in the lake. Before the upgrade, the data was collected manually; now near real-time 15-minute data are being sent automatically to the NIWA TD Server. From here, the clients, ECan and Christchurch City Council, are able to access recent and historical data via the internet.

ECan already provides river and beach water quality data to the public via its website, and will consider adding near real-time information from Lake Forsyth in the future. This may include prediction and rapid notification of toxic algal blooms.

Looking seaward at Lake Forsyth. The monitoring station is solar-powered (solar panels visible on top & side of the station). [Photo: Marty Flanagan, NIWA]

Main body of Lake Forsyth. [Photo: Iaean Cranwell]

Banks Peninsula showing the location of Lake Forsyth.

Improving water flow measurement

The Unidata Starflow 6526 is a low-cost ultrasonic Doppler instrument used for measuring velocity, depth, and temperature of water in rivers, streams, open drainage channels, and large pipes. It can also derive flow rate and total flow. The Starflow has been around for a while, but the latest version 'E' is the most reliable and accurate yet.

The Starflow measures velocities up to 4.5m/s with a resolution of 1mm/s and an accuracy of 2% of measured velocity. It measures depth to 5 m (to 0.25% accuracy) and temperature (range of –17 ^{0}C to +60 ^{0}C). The Starflow is fully programmable and has an output that can be used to trigger other instruments such as a water sampler.

Starflow instrument. [Photo: Dave Gibb, NIWA]

Auckland Regional Council recently used Starflow in a Volume Proportional Sampling project. The aim: to determine the rate at which erosion-derived stream-borne sediment was being discharged past a monitoring point. The Starflow was mounted in a pipe; it measured water flow and calculated the accumulated water volume from flow rate and time. When the water volume reached a pre-determined value, the Starflow triggered a water sampler; sediment levels were analysed later in the laboratory. The amount of sediment discharged was determined from the mean sediment concentration, the mean flow, and the time period.

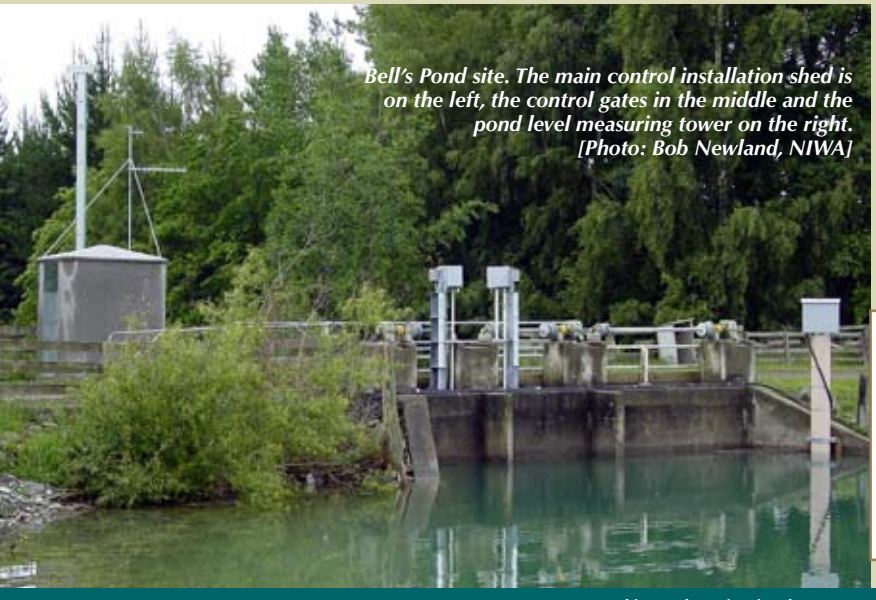
Automating irrigation

NIWA's Instrument Systems group has now automated flow monitoring and gate control systems within five major irrigation schemes throughout Canterbury, in conjunction with Attewell Irrigation Ltd. A recent project has been automation of intake stations of the Morven-Glenavy-Ikawai Irrigation (MGII) scheme in South Canterbury. MGII has consent to abstract water from the Waitaki River of up to 14.3 cumecs at Bells Road and up to 6 cumecs at Stonewall.

The Stonewall area of the scheme was constructed in the 1930s and the Bells Pond area in the 1970s. The scheme was designed for border dyke irrigation where large 'blocks' of water are supplied for a short duration. Today about 43% of the scheme is spray irrigated, and automation is being introduced to maximise water distribution efficiency.

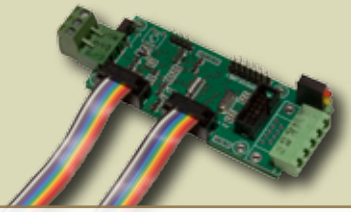
An initial objective of MGII automation has been to manage the variable intake flows from the Waitaki River, to provide consistent flow into the main race system; thus matching water supply as closely as possible to irrigation demand. To help with this, the MGII has two ponds, Head Pond and Bell's Pond, which buffer the scheme from the regular and rapid level changes that occur due to hydroelectric generation on the Waitaki, and provide water storage.

Automatically controlled gates at the ponds now regulate flow to programmed targets and any demand for more, or less, water is fed forward to the main supply gates over a 1.6 km Wireless High Speed Serial (WHSS) link. The systems are completely solar powered. Flow targets can be changed remotely by computer or cell-phone text message; commands can be acknowledged, and system alarms received.



Bell's Pond site. The main control installation shed is on the left, the control gates in the middle and the pond level measuring tower on the right. [Photo: Bob Newland, NIWA]

New product: *a general purpose 'protocol-converter' interface used to send High Speed Serial (HSS) water level (encoder) data from Bell's Pond 1.6 km upstream to the control gates at the Head Pond over a Wireless HSS link. [Photo: Dave Gibb, NIWA]*



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