1. Data

1.1. Water quality indicators

The water quality indicators available in the *Know Your Catchment* dashboard are presented in Table 1.

Table 1: Water quality indicators.

Indicator	Units
Total Nitrogen	g/m^3
Nitrate Nitrogen	g/m^3
Nitrite Nitrogen	g/m^3
Ammoniacal Nitrogen	g/m^3
Total Phosphorus	g/m^3
Dissolved Reactive Phosphorus	g/m^3
Suspended Solids	g/m^3
Dissolved Oxygen	g/m^3
E Coli	organisms/100ml

1.2. Water quality sites

1.2.1. Environment Canterbury (ECan)

The *Know Your Catchment* dashboard displays information for 23 surface sites and 20 ground sites from ECan (Table 2). All measurements for these sites were extracted from 1 January 2000 to the present day and are updated every month to include new data.

Table 2: ECan sites

Sites	Type	Description	Lat	Lon
SQ20601	Surface	Wainono Lagoon off Lake Road	-44.70244	171.146
SQ10160	Surface	Maerewhenua River SH83	-44.8565	170.69
SQ10174	Surface	Penticotico Stream SH83	-44.8159	170.6365
SQ20575	Surface	Waihao River Bradshaw Bridge	-44.77929	171.1578
SQ21160	Surface	Waikakahi Stream Cock & Hen Road	-44.87147	170.965
SQ21255	Surface	Waikakahi Stream Old Ferry Road	-44.89049	171.0343
SQ21289	Surface	Whitneys Creek Carrolls Road	-44.89907	171.1224
SQ21292	Surface	Buchanans Creek upstream confluence Waihao River	-44.7753	171.1529
SQ21298	Surface	Hook River Beach Road	-44.67622	171.1475
SQ21299	Surface	Hook Drain end Hook-Beach Road	-44.66568	171.162
SQ00579	Surface	Merrys Stream d/s SH1 bridge	-44.67742	171.1335
SQ10167	Surface	Otiake River Mt Bell Station	-44.8177	170.5092
SQ21254	Surface	Waikakahi Stream Te Maiharoa Road	-44.9163	171.095
SQ35871	Surface	Otekaieke River Special School Road	-44.88021	170.532
SQ35997	Surface	Hook Drain Hook Swamp Road South	-44.66077	171.1495
SQ20384	Surface	Hook Stream Waimate Hunter Road	-44.6892	171.0362
SQ36006	Surface	Hook Stream Gunns Rd 2	-44.6795	171.0092
SQ20385	Surface	Hook River Youngs Road Bridge	-44.67712	171.0603
SQ36003	Surface	Hook River - North Trib Lower Hook Rd	-44.67527	171.1118
SQ20577	Surface	Waihao River McCulloch Bridge	-44.8005	170.9757
SQ21296	Surface	Sir Charles Creek end of Haymans Road	-44.74916	171.1606
SQ36022	Surface	Spring at SH1	-44.66649	171.1349
SQ36002	Surface	Hook River SH1	-44.67121	171.1325
J40/0163	Ground		-44.87143	170.9419
J40/0217	Ground		-44.77393	171.1145
J40/0333	Ground		-44.66919	171.0912
J41/0018	Ground		-44.91651	171.103

J40/0256	Ground	-44.74552	171.0666
J40/0286	Ground	-44.74325	171.1404
J40/0469	Ground	-44.78112	171.0865
J40/1106	Ground	-44.81086	171.0849
J40/1024	Ground	-44.78674	171.1582
J40/0097	Ground	-44.81939	171.1603
CA17/0007	Ground	-44.69783	170.5031
CA17/0008	Ground	-44.665	170.5807
J40/0816	Ground	-44.70183	171.0602
I40/0543	Ground	-44.82341	170.5691
I40/0666	Ground	-44.78622	170.5072
J40/0080	Ground	-44.72873	171.0699
J40/0081	Ground	-44.68365	171.0973
J40/0089	Ground	-44.87138	170.9188
J40/0106	Ground	-44.8713	171.1361
J40/0118	Ground	-44.84239	171.1459

1.2.2. Otago Regional Council (ORC)

The *Know Your Catchment* dashboard displays information for 14 surface sites and 10 ground sites from the ORC (Table 3). All measurements for these sites were extracted from 1 January 2000 to the present day and are updated every month to include new data.

Table 3: ORC sites

Sites	Type	Description	Lat	Lon
Kakanui at Clifton Falls Bridge	Surface		-45.03179	170.7522
Kakanui at McCones	Surface		-45.17721	170.8811
Kauru at Ewings	Surface		-45.11103	170.7364
Waiareka Creek at Taipo Road	Surface		-45.15382	170.8819
Awamoko at SH83	Surface		-44.90631	170.8337
Awamoko Stream at Island Cliff Bridge	Surface		-44.93237	170.6816
Battersby Stream at Battersby Road	Surface		-45.0326	170.8714
Big Hill Creek at Weston-Ngapara Road	Surface		-45.02414	170.8551
Bobbing Creek at Bobbing Creek Road	Surface		-44.95897	170.7724
Island Stream at Herbert Road	Surface		-45.16562	170.7795
Waiareka Creek at Bobbing Creek Road	Surface		-44.95994	170.7716
Waiareka Creek at Need Road	Surface		-45.11627	170.8719
Waiareka Creek at Weston-Ngapara Road Bridge	Surface		-45.00057	170.8062
Waimotu Stream at Island Stream Bridge 1	Surface		-45.16464	170.8322
Kakanui at Bore 10 Gemmels Crossing	Ground		-45.11709	170.8261
Kakanui at Bore 3 Wallis Farm	Ground		-45.06467	170.7828
Kakanui at Bore 5 Newlands Farm	Ground	Blacks Rd	-45.08823	170.7807
J41/0317	Ground	Steward Rd	-44.94974	171.0773
J41/0008	Ground	Fortification Rd	-45.13068	170.8967
J42/0126	Ground	Fenwick St	-45.17123	170.8991
J41/0442	Ground		-44.92764	170.9191
J41/0571	Ground	Hilderthorpe-Pukeuri Rd	-45.00275	171.0472
J41/0576	Ground		-44.97886	171.0686
J41/0586	Ground	Ferry Rd	-44.93794	171.0271

1.2.3. National Institute of Water and Atmospheric Research (NIWA)

The *Know Your Catchment* dashboard displays information for 3 surface sites from NIWA (Table 4). All measurements for these sites were extracted from 25 January 1989 to the present day and are updated every month to include new data.

Table 4: NIWA sites

Sites	Type	Description	Lat	Lon
NIWA-TK4	Surface	Kurow	-44.70054	170.45119
NIWA-TK5	Surface	Hakataramea	-44.7248	170.49055
NIWA-TK6	Surface	Waitaki at SH1	-44.92712	171.10034

1.3. River flows

The river flow sites are indicated on the map with a blue triangle, which brings up a link directly to either ECan or ORC where the hydrological information is hosted. The Council's or NIWA own and operate the hydrological monitoring stations and the river flow is calculated from a rating curve that reflects the relationship between the height of water (stage height) and the rate of discharge (flow).

1.4. Information

The map indicates the availability of additional information with an "I" symbol for information. These information pins generally contain a photo and caption and in some cases a link back the landing page for more information about the place or person. Narratives are more detailed stories about the water quality data relationships and trends. Narratives can be accessed from the side menu. A narrative is an expert commentary on what selected data may be indicating, so it is an explanation about the trends that we may be seeing. Narratives are the opinion of selected qualified experts based on the data observations, but as with any observation or opinion, there may be other commentators who disagree or have a different theory. For this reason, the *Know Your Catchment* dashboard also presents the raw data observations so that interested parties can also form their own view regarding any trends or cause and effect relationships.

2. Data analysis

2.1. Time series decomposition for seasonal adjustment

Measurements are adjusted for seasonality using the following procedure:

For each site and indicator with at least 2 years between the first and the last measurement:

1) Daily measurements are generated using linear interpolation between consecutive measurement dates.
2) For all indicators except dissolved oxygen, measurements are log-transformed.
3) Procedure STL (Cleveland *et al*, 1990) is used to decompose the time series into trend, seasonal and remainder components.
4) Trend, seasonal and remainder components are back-transformed, if required.

The seasonally adjusted values are the values of the trend component at the measurement dates.

2.2. Calculation of site and measurement states, and site trends

An empirical cumulative distribution function of seasonally adjusted values is constructed to obtain relative ranks from 0 (minimum value) to 1 (maximum value), for each indicator and site type (surface or ground).

The state of a site for an indicator is the median of the ranks of its last year of measurement. The state of an individual measurement for an indicator is its rank.

The trend of a site for a particular length of time of x years (with x = 3, 5, 10, 15, or 20 years) is calculated using the p-value of the linear regression of the seasonally adjusted values on the measurement times using all values measured in the last x years from the most recent measurement date, and is only calculated if the first measurement date happened earlier than x years before the most recent one.

3. Map

3.1. Site shapes

The shapes (symbols) denote different categories of site locations. Surface water sites are circles and groundwater sampling sites are squares. Surface water sampling sites are simply river or stream locations that are routinely sampled for water quality, typically with a grab sample in a bottle that is sent to a laboratory for analysis. Groundwater sites are physical structures, a bore, piezometer or well.

Information sites are indicated with the "I" pins and river flow measurement sites are indicated with a triangle.

3.2. Site colour

The colour of a site displays the state of an indicator, using a red – yellow - orange – red traffic light colour scheme where green is state = 0 and red is state = 1.

The legend displays the respective deciles of the indicator selected, for surface and ground sites respectively (since the ranks depend on site type).

Sites with some data but no state (because there is not enough data for the times series decomposition) are displayed in dark grey. Sites with no data are displayed in light semi-transparent grey.

3.3. Site arrow

The arrow on a site displays the site indicator trend. The angle α of the arrow is calculated as:

$$\alpha = s\ \mathrm{sign}(Q) \tan^{-1}(k\ \log_{10}(|Q|))\ /\pi \times 180°$$

Where $Q = -s\ \mathrm{sign}(b)\ p$, s = -1 for all indicators except s = 1 for dissolved oxygen, b is the slope and p the p-value of the linear regression of the seasonally adjusted values on the measurement times, and k = ¼.

For all indicators, except dissolved oxygen, an arrow pointing up (resp. down) indicates the amount of an indicator is increasing (resp. decreasing), and hence the water quality is degrading (resp. improving). This is reversed for dissolved oxygen, where an arrow point up (resp. down) indicates that water quality is improving (resp. degrading).

4. Measurements scatter plot

The colour of a measurement displays the state of that individual measurement for the site and indicator combination. Timespan for the trend calculations is highlighted in green. The blue line interpolates the seasonally adjusted values. Alternating blue and white bands indicate years.

5. Measurement tables

The *Yearly Averages* table displays yearly averages for the indicators at the site. The indicator currently displayed on the scatter plot is highlighted in green.

The *Trend Over Time* table displays an arrow going up (resp. down) if the trend of the corresponding timespan is significant at the $\alpha = 5\%$ level and going up (resp. down).

6. References

Cleveland, R. B., Cleveland, W. S., McRae, J. E. & Terpenning, I. (1990). STL: A Seasonal-Trend Decomposition Procedure Based on Loess (with Discussion). Journal of Official Statistics, 6, 3-73.