Trigger for alum dosing Lake Rotorua

Bay of Plenty Regional Council
TAG meeting
18/2/2013
J McIntosh

Trigger for alum dosing Lake Rotorua

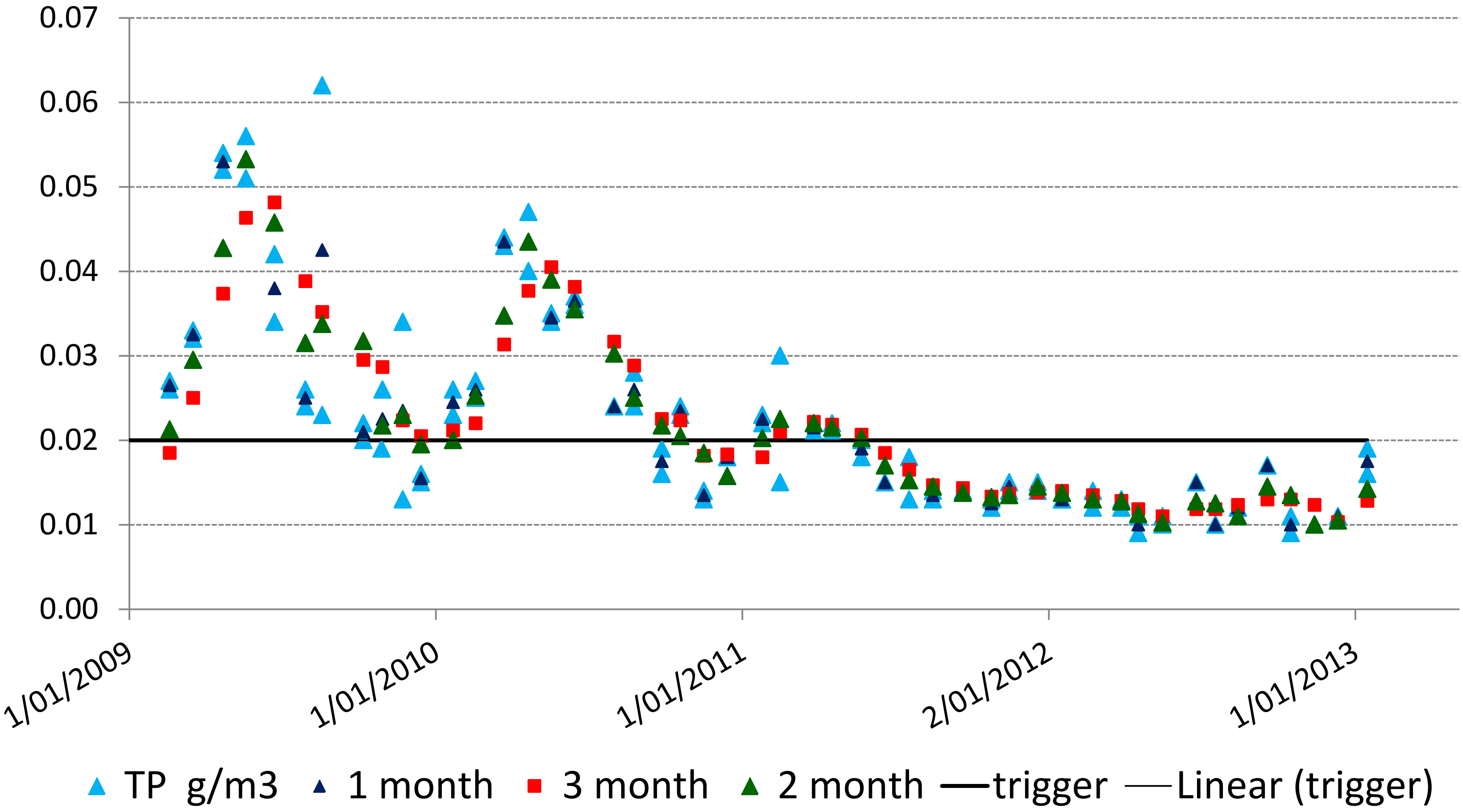
- **Objective**

  The method of alum dosing is transparent.
- **Purpose**

  So that a statement can be made about how the alum dosing system for Lake Rotorua is operated *eg* in a hearing or in the Environment Court.
- **Method**

  To be developed by the Regional Council with guidance from TAG.

Total Phosphorus in Lake Rotorua
last data point January 2013

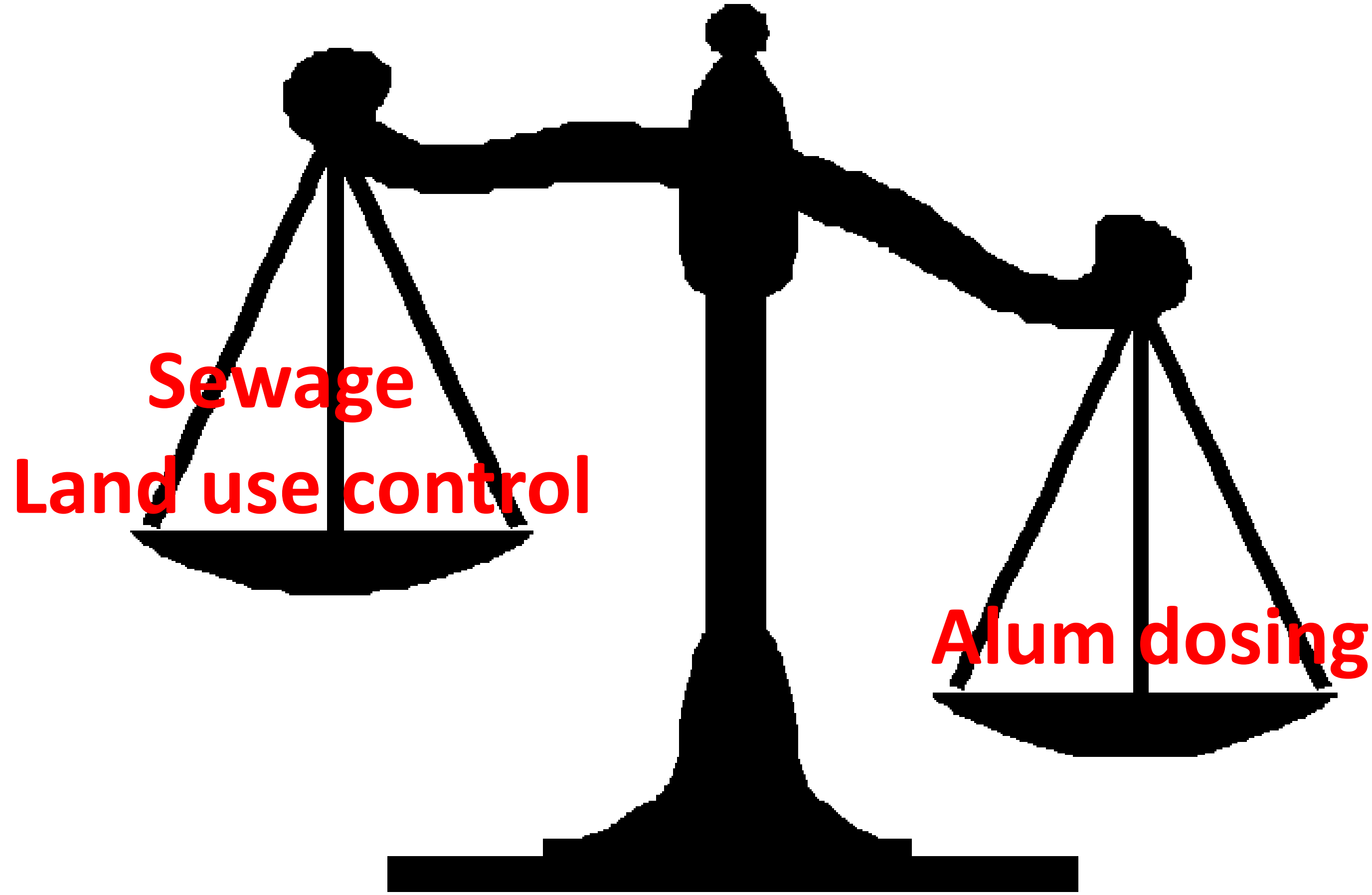


Trigger for alum dosing of Lake Rotorua

Suggested principle of operation

- Alum dosing of the Utuhina and Puarenga Streams is managed by the Bay of Plenty Regional Council, to maintain the total phosphorus (TP) concentration of Lake Rotorua surface water at or below 0.020 g/m^3.
- If algal blooms become a persistent issue when the TP is at or below 0.020 g/m^3, then a lower TP trigger level should be considered.

Maintaining the TP concentration in Lake Rotorua becomes a balance between alum dosing and nutrient control actions in the catchment. If someone increased the phosphorus load they would take ownership of controlling that increase.



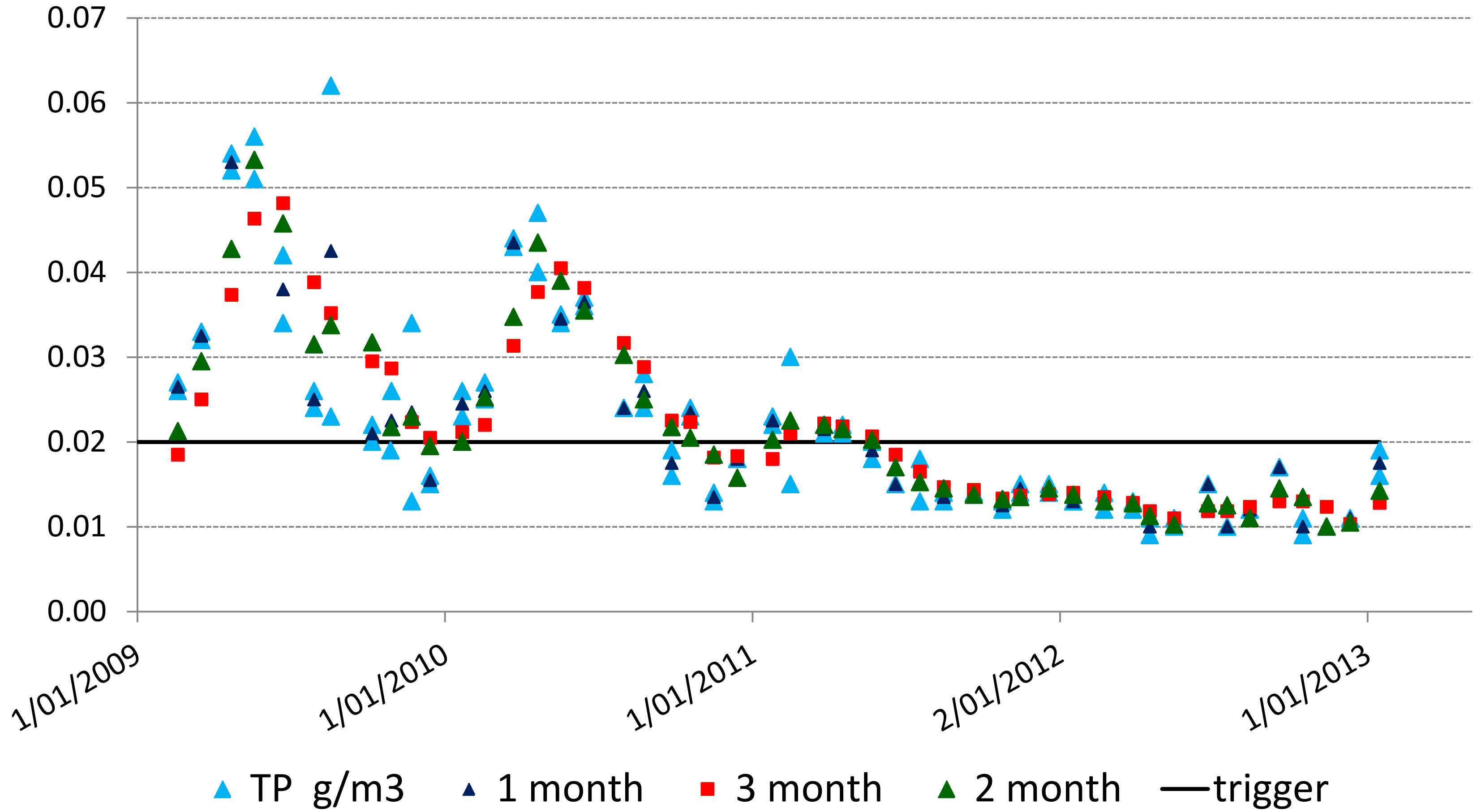
Trigger for alum dosing Lake Rotorua

- Iterative process
- Currently the plants are operating at a fixed dose.
- 100 L/hr (divided between the 2 sites)
- About 50 t Al/yr (about 0.5 g/m^3 Al added to each stream)
- The Action Plan objective is to reduce the catchment TP load by 10 t/yr
- Alum dose rate should be sufficient to reduce TP by 10 t/yr but 10 t reduction may not be enough or may be too much or ....

Trigger for alum dosing Lake Rotorua

- Over the past 6 months the TP has fluctuated around the 3 month average.
- Adjust in increments of 10 L/hr
- If monthly average TP > 0.020 g/m^3, increase alum dose by 10 L/hr
- If 2 monthly average TP > 0.020 g/m^3, increase alum dose by 10 L/hr
- If 3 monthly average TP > 0.020 g/m^3, increase alum dose by 10 L/hr

Total Phosphorus in Lake Rotorua
last data point January 2013



Trigger for alum dosing Lake Rotorua

- How do we deal with a reducing TP concentration?
- Adjust in increments of 10 L/hr
- If monthly average TP < 0.017 g/m^3, decrease alum dose by 10 L/hr
- If 2 monthly average TP < 0.017 g/m^3, decrease alum dose by 10 L/hr
- If 3 monthly average TP < 0.017 g/m^3, decrease alum dose by 10 L/hr

Trigger for alum dosing Lake Rotorua Conclusion

- Control between lake TP concentrations 0.017 – 0.020 g/m^3 using alum dosing
- May be able to decrease the increments in time

Future objectives

- TAG position statement on alum dosing Lakes Rotorua and Rotoehu
- Regional Council policy

RDC WWTP consent change

1 ROTAN cf current method

2 Premise on which the consent is based is Table 1 (Rutherford et al 1989). Consent assumes no error margins.

3 Consent limit is an upper bound to permit an activity to take place with a reasonable allowance for variation.

Lake Rotorua targets (Rutherford *et al* 1989)

TABLE 1. Lake Rotorua Nutrient Inputs and Water Quality

Factors (1)	1965 (2)	1976–77 (3)	1981–82 (4)	1984–85 (5)	Target (6)
Population	25,000	50,000	52,600	54,000	—
Phosphorus inputs (t/yr)					
Raw sewage	5	18	30	47	—
Treated sewage	5	7.8	20.6	33.8	3
Stream	34	34	34	34	34
Internal	0	0	20	35	0
Total	39	41.8	74.6	102.8	37
Nitrogen inputs (t/yr)					
Raw sewage	34	100	170	260	—
Treated sewage	20	72.5	134	150	30
Stream (including septic tanks)	455	485	420	415	405
Septic tanks	50	80	15	10	0
Internal	0	0	140	>260	0
Total	475	557.5	694	>825	435
Average lake water quality					
Total phosphorus (mg/m^3)	—	23.8	47.9	72.6	20
Total nitrogen (mg/m^3)	—	310	519	530	300
Chlorophyll (mg/m^3)	—	5.5	37.8	22.6	10
Chlorophyll a (peak; mg/m^3)	—	28	62	58	17–24
Secchi disc (m)	2.5–3	2.3	1.9	1.7	2.5–3
Oxygen depletion rate ($g/m^3/day$)	—	0.4	0.7	0.9	0.25

Note: Catchment area = 424 km^2; surface area = 81 km^2; mean depth = 10.7 m; volume = 0.865 km^3; outflow rate = 18.5 m^3/s; and residence time = 1.5 year.

Update of Table 1 (Rutherford et al 1989) Phosphorus

Table 2 Summary of nitrogen and phosphorus inputs to Lake Rotorua from 1990 to 2011. Adapted from Howard-Williams et al (1986), Rutherford et al (1989) and Rutherford et al (2011).

		1990-95	1995-00	2000-05	2005-10	2010	2011	Target
Phosphorus input								
Raw sewage t/y								
To irrigation site t/y		12	26	30	30	17	20	
Treated sewage t/y		1	1	1	1	1	3	3
Stream t/y[a]		37	37	37	37	37	37	33
Internal t/y		12	19	17	17	20	6	0
Rainfall t/y		1	1	1	1	1	1	1
P locked t/y		0	0	0	0	-16	-22	
Sub-total tP/y		51	58	56	56	43	25	37

Update of Table 1 (Rutherford et al 1989)
Nitrogen

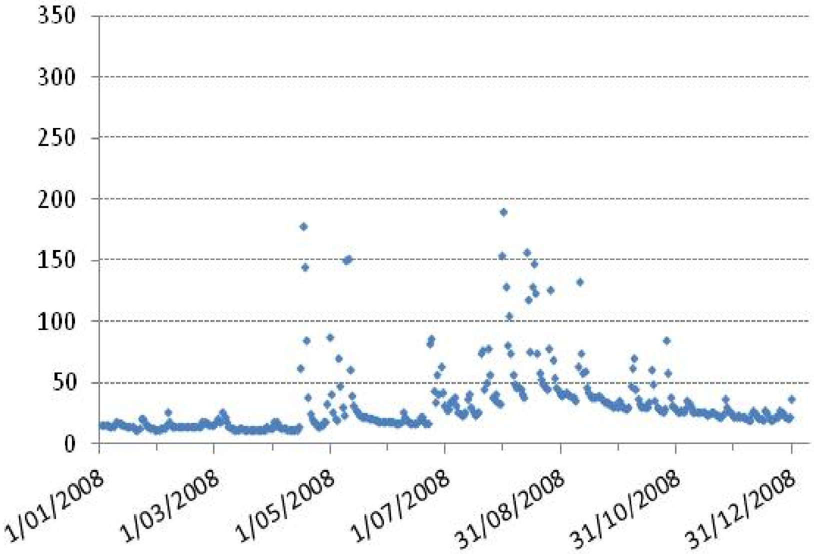
		1990-95	1995-00	2000-05	2005-10	2010	2011	Target
Nitrogen input								
Raw sewage t/y								
To irrigation site t/y		83	94	64	76	47	54	
Treated sewage t/y		25	35	38	35	32	41	30
Stream t/y[a]		483	473	470	476	484	475	375
Septic tank t/y		18	18	18	15	10	10	0
Internal t/y		61	167	156	117	65	45	0
Rainfall t/y		30	30	30	30	30	30	30
Sub-total tN/y		617	723	712	673	621	601	435
In-lake change tN/y		-7	-111	-54	0	-121	-128	
Total tN/y		610	612	658	673	500	473	435
Median lake quality								
Total phosphorus mg/m^3		53	31	42	33	32	17	20
Total nitrogen mg/m^3		421	422	454	464	345	326	300
Mean chlorophyll a mg/m^3		9	11	26	19	15	15	10
Secchi disc m		2.4	3.2	2.6	2.6	2.6	3.3	2.5-3

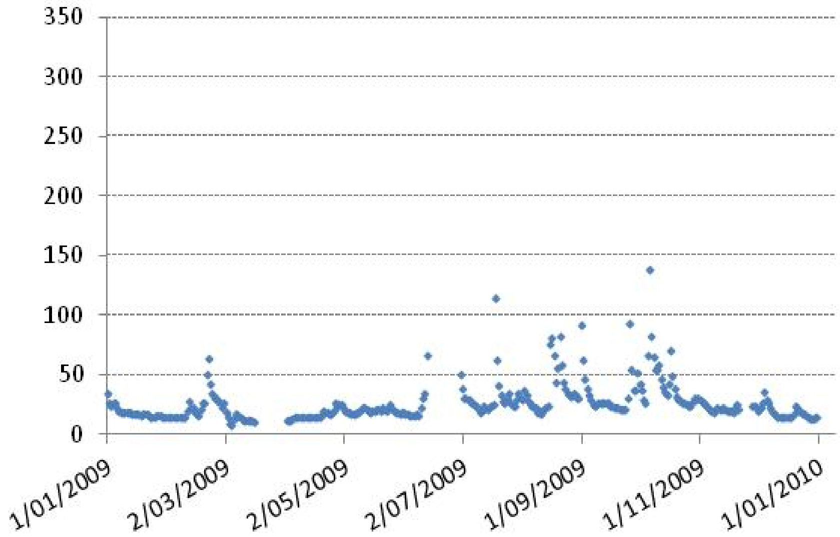
Annual rainfall; Birchall Herd Home weather station.

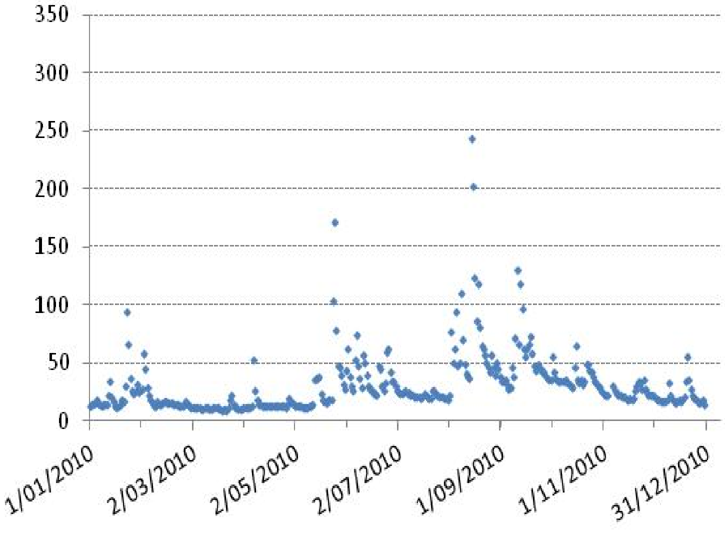
2008	998 mm
2009	630 mm
2010	1320 mm
2011	1680 mm
2012	1290 mm

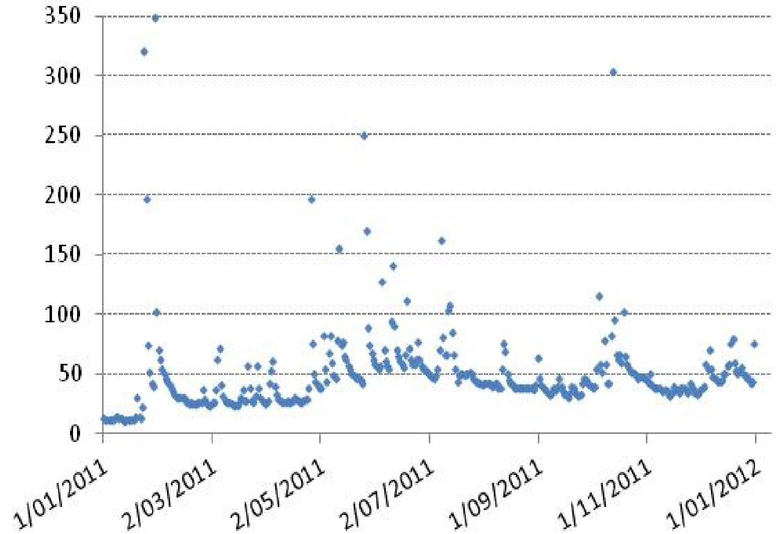
Flow from the Okaro Wetland

Mean daily flows L/s









Mean daily flows L/s