A Better Mouse Trap ?

A study of a New Zealand developed Pond Aerator

by Tara Okan

Co - Authored by John Nagels

Meet Brendan Walsh

Hi, Brendan. Why are you doing this?

“In Australia we get bacteria to break down the solids by aerating them with machines, 24 hours a day. It's a very aggressive environment, and moving parts constantly break.”

So what's broken here?

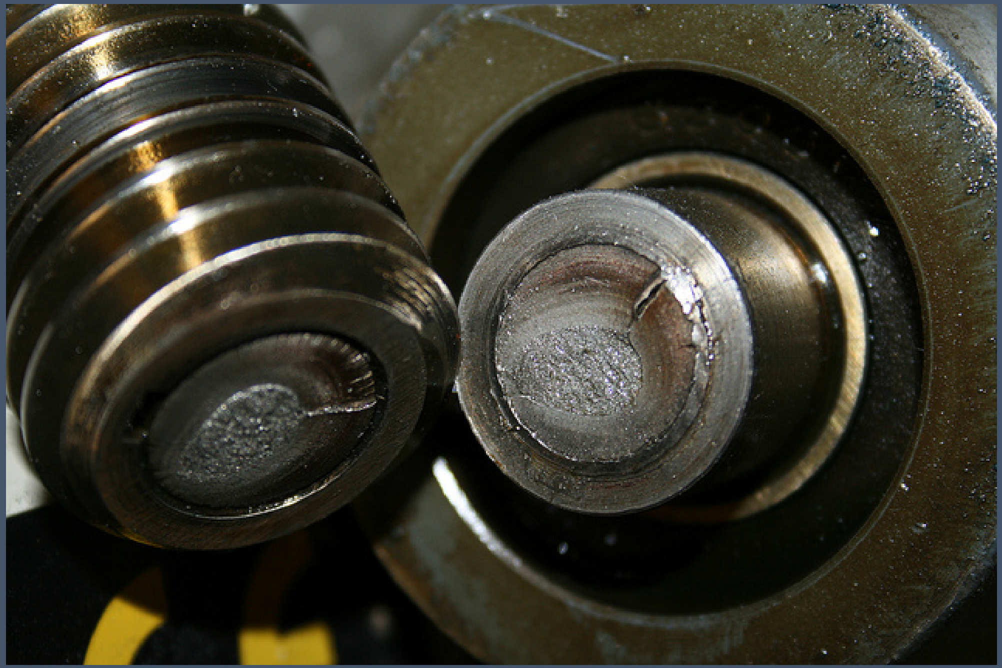
“One of the motors. The motors are now in the pond, and there's no other way to access them without getting in.”

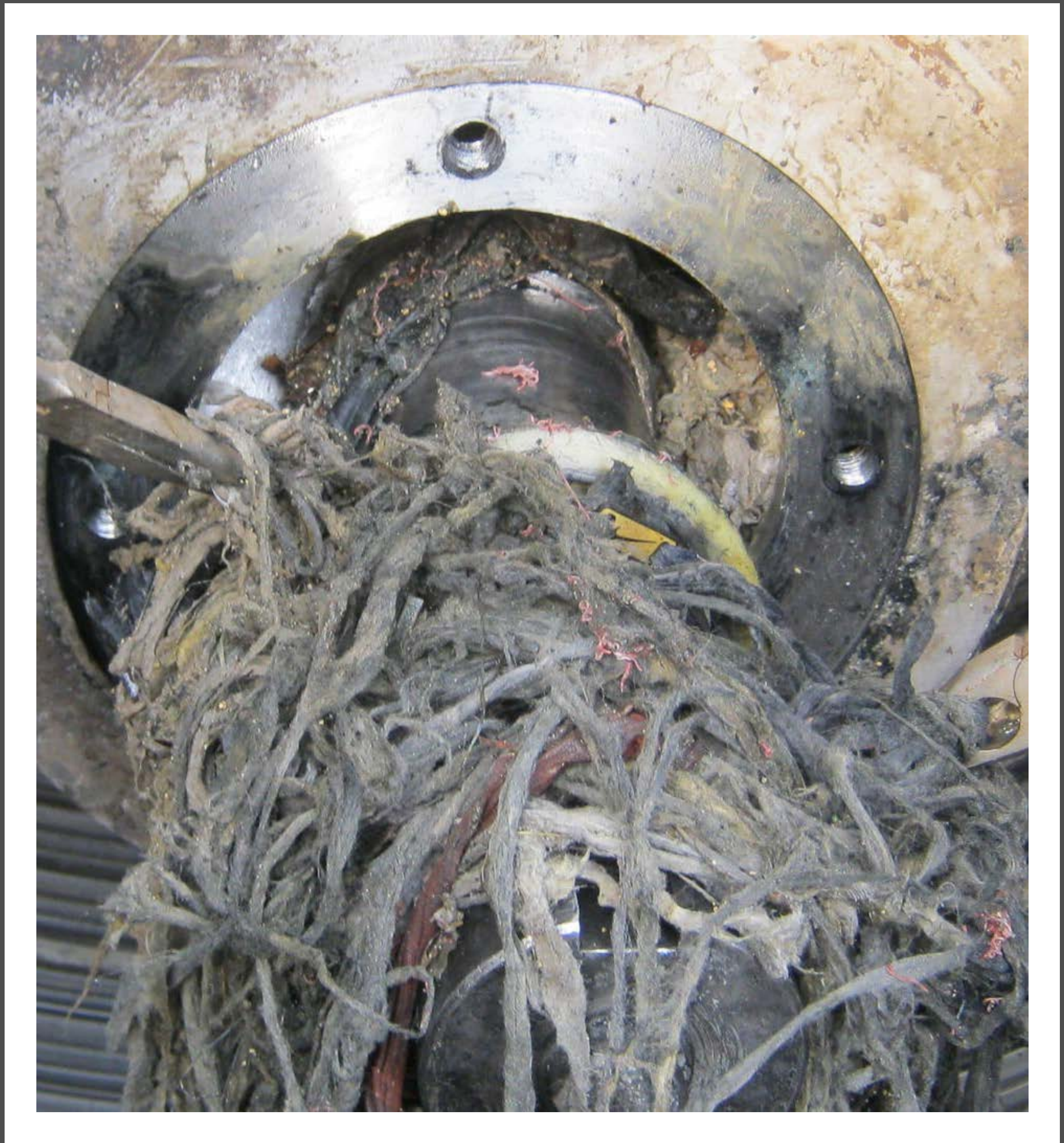
That all sounds like a design flaw. Shouldn't there be an easier way?

“Ah, you'd think so, but then it gives me a job.
Got to earn the ex-wife money somehow.”









After a particularly spectacular failure on one plant in NZ we decided there simply had to be a better way

Known Challenges with Mechanical surface Aerators

- Mechanical components are subject to wear & breakage - Gear boxes need greasing and replacing regularly – this puts operators in boats on ponds and at risk to health and safety

- Electricity on the water is subject to cable pin holing, gland leakage

- Aerators are heavy (we wanted something a farmer could throw on the back of a ute)

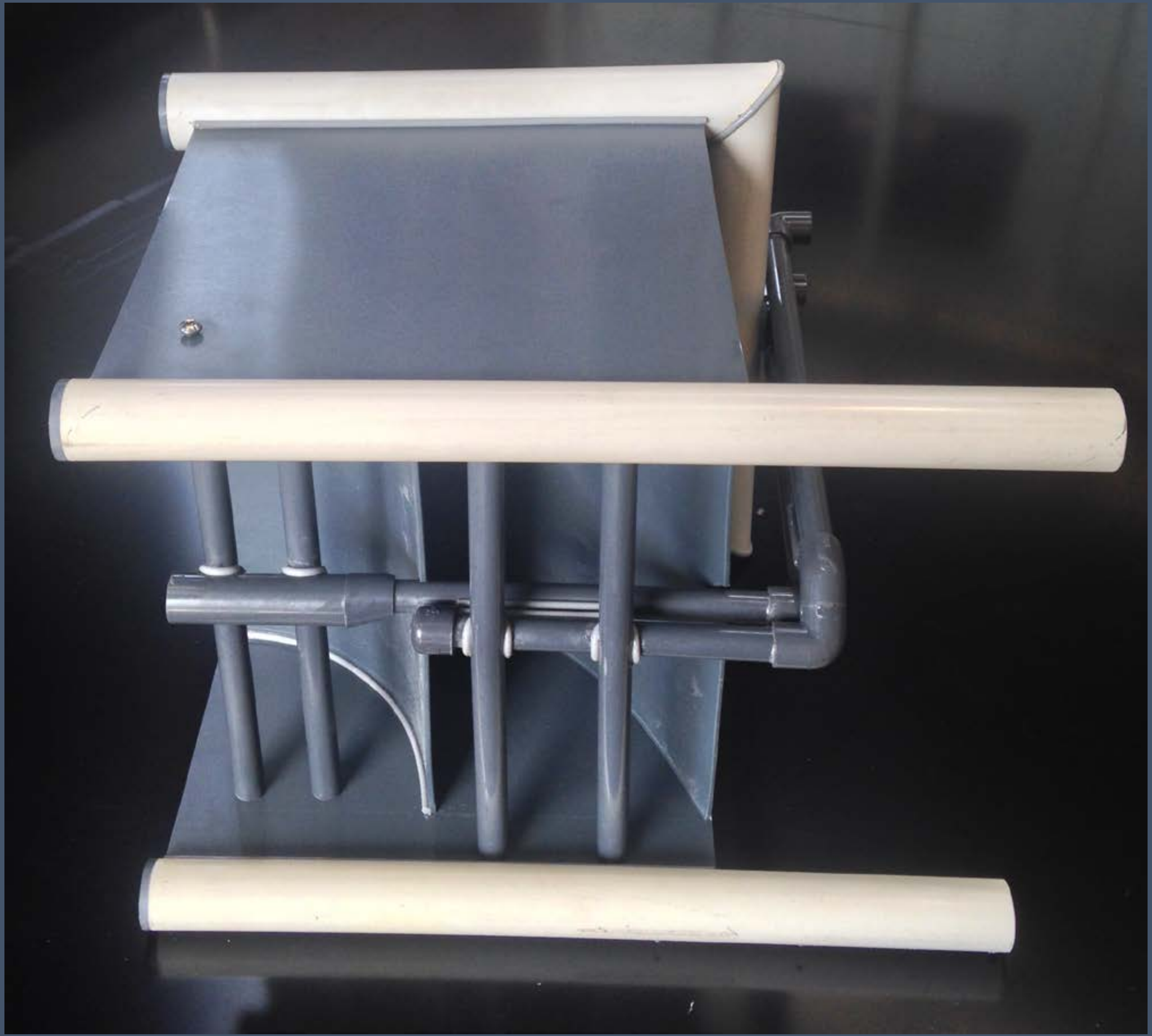
- The amount of dissolved oxygen made available compared to the amount of energy required in the field is often inefficient.

The Aquarator makes three major fundamental changes in the way we consider surface aerators

- The Aquarator has no moving parts in the water
  All mechanical components are land based allowing for land based service and maintenance

- No electricity on the water and therefore the unit is fully submersible

- The Aquarator is a surface aerator that utilises the efficiencies of subsurface fine bubble diffusion

Paul Cheshire – duly Proud of his creation

And Now for the science


Sludge drying area
Pond one Influent
Pond Two Effluent
Aerial Images by John Nagels

Eureka Manta 2 in-situ water quality sonde deployed in the influent Channel by BPO

Aquarator deployed facing the influent channel

YSI DO Probe Sonde in the outlet channel

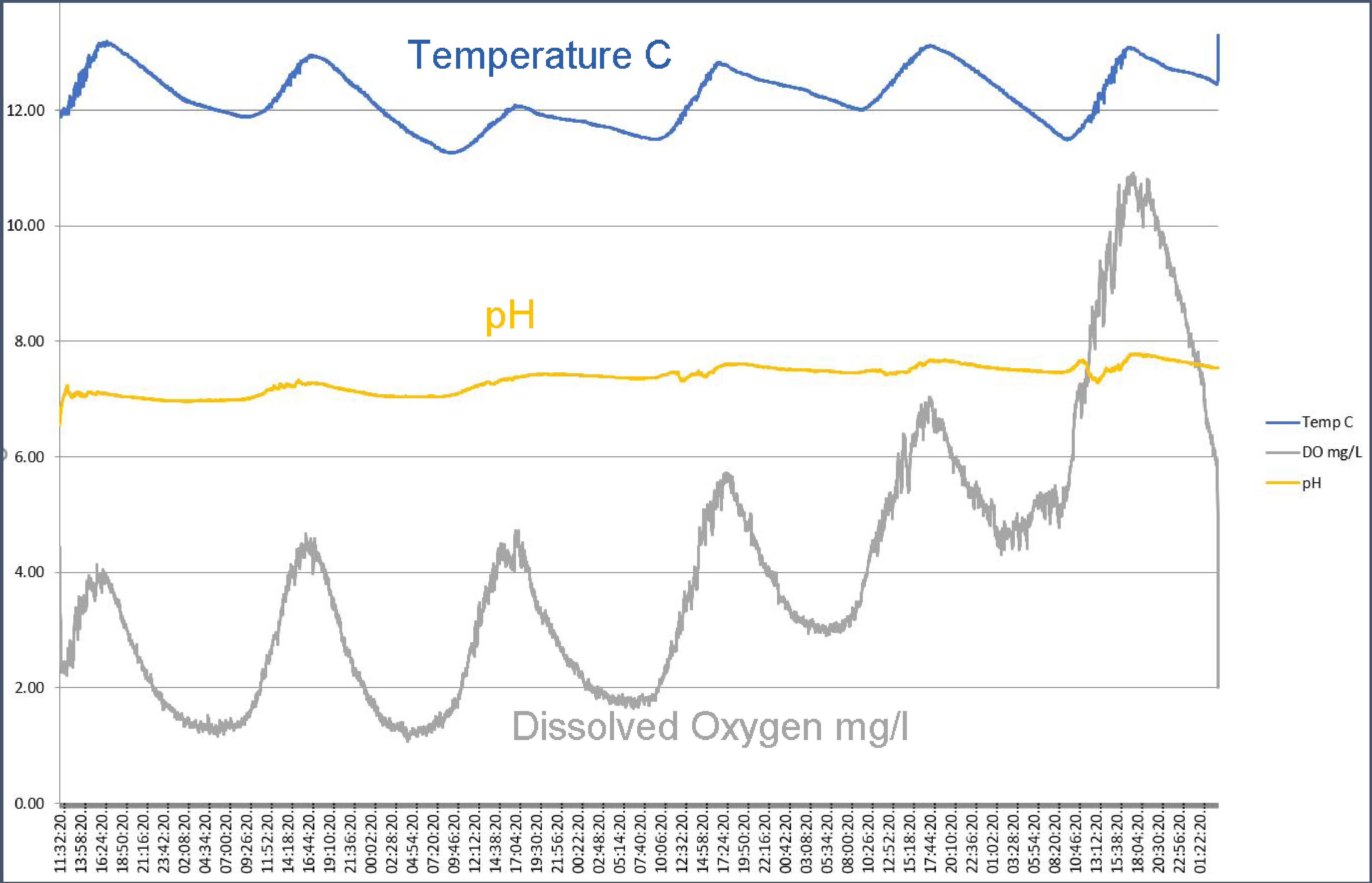
DCM
Process Control
Portable
Monitoring
Station

Supplying
COD
CODf
TSS
NO_3
pH

And other
measurements
Including from tird
party devices

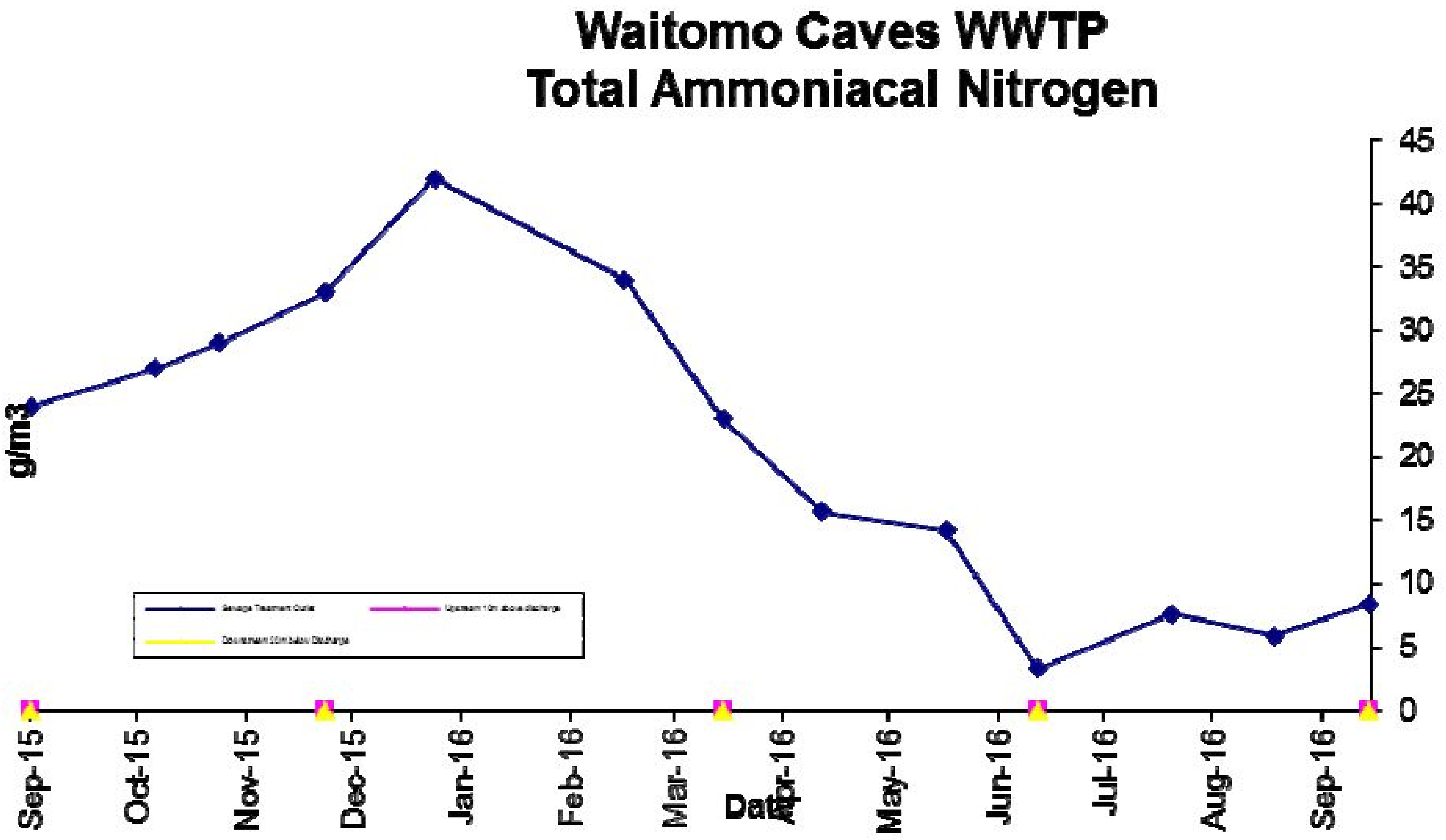
- Oxygen Profile results

Waitomo WWTP

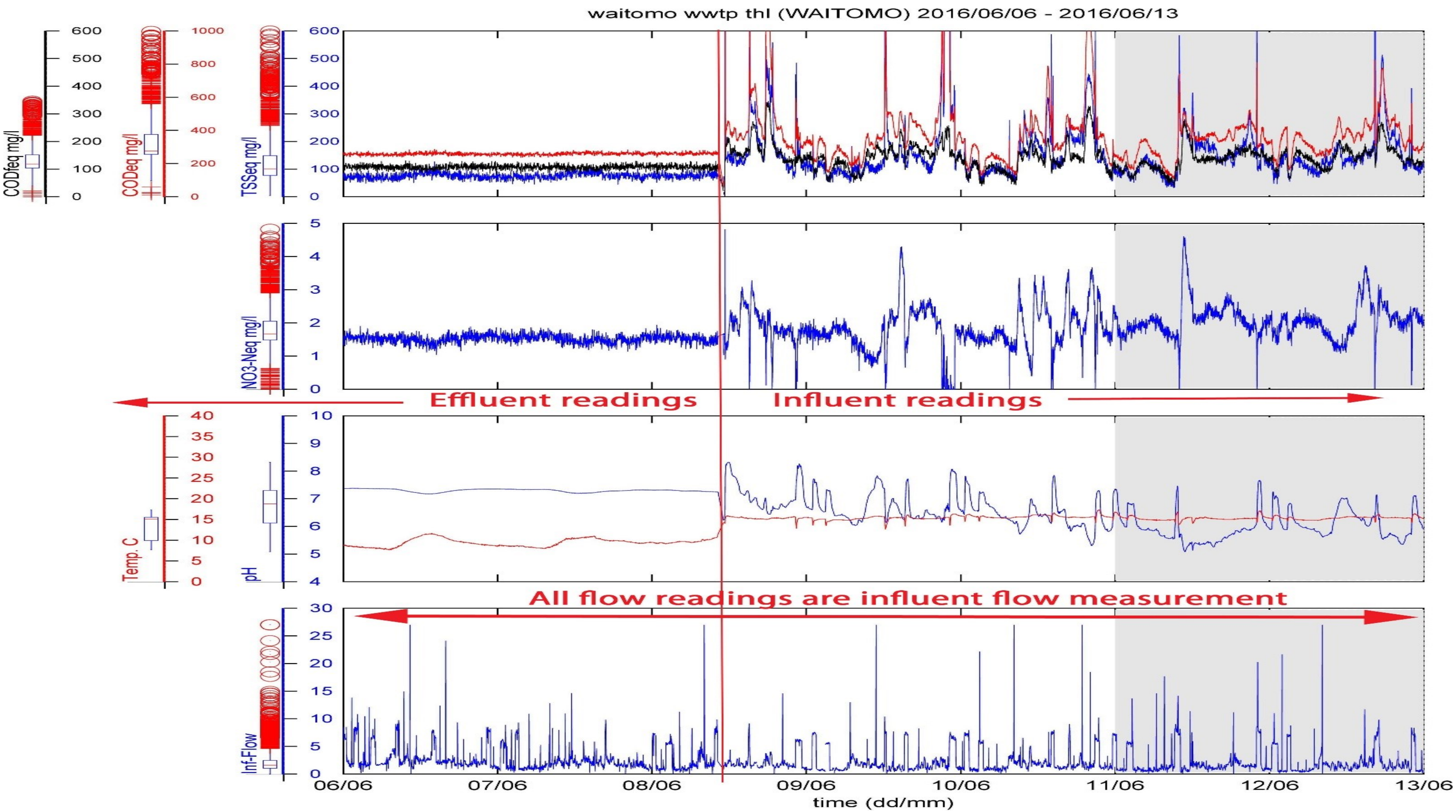

Temperature C
pH
Dissolved Oxygen mg/l
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Temp C
DO mg/L
pH
11:32:20.
13:58:20.
16:24:20.
18:50:20.
21:16:20.
23:42:20.
02:08:20.
04:34:20.
07:00:20.
09:26:20.
11:52:20.
14:18:20.
16:44:20.
19:10:20.
21:36:20.
00:02:20.
02:28:20.
04:54:20.
07:20:20.
09:46:20.
12:12:20.
14:38:20.
17:04:20.
19:30:20.
21:56:20.
00:22:20.
02:48:20.
05:14:20.
07:40:20.
10:06:20.
12:32:20.
14:58:20.
17:24:20.
19:50:20.
22:16:20.
00:42:20.
03:08:20.
05:34:20.
08:00:20.
10:26:20.
12:52:20.
15:18:20.
17:44:20.
20:10:20.
22:36:20.
01:02:20.
03:28:20.
05:54:20.
08:20:20.
10:46:20.
13:12:20.
15:38:20.
18:04:20.
20:30:20.
22:56:20.
01:22:20.

RESULTS

Waitomo Caves	Consent limits or Targets													
Date		Sep-15	Oct-15	Nov-15	Dec-15	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16
Sewage Treatment Outlet														
Time		14:00	10:30	12:27	12:30	10:46	14:10	10:46	12:10	11:00	10:40	8:26	11:43	10:00
Lab number		1473944	1489195	1505709	1510269	1528463	1543192	1556827	1571880	1590621	1603058	1623461	1638326	1653708
Sample No		58347	58724	59108	59215	59748	60318	60698	60962	61312	61545	61891	62178	62474
E-coli MPN/100ml		1,110,000	5000	100	350	400	150	5,000	11,000	3,000	8,000	2,300	2,000	1,000
Faecal Coliforms MPN/100ml		20,000	10,000	500	400	1600	610	9,000	23,000	26,000	28,000	6,300	11,000	10,000
pH	9	7.09	8.3	7.1	7.36	7.1	6.99	6.96	7.08	7.39	7.7	6.97	7.51	7.46
pH (Lab)	9	8	8.3	8.4	8	8.1	8.2	8.4	8.5	7.9	8.4	6.97	7.7	8.4
Temperature °C	25	9.6	14.1	14.9	16.4	14.1	16.1	14.1	14.3	14.1	11.5	14.1	14	12.7
Suspended Solids (g/m3)	100	40	29	22	35	49	35	89	**104**	33	36	17	27	32
Total Ammoniacal N (g/m3)	10	**24**	**27**	**29**	**33**	**42**	**34**	**23**	**15.7**	**14.2**	3.3	7.6	5.9	8.4
Total Nitrogen (gm/m3)		34	36	33	39	51	43	31	30	22	17.9	17.5	19.2	18.7
Total Kjeldahl Nitrogen (TKN) (g/m3)		34	35	33	39	50	42	30	30	21	10.5	9.6	9.8	13.4
Nitrate N + Nitrite N (g/m3)		0.183	0.23	0.21	0.059	0.128	0.48	0.84	0.62	1.35	7.4	7.9	9.4	5.3
Dissolved Reactive Phosphorus (g/m3)		5	5.8	6.5	8.2	5.9	8	4.1	1.21	0.87	0.89	3.6	4.1	8.4
CBOD5 (gm O2/m3)	30	24	11	14	23	**31**	18	17	13	21	**48**	7	14	18


Waitomo Caves WWTP
Total Ammoniacal Nitrogen
g/m3
45
40
35
30
25
20
15
10
5
0
Sep-15
Oct-15
Nov-15
Dec-15
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Date

Waitomo Caves	Consent limits or Targets										
Date		28/10/2016	28/11/2016	20/12/2016	19/01/2017	7/02/2017	13/03/2017	27/04/2017	17/05/2017	29/06/2017	10/07/2017
Sewage Treatment Outlet											
Time		10:30	13:00	10:37	12:00	13:27	10:30	12:30	14:27	11:00	12:10
Lab number		1671799	1687887	1700994	1711315	1720219	1740028	1766013	1777799	1801319	1806980
Sample No		62807	63101	63396	63662	63915	64385	64887	65102	65537	65625
E-coli MPN/100ml		2,600	2,000	70,000	9,000	5,000	10,000	70,000	1,000	29000	68000
Faecal Coliforms MPN/100ml		16,000	7,000	45,000	19,000	9,000	190,000	320,000	11,000	42000	110000
pH	9	7.54	6.96	7.1	6.81	6.98	7.75	6.94	7.18	7.39	6.94
pH (Lab)	9	7.1	7.6	6.8	7.3	6.9	7.9	6.9	7.8	6	5.7
Temperature ºC	25	14.7	14.6	14.6	13.1	14.6	20.3	18.4	14.27	14.1	12.1
Suspended Solids (g/m3)	100	39	65	78	46	103	46	62	35	80	101
Total Ammoniacal N (g/m3)	10	0.22	**11.2**	1.3	**14.3**	0.71	**35**	8.7	8.5	0.06	0.03
Total Nitrogen (gm/m3)		18.2	30	32	37	31	46	41	41	41	47
Total Kjeldahl Nitrogen (TKN) (g/m3)		6.9	25	19.2	28	13	44	23	26	11.2	14.8
Nitrate N + Nitrite N (g/m3)		11.3	4.6	13.2	8.9	18.2	2.2	18.4	14.7	30	32



waitomo wwtp thl (WAITOMO) 2016/06/06 - 2016/06/13
CODfeq mg/l
CODeq mg/l
TSSeq mg/l
NO3-Neq mg/l
Effluent readings
Influent readings
Temp. C
pH
All flow readings are influent flow measurement
Inf-Flow
06/06
07/06
08/06
09/06
10/06
11/06
12/06
13/06
time (dd/mm)

Conclusions

- The Aquarator introducing compressed air and using an innovative horizontal venturi action consistently increased the dissolved oxygen levels in Waitomo WWTP pond one.

- The amount of oxygen introduced enables the nitrification of high levels of ammoniacal nitrogen greater than 10mg/l (but sometimes exceeding 120 mg/l) to nitrate.

- Other parameters which measured wastewater strength also showed significant decreases in concentration in Pond one with the Aquarator operational.

- The comparison of data from the previously recorded 9 years with that of this 2016 study using the Aquarator (instead of a brush aerator) showed compliance of all waste water parameters and in particular the Ammoniacal nitrogen.

- The Aquarator – showed a significant increase in pond assimilative capacity to be able to comply with most future demands.
- Aquarators are cheaper to run and maintain than conventional aeration systems.

So have we got a better mousetrap ?

?’s

Thank you for your attention .
Tara Okan