



# *Impacts of Septic Tanks in Glenorchy*

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# Overview

- What are we worried about?
- Contaminants – Which ones?
- Transport - Where do they go?
- Fate - How are they transformed?
- Receptors -What impacts do they have?

# Contaminants

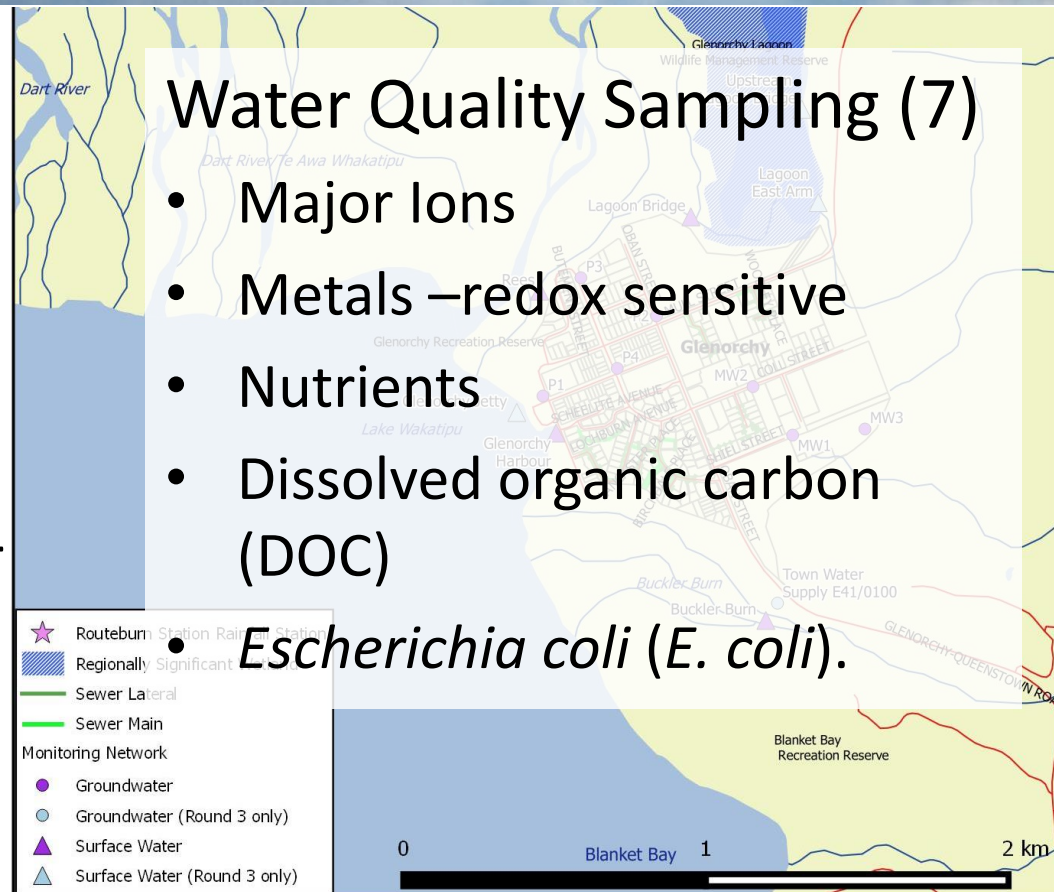
## Septic Tank Effluent

Parameter	Unit	Mean
pH		7.01
Dissolved Organic Carbon	mg/L	48
Total Phosphorous	mg/L	14.55
Total Nitrogen	mg/L	68
NH <sub>4</sub> -N	mg/L	55
NO <sub>3</sub> -N	mg/L	0.44
Sulfate	mg/L	6.21
Br	mg/L	0.02
Chloride	mg/L	51
<i>E. coli</i>	<a href="#"><u>MPN/100 mL</u></a>	1.3 × 10 <sup>6</sup>
Iron	<u>mg/L</u>	0.198

Source: (Richards, Withers, Paterson, McRoberts, & Stutter, 2016)

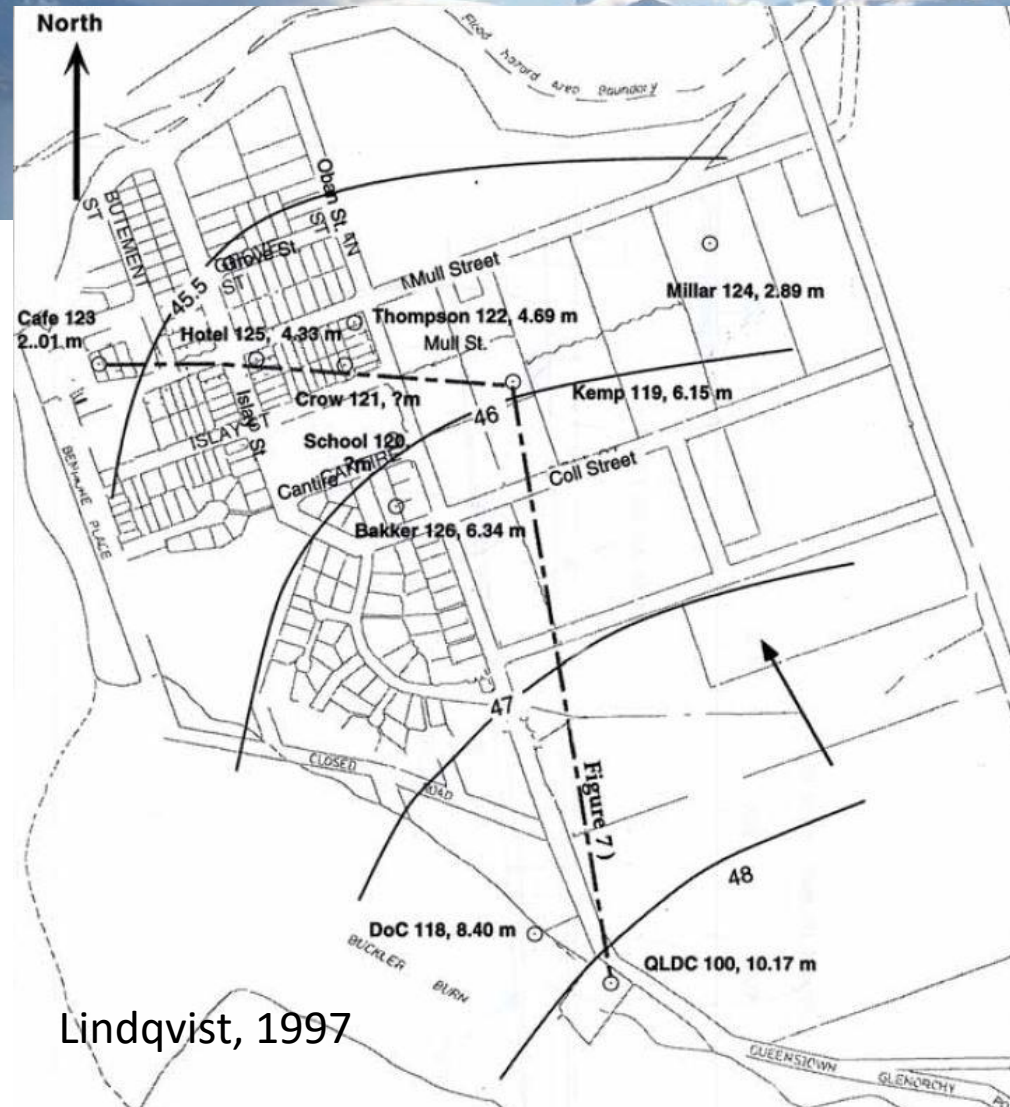
# Our Approach

- Desktop Assessment
- Monitoring Network – Surface water, groundwater levels and quality
- Ecological Assessment - aquatic plants and animals Lake & Lagoon



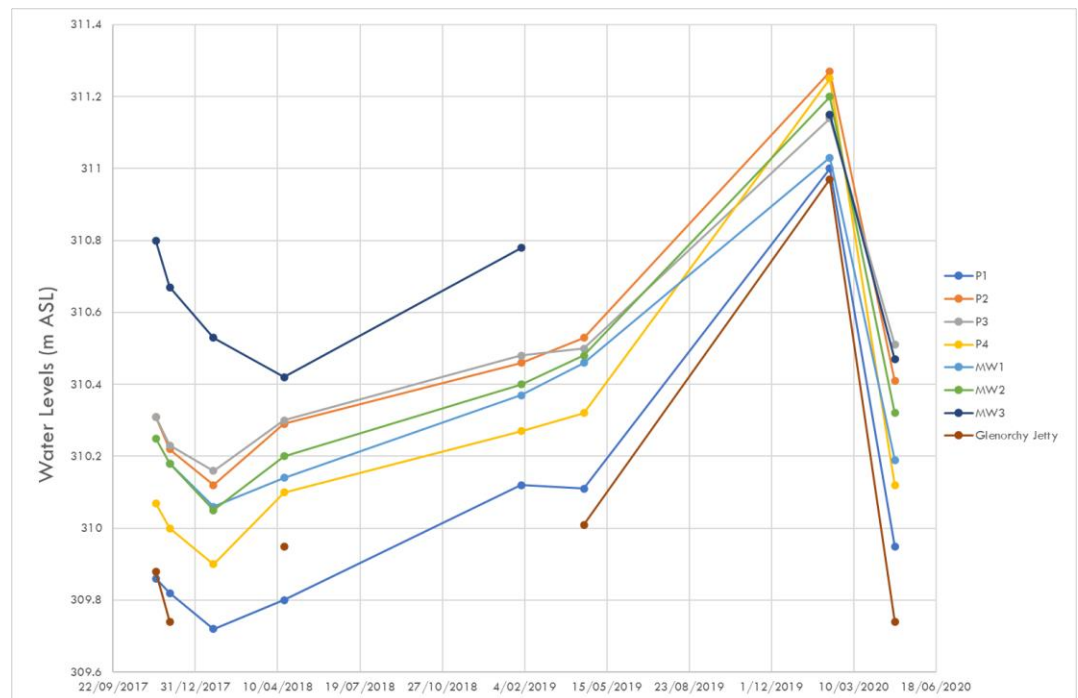
# Where does it go?

- Water levels
- Surveys



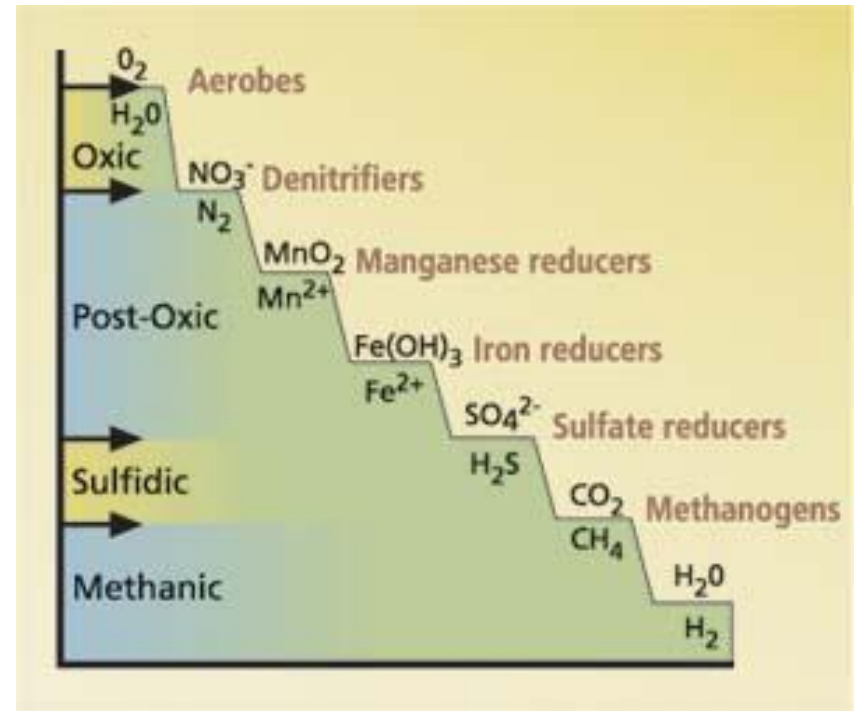
# Groundwater levels

Location	Water Level (m below ground)		
	Min (Feb 2020)	Max (Jan 2018)	Median
P1	0.15	1.43	1.25
P2	2.82	3.97	3.73
P3	0.16	1.14	0.91
P4	2.75	4.10	3.89
MW1#	7.86	8.83	8.70
MW2	5.35	6.50	6.27
MW3	13.12	13.85	13.60



# Some background chemistry - redox

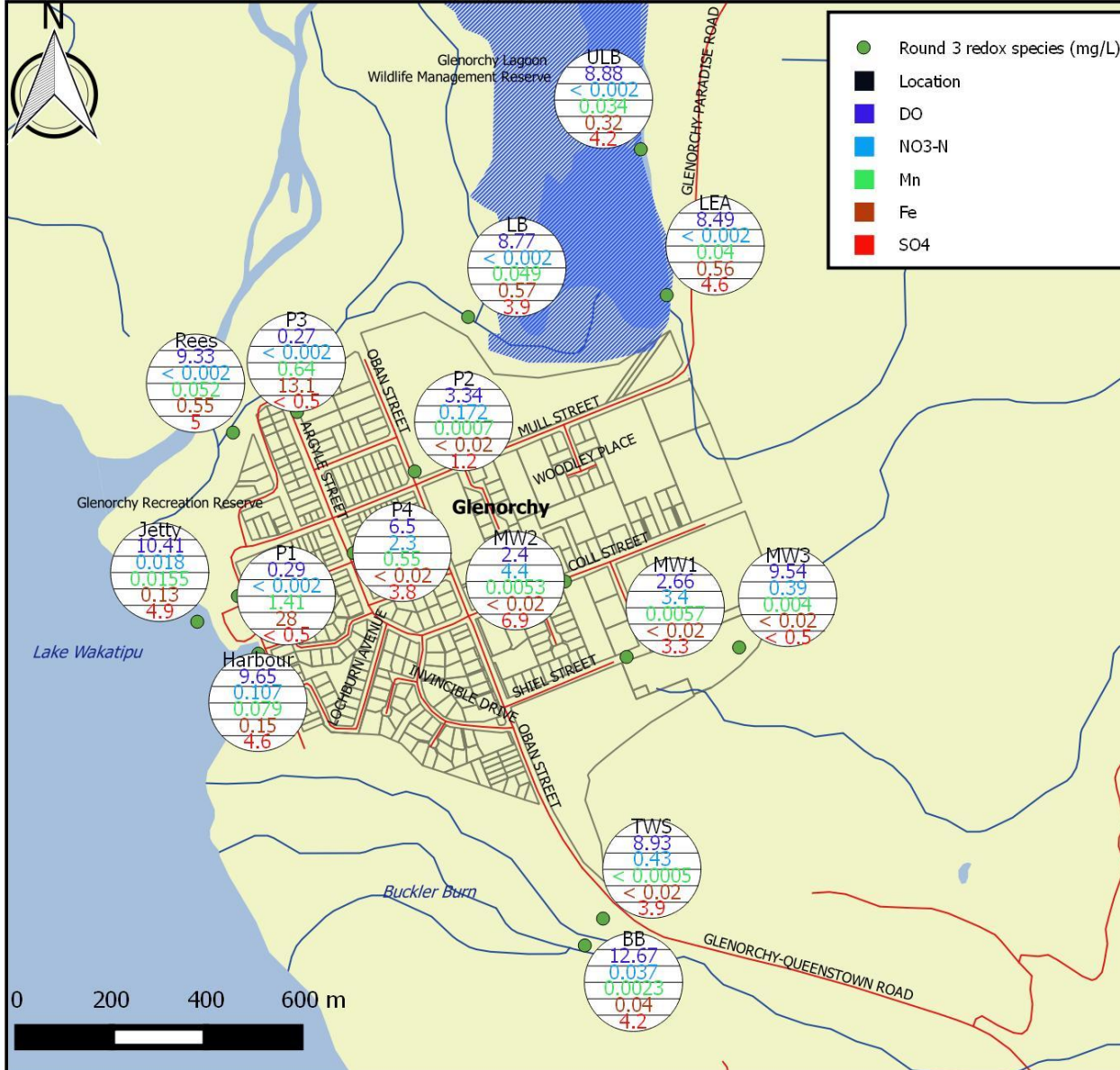
- Dissolved organic matter leaching from soils can change the chemistry of the groundwater



Source: Duke University (2012)  
<https://sites.duke.edu/microbialecolgy/files/2012/01/fig5702p56athumb.jpg>

# Water Quality Result

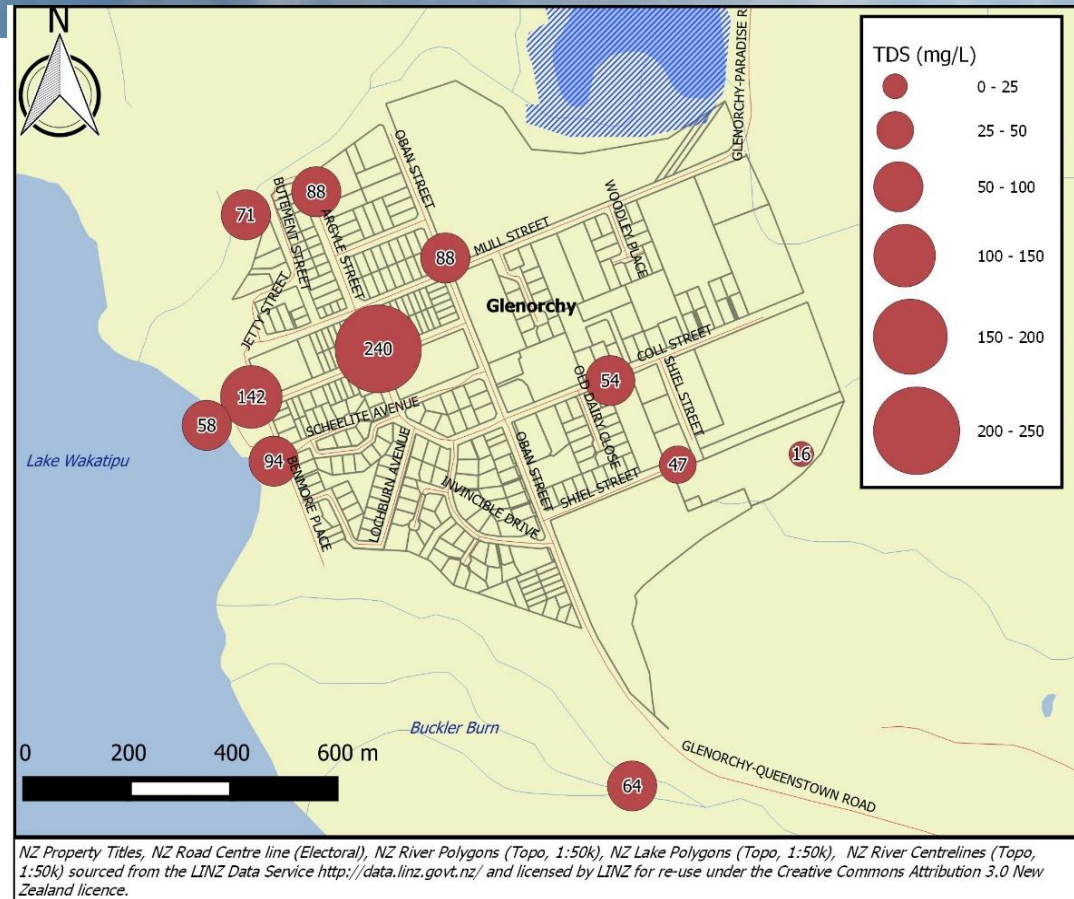
- Redox sensitive species
- Iron P1 (26.7 – 42 mg/L) and P3 (8.9 – 15.7 mg/L)
- Manganese P1 (1.22 – 1.92 mg/L)



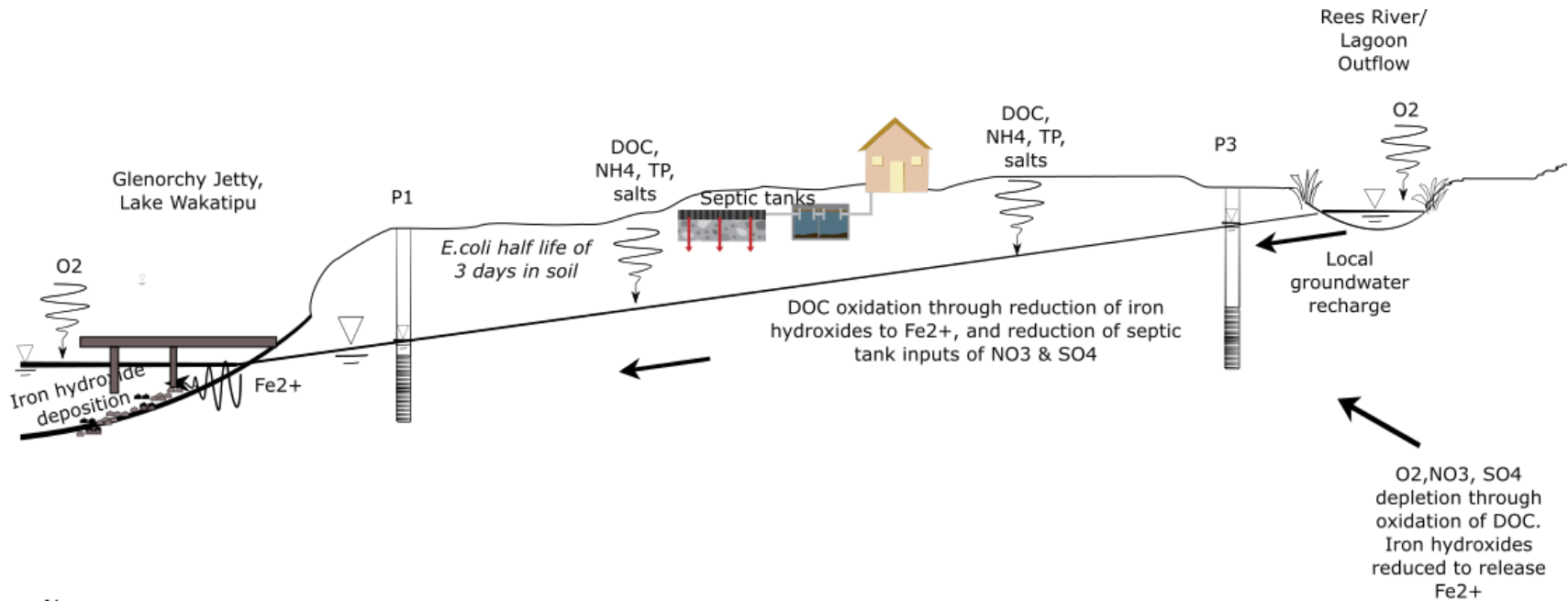
NZ Property Titles, NZ Road Centre line (Electoral), NZ River Polygons (Topo, 1:50k), NZ Lake Polygons (Topo, 1:50k), NZ River Centrelines (Topo, 1:50k) sourced from the LINZ Data Service <http://data.linz.govt.nz/> and licensed by LINZ for re-use under the Creative Commons Attribution 3.0 New Zealand licence.



# Water Quality Results



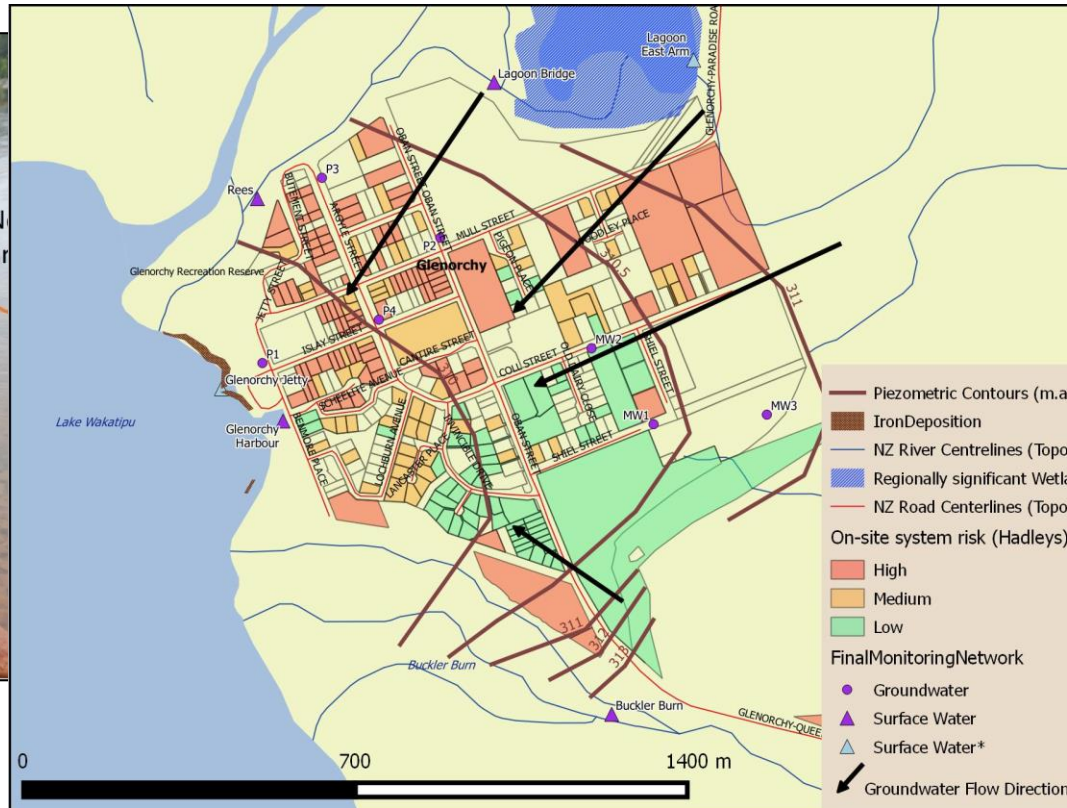
# Iron Deposition



NOT TO SCALE

Septic tank image source: Jane Thomas  
(<http://ian.umces.edu/imagelibrary/displayimage-6130.html>)

# Iron Deposition



NZ Property Titles, NZ Road Centre line (Electoral), NZ River Polygons (Topo, 1:50k), NZ Lake Polygons (Topo, 1:50k), NZ River Centrelines (Topo, 1:50k) sourced from the LINZ Data Service (<http://data.linz.govt.nz/>) and licensed by LINZ for re-use under the Creative Commons Attribution 3.0 New Zealand licence. Aerial Imagery sourced from the the LINZ Data Service (insert URL) and licensed by (insert Licensee) for re-use under the Creative Commons Attribution 3.0 New Zealand licence.

# Iron Deposition Ecological Effects

*Myriophyllum triphyllum*



Inside iron deposition area



Outside iron deposition area

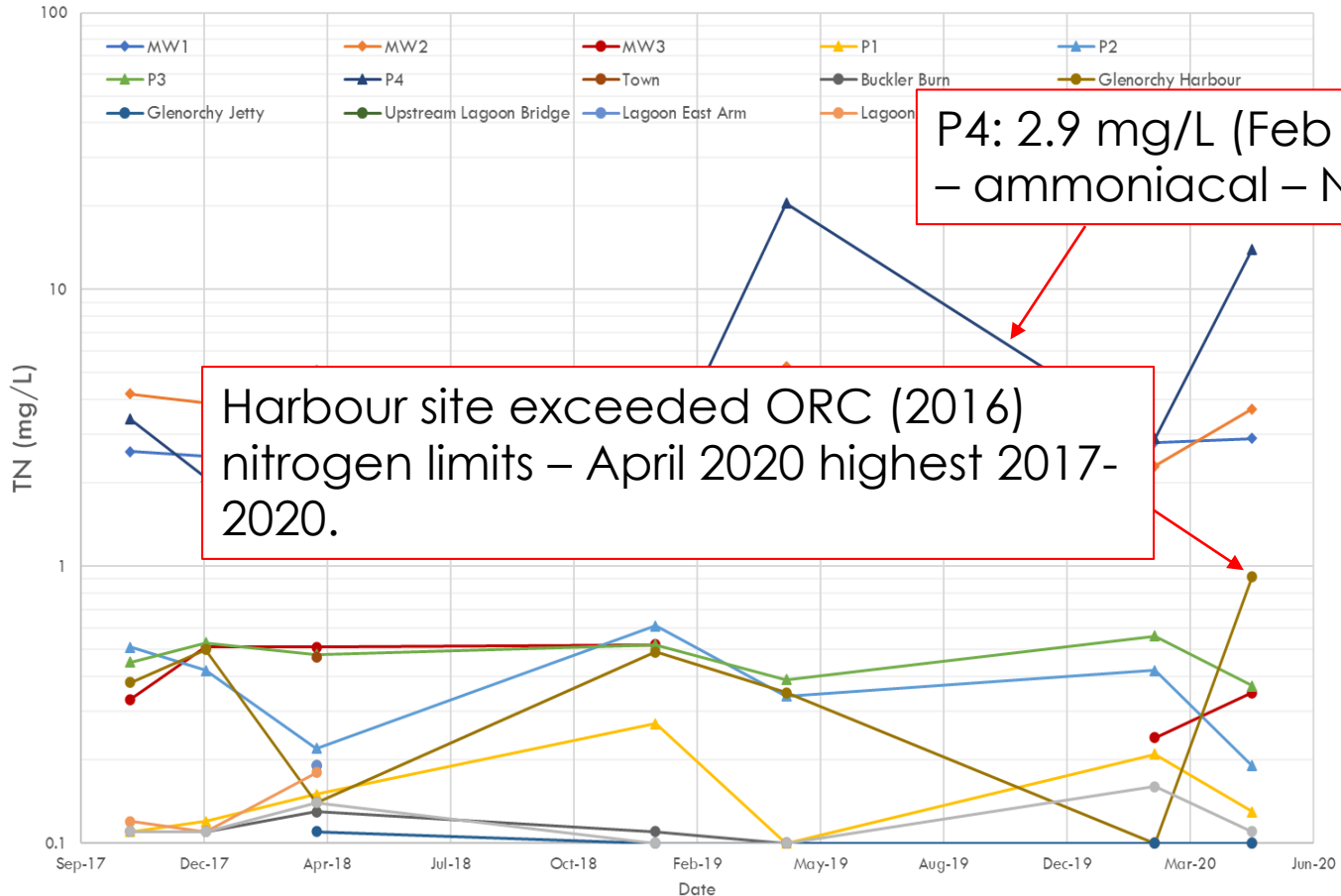
*Potamogeton crispus*



- Only one type of snail
- No large adult fish

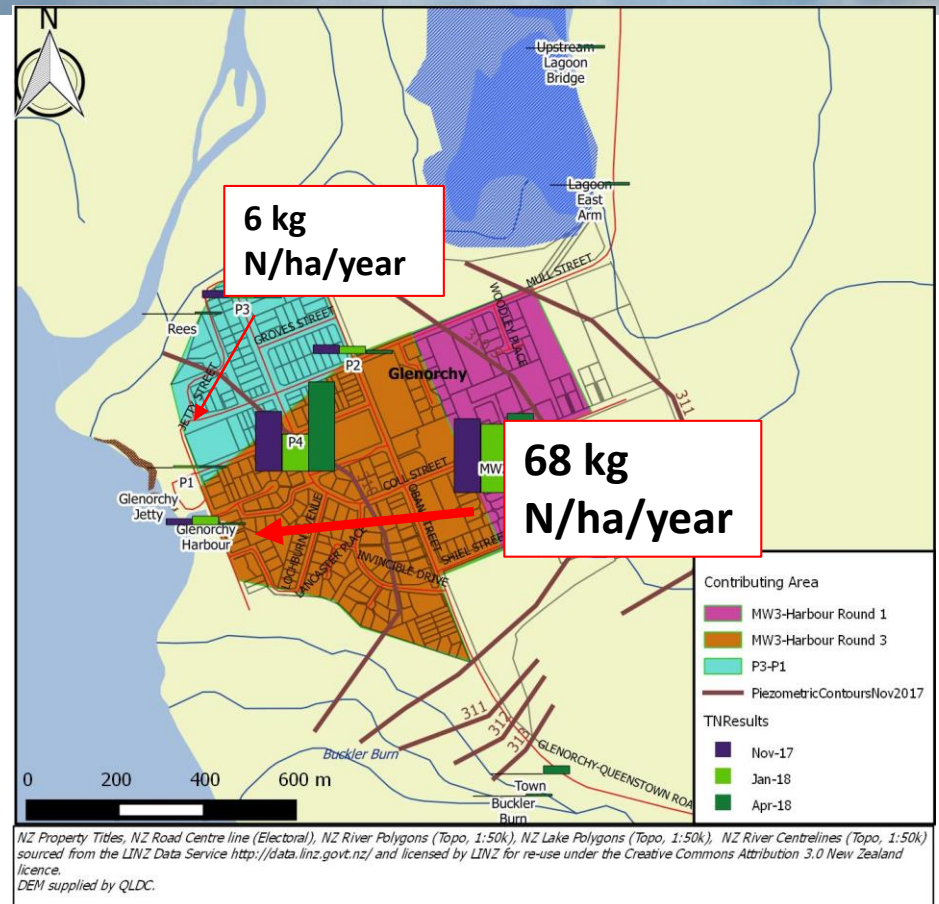
# Nitrogen

## Total Nitrogen-N



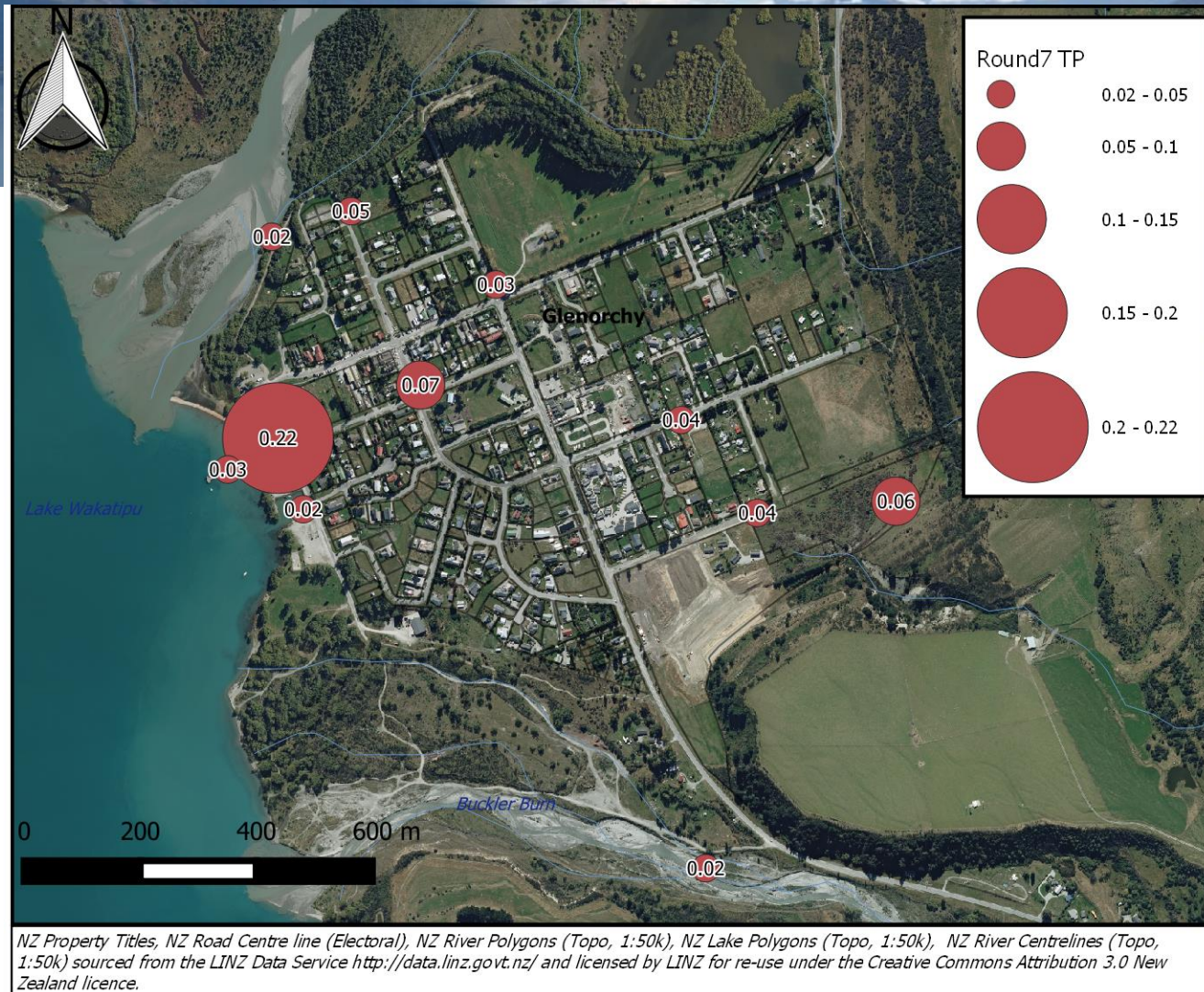
# Nitrogen Loadings

- Otago Regional Council: areas where nitrogen loading exceeds 30 kg/ha/year = high priority for change.



# Phosphorous

- DRP in P1, P3, and P4, exceeded ORC (2016) Schedule 15 limits for tributaries entering Lake Wakatipu.
- Oligotrophic bracket (0.004 – 0.01 mg/L).



# Overall Impacts

Location	Hydrology	Water Quality	Ecology
<b>Glenorchy Harbour</b>	Receives groundwater discharge poorly mixed	Total Nitrogen, NH <sub>4</sub> -N and E.coli. > ORC (2016) Schedule 15 good water quality targets for Lake Wakatipu Manganese and iron concentrations elevated.	Seasonal surface water quality degradation within the harbour May be declining annually. So far nutrient levels healthy macrophyte growth and diversity
<b>Glenorchy Jetty</b>	Receives groundwater discharge well mixed	Iron deposition, phosphorous increasing (may bind to iron)	Macroinvertebrates diversity and abundance is decreased Longevity of benthic dwelling fish may be limited in this area. Macrophyte communities suffered morphological iron toxicity symptoms.



# Risks to Human Health?

- Recreational use of Lake
- E.coli and health risk...viruses
- For gravel aquifers, the ESR indicative groundwater depth of 10 m is required for the satisfactory removal of viruses within 300 m of the disposal field (McIntyre, 2017)
- Efficacy of soil treatment of wastewater reduces “as septic tank density increases, as systems age, or if they are sited too close to groundwater or within saturated or otherwise unsuitable soils” (Lusk, et al., 2017)

Groundwater

1 – 4 m

below ground surface

# Reports available....

- e3Scientific (2018) Ecological Assessment of Glenorchy Freshwater Habitats: Lake Wakatipu Margins and Glenorchy Lagoon
- e3Scientific (2018) Environmental Effects of On-Site Sewage Management in Glenorchy Stage 2: Investigations
- e3Scientific (2020) Environmental Effects of On-Site Sewage Management in Glenorchy Stage 3: Monitoring

# Surface Water Results

Parameters	Field Measurements					Major ions (mg/L)								Metals (mg/L)			Nutrients & Organics (mg/L)											
	Temp C	DO (mg/L)	EC	pH	Eh (mV)	Calcium	Magnesium	Potassium	Sodium	Chloride	Bicarbonate (@ 25°C)	Sulphate	Bromide	TDS	Iron	Manganese	Boron	Total Nitrogen	Total NH <sub>4</sub> -N	Nitrite-N	Nitrate-N	Total Kjeldahl Nitrogen	Dissolved Reactive Phosphorus	Total Phosphorus	DOC	E.coli (ctu/100ml)		
Buckler Burn	Nov-17	13.9	11	76.2	7.26	104.1	13.6	0.47	0.36	0.89	0.6		41	4.5	< 0.05	61	0.03	0.002	< 0.0053	< 0.11	0.012	< 0.002	0.002	< 0.10	< 0.004	< 0.004	< 0.5	< 1 #
	Jan-18	13.6	10	103	7.94	136	17.8	0.66	0.5	1.24	< 0.5		55	6.5	< 0.05	82	< 0.02	0.0021	< 0.005	< 0.11	< 0.010	< 0.002	< 0.002	< 0.10	< 0.004	< 0.004	< 0.5	46
	Apr-18	5.4	13	80	7.45	136.1	13.7	0.57	0.42	0.99	< 0.5		40	4.2	< 0.05	60	0.04	0.0023	< 0.005	0.13	< 0.010	< 0.002	0.037	< 0.10	< 0.004	0.059	1	7 #
	Jan-19	15.8	11	90	7.96	15	15.9	0.59	0.42	1	0.64	49	5.34		73	0.031	0.0013	< 0.005	0.11	< 0.005	< 0.001	0.0091	0.1	< 0.002	0.014	< 0.5	13	
	Apr-19	6.9	13	90	7.86	89	15.6	0.63	0.42	1	< 0.5	55	5.44		78	0.011	0.0011	< 0.005	< 0.1	< 0.005	< 0.001	0.028	< 0.1	< 0.002	0.021	< 0.5	< 10	
	Feb-20	12.3	10	85.6	7.77	-2.2	15	0.61	0.41	1.04	< 0.5	47	4.73		69	0.022	0.0018	< 0.01	< 0.1	< 0.005	< 0.001	0.024	< 0.1	< 0.002	0.016	0.81	13	
Apr-20	6.9	21	78	7.8	-19.1	14.8	0.63	0.42	1.13	< 0.5	41	5.64		64	0.021	0.0013		< 0.1	< 0.005	< 0.001	0.0147	< 0.1	0.003	0.02	0.58	1		
Glenorchy Harbour	Nov-17	15.4	6	121	6.45	27	17.9	1.8	1.09	2.6	1.5		69	3.4	< 0.05	99	0.56	0.4	0.0073	0.38	0.036	0.004	0.28	< 0.10	< 0.004	< 0.004	< 0.5	4 #
	Jan-18	15.5	4	133.6	6.21	32.2	19.4	1.96	1.29	2.8	1.8		76	2.5	< 0.05	107	0.43	0.75	< 0.005	0.5	0.036	0.008	0.37	0.13	< 0.004	0.004	< 0.5	25
	Apr-18	12	10	83.2	7.02	17.3	11.4	0.84	0.58	1.42	0.7		38	4.6	< 0.05	58	0.15	0.079	< 0.005	0.14	< 0.010	< 0.002	0.107	< 0.10	< 0.004	< 0.004	< 0.5	14 #
	Jan-19	15.3	7	106	7.26	-26	16	1.4	0.92	2.1	1.22	58	3.53		85	0.441	0.451	< 0.005	0.49	0.028	0.0048	0.36	0.13	< 0.002	0.0065	< 0.5	5	
	Apr-19	12.7	7	105	6.82	17	15	1.4	0.87	2.1	1.28	61	3.76		86	0.384	0.323	0.0079	0.35	0.03	0.0043	0.34	< 0.1	< 0.002	0.021	< 0.5	10	
	Feb-20	16.1	12	68.1	7.32	-13	10.6	0.65	0.51	1.28	0.75	32	4.14		50	0.077	0.0659	< 0.01	< 0.1	0.01	< 0.001	0.064	< 0.1	< 0.002	0.01	0.86	24	
Apr-20	12.4	8	118.2	6.72	-7.1	18.8	2.15	1.4	3.03	1.5	62	3.62		94	0.11	0.318		0.92	0.03	0.0028	0.444	0.47	< 0.002	0.023	0.77	11		
Glenorchy Jetty	Apr-18	12.1	10	64.4	7.54	2.6	9.4	0.58	0.41	1.15	< 0.5	29	4.9	< 0.05	46	0.13	0.0155	< 0.005	< 0.11	< 0.010	< 0.002	0.018	< 0.10	< 0.004	< 0.004	< 0.5	170 #	
	Jan-19	15.9	10	68	7.39	-33	10.6	0.6	0.48	1.2	0.68	36	4.16		54	0.443	0.072	< 0.005	< 0.1	0.009	< 0.001	0.025	< 0.1	< 0.002	0.0085	< 0.5	33	
	Apr-19	14.2	10	61	7.74	-32	9.2	0.55	0.37	1.1	0.65	33	4.56		49	0.037	0.005	0.024	< 0.1	< 0.005	< 0.001	0.013	< 0.1	< 0.002	0.007	0.95	< 10	
	Feb-20	16.4	9	63.1	7.47	-25.3	9.92	0.56	0.42	1.17	0.56	29	4.24		46	0.035	0.009	< 0.01	< 0.1	< 0.005	< 0.001	0.0264	< 0.1	< 0.002	0.006	< 0.5	4	
Apr-20	12.2	7	91.8	6.96	-28.2	11.4	0.67	0.55	1.31	0.5	37	4.22		58	1.55	0.147		< 0.1	0.006	< 0.001	0.0233	< 0.1	< 0.002	0.031	0.68	5		
Lagoon bridge	Nov-17	19.1	8	101	7.27	-2.5	17.5	0.8	0.36	1.36	0.7	55	4.5	< 0.05	81	0.79	0.126	< 0.0053	0.12	< 0.010	< 0.002	< 0.002	0.12	< 0.004	< 0.004	1.2	150 #	
	Jan-18	21.6	8	105.6	7.35	-10.4	17.7	0.8	0.48	1.38	0.7	55	4.1	< 0.05	81	0.34	0.142	< 0.005	< 0.11	0.014	< 0.002	< 0.002	< 0.10	< 0.004	0.009	< 0.5	380	
	Apr-18	7.8	9	85.1	6.93	29.1	12.7	0.76	1.45	1.45	0.8	40	3.9	< 0.05	62	0.57	0.049	< 0.005	0.18	< 0.010	< 0.002	< 0.002	0.18	< 0.004	0.011	2.1	1,100 #	
	Jan-19																											
Apr-19	10.1	8	93	7.17	52	15.6	0.81	0.81	1.3	0.77		51	5.29		76	0.123	0.075	0.013	< 0.1	< 0.005	< 0.001	< 0.002	< 0.1	< 0.002	0.017	1.7	10	
Rees	Nov-17	17.9	9	94.4	7.27	-35	16.2	0.73	0.38	1.25	0.6	51	4.6	< 0.05	75	0.64	0.084	< 0.0053	< 0.11	< 0.010	< 0.002	< 0.002	< 0.10	< 0.004	< 0.004	0.6	110 #	
	Jan-18	20.9	9	105.7	7.33	-16	17.2	0.76	0.48	1.38	0.7	58	4.1	< 0.05	83	0.52	0.123	< 0.005	< 0.11	< 0.010	< 0.002	< 0.002	< 0.10	< 0.004	0.008	< 0.5	200	
	Apr-18	7.8	9	85.4	7	44.4	12.8	0.72	1.35	1.41	0.8	43	5	< 0.05	66	0.55	0.052	< 0.005	0.14	< 0.010	< 0.002	< 0.002	0.14	< 0.004	0.022	1.5	650 #	
	Jan-19	17.6	10	80	7.67	-5	13.4	0.68	0.46	1	0.52	42.334	5.51		64	0.279	0.0092	< 0.005	< 0.1	< 0.005	< 0.001	0.028	< 0.1	< 0.002	0.045	0.64	33	
	Apr-19	9.8	8	93	7.41	41	15.1	0.8	0.8	1.3	0.63	52.46	5.34		77	0.186	0.071	0.0051	< 0.1	< 0.005	< 0.001	< 0.002	< 0.1	< 0.002	0.021	1.3	63	
	Feb-20	14.8	6	111.1	6.87	16.5	16.9	0.88	0.72	1.29	0.56	56.852	4.12		82	0.632	0.203	< 0.01	0.16	< 0.005	< 0.001	0.0088	0.15	< 0.002	0.018	1.3	228	
Apr-20	9.6	10	71.7	7.27	23.6	14.5	0.82	1.2	1.46	0.64	46.238	5.24		71	0.352	0.03		0.11	< 0.005	< 0.001	< 0.002	0.11	< 0.002	0.023	0.73	111		
Guideline Values	n/a	<4 <sup>2</sup>	n/a	5.0 - 9.01	n/a	n/a	n/a	n/a	n/a	120 <sup>3</sup>	n/a	n/a	n/a	1000 <sup>4</sup>	0.3 <sup>3</sup>	1.2 <sup>5</sup>	0.09 <sup>5</sup>	0.1 <sup>6b</sup> / 0.16 <sup>7a</sup> / 0.35 <sup>7b</sup>	0.01 <sup>6ab</sup> / 0.03 <sup>7a</sup> / 0.24 <sup>7b</sup>	0.075 <sup>6a</sup>	0.075 <sup>6a</sup>	n/a	0.005 <sup>6a</sup>	Oligotrophic 0.004 - 0.01 <sup>3</sup> / 0.005 <sup>6b</sup> / 0.01 <sup>7a</sup> /0.02 <sup>7b</sup>	n/a	50 <sup>6a</sup> /10 <sup>6b</sup>		

