Analysis of stormwater and groundwater influences on ammonia-nitrogen (NH3-N) concentrations in the Bell St Main Drain

Lets first consider relationships between the measured NH3-N concentration at the drain, and recent rainfall and creek flows.

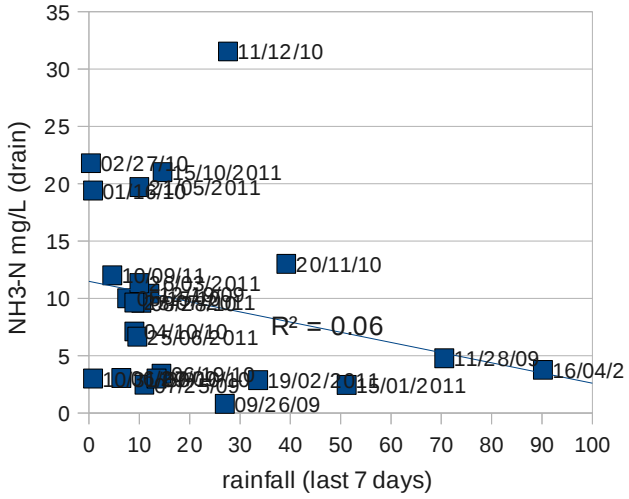
	rainfall in last x days (mm)						
Date	**60**	**30**	**15**	**7**	**Qcreek**	**Qdrain (calculated)**	**NH3-N mg/L (drain)**
02/28/09	7.6	4.6	2	1.8	1.73	#DIV/0!	>0.5
03/28/09	49	45	27	4.4	2.59	-5.7	>4.0
04/25/09	75.6	30.2	2.4	0	5.18	-2.25	>4.0
05/23/09	47.8	15.8	3.6	0.2	2.59	0.19	>4.0
06/27/09	57.6	41.6	6.6	6.4	6.05	0.35	3.05
07/25/09	75.8	33.8	17.8	11	7.78	0.53	2.47
08/29/09	82.6	51.4	28.2	11.4	14.69	#DIV/0!	Not measured
09/26/09	108.6	57.4	40.4	27	226.37	-23.42	0.79
10/31/09	95.6	16	3.2	0.8	9.5	-0.16	3
11/28/09	91.2	75	70.6	70.6	44.93	1.87	4.76
12/19/09	130.8	126.4	36.8	12	12.96	0.71	10.4
01/16/10	23.2	23.2	23.2	0.8	1.73	0.08	19.4
02/27/10	78.8	46.2	32	0.4	1.73	0.14	21.78
03/20/10	89.8	35.8	35.4	0	34.56	-3.95	>4.0
04/10/10	87.2	20.6	19.2	9	12.1	0.42	7.11
05/15/10	42.7	20.8	17.4	7.6	9.5	0.39	10
06/19/10	77.4	56.4	41.8	14.4	31.1	1.59	3.42
07/24/10	114.4	51.8	28.4	16.8	12.1	-5.73	>4.0
08/28/10	115.6	83.2	23.4	10.4	33.79	1.41	9.6
18/09/10	131.2	52.4	24.8	4	8.42	8.42	>0.5
30/10/10	126.4	80.2	54.8	13.4	92.25	-0.69	3.01
20/11/10	203.6	130.2	39.6	39.2	29.15	0.51	13
11/12/10	291.02	144.02	87.62	27.6	121.47	0.71	31.52
15/01/2011	180.8	66	51.2	51.2	256.18	-3.77	2.44
19/02/2011	213.2	128.8	121.4	33.6	50.25	2.29	2.86
26/03/2011	196.4	58.4	35.4	10	16.88	0.37	11.32
16/04/2011	188.6	101.6	91.6	90.2	246.56	29.93	3.76
21/05/2011	170.8	69	43	10	16.71	0.08	19.7
25/06/2011	95.8	24.4	13	9.6	66.42	2.08	6.66
23/07/2011	62.8	28.6	20.8	9	23.72	-0.36	9.64
20/08/2011	80.6	46.6	29.6	8.8	22.19	#DIV/0!	>0.5
10/09/11	67.2	17.2	5	4.6	34.27	0.11	12
15/10/11	115.4	91.4	40.4	14.6	5.65	0.07	21

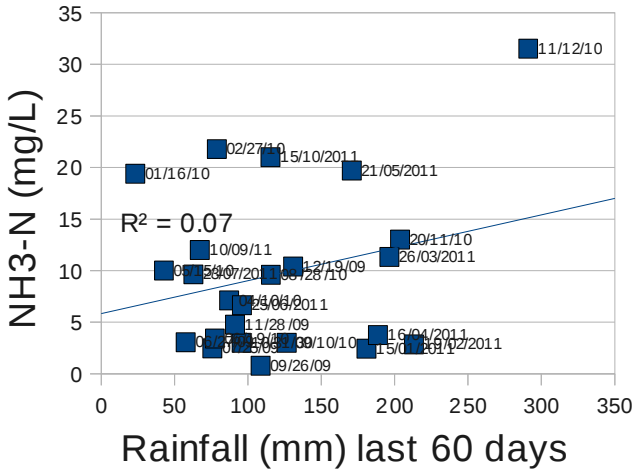
The table above shows the ammonium levels we've found in the drain versus recent rainfall, measured creek flows (melbourne water) and calculated creek flows (using our data). Note 9 of 33 estimated drain flows were negative (highlighted in red). This indicates that the NH3-N concentration upstream was greater than the concentration downstream, despite the NH3-N concentration in the drain being higher than both, or that the NH3-N concentration in the drain wasn't determined beyond the limit of the instruments (ie. >0.5 or >4.0). This was also the reason for some calculated drain flow values display the value '#DIV/0!'.

The three rows highlighted in light blue above were only values where the last 60 days rainfall was less than 45mm- Feb 2009, Jan 2010 and May 2010. The measured NH3-N values corresponding with these dry periods were quite high, but higher values of NH3-N were found in wetter 2-month periods, such as Feb 2010, Dec 2010, May 2011 and October 2011 (highlighted in green). The highest ever value of NH3-N (31mg/L) in the drain coincided with the wettest 2 month period in the history of our monitoring – 291mm rain in the two months leading up to 11/12/2010. The rows highlighted in orange were the occasions with the highest last 7 days rainfall, it is clear that the measured NH3-N are below average.

Putting these pieces together, the data suggests that when rainfall within the last 7 days is higher, NH3-N in the drain are lower, due to dilution with fast stormwater flows, whereas when rainfall in the last 60 days is highest, especially when

rainfall in the last 7 days is relatively low, NH3-N in the drain are much higher. To me the data suggests that the seeps are groundwater driven.





There appears to be an inverse correlation between NH3-N and rainfall in the last 7 days- ie. The higher rainfall, the lower the concentration measured in the drain.

In contrast if we plot NH3-N against the last 60 days of rainfall, we find that there is a positive correlation between last 60 days rainfall and NH3-N in the drain.
In both cases, the correlation is not very strong- R^2 is only 0.06- a correlation coefficient of 1 would be perfect linear relationship, 0 is no linear relationship, so 0.06 is much closer to 0.0 than 1. Two factors to consider in accounting for the weak correlation are:
i) The rainfall data is from BOM website for the Preston Reservoir site, so the actual rainfall at Bell St Main Drain needn't be the same as the rainfall as Preston Reservoir nor uniform over the Bell St Main Drain catchment.
ii) The higher the last 7 days rainfall, the higher the last 60 days rainfall will be. So the two relations cancel each other to some extent.

The following graph plots NH3-N (mg/L) in the drain against the ratio of the last 7 days rainfall with the last 60 days rainfall. My interpretation is that when last 7 days rainfall is small compared to the last 60 days rainfall- groundwater is the major component in the drain flowing through the seeps and ammonia concentrations are highest. Conversely when last 7 days rainfall makes up a large fraction of the last 60 days rainfall, stormwater is the dominent influence in the drain with much lower ammonia concentrations.