AUSTRALIAN EARTH SCIENCE EDUCATION

Stormwater Treatment Data Analysis Activity

Background

Local councils are responsible for the environmental health of waterways in their area. An important aspect of this is stormwater treatment. You can get an overview of stormwater treatment in the AusEarthEd blog and model it as shown in the video.

Stormwater biofilters trap large items in nets or grates, allow sediments to settle in ponds, use vegetation to absorb excess nutrients, and direct water through sediments to trap fine pollutants. This is shown in the diagram below.

Generalised biofilter for stormwater treatment. Image courtesy of Hornsby Shire Council

Measuring stormwater quality

Many different factors can be used to measure the quality of stormwater. These include:

- **Suspended solids** – Suspended solids are the organic and inorganic items that remain suspended in water because they are small and light. Suspended solids make water cloudy and can clog the gills of aquatic animals.
- **Nutrients** – Phosphorus and nitrogen are found in fertilisers, detergents and animal waste. They promote the growth of algae and can lead to eutrophication.
- **Faecal coliforms** – Coliform bacteria are found in the faeces of animals. These bacteria are a

measure of contamination and health risk.

- **pH** – The pH of water reflects its alkalinity (>7) or acidity (<7). Water pH affects the health of aquatic organisms and vegetation along waterways.

We will analyse some of these factors to determine the efficacy of a stormwater quality improvement device (SQID).

Data Analysis

Data were collected by Hornsby Shire Council from the inlet and outlet of a biofilter installed and maintained by the council. The system is like that shown in the diagram above, with urban water flowing through a net into a large settling pond with a retaining wall. From there, water flows into a vegetated sand bed. The water filters through the sand bed, is collected by drains to flow into a sump, and flows on to waterways via outlet pipes. The pipes can be raised to keep the sand bed saturated or lowered to drain the water out of the bed between storms. Data from both conditions are included.

Six samples were taken from each inlet and outlet pipe. These were analysed in the same lab. Maximum, minimum, and average values are presented below.

Suspended solids (mg/L)

Rainfall (mm)	Pipe position	Inflow Suspended Solids (mg/L)			Outflow Suspended Solids (mg/L)		
		Max	Min	Average	Max	Min	Average
3.5	Down	57	10	**26**	32	6	**15**
4.3	Down	150	14	**46**	9	1	**5**
4.4	Up	23	1	**13.3**	10	1	**2.7**
5	Down	14	1	**8.5**	18	4	**9**
5	Down	130	61	**101**	24	8	**14**
5	Up	58	12	**32**	4	3	**3.7**
8	Down	51	5	**21**	96	11	**37**
10	Up	20	4	**11**	6	2	**4**
11	Up	6	3	**4.6**	12	5	**7.4**
11	Up	42	16	**26**	4	4	**4**
12	Up	7	4	**5.5**	4	2	**2.8**
13	Down	130	2	**27**	6	2	**5.7**
17	Up	12	5	**7.7**	7	3	**4.8**
21	Down	8	4	**6**	8	3	**5**
23	Up	33	4	**16.7**	1	1	**1**

1. Are the suspended solids entering the system related to the amount of rainfall?___________

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2. Using data from the table, evaluate the effect of the biofilter in removing suspended solids.

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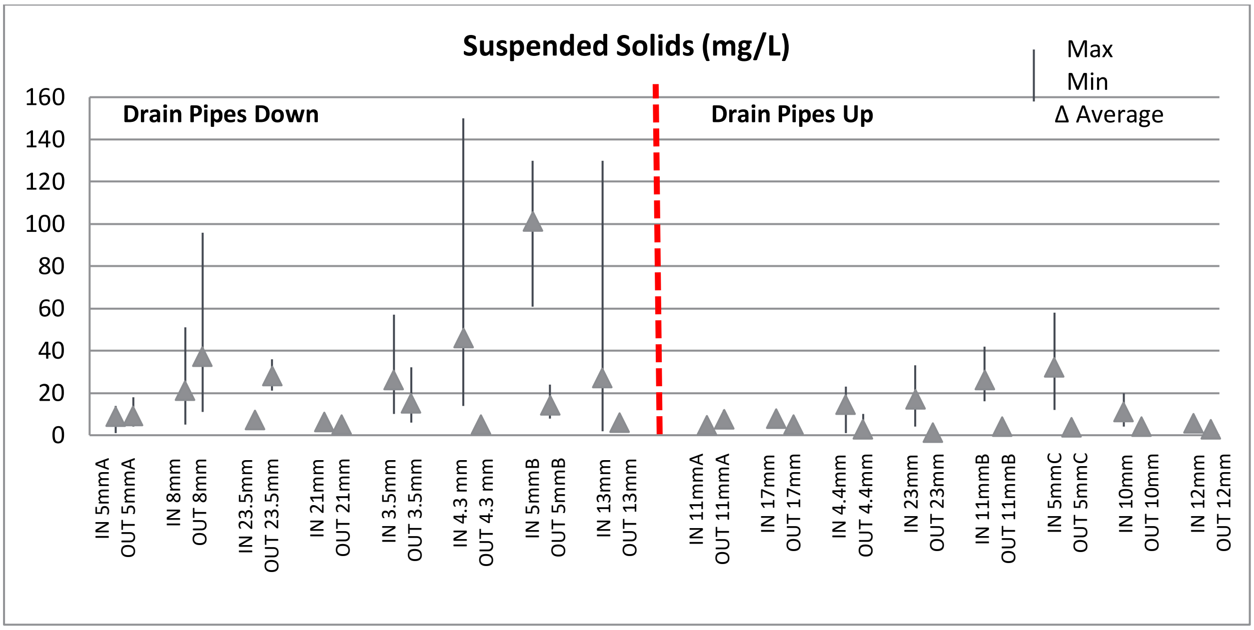

3. The box plot shows paired values for suspended solids at the inflow and outflow of the biofilter.

Evaluate the effect of pipe position on suspended solids, using data to support your answer.

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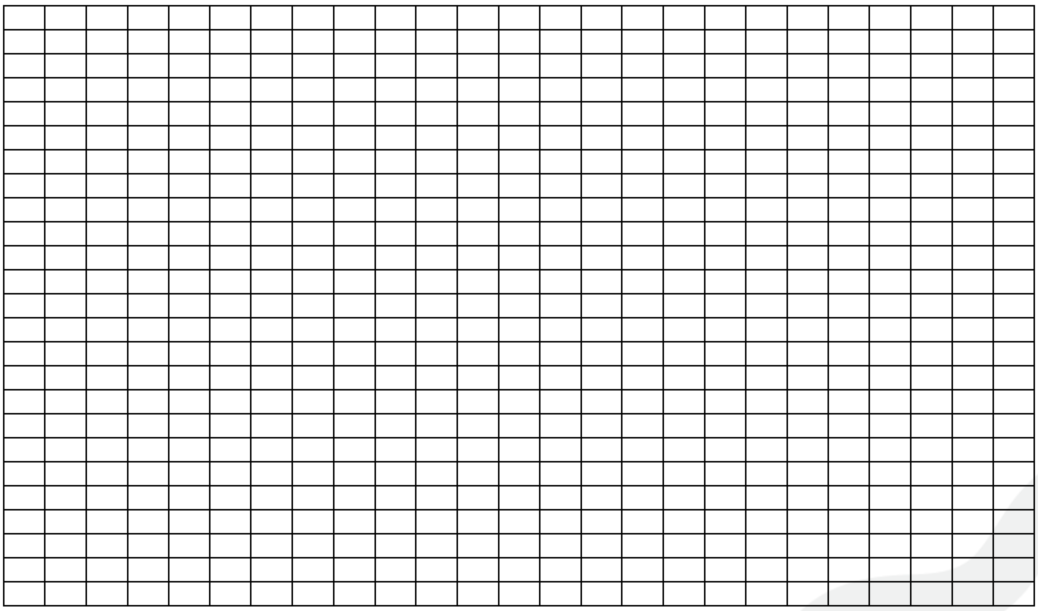
Total phosphorus (mg/L)

Rainfall (mm)	Pipe position	Inflow Phosphorus (mg/L)			Outflow Phosphorus (mg/L)		
		Max	Min	Average	Max	Min	Average
3.5	Down	0.74	0.43	**0.515**	0.32	0.09	**0.15**
4.3	Down	1.42	0.46	**0.69**	0.12	0.073	**0.091**
4.4	Up	0.37	0.13	**0.21**	0.11	0.061	**0.073**
5	Down	0.3	0.19	**0.23**	0.228	0.074	**0.113**
5	Down	1.28	0.78	**1.03**	0.13	0.09	**0.11**
5	Up	0.174	0.139	**0.156**	0.092	0.086	**0.089**
8	Down	0.31	0.21	**0.25**	0.19	0.1	**0.13**
10	Up	0.27	0.115	**0.171**	0.12	0.09	**0.11**
11	Up	0.282	0.142	**0.194**	0.43	0.088	**0.14**
11	Up	0.19	0.145	**0.17**	0.088	0.076	**0.082**
12	Up	0.086	0.069	**0.077**	0.076	0.05	**0.065**
13	Down	0.4	0.11	**0.19**	0.14	0.11	**0.12**
17	Up	0.143	.0.088	**0.103**	0.186	0.122	**0.153**
21	Down	0.276	0.143	**0.194**	0.093	0.063	**0.08**
23	Up	0.161	0.058	**0.097**	0.091	0.043	**0.053**

1. Graph the average values for phosphorus at inflow and outflow against rainfall in the grid below.

Total Phosphorus (mg/L)



Rainfall (mm)

Key

X inflow
Δ outflow

2. Outline any trend(s) apparent in your graph. ______________________________

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3. Phosphorus is dissolved in water (e.g., NOT part of suspended solids). Explain how the biofilter removes dissolved phosphorus. ______________________________

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4. Why is it important to reduce phosphorus levels in stormwater? ______________________________

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5. What can people do to decrease the amount of phosphorus in stormwater? ______________

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6. Examine inflow data for pipes up versus down. Are the two sets of data comparable? Do you think it is fair to compare the data on efficacy of pipe position?

Explain your answer. ______________________________

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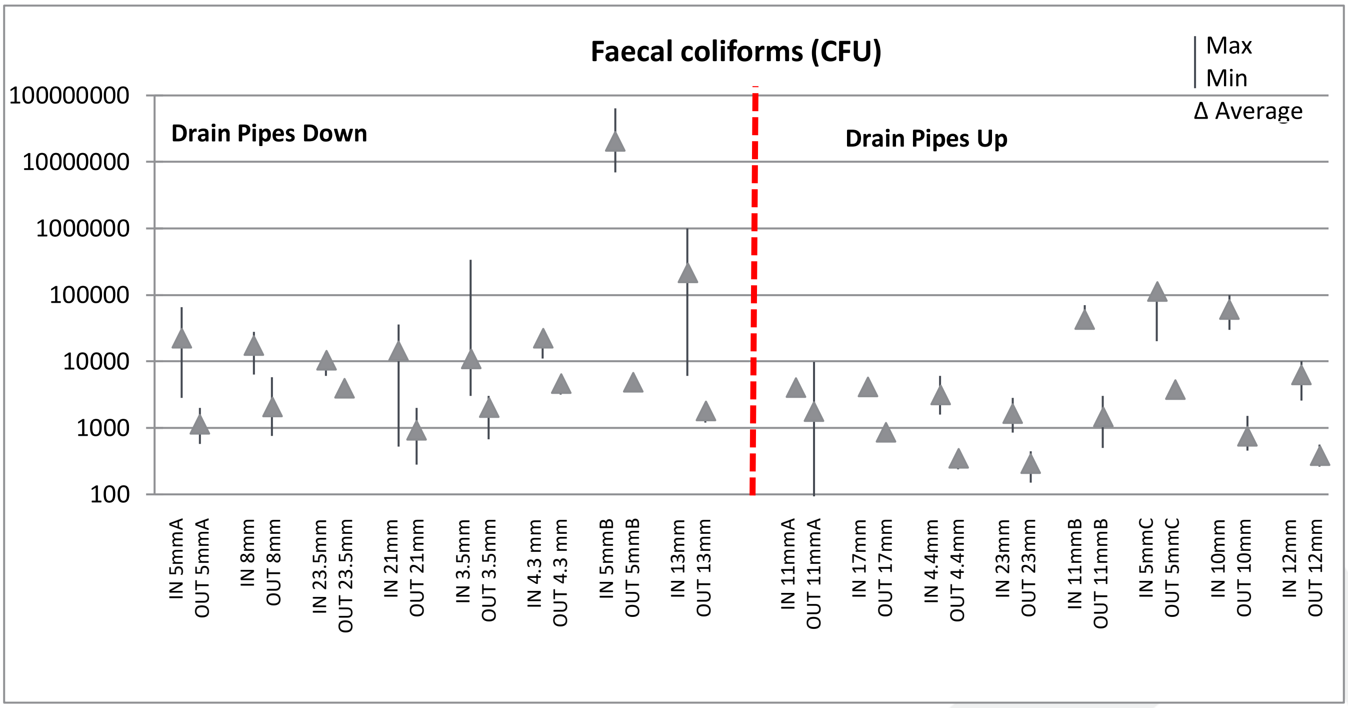
Faecal coliforms (CFU = colony forming units)

Rainfall (mm)	Pipe position	Inflow Faecal Coliforms (CFU)			Outflow Faecal Coliforms (CFU)		
		Max	Min	Average	Max	Min	Average
3.5	Down	340 000	3 000	**10 800**	3 000	670	**2 034**
4.3	Down	28 000	11 000	**22 200**	5 900	3 200	**4 660**
4.4	Up	6 100	1 600	**3 140**	440	240	**346**
5	Down	66 000	2 800	**22 550**	2 000	570	**1 130**
5	Down	64 000 000	7 000 000	**20 175 000**	5 400	4 100	**4 833**
5	Up	84 000	20 000	**42 330**	4 500	3 400	**3 800**
8	Down	28 000	6 400	**17 330**	5 800	750	**2 090**
10	Up	100 000	30 000	**61 000**	1 500	460	**752**
11	Up	4 900	3 100	**4 060**	9 900	54	**1 770**
11	Up	70 000	33 000	**42 670**	3 000	500	**1 450**
12	Up	10 000	2 600	**6 200**	560	260	**380**
13	Down	1 000 000	6 000	**215 400**	2 100	1 200	**1 800**
17	Up	5 100	3 200	**4 120**	890	810	**860**
21	Down	36 000	520	**14 500**	2 000	280	**930**
23	Up	2 800	840	**1 650**	440	150	**290**



1. The faecal coliform box graph uses a logarithmic scale. Justify this choice. ______________

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2. Faecal coliforms are an indicator of animal droppings in stormwater. To what extent can people affect this input? Explain your answer, identifying natural and modifiable sources. ________

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3. Assess the effect of a biofilter in removing bacteria (as indicated by faecal coliforms) from stormwater. ____

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Overall analysis

1. The Council took 6 samples of inflow and outflow for each rain event and had the water analysed in a professional laboratory. What factors may have influenced the number of samples? Is this a valid and reliable study?
Justify your answer. ____

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2. Comment on the overall variability in this data. What challenges does this pose for environmental managers? ____

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3. Building and maintaining SQIDs requires ongoing time and financial commitment from Council. Analyse the benefits of SQIDs for human and environmental health. ____________________

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Prepared with the support of Hornsby Shire Council

HORNSBY SHIRE COUNCIL