The Effect of Springfield on a Natural Water System

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Abstract:

Through May 30, 2001 to June 4, 2001, a series of water tests was run at the Springfield Guest House on Dominica. The tests were to show the effects of run off from Springfield Guest House on the stream (between the main guest house and the stream house) and the Check Hall River. By use of the HACH test kit, the project showed the run off has very little effect on the water systems surrounding Springfield.

Introduction:

The Commonwealth of Dominica is a volcanic island located on the Lesser Antilles chain in the Caribbean. Dominica, an island 24.2 km wide and 48.3 km long, experiences up to 914.4 cm of rain each year. There are many rivers on the small island with each having high flow rates. The water from the rivers is as pristine as any other in the world. One of these rivers, the Check Hall River, runs just below Springfield. This project examines how vulnerable these natural waters are to the run off from Springfield. The hypothesis is that the water in the Check Hall will be very delicate; therefore, gray water run off from Springfield should decrease the water quality down stream.

Materials:

HACH test kit – surface waters
Eleven 120-ml collection jars
Graduated cylinder

Methods:

For this project, three tests were performed on water samples taken from the stream between the guesthouse and the streamhouse as well as from the Check Hall River. My first step in the project was to take the water samples during a low intensity use period. Low intensity is defined as the period during the day when the gray water flow rate is at its minimum. Following the low intensity sample, the tests were performed again on water collected during high intensity use. High intensity use is defined as the period during the day when the gray water flow rate is at its maximum. The first site for water collection was upstream from Springfield. This site should act as the control group as Springfield has no effect on the water quality in the stream. Next, water samples from the gray water were taken. The streamhouse's gray water simply runs from the bathroom to the ground. Direct samples were taken from the gray water drain. Then, water samples were collected from the stream downstream of the guesthouse. In addition, water samples were taken upstream from the intersection of the stream and the Check Hall as well as downstream from the intersection. After collecting all of the water samples, a series of three tests were administered to determine the pH, nitrate, and phosphate levels. In order to test for pH, the Pocket Pal pH Tester was used. The tester is accurate plus or minus 0.1 at 20 degrees Celsius. The procedure is very simple. Simply turn on the tester and place it in the water sample. Stir the sample for several seconds and wait for the digital display to stabilize. Next, nitrates were tested. First, fill a viewing tube with 5 ml of sample water and place it in the top left opening of the color comparator. Then, fill a second viewing tube with 5 ml of sample water and add one NitraVer 5 Nitrate Reagent Powder Pillow. Shake the sample for 1 minute, and

then place the tube in the top right opening of the color comparator. In order to get a reading, match the colors of the two tubes and read the corresponding nitrate level. Finally, phosphates were tested by a similar method. Fill two tubes with 5 ml of sample water. Put one in the top left of the color comparator to act as the blank. With the other, add one PhosVer 3 Phosphate Reagent Powder Pillow and mix well with the sample water. Wait eight minutes for full color to develop, then match the colors and take the respective reading. Each test was run twice to ensure accuracy. The same pattern was followed when the other samples were taken.

Results:

The results of the testing are presented below. On test 1, the low intensity test, the pH ranged from 7.3 to 7.85. The phosphate level ranged from .08 mg/L to 0.7 mg/L. There were no nitrates found on the first test. On test 2, the high intensity test, the pH ranged from 7.65 to 7.85. The phosphate level ranged from 0.12 mg/L to 0.30 mg/L. There were no nitrates found in any samples in the second test.

TEST 1 5-30-01	test 1 test 2			test 1 test 2			test 1 test 2		
	pH		avg. pH	Nitrate (mg/L)		avg. Nitrate	Phosphate (mg/L)		avg. Phosphate
gray water	7.3	7.3	7.3	0	0	0	0.32	0.32	0.32
up stream house	7.8	7.8	7.8	0	0	0	0.7	0.7	0.7
down stream house	7.7	7.7	7.7	0	0	0	0.08	0.08	0.08
up intersection	7.9	7.8	7.85	0	0	0	0.31	0.36	0.335
down intersection	7.6	7.6	7.6	0	0	0	0.23	0.2	0.215

TEST 2 6-04-01	test 1 test 2			test 1 test 2			test 1 test 2		
	pH		avg. pH	Nitrate (mg/L)		avg. Nitrate	Phosphate (mg/L)		avg. Phosphate
gray water	7.7	7.6	7.65	0	0	0	0.3	0.3	0.3
up stream house	7.8	7.8	7.8	0	0	0	0.22	0.22	0.22
down stream house	7.8	7.7	7.75	0	0	0	0.2	0.16	0.18
up intersection	7.9	7.8	7.85	0	0	0	0.12	0.12	0.12
down intersection	7.7	7.7	7.7	0	0	0	0.2	0.2	0.2

Let 1 = gray water
2 = upstream from stream house
3 = downstream from stream house
4 = upstream from intersection of the stream and the Check Hall
5 = downstream from intersection of the stream and the Check Hall

Fig. 1

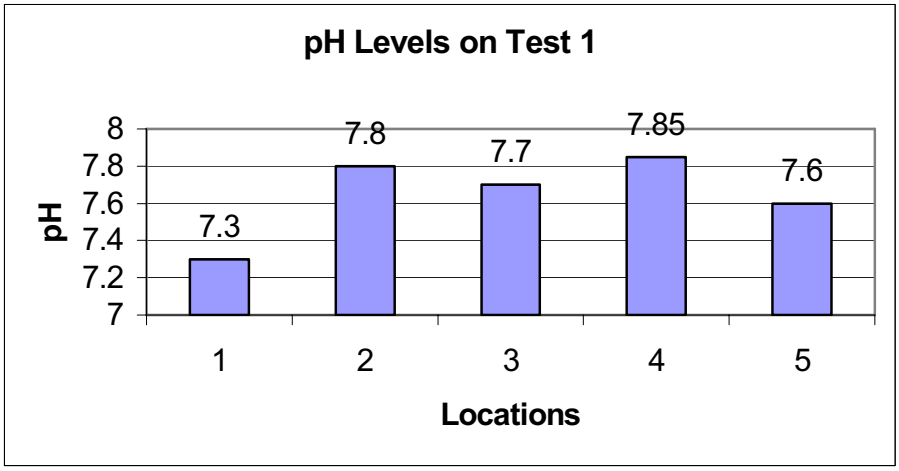


Fig. 2

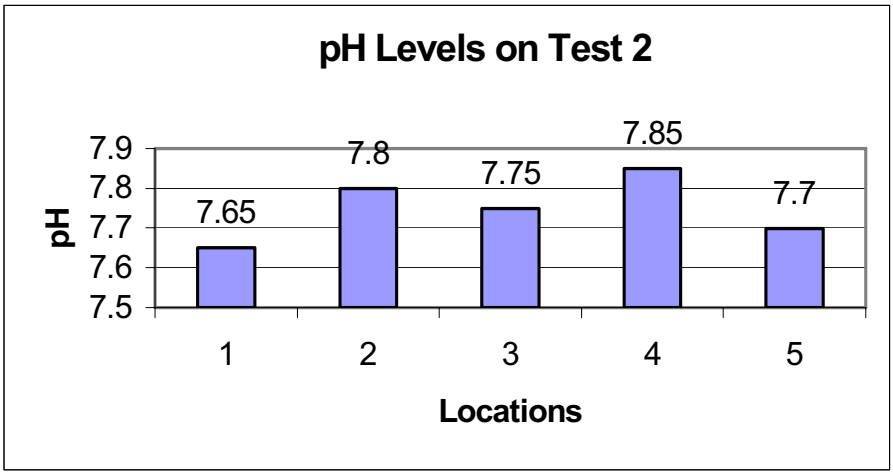


Fig. 3

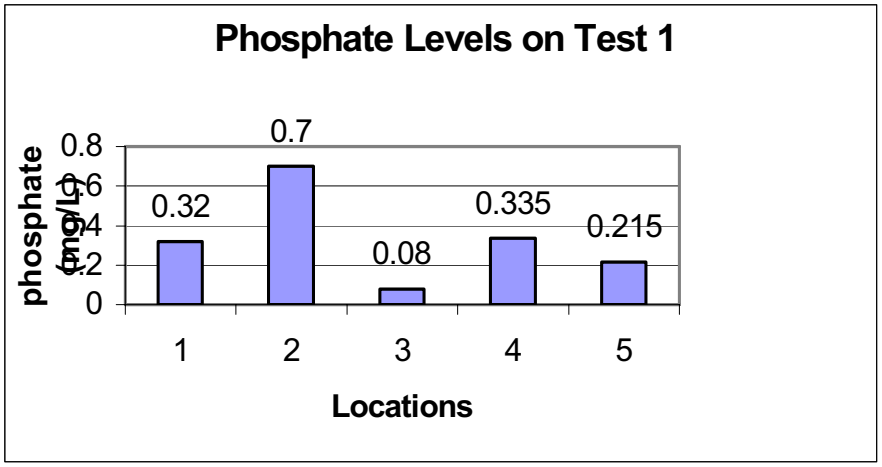

Phosphate Levels on Test 1
phosphate (mg/L)
0.8
0.6
0.4
0.2
0
0.32
0.7
0.08
0.335
0.215
1
2
3
4
5
Locations

Fig. 4

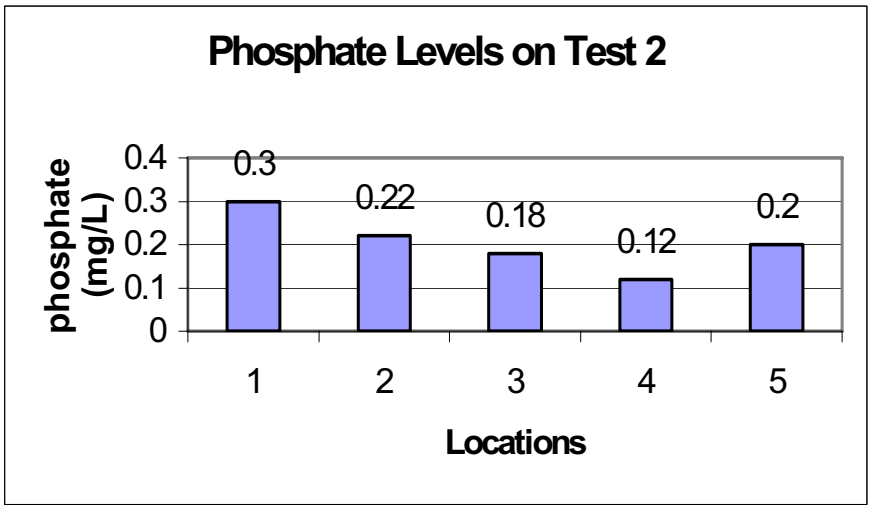

Phosphate Levels on Test 2
phosphate (mg/L)
0.4
0.3
0.2
0.1
0
0.3
0.22
0.18
0.12
0.2
1
2
3
4
5
Locations

Fig. 5

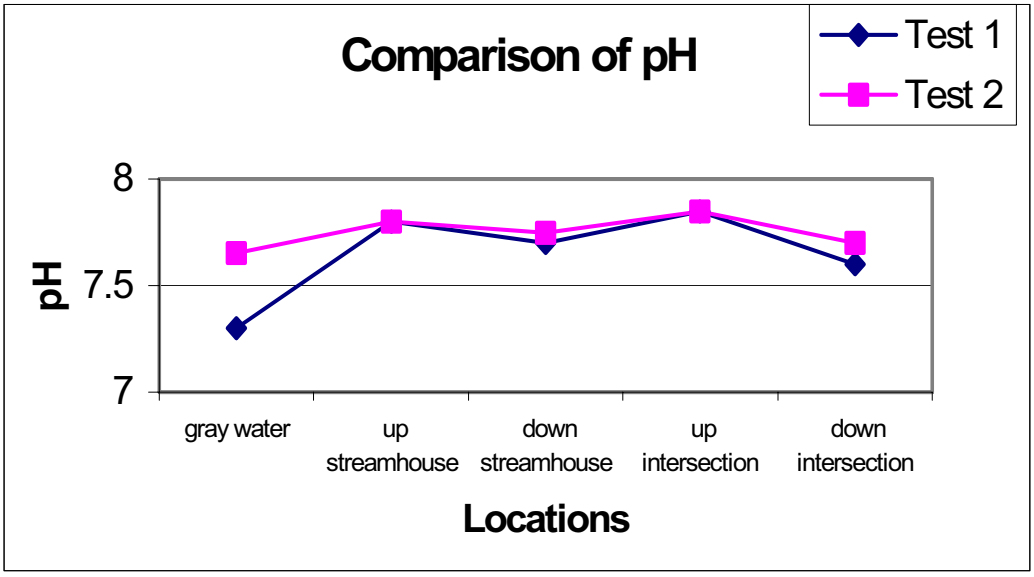
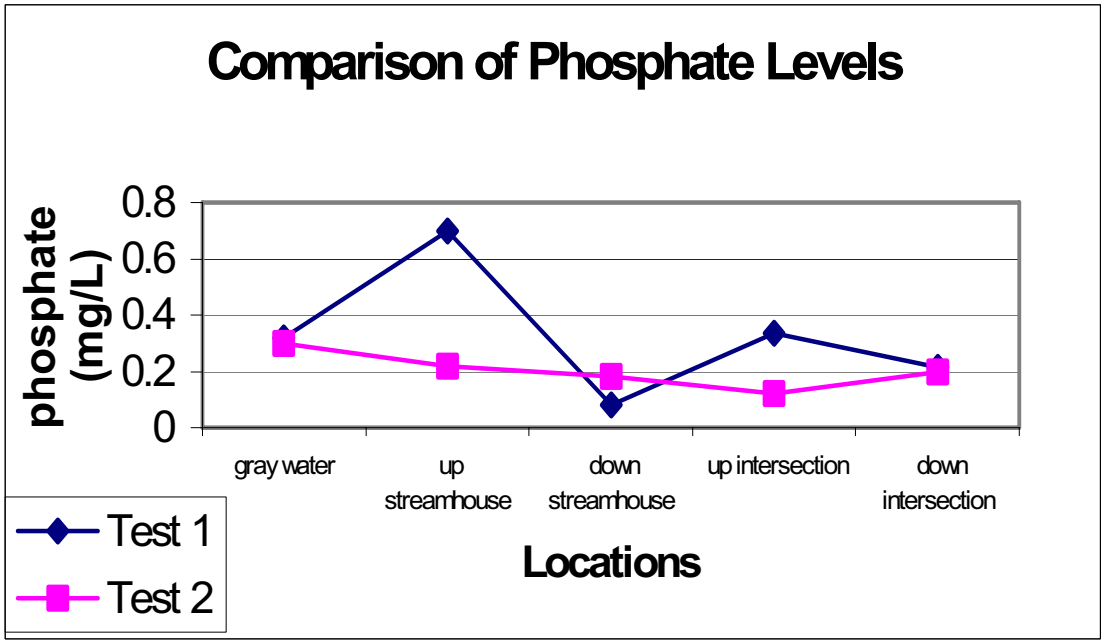

Comparison of pH
Test 1
Test 2
8
7.5
7
pH
gray water
up streamhouse
down streamhouse
up intersection
down intersection
Locations

Fig. 6


Comparison of Phosphate Levels
0.8
0.6
0.4
0.2
0
phosphate (mg/L)
gray water
up streamhouse
down streamhouse
up intersection
down intersection
Locations
Test 1
Test 2

Discussion:

During the low intensity period, the pH of the gray water was the most neutral (see Fig. 5). Test 2 concluded that the pH of the gray water increased to 7.65. The reason for the increase is the amount of bases in the gray water. However, after analyzing the rest of the data, the gray water had no significant effect on the pH of the water down stream. The phosphate test during the low intensity period had a .7 mg/L result for the site up stream from the stream house. This is extremely high when compared with the other results. The water sample was tested four times and .7 mg/L was the result on every test. A possible explanation for the high reading could be a point source pollutant. The sample site was very close to the road; therefore, the possibility of dump sites in the stream increases. Also, run off from Miranda's, a local bar, will eventually find it's way into the stream. Although the phosphate level was very high up stream from the stream house, the level was back down to 0.08 mg/L down stream (see Fig. 3). This suggests that the high flow rate dilutes the phosphates in a very short time.

The gray water phosphate level on both low and high intensity tests were around 0.32 mg/L. On average, these were some of the highest readings. However, by the time the gray water reaches the Check Hall, the phosphate level is 0.20 mg/L (see Fig. 6). This reading was consistent on both tests.

One possible reason gray water has no significant effect on the stream or the Check Hall is the filtration of the soil. The gray water runs directly out of the bathroom to the ground. Therefore, the gray water must find its way down to the stream. The soil acts as a filter as the water runs over it. On both tests, the phosphate level dropped

considerably from the gray water to down stream of the stream house. Further research is recommended to determine if the soil around Springfield acts as a filter or as a contributor to the phosphate level.

In conclusion, this project shows that although the stream and Check Hall are pristine, they are not fragile enough to be affected by the gray water run off from Springfield Guest House. Only small differences occurred at the different sample sites. The flow rate and soil could have possibly been the reason for the small variations. Using this data, research on the dilution of phosphates in a water system and the effect of soil on a water system are recommended.