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From: Marissa Woolsey, Chris Bautista, Steven Hopper
Subject: Water Quality Memo
Date: 2/19/16
CC: Jack Rovai, Leslie Miller-Robbie
(Further editing by Steven Hopper)

Intro:

The objective of this study is to determine water quality in several parts of the waterways around HSU. On Friday, February 12, 2016 students of HSU Engineering 115 measured the waterways concurrently. The students took readings from the campus fish hatchery, within Fern Lake's outlet, in-stream several feet before the Fern Lake inlet, and finally in the Jolly Giant creek upstream of the dorms. The values studied include dissolved oxygen (DO), turbidity, pH, and temperature.

Materials and Methods:

DO, turbidity, pH, and temperature were measured using various instruments. We used a YSI model 55 oxygen meter to measure DO within the water. The YSI measures the amount of dissolved oxygen in units of mg/L, and takes into consideration the salinity as well as elevation of the water sampled. It is also able to measure temperature, figured here in units C. We also used a Hanna Instruments HI93703 turbidity meter to assess particulate concentration in the water. All data collected was averaged from at least three measurements.

Results:

At the fish hatchery we found that the DO level was 10.4 mg/L, with a temperature of 13.2°C, pH of 7.6, and turbidity of 8.63 NTU. At the Fern Lake inlet we found the lowest DO level of 7.69 mg/L, with a temperature of 11.8 °C, a pH of 7.6, and a turbidity of 9.22 NTU. The outlet of Fern Lake showed a DO of 9.87 mg/L, temperature of 11.3°C, pH of 7.07, and a turbidity of 9.22 NTU. Our last location, Jolly Giant creek (several hundred yards upstream of the HSU dorms), saw a DO of 11.25 (mg/L), temperatures of 11.2°C, a pH of 7.90, and a turbidity of 9.11 NTU.

Discussion:

Overall our hypotheses for DO were fairly accurate, with the exception to Fern Lake. It was assumed the dissolved oxygen would be higher at the fish hatchery because of the pumps circulating the water, lower upstream of Fern Lake resulting from shallowness and low flow rate of the water, low at fern lake because of the decomposing organic matter in the still water, and high in Jolly Giant Creek due to the high flow rate of the water. Samples were taken from the surface level of the outlet where water was leaving the lake where atmospheric mixing may be comparatively higher compared with water deeper in the lake. We expected a controlled temperature of 13°C for optimal fish farming at the hatchery, 12°C upstream of Fern Lake due to shaded forest conditions, 14°C at Fern Lake due to higher sun exposure and decomposition, and 12°C at Jolly Giant Creek because of forest shading. Temperature followed the same trend as DO, being accurate with the exception of Fern Lake. The fish hatchery pH was predictably neutral due to controlled conditions. Upstream and Jolly Giant Creek we predicted a slightly acidic pH because healthy water is slightly acidic, and at Fern Lake we predicted a low pH due

to the settling of the acidic organic matter in the lake. It had been raining the day samples were taken, therefore high pH runoff was likely the cause for higher pH than anticipated at all the locations. Turbidity was predicted low at the fish hatchery due to controlled conditions, higher upstream of Fern Lake because the water was shallow and running, lower at the Fern Lake outlet because of settling, and higher at Jolly Giant Creek because of the running water. For the most part predicted turbidity conditions matched resulting measurements with the exception of Fern Lake, likely due to the high number of measurements being taken simultaneously.

In a US Geological survey paper by Paul Woods titled, “*Interchange of Surface and Intergravel Water in Redwood Creek, Redwood national Park, California*,” it was found that forested creek surface water DO ranged between 8.3 and 11.6 mg/L, with surface temperatures ranging from 9.0 to 26.0 degrees C. Our findings in the local campus waterways, ranging from 7.69 to 11.25 DO, and 11.2 to 13.2 degrees C, fall roughly within the same parameters as the Redwood Creek. Furthermore, according to the Georgia Watershed Protection Plan Development Guidebook by Brown and Caldwell, streams draining from coniferous woodlands tends to have a PH of 6.8 to 6.5, relatively close to our redwood stream’s findings between 7.07 and 7.90. The guidebook also references a 10 NTU benchmark for clear streams, corroborating our range of 8.63 to 9.22 NTU.

Our measurements could have been subject to both human and mechanical inaccuracies. Human error may include misuse of the instruments; for example the DO may have been compromised by the movement of the meter in the water. The turbidity may have been compromised by high student activity in the area disturbing sediment downstream. It is highly likely that our pH reading was abnormally high due acidic runoff from recent rains. Instrumental error may have occurred during the experiment or before the experiment, causing faulty data.

Conclusion

We found that our results matched our hypotheses fairly well, with several obvious divergences. Our DO calculations varied from 7.69 to 11.25 NTU’s. The temperatures which were extremely close to our hypotheses ranged from 11.2°C to 13.2°C. The pH was much more basic than we believed it to be due to the high number of tannins in the area; the pH ranged from 7.07 to 7.90. Our turbidity was fairly consistent, ranging from 8.63 NTU to 9.22 NTU. Further study of the area may yield useful information about water quality year round and subject to different environmental conditions.

Appendices:

<u>Location</u>	<u>DO (dissolved oxygen)</u>	<u>Temperature</u>	<u>pH</u>	<u>Turbidity</u>
Fish Hatchery	Result: 10.4 mg/L Hypothesis: 10 mg/L - mid/high	Result: 13.2°C Hypothesis: 13°C - comfortable trout temperature	Result: 7.6 Hypothesis: 7-neutral	Result: -4.17 NTU -3.46 NTU -3.54 NTU 3.72 NTU AVG. Hypothesis: low: 5-6 NTU
Upstream Fern Lake	Result: 7.69 mg/L Hypothesis: 8 mg/L - mid	Result: 11.8°C Hypothesis: 12°C	Result: 7.6 Hypothesis: 6.3 -slightly acidic	Result: -10.03 NTU -11.19 NTU -10.12 NTU 10.45 NTU AVG. Hypothesis: higher: 25 NTU
Fern Lake Outlet	Result: 9.87 mg/L Hypothesis: 7 mg/L -low/ mid	Result: 11.3°C Hypothesis: 14°C - warmer	Result: 7.07 Hypothesis: 6.0-slightly acidic	Result: -28.05 NTU -28.56 NTU -24.67 NTU 27.09 NTU AVG. Hypothesis: lower: 10 NTU
Jolly Giant Creek upstream	Result: 11.25 mg/L Hypothesis: 12 mg/L - high	Result: 11.2°C Hypothesis: 11°C cooler	Result: 7.90 Hypothesis: 6.5-slightly acidic	Result: -28.51 NTU -24.51 NTU -35.05 NTU 29.36 NTU AVG. Hypothesis: higher: 30 NTU

References:

Woods, P. F. (1995). Interchange of Surface and Intragravel Water in Redwood Creek, Redwood National Park, California. GEOMORPHIC PROCESSES AND AQUATIC HABITAT IN THE REDWOOD CREEK BASIN, NORTHWESTERN CALIFORNIA.

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