Water Quality of Peralta and Courtland Creeks in East Oakland, California

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Introduction

Courtland Creek and Peralta Creek are urban streams that originate in the Oakland hills and connect to the San Leandro Bay, East Creek slough watershed. (See map.) These two creeks were selected for study because they run parallel with each other, potentially exhibiting similar characteristics.

Courtland Creek is located within and surrounded by a very densely populated residential area and is easily accessible. However, given that there are very few open spaces suitable for congregation, there is little public activity. The area of study surrounding Peralta Creek is similar to a park and therefore includes a greater degree of public activity. Comparing Peralta Creek to Courtland Creek provides us with a clearer understanding of what a healthy creek should look like and what might be affecting San Leandro Bay.

During the study period (summer and fall), researchers restored one of three sites at Courtland Creek that are easily accessible. This effort included the removal of non-native and invasive plants and replacement of these plants with native species. Trash was also removed at these sites. Following these restoration efforts an increase in water flow was observed, which believe also contributed to an improvement in water quality.

Overall, in conducting this study we attempted to answer the following questions:

- What should be done to improve the health of Courtland Creek in particular and local creeks in general?
- Have any changes in water quality occurred as a result of our restoration efforts?
- How do seasonal weather-related changes, public use, etc. affect the health of the creeks under investigation?
- How have our data collection efforts over the years increased our capacity to advocate for changes in city government policies related to local watersheds?

Background

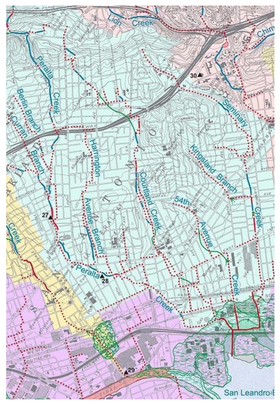
When interpreting findings derived from our research, it is important to recognize the various characteristics play an essential role in creating conditions manifest in areas surrounding each creek. At Courtland Creek, there is a culvert that is used as a gathering spot by local residents. Researchers and community members have observed people smoking, drinking alcohol, urinating, and depositing trash into the creek. Because there is so much vegetation surrounding the creek, such environmentally damaging activities often go unnoticed. Similarly in Peralta Creek, individuals sitting on benches have been observed drinking, smoking, bathing, and depositing trash in surrounding areas.

Unlike previous years, concentration levels of only three chemical species were measured throughout this study: phosphate, ammonia, and nitrate. In past years, levels of dissolved oxygen, E. coli, and chlorine also were measured. However, concentration levels of these other species were consistently low and thus not very useful as creek health indicators. In contrast, phosphate, ammonia, and nitrate concentrations were well above the levels recommended by the EPA.

Materials and Methods

Test kits produced by Aquarium Pharmaceuticals Inc. (API) were used to measure nitrate, phosphate, and ammonia concentrations in collected water samples. For each test, a small sample of a creek's water was obtained and mixed with indicator chemicals. The results were then compared to a color scale.

Samples were collected from three different sites along both Courtland Creek and Peralta Creek. (. Water samples at Courtland Creek were collected from July-September 2014, and samples from Peralta Creek were collected during July-August and October-November 2014.



Figures

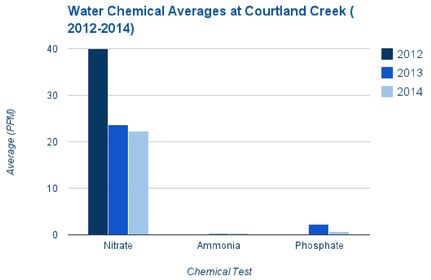


Figure 1: Variation in concentration levels from 2012-2014. Ammonia levels increased slightly from 2013-2014, and both nitrate and phosphate levels decreased from 2013.

EBAYS researchers participating in Oakland's Creek to Bay Day 2014, removing invasive plants from Site 1 at Courtland Creek.

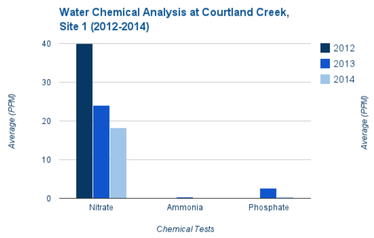


Figure 2: Courtland Creek - Site 1. The majority of creek restoration efforts occurred at this site, and a corresponding decrease in the concentrations of nitrate, ammonia, and phosphate in collected water samples was observed. This correlation suggests that restoration efforts contributed significantly to an improvement in the creek's overall health.

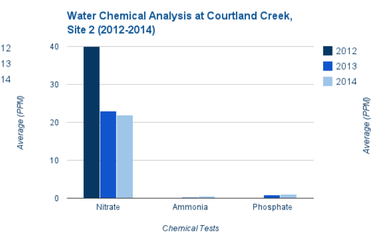


Figure 3: Courtland Creek - Site 2. Nitrate concentration levels decreased from 2012 to 2014. However, ammonia and phosphate levels were observed to be higher in 2014 than in 2013.

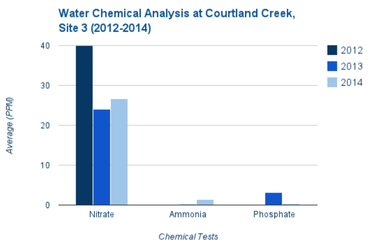


Figure 4: Courtland Creek - Site 3. Although nitrate concentrations have decreased overall, the amount of nitrates in Site 3 increased from the previous year. In addition, ammonia levels increased from 2013-2014, and phosphate levels decreased from 2013-2014.

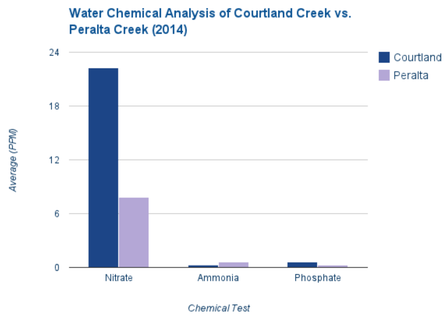


Figure 5: In 2014, Courtland Creek waters were observed to have higher levels of nitrates and phosphates than those collected from Peralta Creek, while Peralta Creek waters had higher levels of ammonia.

EBAYS researchers performing water analysis using Aquarium Pharmaceuticals Incorporated (API) test kits at Courtland Creek.

A drainage pipe, Peralta Creek Site 2.

Results & Discussion

Courtland Creek water quality research from 2012-2013 was extended to include work undertaken during the summer and fall of 2014 in an effort to evaluate the health of the creek over time. Additionally, the 2014 research compared the conditions of two parallel creeks: Courtland Creek and Peralta Creek. Results from the most recent research indicate an overall decrease in phosphate and nitrate levels, and an overall increase in ammonia levels in waters collected from Courtland Creek. In comparing the three sites at Courtland Creek, sizeable increases in ammonia and nitrate were observed in samples collected at Site 3. Decreases in concentrations of all three species were observed in samples collected at Site 1, , indicating an overall improvement in health of the creek at this site. Additionally, nitrate and phosphate levels were lower at Peralta Creek than at Courtland Creek, possibly due to the openness of Peralta's banks.

Despite an observed overall improvement in the health of Courtland Creek that has occurred from 2012-2014, concentration levels of several chemical species in creek waters still exceed U.S. Environmental Protection Agency (EPA) recommended levels. The EPA recommended nitrate concentration level limit for drinking water is 10 ppm. As shown in Figure 1, nitrate levels have been higher than that during all three years that measurements have been made from 2012 to 2013 to 2014, the average nitrate concentration decreased from 40 ppm to 23.6 ppm to 22.3 ppm, respectively. Additionally, as seen in Figure 1 average ammonia concentrations in collected samples were 0.23 ppm in 2013 and 0.29 ppm in 2014, both of which are higher than the 0.02 ppm level considered toxic for many aquatic organisms. Finally, the EPA recommended upper limit of phosphates in streams is 0.1 ppm. Although phosphate levels in creek waters decreased from 2.2 ppm to 0.6 ppm, such concentrations are considered toxic as a result of the fact that they contribute to eutrophication that has an extremely damaging effect on macroinvertebrates.

Figure 2 illustrates a decrease in concentration levels of all chemical species of interest in waters collected at Courtland Creek - Site 1. The average nitrate level in 2012 was 40 ppm, which decreased in 2014 to 18 ppm. The average ammonia levels from 2012 to 2013 decreased from 0.3 ppm to 0.1 ppm. Furthermore, the average phosphate level in 2013 was 2.7 ppm, and it decreased to 0.4ppm in 2014. Based on preliminary analysis, we believe that nitrate, ammonia, and phosphate levels decreased due to our restoration efforts, which included removing non-native plants and planting native plants and picking up trash.

Figure 3 illustrates a decrease in nitrate levels and a slight increase in ammonia and phosphate levels in samples collected between 2012-2014 at Courtland Creek - Site 2. In 2012, the average nitrate level measured was 40 ppm, and in 2013 the average nitrate level was 21 ppm. In the case of ammonia levels, there was an increase from 0.22 ppm to 0.51 ppm from 2013 to 2014. With regard to phosphate levels, the average increased from 0.8 ppm in 2013 to 1.0 ppm in 2014.

Figure 4 illustrates a comparison of concentration levels in samples collected at Courtland Creek - Site 3 over the years. Examination of the figure indicates an increase in nitrates and ammonia and a decrease in phosphates. Although nitrate levels appear to have decreased from 40 ppm in 2012, a slight increase from 24 ppm to 26 ppm from 2013 to 2014 also is apparent. At this time it is believed that this increase occurred as a result of fertilizer runoff from nearby houses and/or human and pet defecation. In terms of average ammonia concentration levels in samples collected at Site 3, an increase from 0.17 ppm in 2013 to 1.35 ppm in 2014 was observed. This increase may have resulted from human urination. In contrast, average phosphate levels decreased from 3.2 ppm in 2013 to 0.27 ppm in 2014.

Conclusions

The bar graph in Figure 5 may be used to compare the relative health of Courtland Creek and Peralta Creek in 2014. Nitrate levels in waters collected at Courtland Creek were 22.3 ppm in comparison to 7.9 ppm in waters collected at Peralta Creek. It is believed that there are more nitrates in Courtland Creek waters due to excessive animal and human dumping, urination, and fertilizer runoff. Additionally, prior to our restoration efforts at Courtland Creek - Site 1 a thick canopy of weeds and non-native plants enveloped the creek, inhibiting water flow and creating spots hidden from view. On the other hand, Peralta Creek waters contained fewer nitrates. It is believed that one factor contributing to this finding is the greater amount of open space associated with this creek, which discourages individuals from committing illegal actions such as those occurring at Courtland creek. Figure 5 also illustrates that ammonia levels in waters collected from Courtland Creek were lower than at Peralta Creek (0.29 ppm and 0.61 ppm respectively). As a leading contributor to ammonia in creeks is sewage, it is possible that a drainage pipe located near Peralta Creek - Site 2 is introducing raw sewage into the creek. . Lastly, Figure 5 illustrates that phosphate levels at Courtland Creek were higher than at Peralta Creek in 2014 (0.62 ppm and 0.28 ppm respectively). One explanation for this occurrence is leaching of fertilizers and animal manure related to erosion of soil in neighboring backyards located near the banks of Courtland Creek. This explanation is supported by observations of loose and deteriorating soil made during restoration efforts. Looking forward, this study will continue with its restoration and water quality testing efforts in order to monitor the health of the creeks.

Acknowledgements: Special thanks to Kevin Cuff, Humberto Bracho, Samantha Nguyen and Colin Dixon for their support.