Casey Erickson

6/12/17

Oregon Abroad: Millrace Project

Preliminary Evaluation and Critique of Millrace Pond Suitability for Swimming

Introduction

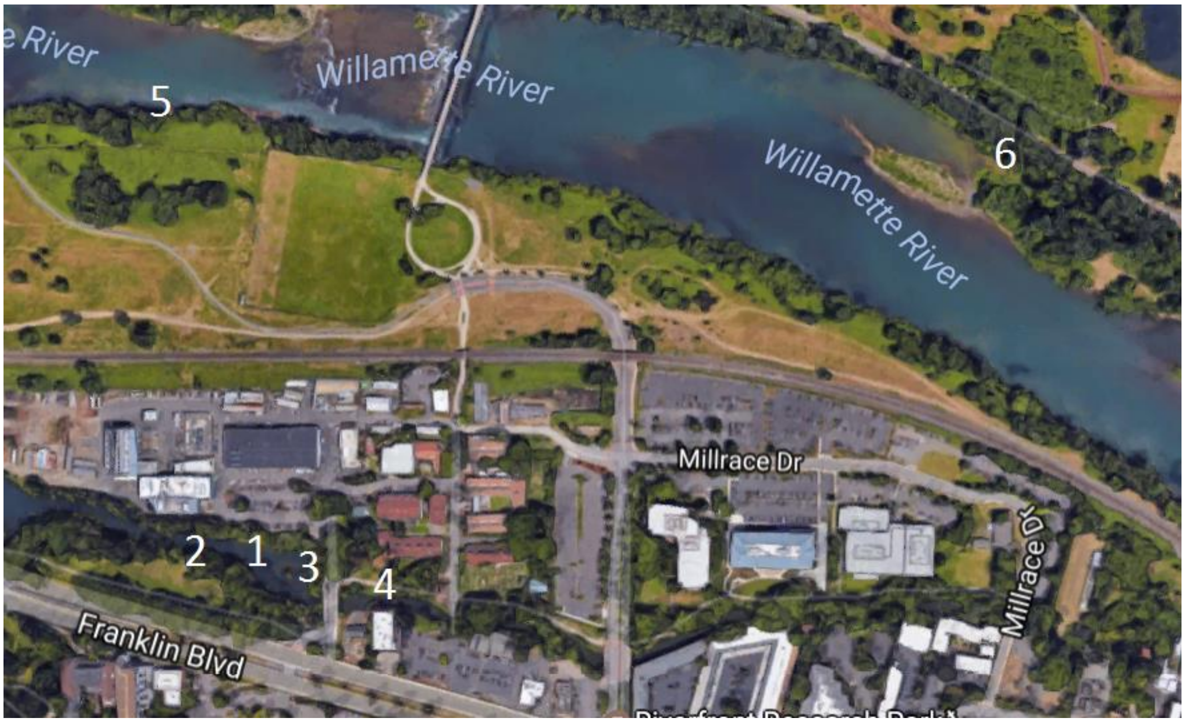
The purpose of this paper is to evaluate the millrace pond for suitability as a community swimming hole. The question is whether or not the millrace is safe to swim in. My hypothesis is that the millrace is safe to swim, or could be with few accommodations. To evaluate this idea, I will be testing the null hypothesis that the millrace pond is not swimmable. The quality of work I can produce is not scientifically significant to say whether or not millrace is definitively clean. Instead my focus is on immediately obvious red flags that would disqualify the millrace pond (henceforth referred to as the millpond) as a swimming location. An example would be if fecal coliform bacteria showed up in one of my tests, this would immediately disqualify the millrace pond from further consideration on the grounds of potential impact on human health. Testing the null hypothesis is accomplished through a mixture of water chemistry and field observations.

The main considerations regarding whether or not the millpond is appropriate as a swimming hole are the potential impacts on human health, health of the millrace ecosystem including life and soil, and general human impact. This paper evaluates each of these considerations and offers potential solutions to potential issues as they arise. Nutrient and mineral testing was done to see if there were any pollutants that would immediately disqualify the millpond from being safe to swim in. The criteria for water safety and quality are based on the EPA 2012 Recreation Water Quality Criteria (EPA, 2012) and National Recommended

Water Quality Criteria (EPA, 2017). In conjunction standards from Kumar, M., & Puri, A. (2012) & Mainston CP, Parr W. (2002) will be used where standards were not set by the EPA. The EPA criteria for whether or not a water is safe to swim in is limited to the presence or absence of E.coli or fecal coliform bacteria. Oregon has even less regulation, only regulating pools and spas. Pools are defined as artificial structures, which the millpond is not thereby falling outside of Oregon pool regulations (Oregon Health Authority, 2014). The main things being looked for are evidence of fecal coliform bacteria, metals left over from industry, and eutrophication either naturally sourced or from farm runoff. Initial testing has not shown elevated levels of nutrients or metals. Fecal coliform tests were unsuccessful and can therefor the presence of fecal coliform can only be inferred by indicators. This paper is not conclusive on the fitness of the millpond as a swimming hole, however initial tests and considerations indicate that further study is warranted.

The use of the millrace pond as a swimming hole could benefit the University of Oregon as a community hub, a place to connect students with the outdoors, and as a way to bring students across Franklin Boulevard towards the river, the urban farm, and the new Knight campus. The pond has independent merit as an outdoor place to swim due to the location, size, and environmental factors. In context of the university the millrace pond as a swimming hole gains value by filling an unmet community want. Currently there are no suitable outdoor swimming locations within a twenty minute walk from the University of Oregon campus. The Willamette River is shallow, cold, and has a strong current which makes swimming difficult and unsafe. Despite these factors, students still attempt to swim in the Willamette. This demonstrates a community desire for a place to swim. However, there is currently a lack of an adequate space to do so in an outdoor setting. The millrace pond could be a quality alternative to swimming in the Willamette River and a benefit to the University of Oregon and its community.

Materials and Methods



Six sites were chosen for testing water quality of the millrace. Site 1 is the potential swimming hole at the mill pond. Site two is down stream of the swimming hole. Site three is upstream of the swimming hole just after the stormwater drain. Site four is upstream of site one and three so that the water quality of the millrace before and after the introduction of the storm drain could be compared. Site five is a spot along the Willamette. The millrace is fed by the Willamette, the purpose of site five is to see if there is significant difference between the water when it is in the Willamette versus the once it enters the millrace. Site six is a cove along the Willamette that is stagnant except during flood events. Site six was meant to be an equivalent to the millpond, however tests revealed it to be potentially much more harmful to human health than the millpond due to elevated nutrient levels and not a good comparator to the millpond so it will not be a focus of this paper.

Each site was tested for minerals and nutrients of the following compounds and elements: copper, ammonia, nitrite, nitrate, phosphate, and iron. Each site had four samples tested. Two samples before the millrace pumps were turned on, and two after. An attempt was made to have all samples tested within 48hrs of collection, which was successful except for the first set of samples. Tests were done using MARS testing supplies, typically used for fish tanks. All tests are accurate to mg/L or parts-per million, with the exception of the LaMotte tablets which were used during the last test which is accurate to parts-per billion. Due to time constraints, each sample was tested once, with a few exceptions. With the help of a lab assistant I was able to run the last round of tests twice. Ammonia was run twice during the first round of testing because something seemed strange about the results. Iron was tested for the second and fourth (last) set of trials. It was not tested during the first because I was not aware we had the equipment. The third samples were not tested for iron due to oversight. Phosphate was run three times for the fourth (final) set of samples. It was discovered the phosphate test had expired in 2016. Phosphate was then ran twice using LaMotte tablets which are more accurate than MARS. MARS is accurate to parts-per million and LaMotte is accurate to parts-per billion. LaMotte is a low range phosphate test. LaMotte tested extremely low levels of phosphate in both tests which was consistent with early MARS tests.

Fecal coliform bacteria tests were attempted for this experiment, however the tests and attempts to test were unsuccessful. This was due to experiment failure and coordination issues with lab staff. Instead the presence can be inferred via habitat suitability measured through nutrient levels within the millrace pond.

The criteria for water safety and quality are based on the EPA 2012 Recreation Water Quality Criteria (EPA, 2012) and National Recommended Water Quality Criteria (EPA, 2017). In conjunction standards from Kumar, M., & Puri, A. (2012) & Mainston CP, Parr W. (2002) will be used where standards were not set by the EPA. The rubric is compiled into a table at the end of this section.

Copper and iron were tested to potentially indicate the presence of other metals or pollutants (Kumar, M., & Puri, A., 2012). Ammonia, phosphate, nitrogen, and nitrate were tested to indicate the presence of fertilizer and eutrophic pond conditions (Kumar, M., & Puri, A., 2012) (Yang et al. 2008). Both nitrate and nitrite were tested because the presence of nitrate with absent nitrite indicates previous contamination (Yang et al. 2008).

Field observations were used for evaluation of the site for suitability in relation to the potential impacts on the environment from use of the site as a swimming hole. I sat at the beach and looked for things that could be damaged from large amounts of use.

Nutrients & Minerals	Threshold	Standard
Copper	1.3 mg/L	EPA
Iron	1 mg/L	Kumar & Puri (2012)
Nitrate	10 mg/L	EPA
Nitrite	90 mg/L	Kumar & Puri (2012)
Phosphate	1 to 2 ug/L	Mainston & Parr (2002)
Ammonia	No standard	No standard

(Above, water quality standards to be used for evaluating water quality)

Results

Median of all test							
Site	Copper mg/L	Iron mg/L	Nitrate mg/L	Nitrite mg/L	Phosphate mg/L	Phosphate ug/L	Ammonia mg/L
1	0	1	0	0	0	1	0

2	0	1	0	0	0	2.5	0
3	0	1	0	0	0	2.5	0
4	0	1	0	0	0	1.75	0
5	0	1	0	0	0	2.5	0
6	0	5	0	0	0	2.5	4

(Above, chart summarizing data using median)

Note: These tests were not repeated enough times to be significant. These are preliminary results.

Median was chosen because it accurately represents results. Results were uniform without significant outliers, meaning using median did not discard data. Raw data is submitted along with the report.

There was no difference between millrace sites 1, 2, 3, or 4 except in low end phosphate which was sampled once and could therefore be an outlier. Site 6 was an outlier. Site 4 along the Willamette is analogous to site 1 the millpond.

The only threshold surpassed by sites 1-5 was phosphate, which was expected considering the amount of geese feces in the water. Phosphate was not considered a significant pollutant by EPA, Kumar & Puri (2012), or Yang and Wu (2008). However, phosphate indicates suitable conditions for fecal coliform bacteria. Notable to this: earlier in the year the millrace was murky and there was a layer of geese feces across the water, however upon taking my last samples the water was clear and the feces were not visible.

Results of field observations showed multiple potential issues with issuing the millpond as a swimming hole. These issues can be broken down into health of: birds and plants, soil erosion of beach and streambed, and human use (read: garbage and body oils).

Discussion

Preliminary results indicate that millrace is cleaner than popular belief depicts it to be. It is not eutrophic or high in minerals. These initial test results indicate that further study is warranted. There is potential for fecal coliform bacteria to be in the millpond. After observing the “life cycle” of the top layer of the millpond I anecdotally believe fecal bacteria could be seasonally related, however this hypothesis is directly countered by Alderisio & DeLuca (1999). Their study found that Canada geese (*Branta Canadensis*) fecal bacteria is highest in summer which could be a complication for the using the millpond as a swimming hole in the summer if the geese continue to use it. Further study is warranted.

Potential impacts of human use on the millpond plants and animals would likely be minimal. Joanna Lyle observed in her millrace project little in the way of fish in the millrace. I observed a green heron (*Butorides virescens*) once, otherwise Canada geese dominate the area. The geese use the beach as meeting spot during the day and easy access point to the pond with their young. Blackberry is by far and away the dominant plant. Human use of the beach would likely push out the geese. However, there is an entrance to the millrace about 200 feet west of the beach that is blocked only by a small thicket of blackberry that could be pulled to offset taking the beach.

People running up and down the beach as well as walking in the millpond creates potential for erosion. A potential solution to this problem would be to create a dock that goes into the middle of the millpond. At the middle the millpond is about 5ft deep. A large setback to swimming here was noted by Ethan Niyangoda in his project, the sediment here is loose and at minimum four feet deep potentially five or six. This sediment seems to be mostly organic debris. This is a safety hazard. However it could also be a blessing in disguise. The state of New York and Red Cross recommend water depth of at last 9 feet for diving from a dock (New York, 2008). Dredging the bottom of the millpond could potentially remove nutrients, create deeper pools and thus cooler water, and create depths that would prevent people from kicking up sediment when they swim in the pond. A dock and dredging the pond would potentially solve erosion issues.

There are two other main issues with swimming the pond. Garbage and contamination from swimmers (cologne, makeup, shampoo). These issues could be solved by installing facilities near the river. An outdoor or indoor shower of some type, potentially activated by student ID cards, could aid this this problem. Readily available garbage disposal and days of service could help with the issue of garbage. The university is by far the largest local source of potential swimmers in the millpond which means use would likely be primarily students. These things would require some investment, but if there was a community will they could be worth it.

The millpond has potential to become a signature part of the university campus. A place for community to gather and enjoy being outside together in quarters close enough that force some social interaction. Further testing needs to be done to make sure the water is safe, and there would need to be financial backing to make the pond swimmable but as things currently stand I cannot support the null hypothesis that the millrace is not swimmable.

Citations

Alderisio, K. A., & DeLuca, N. (1999). Seasonal Enumeration of Fecal Coliform Bacteria from the Feces of Ring-Billed Gulls (*Larus delawarensis*) and Canada Geese (*Branta canadensis*). *Applied and Environmental Microbiology*, *65*(12), 5628–5630.

Min diving depth:
https://www.health.ny.gov/environmental/outdoors/camps/aquatics/minimum_water_depths_for_head_first_diving.htm

EPA water quality criteria

https://www.epa.gov/wqc/national-recommended-water-quality-criteria-human-health-criteria-table#main-content

EPA 2012 Recreational Water Quality Criteria Documents

https://www.epa.gov/wqc/2012-recreational-water-quality-criteria-documents

Yang, X., Wu, X., Hao, H., & He, Z. (2008). Mechanisms and assessment of water eutrophication . *Journal of Zhejiang University. Science. B*, *9*(3), 197–209. http://doi.org/10.1631/jzus.B0710626

Kumar, M., & Puri, A. (2012). A review of permissible limits of drinking water. *Indian Journal of Occupational and Environmental Medicine*, *16*(1), 40–44. http://doi.org/10.4103/0019-5278.99696

Mainston CP, Parr W. (2002). Phosphorus in rivers--ecology and management. *Science of the Total Environment*, 282-283:25-47. https://www.ncbi.nlm.nih.gov/pubmed/11846073/