Comparing the Effectiveness of Constructed vs. Natural Wetlands

Talia Wilson - College of Southern Nevada, Student

Dr. Stephanie Fiorenza - College of Southern Nevada, Mentor

Overview/ Abstract

Removing excess nitrogen and phosphorus from water sources is crucial for reducing eutrophication, which causes excessive algae growth (What Is Nutrient Pollution?, n.d.). This process decreases the amount of dissolved oxygen in the water, harming aquatic life and generating toxins that impair water quality (Nutrient Pollution: How Excess Nitrogen and Phosphorus Are Shaping Health Outcomes | National Caucus of Environmental Legislators, 2022). This analysis examines the effectiveness of constructed wetlands in comparison to natural wetlands in removing nitrogen and phosphorus from water. Specifically, the percent of Total Nitrogen (TN) and Total Phosphorus (TP) removed leading to improved water quality. Studies indicate that constructed wetlands are more effective at removing pollutants, especially organic matter like nitrogen and phosphorus, because they are designed to perform this function

Introduction/ Background

Wetlands are known as “nature’s kidneys” because of the pollutants they filter from water. They do this through physical, chemical, and biological processes (Nutrient Removal — the Wetlands Initiative, n.d.). Las Vegas receives most of its water from the Colorado River, which is currently experiencing one of its worst drought periods in history. This analysis investigates whether constructed wetlands are as effective as natural wetlands at removing total nitrogen (TN) and total phosphorus (TP) from water. As well as analyzes what that means for the water quality in Las Vegas.

Methods/Analysis

Effectiveness in this project means the constructed wetland’s ability to meet or exceed the level of nutrient removal done by a natural wetland. Specifically, the percent of removal of Total Nitrogen and Total Phosphorus. While maintaining reliable seasonal performance and stable hydraulic retention time (Land et al., 2016).

Results

Aspects	Natural Wetlands	Constructed Wetlands
Nutrient Removal	Natural nutrient cycle that is effective over large areas	engineered specifically to remove nutrients
Biodiversity	High level of biodiversity	Lower biodiversity (may grow over time)
Ecosystem Services	Carbon sequestration, habitat, flood mitigation, water filtration, not tailored to anything specific	Depends on what it was designed to do but may offer other services inadvertently
Cost	No cost unless it needs to be conserved or restored	initial cost but is more cost effective in the long term (especially for wastewater, treatment)
Scalability	Determined by geography	Can be customized depending on land that is available
Maintenance	Self-maintaining, but may require maintenance if polluted or 3otherwise degregated	Requires maintenance to sustain
Performance	Moderate nutrient removal 30% - 70% for TP and TN	Consistent high level nutrient removal 40% - 90% TP and 50% TN

Conclusion/ Future Direction

When comparing the effectiveness of a natural wetland and a constructed wetland, the result often depends on context. For instance, natural wetlands may outperform constructed wetlands in cases where the goal is to increase or sustain biodiversity, or to address long-term carbon sequestration. On the other hand, constructed wetlands tend to be more effective in wastewater treatment plans and have a higher pollutant loading capacity, since they are specifically built to handle waste and pollutants. Additionally, constructed wetlands are generally more predictable, as they are designed to function in a particular way. (Client Challenge, n.d.)

References

Client challenge. (n.d.). https://www.slideshare.net/slideshow/natural-vs-constructed-wetlands-understanding-the-differences-pptx/274608174

Ferreira, C. S., Kašanin-Grubin, M., Solomun, M. K., Sushkova, S., Minkina, T., Zhao, W., & Kalantari, Z. (2023). Wetlands as nature-based solutions for water management in different environments. Current Opinion in Environmental Science & Health, 33, 100476. https://doi.org/10.1016/j.coesh.2023.100476

Land, M., Granéli, W., Grimvall, A., Hoffmann, C. C., Mitsch, W. J., Tonderski, K. S., & Verhoeven, J. T. A. (2016). How effective are created or restored freshwater wetlands for nitrogen and phosphorus removal? A systematic review. Environmental Evidence, 5(1). https://doi.org/10.1186/s13750-016-0060-0

Nutrient Pollution: How Excess Nitrogen and Phosphorus are Shaping Health Outcomes | National Caucus of Environmental Legislators. (2022, March 30). National Caucus of Environmental Legislators. https://ncel.net/articles/nutrient-pollution-how-excess-nitrogen-and-phosphorus-are-shaping-health-outcomes

Nutrient Removal — the Wetlands Initiative. (n.d.). The Wetlands Initiative. https://www.wetlands-initiative.org/nutrient-removal

What is nutrient pollution? (n.d.). https://oceanservice.noaa.gov/facts/nutpollution.htm

Acknowledgements

This material is based upon work supported by the NASA NVSGC under Grant No. 80NSSC25M7094