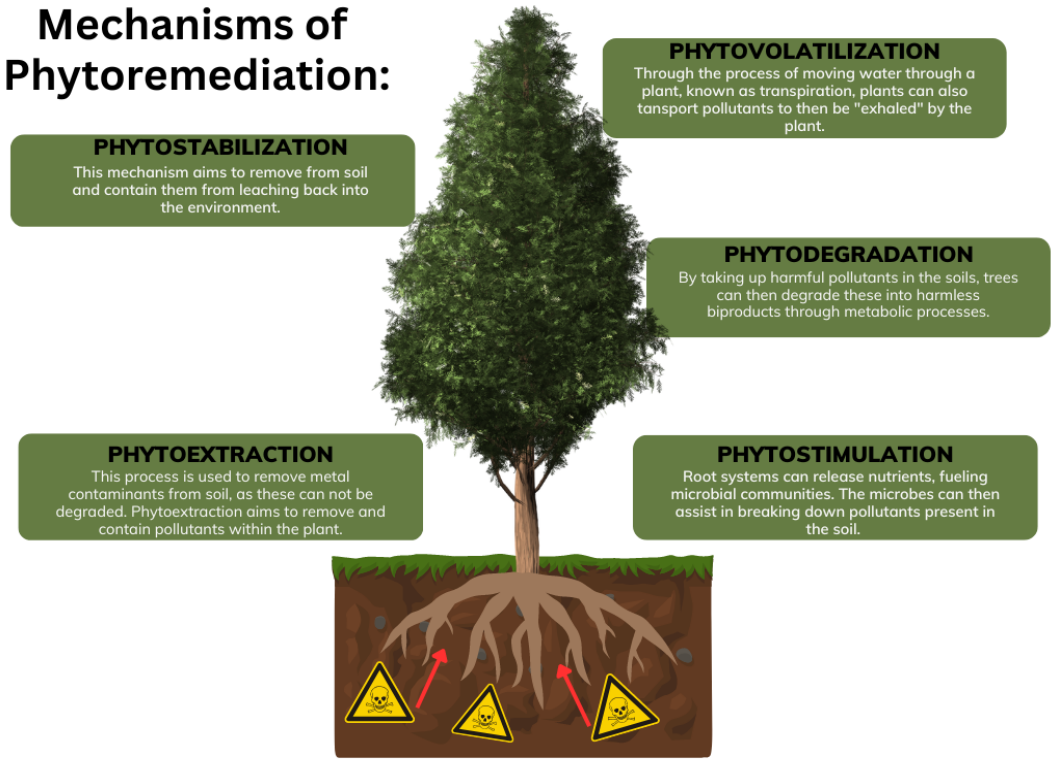
## History of the Union Bay Natural Area

Seattle's Union Bay Natural Area (UBNA), now a well-known bird-watching site with lakeside trails and over 70 acres of wildlife habitat,[1] was not always a thriving environment. The region was originally home to the Yesler Lumber Mill and the Montlake Landfill which served Seattle for over 40 years.[1] During its lifetime, the Montlake Landfill stored up to 60% of the city's garbage. Along with this astounding volume of garbage, the dump lacked detailed records or enforcement of regulations, so the region consisted of a swath of various garbage-types, such as food waste, clothing and anything else humans decided to toss away. Eventually, the space was capped in an effort to switch to more sanitary landfill management.

Capping is a method of pollution treatment that aims to isolate contamination and create a barrier between contaminants and the environment above. The thickness of a cap typically determines the effectiveness of the method; thicker caps tend to decrease the flux of contaminants into the surrounding environment.[2] However, this method is much less effective in wet environments, as the cap can be eroded due to heavy rains and winds, exposing pollutants to the environment once again and resulting in the spreading of pollution. Because UBNA is located in the Pacific Northwest, a region known for cold and wet weather, as well as its placement right along a wetland border of Lake Washington, capping was not a long-term solution for this site.

## What is Phytoremediation?

Phytoremediation is an alternative restoration method that uses plants' abilities to take-up nutrients and water from soil to also uptake and remove pollution from soil as well. This method aims to contain and remove contaminants from a site, along with reducing possibilities for further leaching.[3] Phytoremediation can benefit contaminated areas through different means. For example, the plants introduced to a site establish root systems which decrease chances of erosion (which could also promote leaching of pollution) and are an aesthetically pleasing and inexpensive way to treat a site without introducing large excavation projects to the area.




## Project Background

Professor Sharon Doty began managing the Ravenna Creek site in the fall of 2021. The site serves as an extension of Doty's research and teaching on phytoremediation, and her work is aided by student volunteers and researchers. Originally, Willow branches were coppiced from trees that have shown success in phytoremediation and planted in the site. These branches were planted in a wheel spoke formation. In the spring of 2022, additional Willow branches were planted in the lines of the spoke to increase the density of branches. During this time, Poplar branches were also planted in a more random fashion in the riparian buffer zone that borders Ravenna Creek.

SER-UW has regularly supported the project by providing access to resources, tools, and work parties. The purpose of their work parties are to provide assistance with planting and ongoing site maintenance. With their help, we have removed Himalayan blackberry, grasses, and various other invasive plant species in the site.

## Capstone Project Aut 22/Wtr 23 by Hunter Wade, Allegra Novakoski, Montana Thoroughman, and Kyra Hopkins

The site was initially observed by members of the team in Spring 2022; however, in-depth observations were taken at the onset of the current project in October 2022. The majority of the

original plantings did not survive, likely due to weather conditions and resource competition. During the time period between observations, the area experienced above average temperatures and below average precipitation.[4] Additionally, the grasses and Himalayan blackberry continued to grow within the site and adjacent to the willow plantings, reducing the willow's water and nutrient availability. At the outset of the summer, the willow plantings were exposed to high levels of wildfire smoke which may have decreased their photosynthetic rate and contributed to their poor growth. In the riparian buffer zone, the Poplar plantings turned a maroon color, indicating environmental stress.

Observations were also taken directly south of the site in a previously restored plot in the UBNA. Overall, the plot had a considerably higher plant density than the plot being restored, and there was greater species diversity. The land adjacent to the riparian buffer was less dense and featured large Lombardy poplar. Comparatively, the land adjacent to the riparian buffer in our plot contained cattails, grasses, blackberries, and few mature species. These differences can be attributed to differences in starting conditions. The adjacent site was previously a parking lot, meaning planting took place on a barren piece of land. The Ravenna Creek site, however, was already populated with grasses and invasive species from the placement of the landfill cap.

## Our Mission

Our purpose within this capstone project is to use phytoremediation to help create a healthy ecosystem on top of a previous landfill site; where plants can thrive and tourists can see an aesthetically pleasing plot of land rather than what this site originally looked like. We are aiming to prevent pollutants from leaching further into the nearby waterways, remove pollutants from the soil, provide wildlife habitat, increase biodiversity, and increase protection on adjacent waterways within the site. We are focusing on phytoremediation rather than other remediation methods because it will help increase the species richness of the site and make the site more appealing to observe, while also spreading awareness of phytoremediation as a method of restoration and improving environmental ecosystem conditions.

## Our Methods

Step 1:
This research project was conducted over two quarters (AU22/W23).Work began in September by removing invasive species within the site, including Himalayan blackberry and willow dock. These species were overcrowding the area, preventing the planted willows and poplars from obtaining sufficient sunlight, water and nutrients.[5] To support the growth of the new willows, the removal process was continued throughout the entirety of the project with the help of SER-UW.

Step 2:
Soil and water analyses were conducted throughout Winter 2023. Locations for testing were randomly chosen throughout the site in order to gather a representative data set and these locations were marked for future reference. These tests will be conducted in the same locations throughout the next few years to determine how willows impact the water and soil quality.

Step 3:
The willows were planted in the middle of January, including a variety of willow species, as well as cuttings from another nearby location. Each willow was planted about 2 feet deep, giving the trees a better chance to establish new roots.[6] There was no systematic approach on how they were planted, the main focus was to fill in the area with as many willows as possible to increase the chance of survival.

Step 4:
To support the growth of the newly planted trees, as well as the ones surviving from the initial planting in the last academic year, a method called sheet composting was utilized. For this method the first step done was  trimming down the grasses and other species surrounding the planted willows. Layers of cardboard were then placed on top to inhibit grass growth.[7] The next capstone students plan to lay compost on top of the cardboard in the coming quarters to provide nutrients to the willows.

Step 5:
Lastly, this educational website was set up to inform the community on this project and the importance of phytoremediation.

## **In the Future**

Moving forward, this site will be maintained by future capstone students who will continue working with Professor Sharon Doty to remove toxins from this site via phytoremediation. Soil and water analyses will be conducted throughout the years to determine how phytoremediation impacts the soil and water quality of the surrounding areas. General maintenance of the site will also be done to ensure that the willows will survive. Through this work, we hope to educate the public and inspire future leaders in the environmental science community to utilize similar methods in their own restoration projects.

**Further Information on Phytoremediation:**

Book on Poplar and Willow Phytoremediation Qualities

Studies being done on Poplars and Willows

Benefits of Riparian Buffers

General Information on Phytoremediation

**References**


1. Union Bay Natural Area (Seattle). Accessed December 12, 2022. https://www.historylink.org/File/10182

2. EG C. Conventional and amended capping • EnvGuide. EnvGuide. Published February 23, 2018. Accessed December 12, 2022. https://us.envguide.com/conventional-and-amended-capping/

3. Phytoremediation of Inorganic Contaminants - Northern Research Station - USDA Forest Service. Accessed December 12, 2022. https://www.nrs.fs.usda.gov/disturbance/pollution/phyto_inorganics/

4. National Temperature and Precipitation Maps | National Centers for Environmental Information (NCEI). Accessed December 12, 2022. https://www.ncei.noaa.gov/access/monitoring/us-maps/3/202209

5. The Problem With Invasive Plants | About Invasive Plants | The City of Portland, Oregon. Accessed December 12, 2022. https://www.portlandoregon.gov/bes/article/330681

6. Isebrands JG, Richardson J, eds. Poplars and Willows: Trees for Society and the Environment. CABI ; FAO; 2013.

7. Oregon State University Extension Service. (2022, November 8). *Sheet mulching - aka lasagna composting - builds soil, saves time*. OSU Extension Service. Retrieved March 8, 2023, from https://extension.oregonstate.edu/gardening/soil-compost/sheet-mulching-aka-lasagna-composting-builds-soil-saves-time