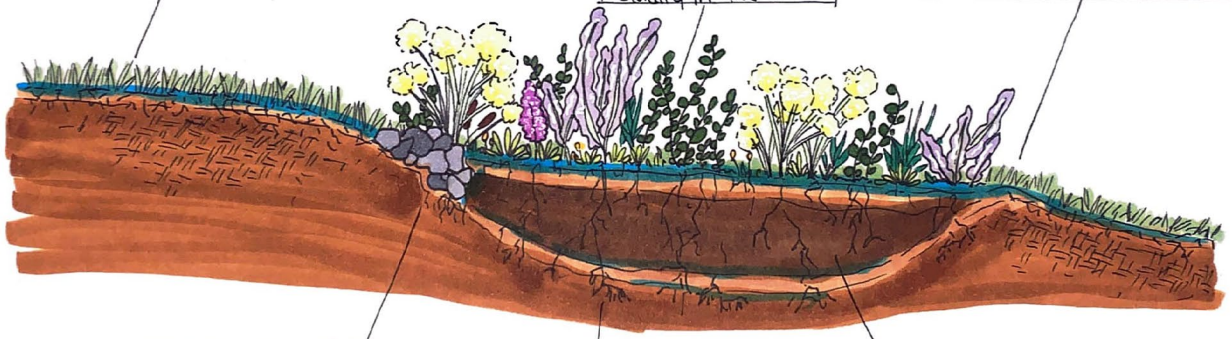
RAIN GARDEN

THE Rain water that falls on the roof of the barn at Hyla is directed into this rain garden, where it will flow through the plants and filter out any pollutants and toxins before entering the sound.

All of the plants planted in the rain garden are native. They will grow and thrive naturally in the PNW.

Once the rain water has flowed and been filtered through all of the plants, any water that hasn't been absorbed by the soil and plants will flow out to the nearest watershed and eventually into the Puget Sound.



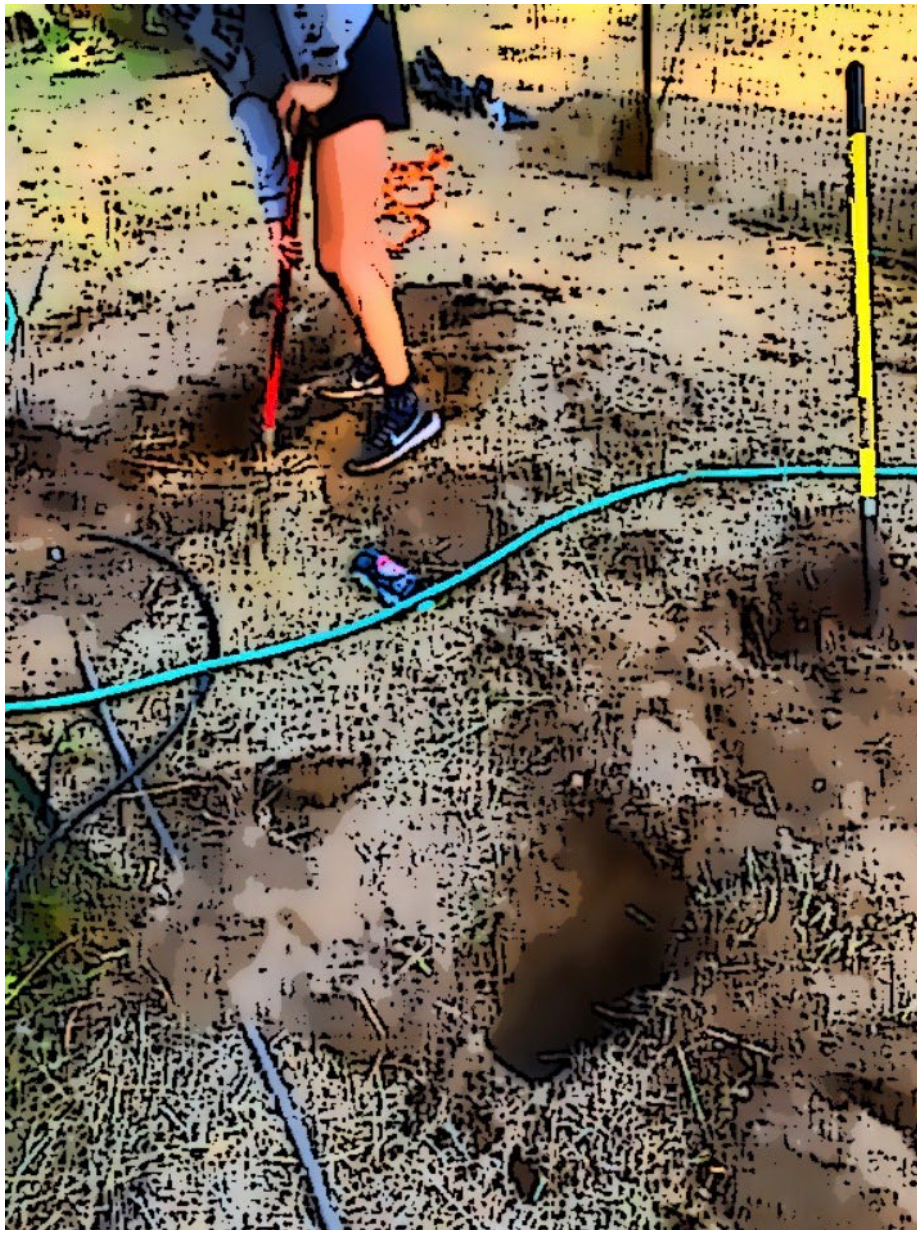
THE rocks at the inflow are used to slow the rain water down as it flows into our garden. This prevents problems such as erosion and flooding.

THE ponding depth and soil layers are displayed in this picture. Hyla's soil is sandy so we needed to add compost on top of the sand to give the plants extra nutrience so that they could grow quickly.

Once the plants are placed in the ground, they are watered regularly until they are established, about a year after. This allows for the roots to grow deep into the soil and collect water and nutrience. This is especially important for drought tolerant plants.

EVERY YEAR in the Pacific Northwest, an average of 37 inches of rain runs straight through streets, roofs, and driveways, collects chemicals, oils, fertilizers, and other toxic substances, and then drains into the Puget Sound. With our waterways polluted, we imperil our beautiful landscape, our spectacular Sound, and the marine life that relies on its health, including salmon and orcas.

A group of concerned high school students investigated this problem, pulled on masks to protect against the COVID virus and created one solution that our community might rely on: rain gardens. These beautiful gardens capture the rainwater runoff and filter it before it enters into our waterways.



High School students designed and built a rain garden at Hyla Middle School on Bainbridge Island. In the process, they explored the hidden ways that we rely on water and the Puget Sound, how we mistreat that water, how these problems disproportionately affect some of us, and what kinds of things we can do to improve our relationship with the Sound. Together, the group spent five sessions in July learning some of the ways water flows on the island—and the ways that our treatment of it damages our home. The group met with geologists, aquatic biologists, environmental engineers and designers specializing in environmental integration work. Using the experts' insights, some calculus learned in high school, garden skills, and a lot of sweat, the project culminated in the final week with the construction of a rain garden at Hyla: a beautiful, environmentally friendly way to help our lives work harmoniously with the water flowing around us, into our Sound, and sustaining life.

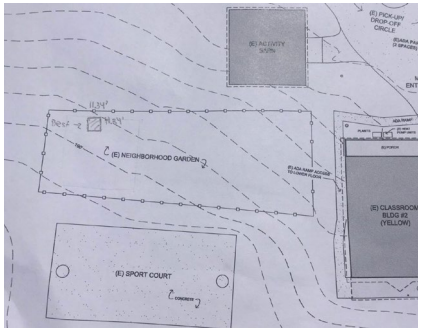
The project culminated in the final week with the construction of a rain garden at Hyla.

The learning process and the construction of the rain garden was documented, and used for the production of this book, for the use and education of future students at Hyla. We hope this book will prove to be a teaching material for middle school students and an example for one of many ways to filter stormwater and improve the health of the local waterways.

PRE-CONSTRUCTION PLANNING

The composition of the soil is incredibly important when building a rain garden. This is because the soil determines what materials will need to be brought in for planting, how long the digging and construction will take, and how quickly the water will be absorbed. To test these factors, we dug a hole, four feet deep, in the area where the rain garden would be placed and poured 5 liters of water into that hole. By doing this, we were able to determine a number of interesting things: 1) The soil was all sand, so it would be incredibly easy to dig and plant in; 2) A small coating of fertilizer would need to be brought in to plant the plants with; and 3) The water infiltration rate was approximately 1.91 inches per minute and the hole drained a total of 5 liters in 4 minutes.

To determine the ideal size of the rain garden, we used the water infiltration rate, the optimal ponding depth and ponding performance, and zoning. This formula was created by the Washington State Department of Ecology. The water infiltration rate is shown above, and that is 1.91 inches per minute. The ponding depth is approximately 12'' so that the plants can be properly positioned in the rain garden and so that the surface of the garden is below the rest of the area so that the water flows into the garden. The ponding performance is determined by multiplying the sizing factor percentage by the draining area. We found the sizing factor percentage by figuring out the performance of the rain garden and how much water we want it to capture. A "good" rain garden would capture approximately 6% of the water, a "better"



garden would capture about 7% and the "best" rain garden would capture about 17% of the water. We chose to use the "best" case scenario, a 17% sizing factor percentage. Our draining area was to be about 42'x18', which is 756 feet squared, and to determine the size of the rain garden we multiplied 756 ft^2 by 17% to get 128.52 ft^2. This allows us to catch over 17,000 gallons of water per year that flows off part of Hyla's Barn.

A "good" rain garden would capture approximately 6% of the water, a "better" garden would capture about 7% and the "best" rain garden would capture about 17% of the water.

Constructing an inflow for a rain garden is incredibly important and it can be done in a variety of ways. One way is to tap a downspout at the bottom of the gutters of the Hyla Barn to direct the water that falls on the roof of the barn to the rain garden. Another way is to create an inflow made of rocks that directs the water from the barn towards the rain garden. For our rain garden, we used the first option of tapping the downspout of the barn and directing the water using a non perforated pipe. To do so, we dug from the base of the Barn all the way to the rain garden to make an underground path for the pipe.

GETTING SMART

SCHEL CHELB

At Schel Chelb, our group spoke with two incredibly talented and knowledgeable individuals: Ali Dennison, a local geologist with Aspect Consulting, and Deb Rudnick, an aquatic ecologist who heads the Bainbridge Island Watershed Council.

With Ali, we learned about the formation of our island through a glacier, and how rock materials were distributed across the island as a result of that glacier. At Hyla, the geology is almost all sand, making it incredibly easy to dig and install our rain garden. Sand is also very absorbent to water, as proved by the water infiltration rate, which mitigates the chance of flooding in the event of a heavy rain. According to Deb, the ecosystem at the Pleasant Beach watershed is incredibly diverse and important. Keeping the water that flows into that watershed from residential houses, streets, and city property clean is very important to the ecology of that area, and that is why a rain garden is a perfect way to keep that water clean and healthy. The take away from Deb's conversation with us was the importance of limiting human intervention with local ecosystems to the point that we can best support life in that habitat.

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MADISON

On Madison Ave, our class met with Steve Burke, a local environmental engineer who designed the rain gardens in Winslow Way. He went through the design features of the rain gardens, such as the divots in the road curbs to allow for rainwater to drain from the street into the garden, and the plant selection and placement to ensure certain plants would receive the proper amount of water. All of the gardens that Steve designed are native rain gardens, meaning they consist of plant species native to the northwest. The rain garden at Hyla is based off of a native plant rain garden, similar to the ones in Winslow. Building a rain garden with native plants is beneficial for two reasons: 1) It eliminates almost all upkeep of the garden because the plants will live and thrive on their own, and 2) It promotes and restores a native plant environment, which is important on Bainbridge because much of the plant species living on Bainbridge today are non-native or invasive.

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SAKAI PARK

Juan Revalo, a local Biohabitats ecologist, spoke with us at Sakai park about the immense biodiversity of plants and animals on the island. We walked the through trails that led us down to a stream and a small lake where we studied all of the movement of life around us and how the native environment used the land it was given. An example of this is a fallen tree, that would usually be considered waste. However, the dead tree was packed with life, from the moss, fungi, and vegetation growing from its fallen trunk to the insects and birds that lived and thrived on the inside of the tree. Nothing in the forest is considered "trash," it is always repurposed and used to support more life. This helped our group to see how our plants in the Hyla rain garden could work harmoniously with the ecosystem there and hopefully attract a greater variety of life and biodiversity.

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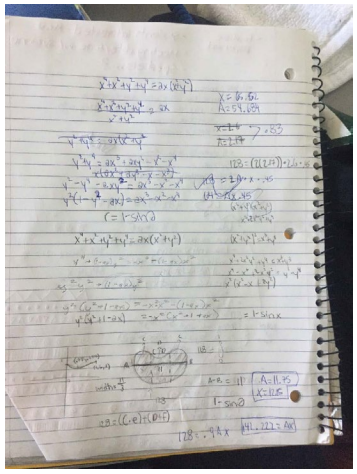
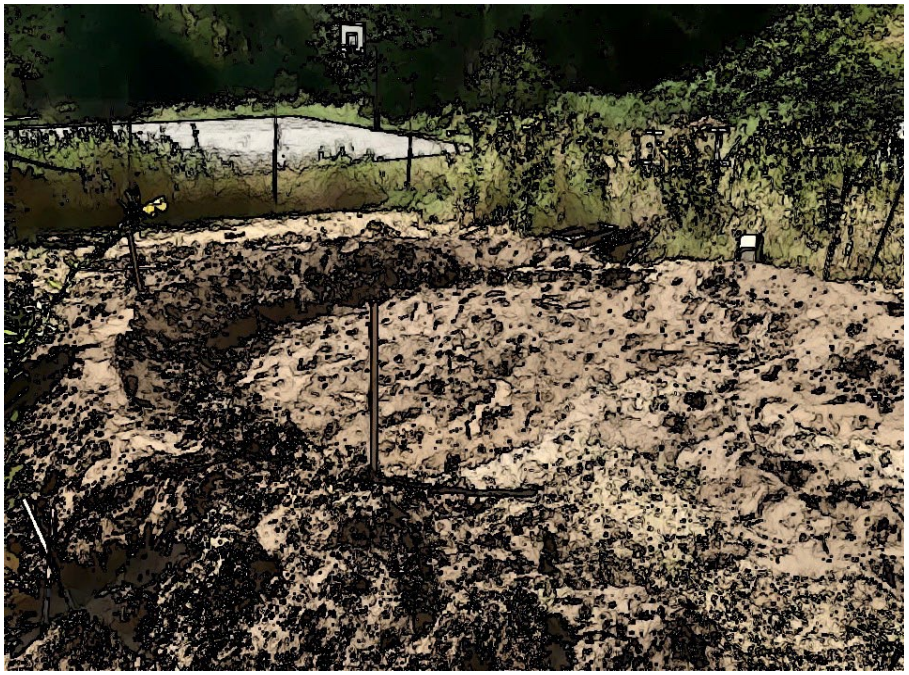
CONSTRUCTION

How big should this rain garden be? Big enough to hold the water that runs off part of the Hyla Barn roof. We measured the roof's square footage, looked at our annual rainfall forecast, and calculated that just half of the roof on the Hyla Barn captured nearly 17,000 gallons of water annually. Next, we dug a test hole where we wanted the garden to be placed and poured in water. We found that the land absorbed almost 2 inches per minute! Putting all of those numbers together, we determined that we wanted the area for our rain garden to be 128.52 ft.^2, but we did not choose a shape for the rain garden until much later. Squares, circles, and rectangles were all considered, but we wanted to give our garden a more natural appearance. Due to that fact, we decided to make a bean shaped garden. Luckily, we already had the desired area of our garden, but in order to determine the dimensions of our bean shape, we needed integral calculus. The equation for a bean shaped function on a graph is x^4 + x^2 + y^4 + y^2 = ax(x^2 + y^2). Using this equation, we were able to calculate the ratio of the length of the bean to the two heights of the bean (height from the bottom of the bean to the top of the humps and height of the button of the bean to the center and low point of the bean). This ratio





was about 2:1.04:1.14. Next, we determined the equation that gave us the area of a bean. That function was: A= (.90)(C)(x), where A is the area, C is the length of the bean, and x is the height of the bean (from the bottom to one of the humps). By plugging in the 128 to the A, and knowing that the x value was 1.04x as large as the C value, we could approximate those values using guess and check. This only took two or three tries, since there are not many factors that go into 128 with that ratio. Our end product was a C value of 11.75 and an x value of 12.2. With these measurements, we were able to map out the shape of the garden that would match a 128 foot area approximately.

Our group met with Burgess, a certified horticulturist who works at the Bainbridge Gardens, to assist us in choosing the appropriate plants for our rain garden. Based on the shape of our garden and the fact that the water inflow would be entering the garden in between the humps of the bean, we needed more drought resistant plants for the tops of the humps and the bottom of the garden, because not much water would reach those points, and plants that like wet environments for the top and middle of the bean shaped garden. Burgess was very helpful in narrowing down our choices, but each member of

the class was able to choose a plant that they wanted in the garden. This made the garden unique to our group of individuals.

After the delivery of the plants, compost and rocks, the group was able to start constructing the rain garden. We began with splitting up the group, half of us working on digging the path the pipe would take to the rain garden, and the other half of us digging the bean shaped garden about 15-18 inches down, to ensure the ponding depth was deep enough for the rain water and the plants with the fertilizer. With the soil that we dug up, we built a berm on the outside of the garden as a preventative measure in the case of lots of rain so the water did not flood the sports court below the garden. Once the pipe path and the garden shape were dug, and the berm was shaped, we installed landscaping rocks at the inflow and outflow, along with along the sides of the berm as additional structural support to ensure it did not cave in on our garden. The pipe team installed a 50 foot ABS non-perforated pipe that led from the mouth of the gutter at the barn to the rain garden. Next, we needed to place 3 inches of compost in the garden before planting the plants and installing the watering system. After the plants and watering system were installed, 1 more inch of compost needed to be added to the plants before the rain garden was completed!

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ACKNOWLEDGEMENTS

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Miranda Schmidt

John Velisaris

Speakers:

Ali Dennison

Deb Rudnick

Steve Burke

Juan Revalo

Burgess Bryant

A HUGE thank you to all of the amazing speakers who dedicated their time and shared their expertise with us for this rain garden. **We could not have done it without you!**

– Chloe and Jenna

Thanks also to:

Bainbridge Gardens Nursery

Suzanne Messinger, Head, Hyla Middle School

Tina and Kee Song

Sarah Shapiro

Greta Chin

Jason Uitvlugt: AP Environmental Studies, Bainbridge High School

Todd Vogel and Karen Hust

RAIN GARDENS FOR A CLEANER PUGET SOUND

SUMMER 2020