Green-Walk Trout Hatchery

Technology Clinic Final Report - December, 2023

Table of Contents

Executive Summary

Green-Walk Trout Hatchery has been serving Pennsylvania and surrounding areas since 1950, providing live trout for stocking and sport, as well as cleaned trout for restaurants throughout the Northeast. The 2023 Technology Clinic team was asked to consider how Green-Walk can become an energy sustainable operation, as well as a destination for visiters to observe how they are using sustainable practices to minimize their environmental impact.

During the spring semester, the Tech Clinic team proposed two main ideas for advancing the farm's sustainability:

- Harnessing the farm's flow of water to generate hydroelectric power using a water wheel.
- Using solar panels to create electricity from the sunlight, including rooftop solar panels, standing panels, floating panels, and bridge panels.

In addition to the sustainability efforts, the Tech Clinic team also provided proposals for an alarm system in the case of pump failure and provided recommendations for online educational outreach opportunities.

During the fall semester, the Tech Clinic team finalized the prototype for the water wheel and installed it at Green-Walk. The team moved forward with the idea of standing solar panels and provided a design for Green-Walk to implement. Additionally, the team evaluated several types of alarm systems, ultimately deciding to set up a Raspberry-Pico powered meter that receives signals from the pressure sensor and sends emails accordingly. Finally, the Tech Clinic team developed a new website to showcase Green-Walk's environmental initiatives in addition to their products and services.

What is Technology Clinic?

Technology Clinic is a two-semester Lafayette College program in which teams of students from each academic division work together to find imaginative solutions for clients' real-world problems. The program was founded in 1988 by now Emeritus Professor of Anthropology Dan Bauer. To encourage "out-of-the-box" thinking, there are no requirements for prior experience, thus reducing incoming "prejudices" and encouraging innovative solutions. The students are nominated by professors and former Tech Clinic students and mentored by two faculty facilitators. Project teams are purposely multidisciplinary and include students and faculty mentors from the Humanities, Social Sciences, Sciences and Engineering departments. Their varieties of talent gives them the ability to assess any challenge or project from different perspectives to achieve effective results. Since its inception, Tech Clinic has worked on over 70 different projects for entities as far ranging as local NGOs to multinational corporations.

Meet the Tech Clinic Team

Angela Busheska ‘25

Angela is a junior pursuing a double degree in Electrical Engineering and Computer Science. Inspired by the climate situation in her home country North Macedonia, she spent the last three years working on climate-tech activism. On campus, she is performing research on brain-computer interface and is involved with the Dyer Center.

Rylee Bordwick ‘25

Rylee is a junior double majoring in Environmental Studies and Anthropology & Sociology with a minor in geology. She is involved in the Track and Field team and is a javelin thrower. On campus she works with the Nurture Nature Center as a Proctor Fellow and is the secretary of Athlete Ally. Rylee is from Lambertville, NJ.

Sean Walshe ‘25

Sean is a junior civil engineering major from Hellertown, PA. He is conducting research on concrete properties in the Lafayette College Concrete Laboratory. He has also done work with the College Writing Program as a Writing Associate. He has a passion for international arts.

Meet the Tech Clinic Team

Tara Amidon ‘25

Tara is a junior double majoring in International Affairs and Government and Law with a minor in Spanish. She is originally from Boulder, Colorado. On campus, she is very involved in the Landis Center for Community Engagement and is a social justice peer educator with Kaleidoscope.

Wanos Bahiru ‘25

Wanos is a junior Mathematics-Economics major, born and raised in Addis Ababa, Ethiopia. She is a Resident Advisor and involved with International Student Association. She is passionate about finding creative solutions to real world problems.

Meet the Tech Clinic Team: Faculty Advisors

Professor Dan Bauer

Dan is a founding member and longtime participant in the Lafayette Technology Clinic Program. His educational background is in Engineering, Journalism (BA San Jose State University), and Social Anthropology (PhD University of Rochester). He served in community development in the Peace Corps in Peru. He has conducted long-term anthropological research on community level economics and politics in Ethiopia and rural Mexico. He is a photographer and has a passion and curiosity for problem solving.

Professor Christopher Ruebeck

Chris is a member of the Department of Economics, teaching classes in game theory, firms' decision making about marketing and strategy, and the simulation of markets and behavior .His research is in related areas with applications to technological innovation and environmental policy. He has employed community-based learning in his Marketing Research class and with student collaborators doing honors theses, EXCEL research, and independent study projects.

Project Significance

Green-Walk Trout Hatchery is a successful farm that provides live trout as well as cleaned trout to restaurants throughout the Northeast. Currently, their day-to-day operations require a substantial amount of electricity, primarily stemming from the pumps that maintain flow rates and oxygen levels. Through partnering with the Technology Clinic team, Green-Walk hopes to make progress toward becoming an energy sustainable operation and a site that groups can visit to observe how they are using environmentally conscious practices to minimize their carbon footprint. The solutions explored by Tech Clinic over the past year should aid Green-Walk in their mission of developing a sustainable business model and setting an example for other businesses and organizations.

Hydroelectric Power

Why Hydropower?

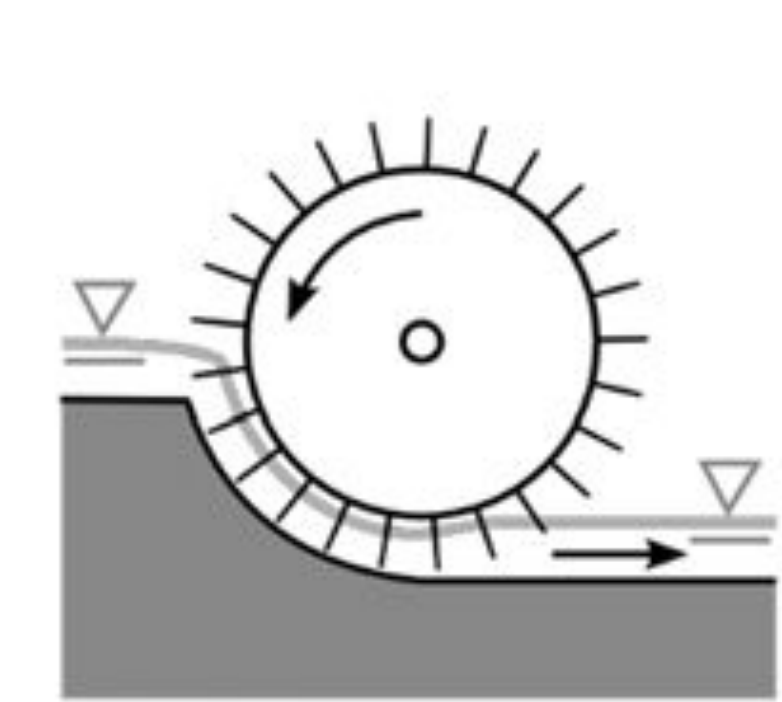
Greenwalk has constant flow throughout the farm in present in the numerous streams on the property. This water runs throughout the year and does not stop during the evening, which gives it an advantage over solar power. We created and tested a water wheel prototype as a proof of concept for future endeavors on Greenwalk.

The following pages cover the process that our design underwent, including an initial conceptualization, fabrication, installation, and redesign.

Initial water wheel test performed by Green Walk

Initial Concept

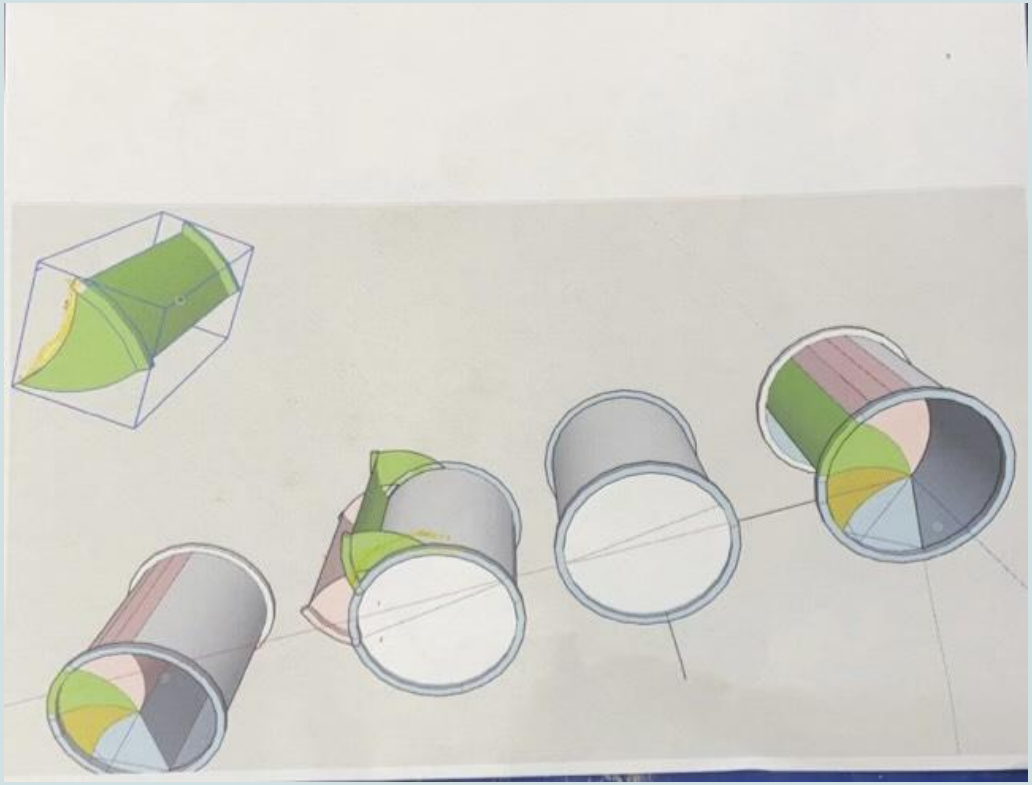
To utilize the energy contained in the stream flowing through the farm, we centered our design process around a 2.5 foot drop with a 4 foot width present on the main farm. We idealized our initial design around the middleshot or breastshot model. We created the wheel to be as big as possible to maximize the torque generated by the force of water. We chose the middleshot option to use the maximum velocity of the water directed by an incline for a greater impulse. This design has since changed.



Middleshot

Preliminary Work

We brainstormed our design by choosing accessible recyclable materials. We used a used 55 gallon steel drum to fashion the base of the water wheel. We created the frame that holds the water wheel out of angle iron from recycled bed frames.



Initial Design of Waterwheel in Sketchup

Fabrication

During Spring 2023, we began fabricating the waterwheel. We fashioned the drum and buckets out of two 55 gallon steel drums. We used power tools to cut one wheel into bucket pieces and welded them to the other drum. We used a water-resistant spray to allow the buckets to hold more water without leaking both inside the wheel and outside the buckets. The wheel has a belt that connects the water wheel to a pulley system that is used to convey rotational energy to an alternator to generate electricity.

Initial Fabrication of Waterwheel

First Installation

The first installation was similar to a pelton wheel, which relies on the momentum of a rapidly moving body of water to create the necessary impulse to rotate the wheel. This design relies less on the dead weight of water in the bucket, so water was directed through a wooden chute to hit the water wheel at the midpoint of its height, making it a breastshot design.

Initial Installation of Waterwheel

First Installation

The wheel is fastened to the frame through bolts on each side connecting to the axle. The alternator is attached to the cross beam between the two frames through a bolt in a drilled hole. The wheel uses two belts in the aim of transferring torque to the alternator to generate electricity.

Wheel installed with alternator

Redesign

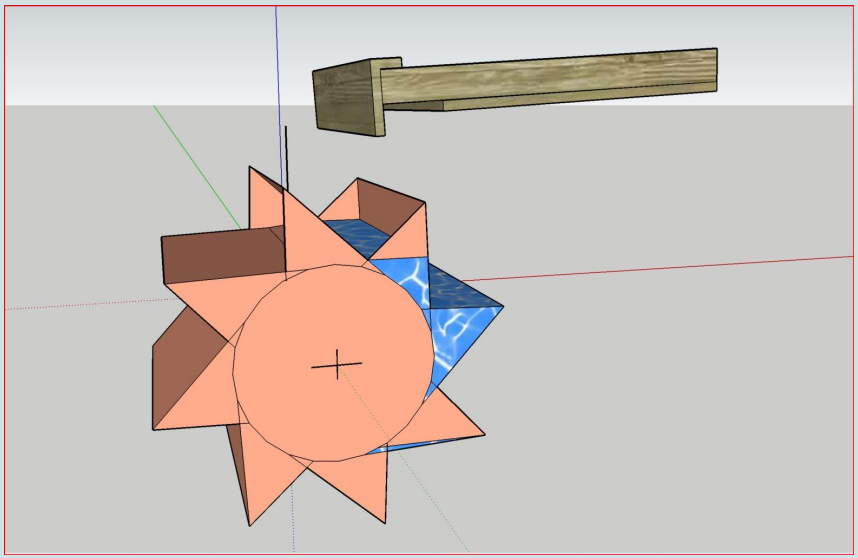
Using an alternator recycled from an ambulance, our initial design was able to produce 11.5V of electricity. As 12V batteries ideally require around 14V to consistently charge, we revised the design to maximize the amount of torque generated by the water wheel to increase the voltage produced by the alternator. Additionally, we pursued testing other alternators and batteries.

Buckets	Area (in^2)	volume (in^3)	Weight (lb)	Radius (in)	Radius (ft)	Torque (ft*lb)
bucket 1	21	672	23	8	0.67	15
bucket 2	40	1280	44	14	1.17	51
bucket 3	3	96	3	14	1.17	4
Total Torque (ft*lb)						**70**

Table of Theoretical torque due to water in redesigned wheel

Redesign

The new design alters the angle and location of water interacting with the water wheel. The water wheel now follows the overshot design philosophy of relying on the dead weight of water to create consistent torque for the water wheel. The water is now released at the apex of the wheel. This allows for more buckets to be consistently filled with a volume of water rather than relying on an initial impulse, which will reduce the amount it will slow down.



Model of Redesign in Sketchup

Generation

Using another alternator with a higher quality battery, a simulated bench test was able to generate 14VDC. However, a recent flood severely damaged one bucket, and the water wheel was not able to be used to test generation using the new alternator and battery. The flood did not damage the old alternator.

Water wheel before flood

Alternative Option

One alternative design to consider experimenting with in the future is the spiral turbine. This could allow us to increase the amount of water that is captured within the buckets by increasing the space that water can reside in on the wheel.

A model spiral wind turbine
Source: https://www.ebay.com/itm/394859251476

Future Plans

We plan to continue working with Greenwalk Trout Hatchery on finalizing the installation of the water wheel. We hope to have the water wheel generating 14V of electricity from several alternators. We also encourage Greenwalk to install more water wheels at locations with larger head to maximize the size and force of water on the wheel.

Waterfall before installing the wheel

Solar Power

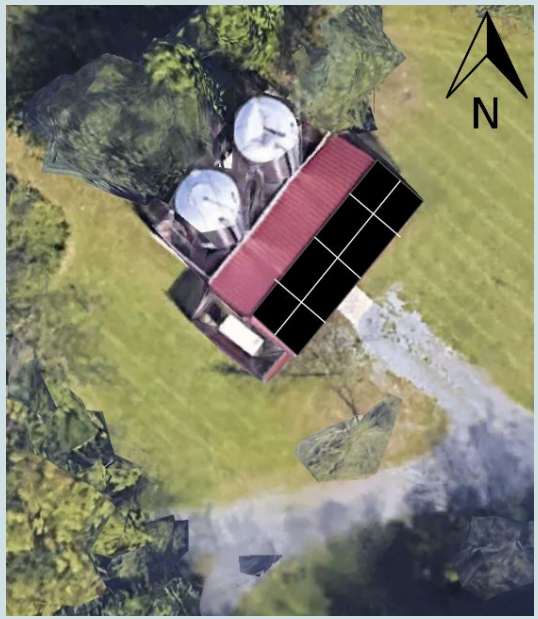
Solar Power at Green-Walk

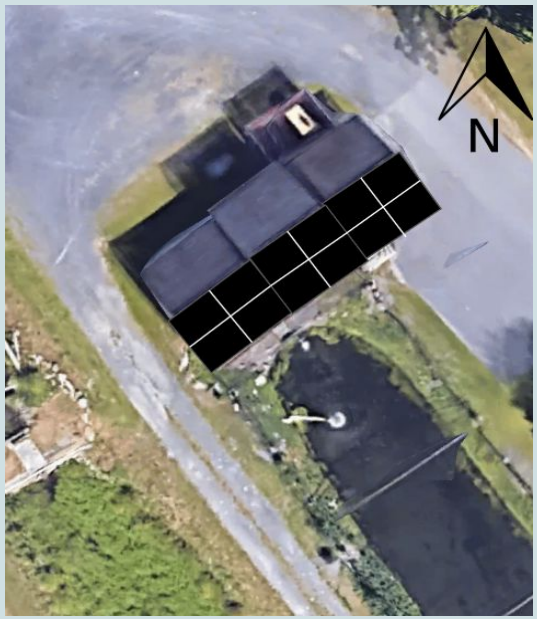
Solar energy is the practice of converting energy from sunlight into electricity. Photovoltaic cells in solar panels are used to generate this energy. Solar energy is not only less expensive than fossil fuels, but it avoids a large portion of the externalities associated with environmental degradation as well. Solar power can save money, improve sustainability, and improve the self-sufficiency of those who choose to utilize this resource.

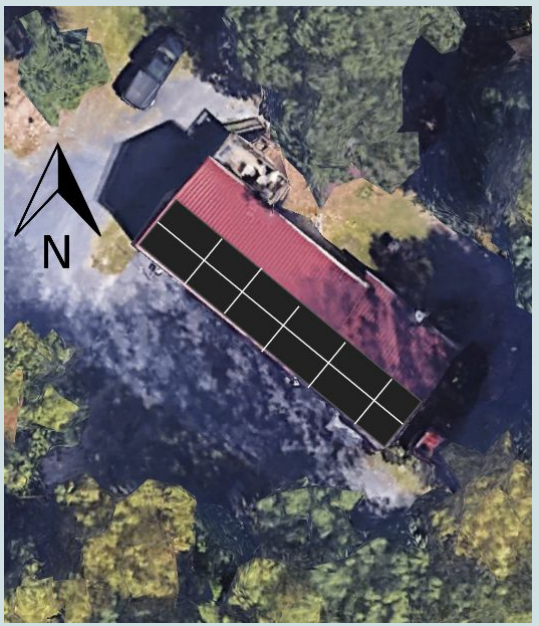
Based on Green-Walk's recent electric bills we have estimated that about 20,000 kWh a month and 240,000 kWh a year are used. MET ED charges 12.57¢ per kWh and Green-Walk pays about $3,000 a month for their electricity bill. Technology Clinic has identified methods of offsetting the power usage through the generation of solar energy. During the spring semester, the team developed recommendations for rooftop panels, standing panels, floating panels, and bridge panels. The Technology Clinic suggested to move forward with rooftop solar panel installation. During the fall semester, the team focused their energy on designing a standing panel system to be placed at the banks of the ponds, casting shade and cooling the water while simultaneously harnessing the sun's energy.

Rooftop Panels

If the suggested rooftop solar recommendation are installed, then they would collectively produce around 44,347 kWh a year, which is about 18% of Green-Walk's yearly needs according to the Tech Clinic's calculations. These solar panels could produce about 3,695 kWh a month. An alternative source, PVWatt, estimate that if the roof panels are put in place they would cover about 16% of Green-Walks yearly electricity needs. The complete solar installation is estimated to cost between $45,000-$75,000.

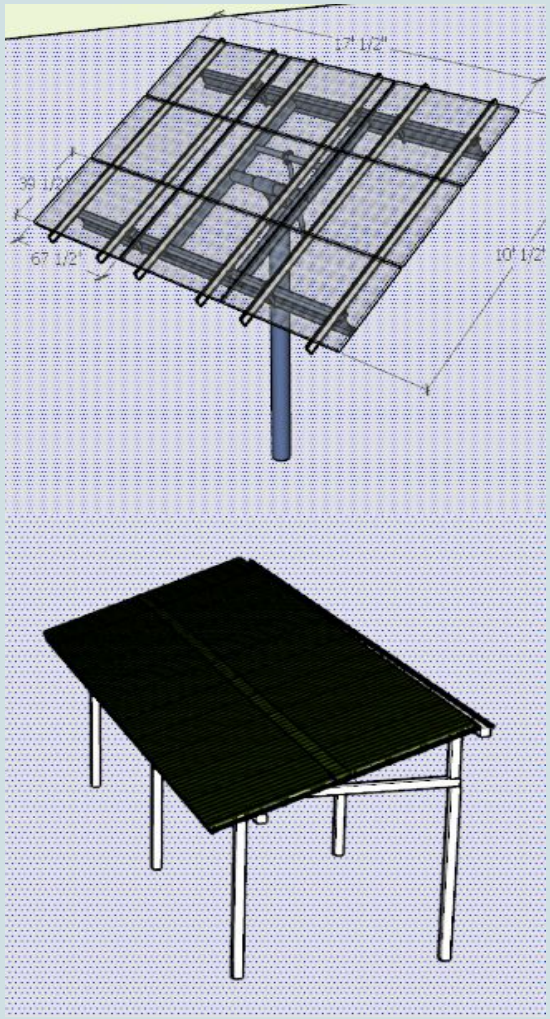






Standing Panels: Development

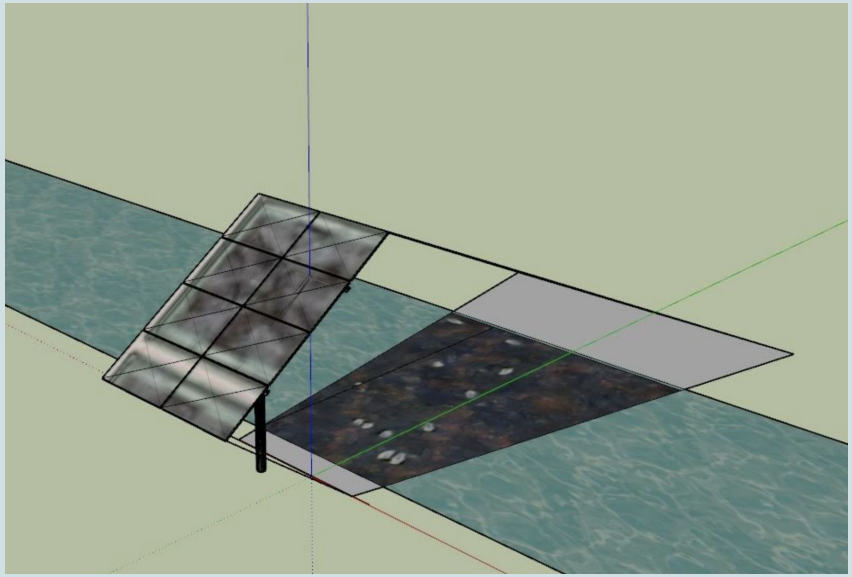
Standing Panels would be able to be positioned on the banks of the ponds so the structure casts shade onto the water. The frames could be positioned to face towards the south for optimal efficiency. The frames would also be able to adjusted throughout the year to track the path of the sun and rach optimal efficiency for energy collection. These panels will serve two main purposes: to cast shade onto the water which will cool it and provide refuge for trout and to capture energy from the sun to charge electric vehicles. With the frequency of warming temperatures increasing due to climate change, having shady areas for trout to cool off in will be increasingly more valuable.



Standing Panel design options from the midterm report

Standing Panels: Development

A potential location for the standing panel design is located in green in this image. The panels will sit along the banks of the trout ponds.



The positioning of the angle of the standing panel can be seen in this image. The sun will hit the solar panels on the structure and shade will be cast onto the water below.

Standing Panels: Design and Implementation

The materials needed for the design of the standing panels included a two inch pipe, u-bolts, and aluminum brackets. This structure would be built to hold two 1.7 meter x 1 meter panels, rated at 400 watts each. This means that 800 watts could be generated per structure. This design would allow for the angle of the panels to be changed seasonally to allow for higher output and it would ideally be 32 degrees off horizontal and aimed due south. Support posters can be placed to provide appropriate shading for trout runs and to minimize interference with cleaning trout runs. The power from panels is approximately 20 volts DC which is not dangerous to human touch. In order to connect to Green-Walk's electrical system inverters would be needed to transform this this output to 120/240 volts AC. Safety can not be overlooked during this installation. Power can be carried from solar panels to Green-Walk's electrical system at 20 VDC or 120/240 VAC but the 20 VDC installation is less expensive. To transmit this energy, open air wiring out of human reach or underground wiring from the solar panels to the below ground with a plastic conduit can be used.

Example of Standing Panel Design

Standing Panel: Design and Implementation

Our recommendation for the most suitable batteries available today for the standing solar panel array available is the Eco-Worthy 12V 200AH Mini Size LiFePO4 Lithium Iron Batteries. These batteries have a good charging rate and cost around $420. The 12 volt versions will work best with the waterwheel or the solar panels. This battery will also serve to help charge any electric vehicle which can be plugged into a regular 120 VAC outlet. We also recommend the Eco-Worthy 200-800W 12V Solar Panel Kit for the array, which costs around $50-$1000 depending on the size and wattage of the kit. This kit also comes with a lithium iron battery.

Alarm System

Methods for Building an Alarm System

Implementing an alarm system was important for the operation of the pump stations. This system aims to help mitigating risks associated with power outages and ensuring the health of fish. We've looked into the following:

Flow Rate Monitoring: Activate the alarm upon detecting a notable decrease in water flow, indicative of potential power failures that may impede pump function.
Pressure Sensor Activation: Initiate the alarm when there are fluctuations in water pressure, as measured by the sensor. This approach guarantees real-time surveillance and prompt notification, which are vital for the well-being of the fish.

By integrating this alarm system, we not only safeguard the fish but also drive cost efficiencies. Early detection of issues enables swift action, reducing fish mortality rates and preventing significant financial losses. Moreover, the assurance of a reliable monitoring system provides peace of mind to our operators and stakeholders.

Attempt 1: Using the Water Flow Meter

In our attempt to implement a water flow monitoring system, we encountered some challenges that led to an unsuccessful outcome.

The primary objective was to establish a system that could read the water flow rate and notify employees when the flow dropped below a certain threshold.

However, the data logger was incompatible with our current devices. However, during our time working with water flow meters, we've learned about several different options that might better support operations. They are covered in the following slide.

The alternative solution we proceeded with was building the alarm using a pressure sensor, due to its simplicity and ability to convey important information.

Options for Water Flow Meters

Ultrasonic Flow Meter (example)

- **Pros**: Non-extensive installation, no pressure drop, works with a wide range of pipe sizes and types. Low maintenance is needed.
- **Cons**: Higher initial cost
- **Estimated Price**: $500 - $4,000

Electromagnetic Flow Meter (example)

- **Pros**: High accuracy, no moving parts leading to less maintenance, foreign
- **Cons**: Requires conductive fluid (shouldn't be an issue for water), relatively expensive, can be affected by external magnetic fields
- **Estimated Price**: $1,000 - $5,000

Mechanical Flow Meter: (the present flow meters belong to this category)

- **Pros:** Versatile, suitable for a wide range of flow rates. Simple design with fewer electronic components.
- **Cons:** Susceptible to damage from debris like rocks, affecting accuracy. Requires more frequent maintenance due to moving parts.
- **Estimated Price:** $100 to $2,000, depending on model and features.

Attempt 2: Using Pressure Sensor

As previously mentioned, we decided to use the pressure sensor instead of the flow meter. The pressure sensor provides two possible measurement outcomes:

- **Low Voltage**: Once the pressure sensor goes below this threshold, a message is sent to Green-Walk to inform them that this low voltage indicates that something unusual might be happening.

- **Regular Voltage**: If everything has been doing well in the last 24 hours, then an email will be sent stating that the pressure sensor is in a good condition.

Method for communication:

The method for sending a message when the meter falls below the specified threshold is entirely cost-free. By sending an email to @tmomail.net (or similar domains for respective carriers), the cell provider automatically converts this email into a text message.

Why Raspberry Pico?

We chose the Raspberry Pi Pico, a microcontroller, for this project because it includes an analog-to-digital converter (ADC). The Raspberry Pi microcomputer does not include this functionality.

The ADC in the Raspberry Pi Pico allows it to take the analog input, which is the format of the data we're receiving, and convert it into a digital format. The Raspberry Pi Pico's onboard ADC eliminates the need for external ADC hardware, leading to a more streamlined and very cost-effective solution.

Additionally, the Raspberry Pi Pico offers a balance of performance, flexibility, and ease of use, making it a suitable choice for projects that require real-time data processing and conversion from analog to digital formats. The WiFi-enabled Raspberry Pico is priced at $6. The emailing is accomplished through Google and so is available at no charge.

How does it work?

Internet Connection for Pico: Start by establishing an internet connection for the Pico. The process how we connect the Pico to Wi-Fi is explained in the Appendix.

SMTP Protocol Configuration: We've implemented an SMTP (Simple Mail Transfer Protocol) using two primary files:

- main.py: This is the main file that manages the email communication process.
- umail.py: This auxiliary file supports the overall email functionality.

With these files in place and properly set up, the Pico is capable of functioning independently. However, it is important to maintain a continuous power supply to the Pico. For ease of use, incorporate a button to toggle the power on and off.

Network Connectivity Requirement:

- Based on the testing results, we recommended that position an Eero router or access point in close proximity to the Pico. Without this, it will not be able to send its emails (and the generated texts).

Inputs

For the code to be configured these are inputs that have to be configured:

```
sender_email = ''
sender_name = ''
sender_app_password = ''
recipient_email =''
email_subject ='Email from RPi Pico'

# Network credentials
ssid = ''
password = ''
```

We will also provide separate instructions on maintaining these inputs.

What does it measure?

We use a voltage divider circuit, comprising a pressure sensor and a stationary resistor. The role of the stationary resistor is to prevent the occurrence of infinite resistance in the circuit. The circuit allows the Pico to measure a voltage from which the resistance of the sensor is calculated.

Standard Measurements, when there is a regular flow

Voltage at the junction: 3.202 V

Resistor at the junction: 32. KOhms

Measurements when there is not a regular flow

Voltage at the junction: 0.033 V
Resistor at the junction: 0.101 KOhms

Options for Further Development

- To enhance the monitoring capabilities, one could implement a database hosted on cloud services such as Google Cloud, AWS, or Microsoft Azure, which will be available for a monthly subscription fee.
    - **Pros**: The data from the logger would be saved, and can be retrieved for further analysis
    - **Cons**: The process will be paid (depending on the chosen service and how long/extensive) it is used

It would also be possible to integrate computer vision technology with the camera systems. This advanced feature would provide additional detection of a greater variety of water flow conditions.

Awareness, Community Outreach, and Education

Introduction

At the beginning of the year, the Technology Clinic team was asked to consider how Green-Walk could become an organization that is open to visits by the public. Green-Walk wanted to share their sustainable and environmentally conscious practices with schools and interested individuals.

Through the midterm report, the Tech Clinic team recommended updating the current website to highlight the hatchery's history, as well as environmental sustainability efforts in addition to Green-Walk's products and services. Over the course of the second semester, the tech clinic team has created an entirely new website with the following pages:

- "Home"
- "About Us"
- "Sustainability & Education"
- "Visit Us"

We hope that these additions will showcase Green-Walk's history and sustainability initiatives in a more accessible way. Eventually, we hope the site will serve as a platform for groups to register to visit the hatchery aiding Green-Walk to be an institution open to education, research, and partnership.

Website

The current website is nearly entirely focused on Green-Walk's business model and products/services. In renovating the website, the Tech Clinic team has kept all of this information, while also adding more on the history and sustainability initiatives at Green-Walk.

The pages of Green-Walk's current website are as follows:

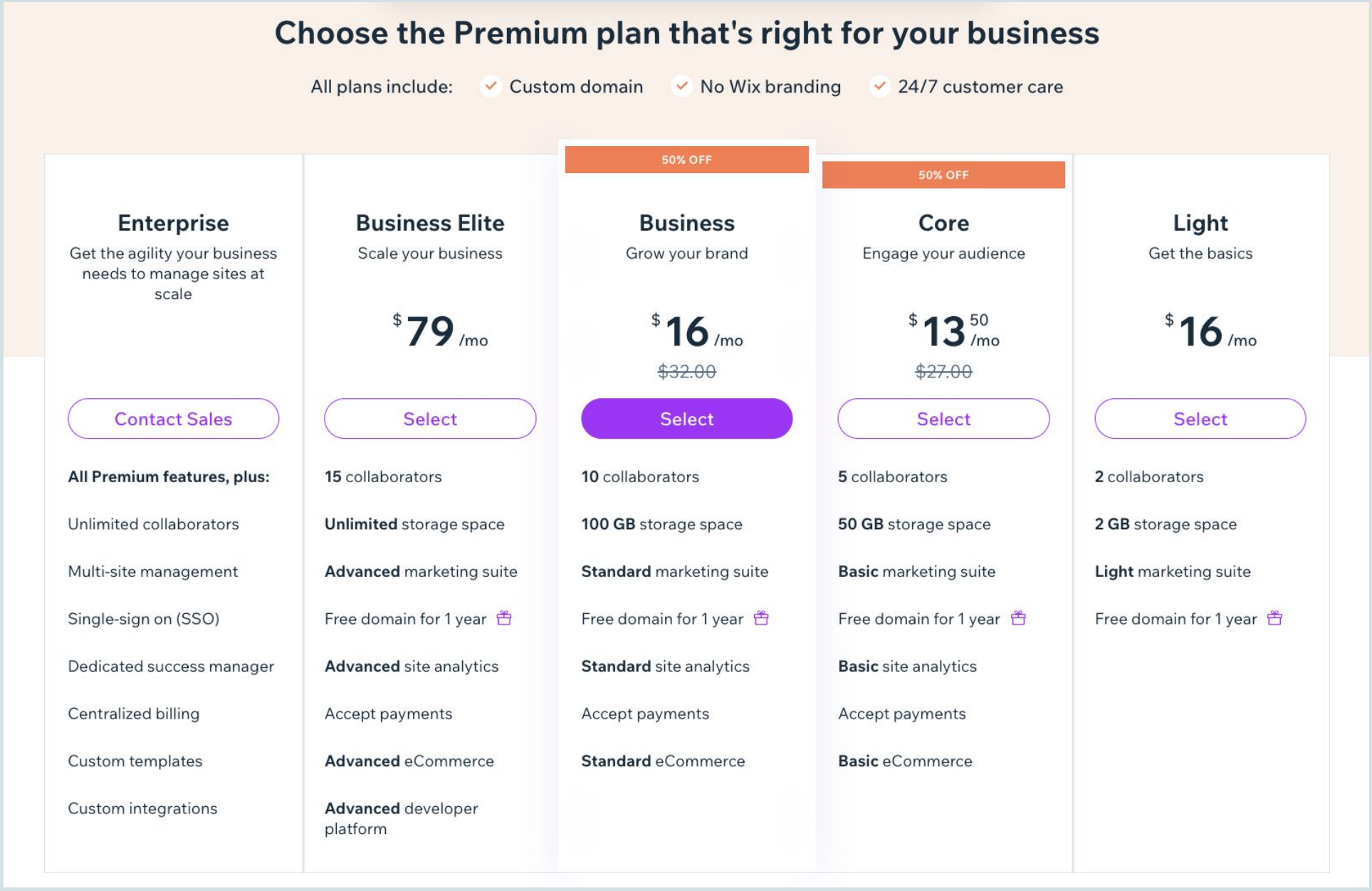
- "Home"
- "Pond Stocking"
- "Stocking Price List"
- "Trout Consumption"
- "Trout Information"
- "Contact"

New Website Provider: WIX

Right now, Green-Walk uses the website provider HIBÜ, costing $137 per month. This website provider owns the access to the website and Green-Walk can only make changes to the website through email communication with HIBÜ. After comparing two alternatives (WIX and SquareSpace), the team decided to move forward with WIX because of its ease of use, variety of plans, and relatively easier drag and drop feature that would allow Green-Walk to edit the website when there are any updates. The Tech Clinic team has created this website as a draft, so moving forward, Green-Walk will need to choose a plan and customize the WIX site to meet their own needs, as well as connect their old domain.

This new website would introduce a new platform for Green-Walk to advertise its history, products, and environmental stewardship initiative. Additionally, this new website would be owned by Green-Walk itself. This would allow Green-Walk to keep an active, professional line of interaction with the public and its clients.

The new WIX website gives Green-Walk access to SEO tools, that can increase visibility on google searches, allowing Green-Walk to compete with similar businesses and be discoverable by potential partners.

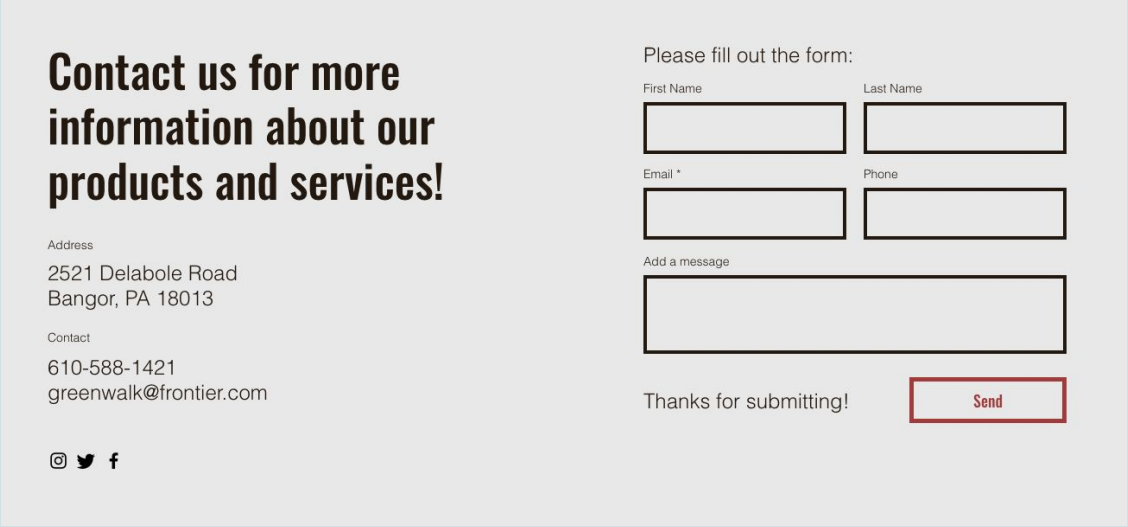


Source: Wix.com

Website Overview: Home Page

As the first page of the website, the home page introduces clients to Green-Walk. Compared to the current website, the new website's homepage is more colorful and inviting. Additionally, it contains the location of Green-Walk and images drawn from Green-Walk's social media.

At the bottom of the home page (and every subsequent page) there is a new feature for consumers to contact Green-Walk using a "Contact Us" form. This feature can be used to schedule meetings, group visits, and ask any questions regarding either educational or outreach opportunities regarding Green-Walk's traditional business and product offerings.



HIBÜ Home Page

GREEN-WALK TROUT HATCHERY INC.

610-588-1421

HOME | POND STOCKING | STOCKING PRICE LIST | TROUT CONSUMPTION | TROUT INFORMATION | CONTACT

Growers of superior trout

Numerous species

Our superior trout is composed of brown, brook and rainbow species.

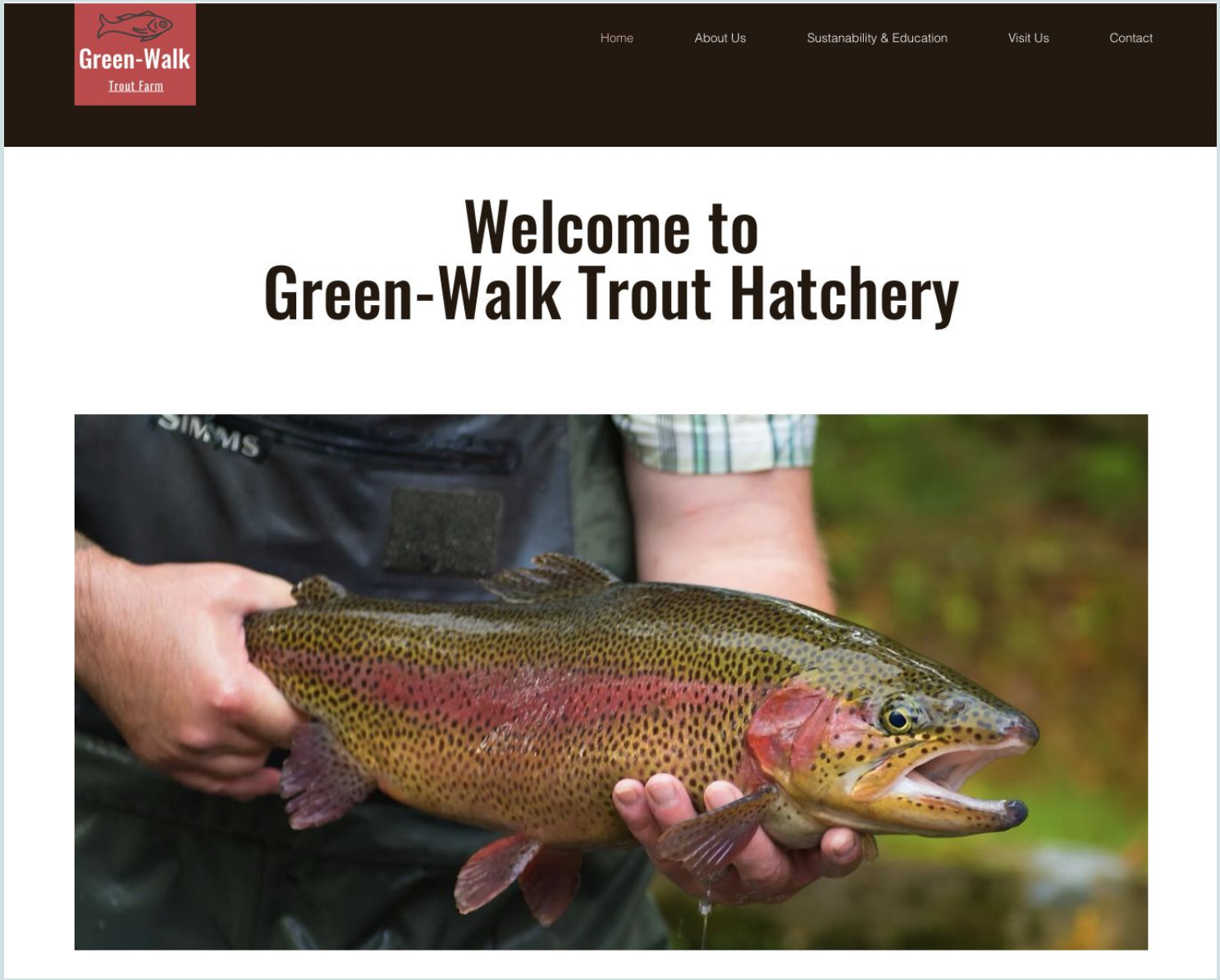
Convenient delivery available

We are proud to serve Pennsylvania and Connecticut.

Reliable fish stocking

We certify trout of the highest quality, with pond stocking and live hauling service options.

WIX Home Page



Website Overview: About Us Page

Home: Our History

This aspect of the website introduces the history of Green-Walk to the client. The page uses pictures of second, third, and fourth generation Green-Walk family. It also depicts the quality product trout that Green-Walk Hatchery produces with details on how to get in contact with Green-Walk.

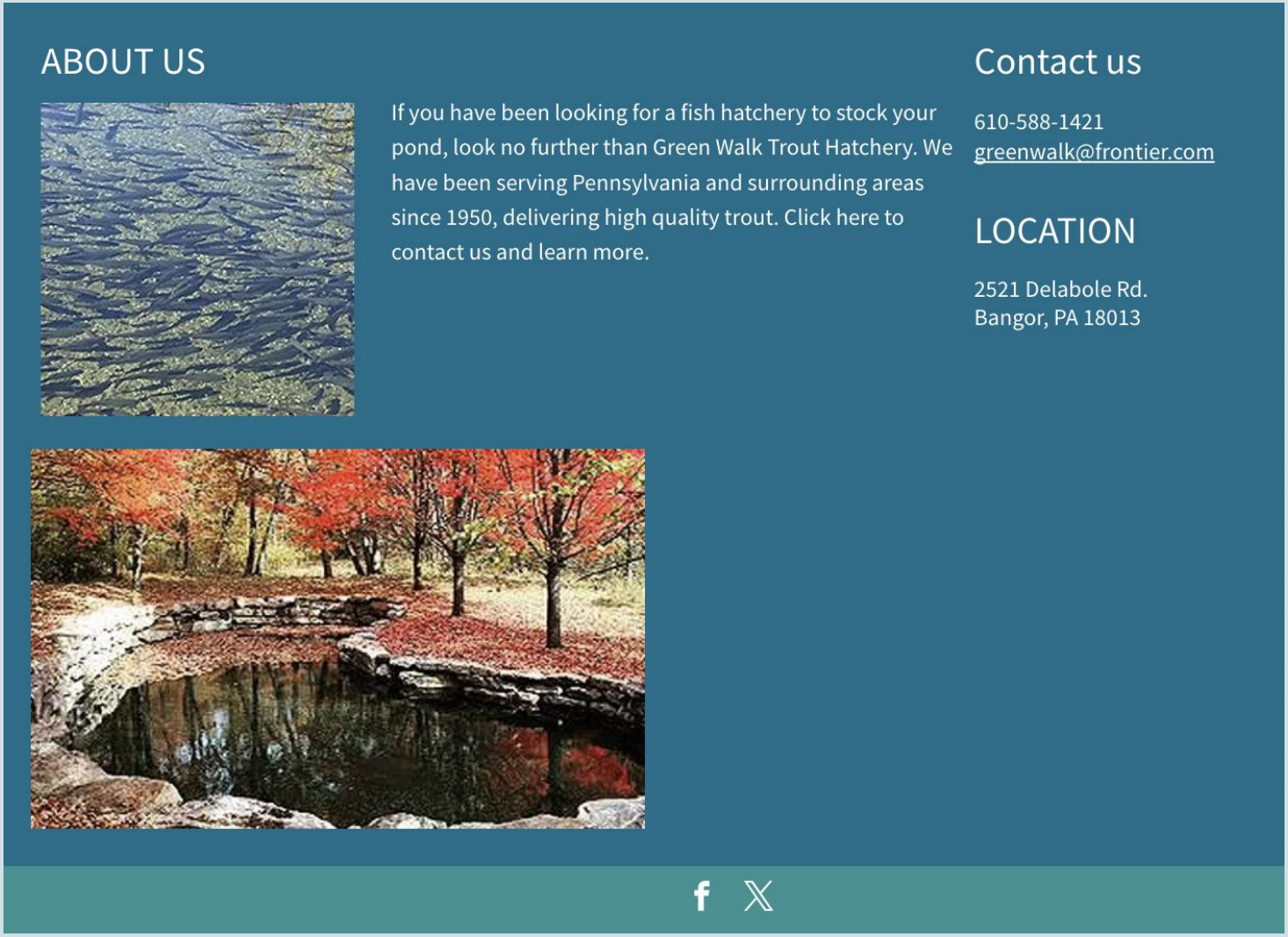
About Us: Our Services, Our Products, & Our Team

The “Our Services” sub page includes information on pond stocking and provides a price list for how much each type of trout would cost the customer. The customer is also made aware of delivery locations and fees on this subpage. The restaurant function of Green-Walk is also introduced in this page, with a link to an appearance of Ty on Eater YouTube page hyperlinked to the subpage.

The “Our Products” page further elaborates on the type of trout present at Green-Walk trout Hatchery. The different species of trout are introduced here with a picture taken from the hatchery by the Tech clinic team.

The “Our Team” section of the About Us page introduces the family as it relates to their presence on the farm, and shows members of the Bartosh family working at the hatchery and interaction with the trout.

HIBÜ “About Us” Page



Note: on the current website, “About Us” is not its own page. Instead, this information is at the bottom of the home page. We’ve decided to make it separate.

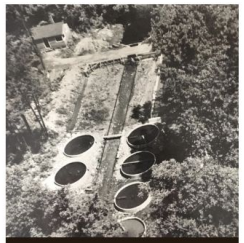
WIX “About Us” Page

About

Green-Walk Trout Farm

Green-Walk is a family run business that has been serving Pennsylvania and surrounding areas since 1950, delivering high quality trout. We are proud of our history and dedication towards the stewardship of the land and waters that our hatchery relies on. We are 4th generation trout farmers and invite you to take a look back in time at a brief history of Green-Walk Trout Hatchery.

Our History



Aerial view of Green-Walk Trout Hatchery around 1950.

The founders of Green-Walk Tout Hatchery : Raymond "Mouse" Williams and Charlie Williams.

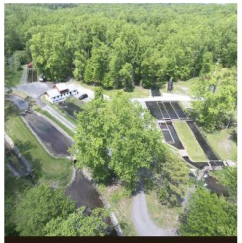
William Roberts driving a Green-Walk delivery truck in 1965.

Jackie Bartosh delivering trout to a customer circa 1987.

Jackie Bartosh was the owner of Green-Walk Trout Hatchery for over 40 years before passing the business on to her son, Ty Bartosh.

Three generations of trout growers!

Jameson is a fourth trout farmer generation here at Green-Walk



Aerial view of the main hatchery property today. Green-Walk has around 80 ponds spread out between 3 properties in an 8-mile radius.

WIX “About Us” Page: Our Services

What We Do

Pond Stocking Services

Green Walk Trout Hatchery has been serving Pennsylvania and surrounding states for over 70 years. Email or call us to schedule your trout stocking.

Stocking your pond in the spring is common, but fall is also a good time! Trout can adjust during the winter months, and are then healthy throughout the summer. Ask us which species will work best for your pond! Brown, brook, and rainbow are available.

2023 Stock Pricing List

Check out our price list for 2023 below. Delivery prices are available upon request. We can deliver to Pennsylvania and Connecticut! Just give us a call to learn more about your delivery options! (All trout measure plus or minus 1/2")

At times some species & sizes may not be available. Availability is dependent upon stock at time of delivery. Every effort is made to fulfill your order as requested. Occasionally substitutions of species & sizes may be offered.

- Delivery Prices Available Upon Request
- Please provide advance notice for orders.
- Rainbow, Brown, Brook & Golden Rainbow Trout Available
- Prices subject to change without notice.
- Prices do not include sales tax (where applicable)
- Minimum order may apply

Size	Per Trout
1” – 2”	$2.00
2” – 3”	$2.50
3” – 4”	$2.75
4” – 5”	$3.45
5” – 6”	$3.60
6” – 7”	$3.90
7” – 8”	$4.55
8” – 9”	$5.00
9” – 10”	$5.80
10” – 11”	$6.50
11” – 12”	$7.50
12” – 13”	$9.00
13” – 14”	$10.25
14” – 15”	$12.50
15” – 16”	$18.00
16” – 17”	$22.00
18”	$30.00
19”	$35.00
20”	$40.00
21”	$50.00
22”	$60.00
23”	$80.00
24”	$150.00
25”+	Contact us for prices.

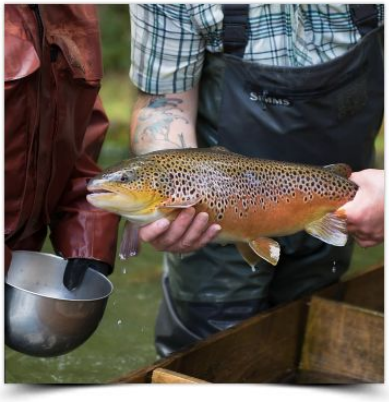
Restaurant Services

Green Walk is proud to hand deliver fresh trout to Michelin 3 Star Restaurants in the tri-state area.
Green Walk Trout Hatchery can provide superior trout for restaurants and distributors. We prepare fresh, farm-raised, cleaned whole trout. Restaurants and distributors may contact us for more information and prices at greenwalk@frontier.com or call us at 610-588-1421.

WIX “About Us” Page: Our Products

Rainbow Trout

Typically, rainbow trout exhibit black spots with a light body and a red stripe that runs along the side of the fish. Rainbow trout have a diet of crayfish and plankton along with some insects.



Brown Trout

Brown trout can be found just about anywhere, and are known to grow to large sizes. They have a spotting pattern of black and red-orange spots, and are known to have a high tolerance for warmer waters.

Brook Trout

The fins are often orange, with black and white mixed in. The body is dark with white and red spots. Brook trout have an olive-green or dark brown color on their back that becomes lighter on the belly.

Golden Rainbow Trout

They exhibit a deep yellow or orange color. Golden Rainbow Trout have pink or reddish tones on their fins and have a reddish stripe along their body.

Our Trout

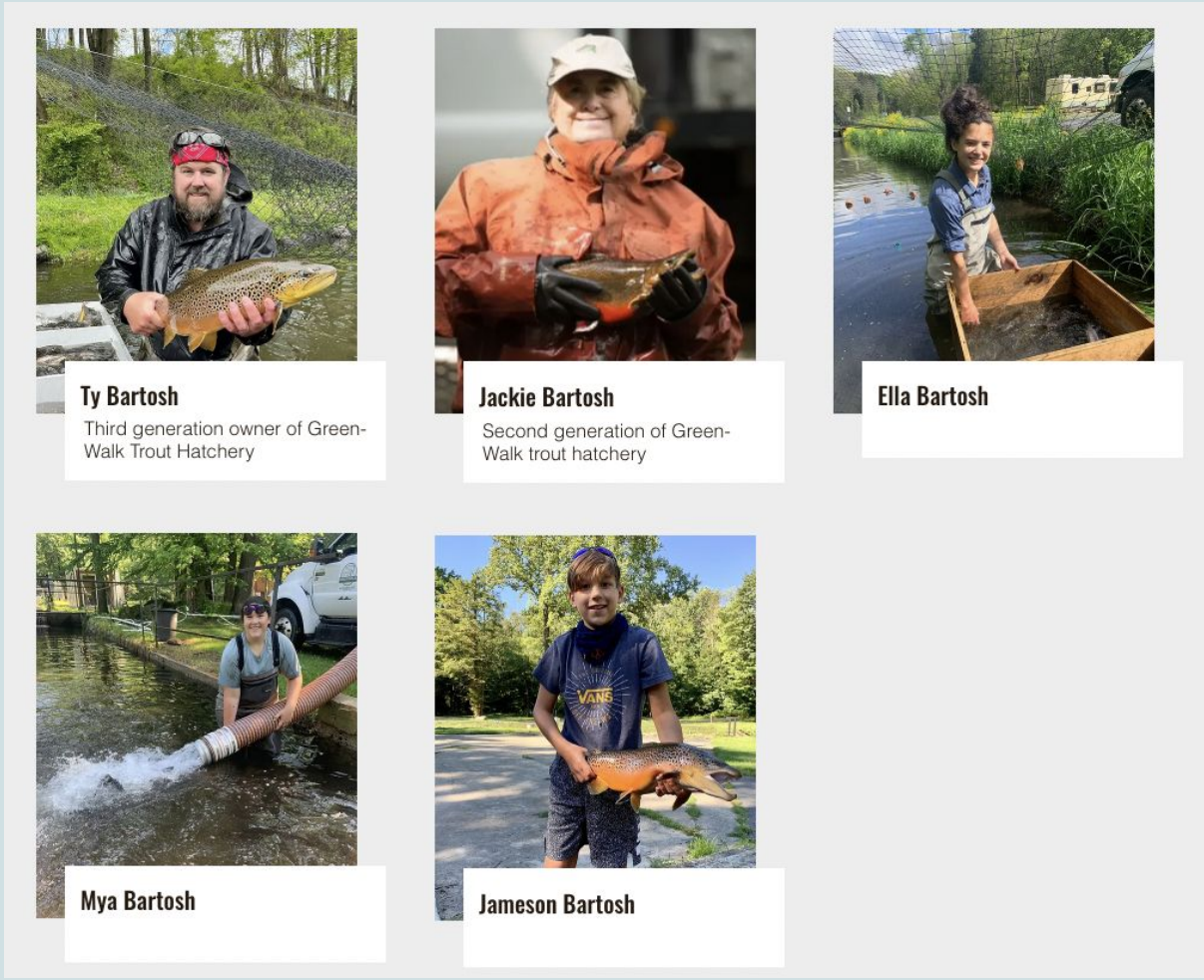
Here at Green-Walk we offer a wide range of hand-raised trout to choose from. Whether you are stocking your pond or creating a culinary masterpiece, we guarantee a superior trout for all your needs. Rainbow, Brown, Brook, and Golden Rainbow Trout are available. Delivery prices are available upon request and prices are subject to change without notice. Please provide advance notice for orders and be aware that at times some species and sizes may not be available. Availability is dependent upon stock at the time of delivery. Every effort will be made to fulfill your order as requested. Occasionally substitutions of species and sizes may be offered.

Our farm raised trout are nurtured from start to finish. Trout are available from small sizes of 1-2" all the way up to 24". Call today to find out more about delivery prices.

WIX “About Us” Page: Our Team

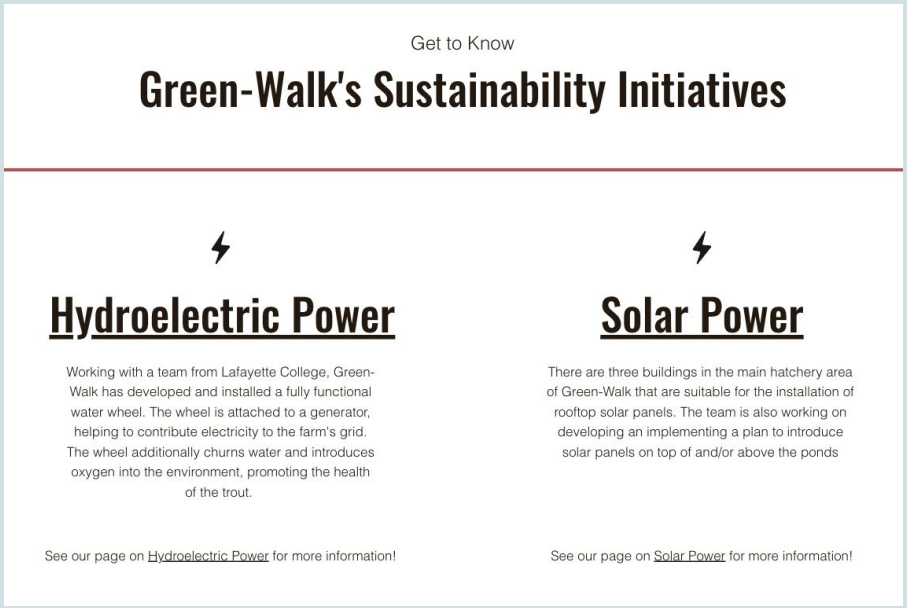
The Bartosh family history is central to Green-Walk’s identity and mission. We’ve included the family members on the website in order to help clients to visualize the family history as it relates to Green-Walk, its products, and its future goals.

This page also helps familiarize potential visitors with the members of the Bartosh family who might be potential tour guides during visits by clients and educational groups.



Tech Clinic Additions: Sustainability and Education Pages

These pages detail the sustainability efforts that Green-Walk has taken through working with the Tech Clinic team, namely future solar panel installation and the water wheel. The homepage summarizes the sustainability efforts as well as education initiatives, including ecosystem education and working with Tech Clinic.



Get to Know

Green-Walk's Sustainability Initiatives

Hydroelectric Power

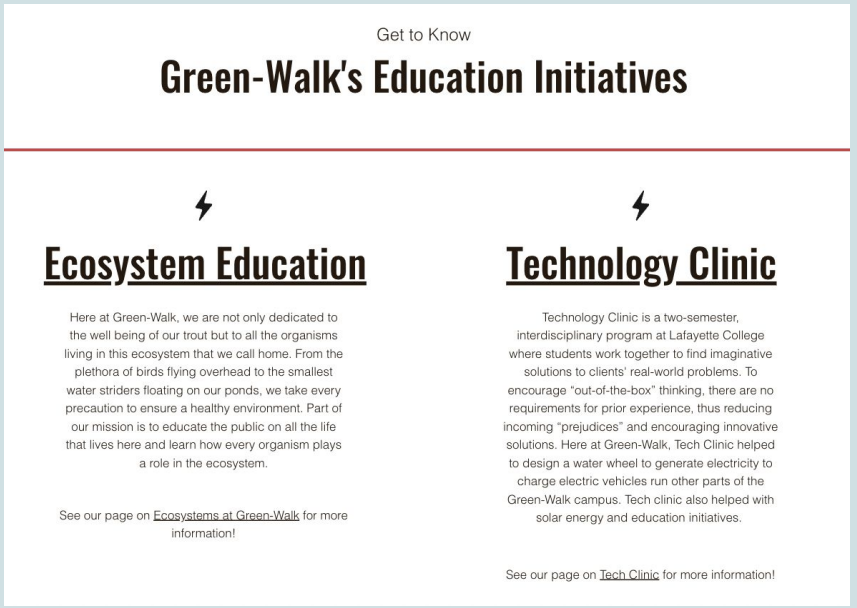
Working with a team from Lafayette College, Green-Walk has developed and installed a fully functional water wheel. The wheel is attached to a generator, helping to contribute electricity to the farm's grid. The wheel additionally churns water and introduces oxygen into the environment, promoting the health of the trout.

See our page on Hydroelectric Power for more information!

Solar Power

There are three buildings in the main hatchery area of Green-Walk that are suitable for the installation of rooftop solar panels. The team is also working on developing an implementing a plan to introduce solar panels on top of and/or above the ponds

See our page on Solar Power for more information!



Get to Know

Green-Walk's Education Initiatives

Ecosystem Education

Here at Green-Walk, we are not only dedicated to the well being of our trout but to all the organisms living in this ecosystem that we call home. From the plethora of birds flying overhead to the smallest water striders floating on our ponds, we take every precaution to ensure a healthy environment. Part of our mission is to educate the public on all the life that lives here and learn how every organism plays a role in the ecosystem.

See our page on Ecosystems at Green-Walk for more information!

Technology Clinic

Technology Clinic is a two-semester, interdisciplinary program at Lafayette College where students work together to find imaginative solutions to clients' real-world problems. To encourage "out-of-the-box" thinking, there are no requirements for prior experience, thus reducing incoming "prejudices" and encouraging innovative solutions. Here at Green-Walk, Tech Clinic helped to design a water wheel to generate electricity to charge electric vehicles run other parts of the Green-Walk campus. Tech clinic also helped with solar energy and education initiatives.

See our page on Tech Clinic for more information!

Hydroelectric Page

This page highlights the hydroelectric power generation efforts undertaken by Green-Walk. This initiative is part of Green-Walk's education and sustainability initiative where it partnered with the Tech Clinic team to build a waterwheel from fully recycled materials.

This page shines light on Green-Walk's education and sustainability initiative as it includes its partnership with a nearby higher education institution by giving students an opportunity to work on a real-world projects. Additionally, this project helps decrease the carbon footprint, and help oxygenate the water for the fish. Green-walk allowed the tech clinic team to build the water wheel through the duration of this project and test out prototypes at the hatchery before developing the final product.

Solar Page

In this section we highlighted Green-Walk's future plans of installing rooftop solar panels on three buildings in the main hatchery area. We are also using this page to showcase development and installation process of the custom made pond-side panels. Harnessing this solar power should allow Green-walk to help offset their electricity usage and carbon footprint overall. This page was put together with the goal of educating site visitors on how Green-Walk is improving their sustainability initiatives and inspiring people to also investigate alternative energy sources.

Solar Power

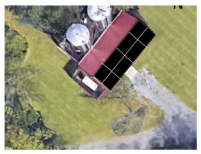
Green-Walk is working on installing rooftop solar panels on three buildings in the main hatchery area. We are also working on developing and installing pond-side panels. Harnessing this solar power should allow us to help offset our electricity usage and carbon footprint overall.

Solar Power at Green-Walk

Solar energy is the practice of converting energy from sunlight into electricity. Photovoltaic cells in solar panels are used to generate this energy. Solar energy is not only less expensive than fossil fuels, but it avoids a large portion of the externalities associated with environmental degradation as well. Solar power can save money, improve sustainability, and improve the self-sufficiency of those who choose to utilize this resource. As we move towards becoming a more sustainable business, Green-Walk is committing to the implementation of solar power. Our plan to move towards a greener future includes two types of solar arrays. We will be installing rooftop panels in order to offset our use of fossil fuels. We also will be utilizing custom-made panel stands that will be situated closer to our ponds. These stands will serve a dual purpose of generating energy as well as providing shade to our fish and cooling the water naturally.

Rooftop Panels

When the rooftop solar panels are installed as planned they are projected to produce roughly 3,695 kWh per month. Together, these solar panels could produce 44,347 kWh a year, amounting to approximately 18% of Green-Walk's yearly needs.



Pond-Side Panels

The implementation of pond-side solar panels will serve three purposes:

1. Harness solar energy throughout the year to power the farm and charge electric vehicles
2. Provide shade coverage for the trout to take cover from the sun under
3. Keep water temperature cool, especially in the face of rising global temperatures

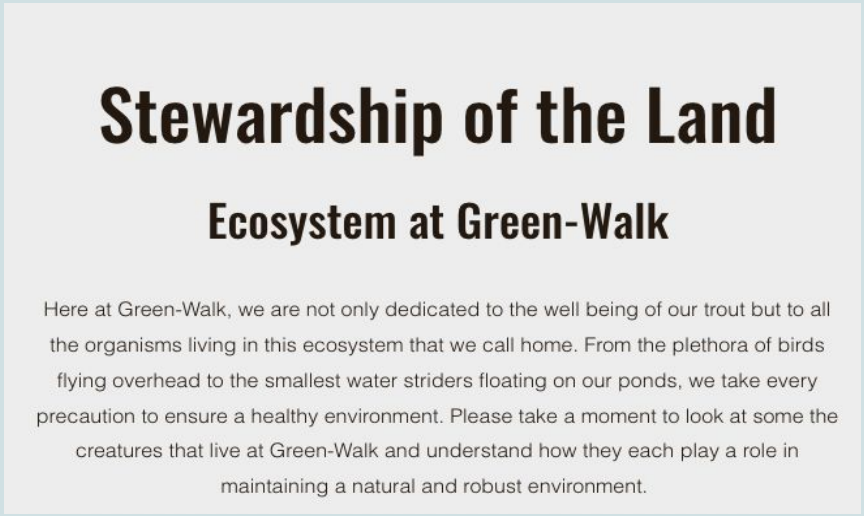
Design

Our design for pond-side panels includes the use of a two-inch pipe, u-bolts, and aluminum brackets. The support posters can be placed to provide appropriate shading for trout runs and to minimize interference with cleaning trout runs. The structures will be aimed at 32 degrees off the horizon and aimed due south. It is important to note that the angle can also be changed seasonally for somewhat higher output. This design holds two 1.7 meter x 1 meter panels, rated at 400 watts each which would result in 800 watts per structure. The power from panels is approximately 20 volts DC.

Once the pond-side panels are installed inverters would be needed to transform this output to 120/240 volts AC. Power can then be carried from panels to Green-Walks electrical system at 20 VDC or 120/240 VAC. Transmission options include open-air wiring out of human reach or underground wiring. The energy from these panels would power some light fixtures as well as electric vehicle charging stations on the property.


Ecosystem Page

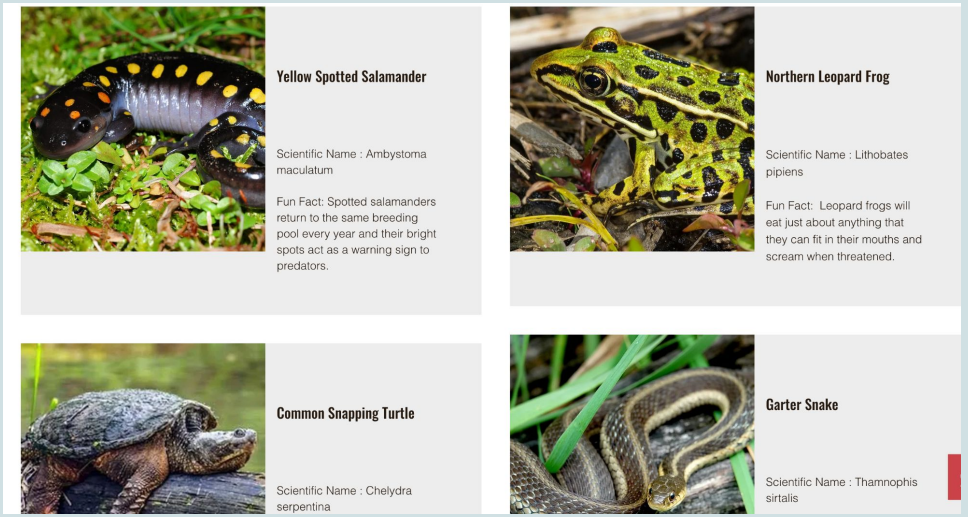
The page features pictures and descriptions of some of the mammals, birds, reptiles, and amphibians that can be found at Green-Walk. This page could be utilized by schools in preparing for upcoming visits, or any other curious consumers.



Stewardship of the Land

Ecosystem at Green-Walk

Here at Green-Walk, we are not only dedicated to the well being of our trout but to all the organisms living in this ecosystem that we call home. From the plethora of birds flying overhead to the smallest water striders floating on our ponds, we take every precaution to ensure a healthy environment. Please take a moment to look at some the creatures that live at Green-Walk and understand how they each play a role in maintaining a natural and robust environment.



Yellow Spotted Salamander

Scientific Name : Ambystoma maculatum

Fun Fact: Spotted salamanders return to the same breeding pool every year and their bright spots act as a warning sign to predators.

Northern Leopard Frog

Scientific Name : Lithobates pipiens

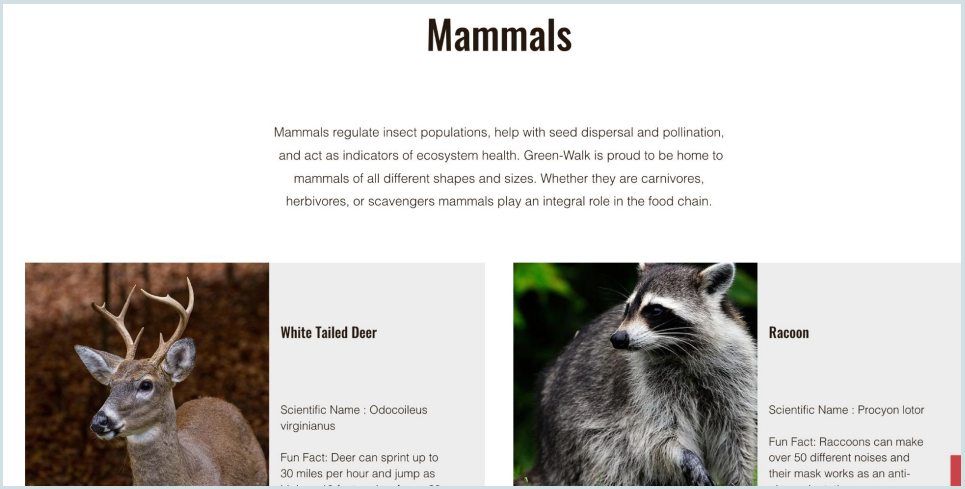
Fun Fact: Leopard frogs will eat just about anything that they can fit in their mouths and scream when threatened.

Common Snapping Turtle

Scientific Name : Chelydra serpentina

Garter Snake

Scientific Name : Thamnophis sirtalis



Mammals

Mammals regulate insect populations, help with seed dispersal and pollination, and act as indicators of ecosystem health. Green-Walk is proud to be home to mammals of all different shapes and sizes. Whether they are carnivores, herbivores, or scavengers mammals play an integral role in the food chain.

White Tailed Deer

Scientific Name : Odocoileus virginianus

Fun Fact: Deer can sprint up to 30 miles per hour and jump as

Racoon

Scientific Name : Procyon lotor

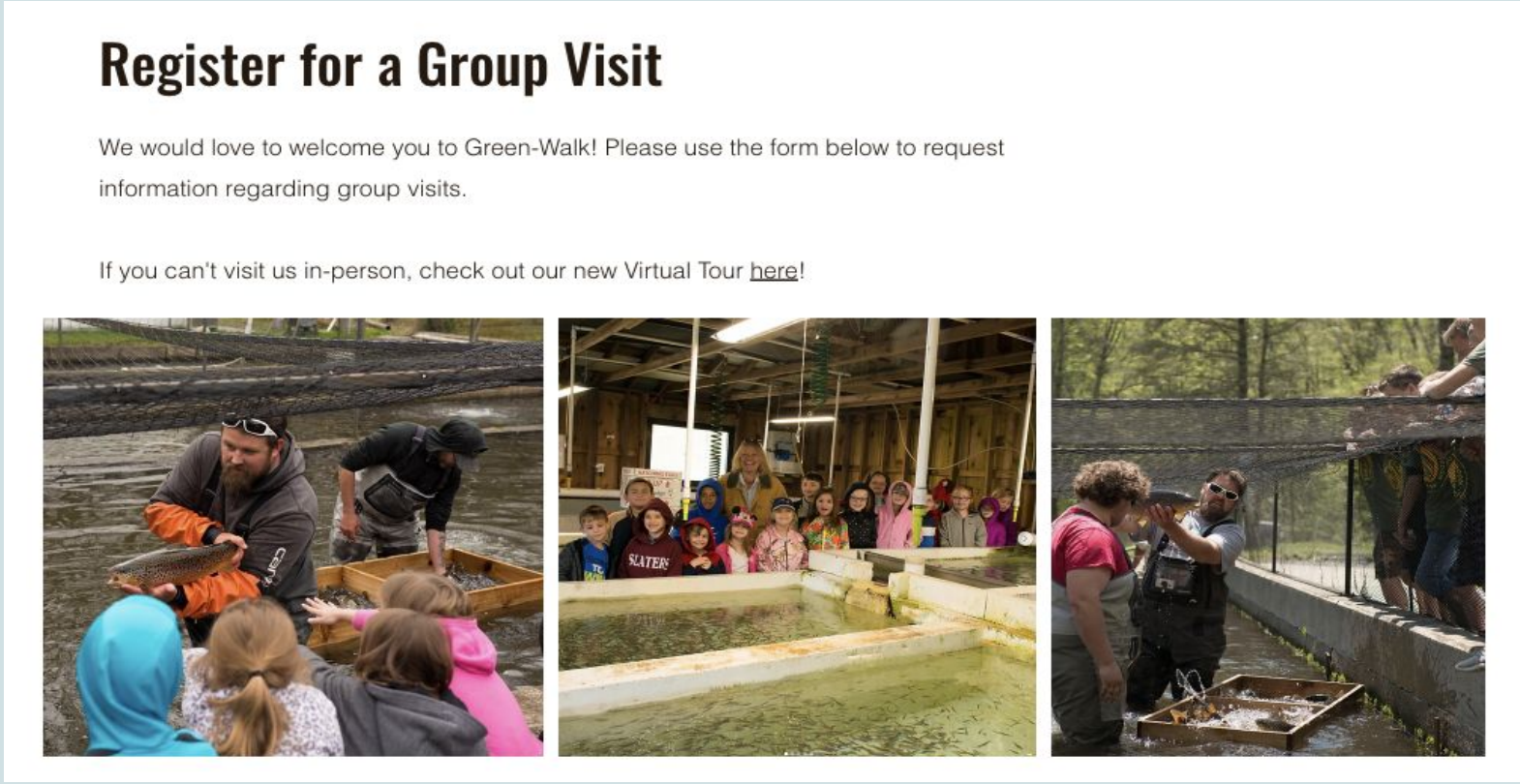
Fun Fact: Raccoons can make over 50 different noises and their mask works as an anti-

Technology Clinic Page

This page gives a review of the different ways Green-Walk partnered with the Tech clinic team. The page also introduces the members of the tech clinic team to give more detail on the students and faculty that collaborated on this project.

This page also serves the purpose of describing the diverse voices that took part in the project as the students and the faculty are from various departments across the college. This adds on the education initiative of Green-Walk and its openness to allow students to practice innovative thinking and collaboration.

Visit Us Page



Finally, we have included a space for interested parties to register for a group visit and created a virtual tour to introduce people to the history of Green-Walk and the services they offer. This page can be monitored by Green-Walk to put visit times and monitor when and on what basis to host visitors and customers at the hatchery.

Maintenance

- When publishing the WIX site the tech clinic team suggests that Green-Walk purchases its own domain rather than using the one created by the team. Based on our research, Green-Walk should be able to connect their old domain (https://www.greenwalktrouthatchery.com/)
- This change to WIX is going to require additional maintenance and updating of information. This will likely require a monthly subscription payment to be able to own a domain and keep making changes even after the first iteration of the website is published; however, the most extensive WIX plan costs less than the current subscription to HIBÜ. Perhaps the difference could be paid periodically to a third party to keep the site up to date.
    - Some examples of information to keep updated might include stocking prices, amount of renewable energy generated, and partnerships with various institutions. These updates can happen at any point, including after the site has gone live.
- Unlike HIBÜ, WIX can be updated by anyone who has access to the login information of the domain, which would simplify the process of making changes to the site.
- This changes can be incorporated by freelance website editors that can be hired when needed or members of the Bartosh family can learn how to use WIX from YouTube and other sites.

Maintenance

Upgrading your site

Upgrade your site at any time to access Premium plan features.

1. Go to the dashboard of your site.
2. Click the **Upgrade** button on the bottom left of your screen.
3. Select the type of plan you want to purchase:
    - **Website**
    - **Business & eCommerce**
4. Click **Select** under the plan you want to purchase.
5. Select a subscription period and click **Continue to Checkout**.
6. Enter your payment details and click **Submit Purchase**.

What Comes Next?

Additional Suggestion: Instagram

Green-Walk's Instagram page is the main source of outreach of the hatchery today. The page has 198 posts with more than 1,500 followers. The Instagram page is relatively active.

The Tech Clinic team used this page as a basis for the website as there are mentions of restaurants and chefs that have used Green-Walk trout. Additionally, the Instagram page features pictures of the Bartosh family members on the farm.

The tech clinic team recommends that the Instagram site incorporates new developments especially with regards to solar power and hydropower generation in a way that is permanent to the Instagram page.

One feature of Instagram that can be used is Instagram highlights, where Green-Walk can add stories and include those stories as highlights. Another permanent way is to use posts dedicated to the environmental sustainability initiatives of the hatchery.

Moving Forward

The Technology Clinic suggests that Green-Walk continue to develop and implement the plans for generating hydroelectric and solar power. For solar energy, this may include contracting rooftop solar panel installation, building and testing the standing panel design provided by the Tech Clinic team. For the water wheel, this will include finalizing its design and building additional wheels to be used throughout the farm. Once these initiatives are up and running then the goal is that the energy from the sun and from the water at Green-Walk can be used to charge electric vehicles, light pathways, run water pumps, and more at the hatchery. The next steps for the website implementation include adding any other pages, such as a mission statement, connecting the new site to their old domain, and publishing it.

Acknowledgements

Thank you to…

Ty Bartosh and Carly Bartosh for their generosity with their time and continued interest in our learning through engagement with these ideas

Michelle Harrison, for constantly working with us

Prof. Lawrence Malinconico, Director of Technology Clinic

Prof. Christa Kelleher, for assistance in calculating hydroelectric power

Ella, Mya, and Jameson Bartosh for their commitment to the future

Appendix: Raspberry Pi Pico code

main.py

Link to the entire code: https://github.com/Angelaangie-ai/raspberry-pico-alarm

```
# Potentiometer Setup
adc_pin = Pin(26)
adc = ADC(adc_pin)
threshold = 0.2

# Email details
sender_email = 'angela.busheska@gmail.com'
sender_name = 'Angela Busheska'
sender_app_password = ‘’
recipient_email = 'angela.busheska@gmail.com'
email_subject = 'Email from RPi Pico'

# Network credentials
ssid = ' '
password = ''
```

main.py

```
# Manage connection errors
if wlan.status() != 3:
    raise RuntimeError('Network Connection has failed')
else:
    print('connected')

# Function to read voltage from the potentiometer
def read_voltage(adc):
    reading = adc.read_u16()  # Read ADC value
    voltage = reading * 3.3 / 65535  # Convert ADC reading to voltage
    return voltage

# Function to send email
def send_email(message):
    smtp = umail.SMTP('smtp.gmail.com', 465, ssl=True)
    smtp.login(sender_email, sender_app_password)
    smtp.to(recipient_email)
    smtp.write("From:" + sender_name + "<" + sender_email + ">\n")
    smtp.write("Subject:" + email_subject + "\n")
    smtp.write(message)
    smtp.send()
    smtp.quit()
    print("Email sent")
```

main.py

```
# Main loop
last_daily_update = utime.time()
while True:
    current_time = utime.time()
    voltage = read_voltage(adc)
    print("Voltage at the junction: ", voltage)

    if voltage < threshold:
        send_email("Potentiometer value is below the threshold\n")
        utime.sleep(60)  # Delay for 1 minute before checking again
    else:
        # Send a daily email if everything is fine
        if current_time - last_daily_update > 86400:
            send_email("Everything is working great!\n")
            last_daily_update = current_time

    utime.sleep(1)  # Delay for 1 second
```