Brief Development AS 91608

Issue

Upon removal from the ground, my stakeholder's tent pegs always have large amounts of soil and dirt stuck in between the three protruding beams, as shown in the image to the right. This is a common issue experienced with all tent pegs, but particularly Y stakes such as his, a Sea to Summit Ground Control Peg, but also similar products from other brands such as an MSR Groundhog. These pegs are very popular due to their high holding power and strength to weight ratio, with three beams to maximise the surface area of ground contact, and therefore the amount of friction. This also means that upon removal soil band dirt is likely to stick to the beams, particularly in softer ground with more moisture.

Figure 2: Example of left over debris

Figure 1: A Sea to Summit Ground Control peg

Figure 4: A peg puller with integrated brush

Figure 3: Shape of a 'Y' stake/peg

Some existing products that address this issue primarily involve brushes which are used to scrub the dirt and debris off, however these are typically ineffective for muddy soil that has dried onto the peg, or for soil that is stuck in the centre between the beams. Examples of these products include an item by Outdoor Revolution, which is a peg puller that includes a circular hole in the handle with brushes facing inwards. The peg is then inserted, in theory removing the debris.

As discussed above, these are typically ineffective for stakes of Y and other shapes, and are designed for use with traditional 'shepherd's hook' stakes which are less likely to collect dirt, and typically simply have a layer of dust and similar light debris, which is easily brushed away. They are also typically awkward to use, as it requires holding both objects in your hands, and it is likely for the peg puller to rotate in your hand as you are unable to hold the grip while cleaning a peg, therefore needing to hold onto the cylindrical puller end.

Stakeholder Consultation

Primary Stakeholder – Bruno Prijic

1. Do you have any ideas to address your issue?

I have been thinking about things such as electric toothbrushes, but maybe improved to be more effective as I find that the toothbrush is too weak to displace all the dirt. I have also thought of using some sort of water gun.

2. What obstacles do you think may need to be considered?

I think if the water gun idea is going to be used then it needs to be carefully made, at least if it uses some sort of electronics. I think it would be hard to clean the pegs completely without using water, especially once the dirt has dried.

3. Have you seen any existing products that you might be interested in?

I have seen existing products such as the peg puller cleaner but I don't think it would be very useful, so I think adapting things such as an electric toothbrush or a dishwasher on a small scale would likely be the best ideas.

Ideas

In order to address this issue, I have considered a system similar to that of the existing brush-centred designs, though adapting and improving its function by implementing a motorised brush. This would reduce the manual exertion to operate the product, and would help with the ergonomics of the system. Another idea I considered was a water-based system that uses jets of water to blast away debris, potentially with a water collection system to conserve water, promoting sustainability. A third concept I have considered to address my issue is a simple scraper that is designed to specially fit around my tent pegs, in theory allowing the peg itself to pass through the cut out, but removing any debris attached.

Concept 1: Motorised brush system

Figure 5: Conceptual diagram of the motorised brush

This concept would function similarly to an electric toothbrush, with a handle connected to a motor at the end connected to a brush head. It would feature an on-off or similar mechanism to turn the product on and off, and would likely need to be powered by a wall socket or a larger, bulkier battery.

Concept 2: Scraper system

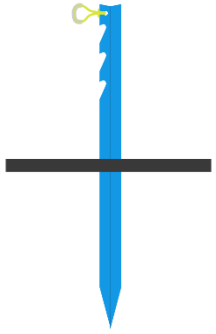


Figure 7: Side view

Figure 6: Top view

This concept involves a simple precision produced disk that has a hole perfectly sized to only let the size of a clean peg through, in theory scraping away any attached debris. It functions by simply inserting the tip end of the peg and sliding the product down, taking away all additional material attached to the peg.

Concept 3: Water blaster system

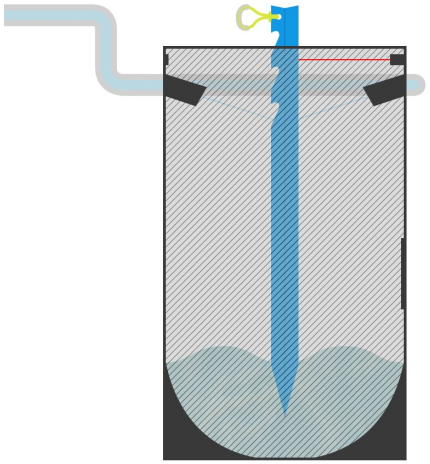


Figure 9: Side view

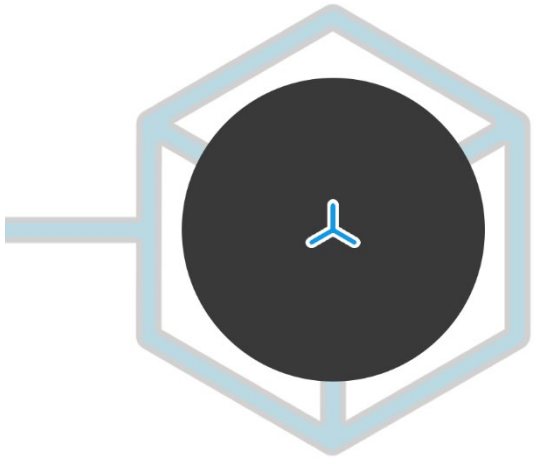


Figure 8: Top view

This concept involves a containment system to prevent water from escaping, with an entry hole in the top of the box. There would be a laser detection system in the top of the container to detect when a peg has been inserted, automatically turning on the water jets. There would be a water level sensor at the side to detect once the water level inside the container has reached an 'emergency' level, automatically opening the drain at the bottom, until the water is below the sensor. Otherwise, the drain remains normally closed until the user actuates a button, which allows for the water to be reused for something such as watering plants.

Stakeholder Feedback

Primary Stakeholder – Bruno Prijic

1. What are your thoughts on the three concepts?

I like the concepts and think they all have good potential to fix my problem, and I like the look of their features.

2. Which concept do you think will most successfully address your issue?

Personally I think that concept 3 will be most effective, as I think it would be the one that is most likely to completely clean my pegs, meaning I don't need to do anything after using the product other than let them dry.

3. Is there anything which you think should be adjusted for that concept?

I would like it if it could also accept a variety of pegs of different shapes and sizes, in case I change pegs in the future or someone else needs to use the product.

Decision Making

Concept	Positives	Negatives
Motorised Brush	This concept would build upon the effectiveness of existing products, and only requires easy to find parts. It would likely be effective with all types of debris, though may require patience depending on the type of debris and the strength of the motor.	It may end up being similarly awkward to the existing products in an ergonomics sense, having to hold a peg while controlling the motorised brush. It may also require enhanced ingress protection if using water to remove some debris prior to use, in order to avoid water damage to the circuitry. It is unlikely a hobby motor will provide sufficient power, therefore is likely to require larger batteries or a power adapter to power the motor, reducing the mobility of the product.
Scraper	This concept would be the easiest to manufacture, as it simply requires a 3D printer or a laser cutter to produce a functional scraper. This concept is also the most lightweight and portable product, meaning it is most appropriate to pack as gear for usage in the field, instead of once the user has returned home.	Although easy to manufacture, this product would have to be made specifically for each model of peg for maximum effectiveness, to ensure a snug fit to prevent any debris from remaining behind. It is also unlikely to result in a completely clean peg, as a thin coat of dust and dried mud is likely to remain stuck, or the finish on the peg may be damaged. It is also the hardest product to use, as it would require either pressing the end of the peg against a hard surface or against your hand, which would be uncomfortable due to the sharp points.
Water Blaster	Given sufficient water pressure, it is likely that this product can easily take care of all types of debris with ease, and given the small footprint of the stake, without much water usage. With a collection system, the water used could be repurposed to water plants or other similar activities, without wasting water. This would also be the easiest system to use out of the three concepts, as the user simply needs to lower the peg into the system, without needing to exert effort.	Due to the usage of water, there is an inherent risk to the electronics, which must be considered to prevent damage. While water is conserved, it is still a consideration that must be made, as it would be inappropriate to use it in environments where water restrictions frequently occur.

After considering the positives and negatives of each concept, and consultation with the primary stakeholder, I have decided to proceed with concept 3, the water blaster system. We believe that this is likely to be the most effective system for ensuring a complete clean, with the fewest and least significant cons, as discussed in the table above.

Ongoing Stakeholder Feedback

Primary Stakeholder – Bruno Prijic

1. What is your role in this project?

I am the main stakeholder in this project.

2. Who is this product for?

This product is for me to address my issue.

3. When is the product required by?

This product is required by the end of the year, at the latest.

4. What worries you about this project? What's the worst thing that could happen?

The worst thing that could happen with this project is that it fails to function, and damages itself or my pegs. The inclusion of water is something that I have concern about, which needs to be managed.

5. How will you, personally, define success for this project?

If this project succeeds in cleaning my pegs completely, without leaving anything behind.

6. How would you like to be involved in the rest of the project?

I would like to have regular status updates, and being kept up-to-date on issues and delays. I would also like to be contacted frequently about decisions on aesthetics and functionality, to ensure it works as I want it to.

7. What does the perfect solution have?

Solves my issue, looks good, easy to store.

8. What kind of functionality do you want the product to have?

I would like it if it was as automated as possible, so it would be good if it could detect when I insert a dirty peg and then cleans it automatically.

9. What kind of aesthetic do you want the product to have?

I don't mind, but I want it to look professional and tidy.

10. What is the ideal size for the product?

I want it to be no bigger than the rough dimensions of a milk bottle, but would be good if it was as compact and storable as possible.

11. What overall shape are you after for the product?

I don't mind too much, whichever minimises the footprint of the final design.

12. What material do you want the product to be made from?

Ideally plastic to save weight and cost, like 3D printed or something similar.

13. What colour finish do you want the product to have?

Blue, grey or black would be nice, though it's not a big deal.

Secondary Stakeholder – Lucija Prijic

1. What is your role in this project?

I am the mother of the primary stakeholder.

2. Who is this product for?

This product is for my son.

3. What worries you about this project? What's the worst thing that could happen?

For me, I am concerned about the water consumption of the product, and for me the worst thing that could happen is that there is a big impact on our household water usage and on the environment.

4. How will you, personally, define success for this project?

I would say that this project is successful if is uses as little water as it can, or it stores all the water to be reused.

5. How would you like to be involved in the rest of the project?

I don't mind about regular updates; however I would like to be contacted with new updates around the consumption of water.

6. What kind of functionality do you want the product to have?

I would like if it could store the used water so I can use it to water my garden or my flowers.

7. What is the ideal size for the product?

I think a good size will be around the size of this plant pot [16 cm in diameter], which would be small enough for me to easily keep it somewhere around the house.

Secondary Stakeholder – Moe Prijic

1. What is your role in this project?

My son is the main stakeholder.

2. Who is this product for?

My son.

3. What worries you about this project? What's the worst thing that could happen?

I am interested about how much power it will require, so I would like if it was very energy efficient.

4. How will you, personally, define success for this project?

Small, low power and water consumption.

5. How would you like to be involved in the rest of the project?

I would like to be informed when the power method and water consumption is decided and if/when it is updated.

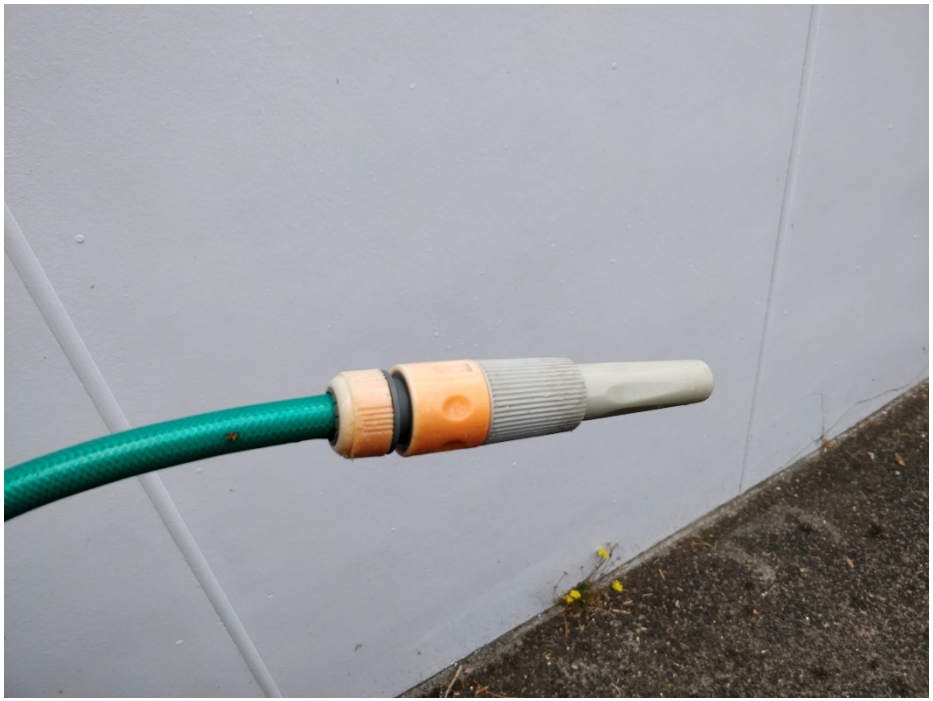
6. What kind of functionality do you want the product to have?

It would be good if it could have a way to turn itself off as sometimes my son is not very good at turning things off.

7. What is the ideal size for the product?

I would like if it was no bigger than my coffee tin, which is around 18cm x 22cm.

Location Research

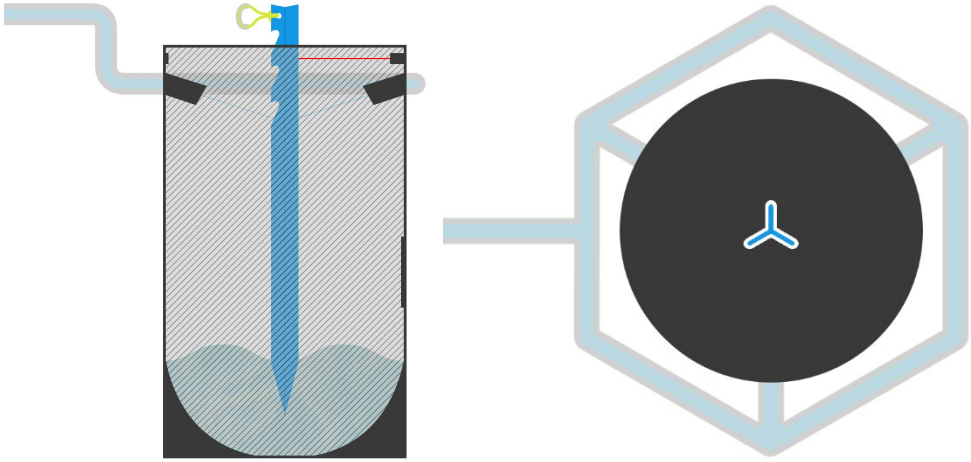


The primary physical environment this product will be used in is outside the stakeholder's house, where the garden and outdoor hose are located. This ensures that unintentional water leakage will not be a concern when connecting and disconnecting the product, and means that recycling the used water in the product is as streamlined as possible. The concrete ground in the location is not perfectly flat, and therefore the product will require a stable base to ensure it does not tip over while in operation. As the ground is concrete, it would be ideal for the product to have feet made out of rubber or a similar material to prevent damage, reduce slippage, and limit vibrations while being used. The hose head is removeable and connects to the hose with a standard 12mm fitting, and so it would be preferable if the product could attach to the hose with its own 12mm fitting, preferably removable to widen the product's possible use cases. While possible to lower an extension lead from the kitchen window located above the garden hose or from his dad's workshop in the crawlspace underneath the house, it would be ideal for simplicity and overall functionality for the product to be battery powered.

Implications and Considerations

Following consultation from my primary stakeholder and the secondary stakeholders who will also be impacted by the outcome, I have recognised the need to ensure my product is compact and storable, efficient in its water and power consumption, effective in addressing my stakeholder's issue, suited to its environment, and adaptable for a variety of locations. For my stakeholder, it is imperative that the product fully addresses his issue and completely cleans his pegs, and has a tidy aesthetic design. For him, it is also desirable that the product is as automated as possible, detecting when he inserts a peg and automatically engaging the jets. The biggest impact of the product for his mother is the water consumption, even more important now due to Auckland's dry spell and the trend towards drier summers. She would like for it to use as little water as possible, or at the minimum for the outcome to retain the used water to be recycled for purposes such as watering her plants and flowers. My primary stakeholder's dad is particularly focussed on the power consumption alongside the water usage, as according to him my stakeholder is not the best at turning things off. Therefore, he would like for the product to automatically turn itself off after being idled for an extended period of time. A factor shared by all three stakeholders is the importance of storability, all preferring a compact product which is no larger than the rough dimensions of a milk bottle.

Chosen Outcome



The outcome I have decided to pursue is concept 3, the water blaster system. Following initial consultation and ongoing feedback from my primary stakeholder and the secondary stakeholders, I have adapted the initial functions detailed at the conceptual phase into the following functions to best suit the needs of everyone who will be impacted by the product. The product will be battery powered and connect to the garden hose using a removable 12mm garden fitting, with a containment system to collect all the water used. The drainage system will be normally closed, and opened either by user input or if the water level rises above the emergency water level sensor. The drain will have sprinkler holes similar to a watering can, to suit recycling the water by using it to water plants. Once a peg has been inserted through the hole in the top of the product, the laser tripwire is broken and the water jets automatically engage. Once the tripwire re-arms, the water jets disengage and the process repeats. If the laser tripwire is left intact for 3 minutes, the product will automatically turn itself off to conserve battery life.

Attributes

Physical

Lightweight. The product should be made out of 3D printed plastic or a similar lightweight and cheap material, with the added benefit of being easily manipulated and adjusted.

Blue, grey or black. The product should be made out of or finished in a blue, grey or black colouring.

Professional. The product should be professional in appearance, with no messy wiring.

Robust and durable. The product should be made with quality in mind, to maximise the lifespan of the product.

Compact and storable. The product should be no larger than the rough dimensions of a 2L milk bottle to ensure storability and sleekness.

Functional

Automated. The product should automatically detect once a peg has been inserted and begin the cleaning process. It should also automatically drain contained water if necessary, and automatically power off if left unattended.

Effective. The product should be capable of completely addressing the issue and cleaning all debris off the peg.

Versatile. The product should be adaptable for a variety of locations and water supply systems.

Stable. The product should feature a stable base with rubber or similar high-friction footing to maintain stability on sloped concrete.

Social

Eco-friendly. The product should be economical in its water and power consumption, and should contain all water used to be repurposed.

Intuitive. The product should be intuitive to use, with logical and user-friendly layouts and inputs.

User friendly. The product should be easily maintained, being easily connected to a water source and easily recharged.

Minimal set up. The product should not require any additional set up other than connecting a water source and ensuring the battery is charged.

Conceptual Statement

An intuitive, automated, eco-friendly solution to unreasonably dirty tent pegs of all shapes and sizes, this product easily cleans pegs to a brand new condition using high pressure water jets, automatically triggered by a laser tripwire. Economical in its water and energy consumption, all water used is also stored for recycling, and is easily used to water plants and flowers.

Specifications

The product will be constructed out of a lightweight, cheap but versatile material such as 3D printed plastic. This will ensure a cost effective product that is easily developed and iterated.

The product will be blue, grey or black in colour to fulfil my stakeholder's requests. I will decide which colour to move forward with after researching the availability and feasibility of each, then seeing which will look the best.

The product will have a professional appearance and design, with no messy wiring. I will achieve this by ensuring all wiring and componentry is tidily laid out and hidden in enclosures.

The product will be robust and durable to maximise the lifespan of the product. This will be achieved through care during production and ensuring quality is always a priority.

The product will be no larger than 270mm x 180mm to ensure compactness and storability. This is derived from stakeholder consultation and feedback, where the directive has been that the product should be no larger than the rough dimensions of a 2L milk bottle.

The product will be portable, allowing the user to store it away inside their house and easily move it around. This will involve ensuring the product is lightweight and easily held.

The product will be watertight to contain all used water and to protect all electronic components and circuitry. To meet this specification, I will explore production methods such as using 3D printing or laser cutting sheets of acrylic and gluing them together to ensure complete ingress and egress protection.

The product will be automated, requiring minimal user input. This will be achieved through a microcontroller such as an Arduino Uno, and electronic components and circuitry.

The product will have the capability to detect when a peg is inserted, automatically engaging the water jets. This is to be achieved by a laser tripwire system with a laser module and a photoresistor/LDR, to ensure maximum functionality in all conditions.

The product will have a system to turn itself on and off in order to conserve the longevity of the battery and reduce the frequency of recharging the battery.

The product will successfully address my stakeholder's issue by completely cleaning all dirt and mud off a Sea to Summit Ground Control tent peg. This is to be met through using some type of water jets to ensure no dried dirt or mud is left behind.

The product will be highly versatile to ensure it suits as many use cases as possible. This will be achieved by ensuring the opening at the top of the product is designed to suit as many shapes and sizes of peg as possible, while still preventing unwanted ingress of objects and egress of water while in operation. Further, the product will be designed to work with a variety of water source systems.

The product will be stable while in operation to ensure it does not tip over while in use. This must include a stable base with some type of rubber or similar footing to maintain stability on the sloped concrete at the location where the product is to be used and also to limit vibrations which may damage the product and make it more likely to tip.

The product will be environmentally friendly. This is to include minimal water and power consumption and recycling all consumed water through watering plants and other uses. This is to be optimised by ensuring the drain has small sprinkler holes to facilitate watering directly from the product.

The product will be economical in its water and power consumption. This will be achieved through ensuring an efficient use of water with high pressure but low volume water jets, and power efficient components that are automatically turned off if not in use.

The product will be intuitive and easy to use, with labelled and well-designed user inputs, to ensure a smooth user experience.

The product will be user friendly, with easily removed battery and water source connectors. This will be achieved using universal connectors and well-designed layouts that are intuitive and easy to operate.

The product will require minimal set-up and assembly to ensure a smooth user experience, with the user only needing to connect a charged battery and connect the product to a water source. This will be met by ensuring the product is fully functional prior to delivery through comprehensive testing.

The product will be easily maintained by the user, with easy access to the battery for a smooth recharging process. It should also offer easy access to electronic components and circuitry to allow for easy troubleshooting.

The product will be completed by the deadline set out by the stakeholder of the end of the school year.

Continued Stakeholder Feedback

Primary Stakeholder – Bruno Prijic

1. What are your thoughts on this final set of specifications?

I like how the sound of how the product will function, and am looking forward to seeing it completed.

2. How do you want these specifications to be prioritised?

I believe in function over form, so I would like if the priority is placed on having something that works as well as possible, but I still want it to look good.

3. Do you want any specifications to be changed?

I would like if I was kept updated and contacted regularly about the design and colour, and if I was shown a sample of each colour so I could see what looks best.

Prioritised Specifications

Essential

1.1 The product must successfully address my stakeholder's issue by completely cleaning all dirt and mud off a Sea to Summit Ground Control tent peg. This is to be met through using some type of water jets to ensure no dried dirt or mud is left behind.

1.2 The product must be automated, requiring minimal user input. This will be achieved through a microcontroller such as an Arduino Uno, and electronic components and circuitry.

1.3 The product must have the capability to detect when a peg is inserted, automatically engaging the water jets. This is to be achieved by a laser tripwire system with a laser module and a photoresistor/LDR, to ensure maximum functionality in all conditions.

1.4 The product must be watertight to contain all used water and to protect all electronic components and circuitry. To meet this specification, I will explore production methods such as using 3D printing or laser cutting sheets of acrylic and gluing them together to ensure complete ingress and egress protection.

1.5 The product must be stable while in operation to ensure it does not tip over while in use. This must include a stable base with some type of rubber or similar footing to maintain stability on the sloped concrete at the location where the product is to be used and also to limit vibrations which may damage the product and make it more likely to tip.

1.6 The product must be environmentally friendly. This is to include minimal water and power consumption and recycling all consumed water through watering plants and other uses. This is to be optimised by ensuring the drain has small sprinkler holes to facilitate watering directly from the product.

1.7 The product must be robust and durable to maximise the lifespan of the product. This will be achieved through care during production and ensuring quality is always a priority.

1.8 The product must be completed by the deadline set out by the stakeholder of the end of the school year.

Important

2.1 The product will have a system to turn itself on and off in order to conserve the longevity of the battery and reduce the frequency of recharging the battery.

2.2 The product will be no larger than 270mm x 180mm to ensure compactness and storability. This is derived from stakeholder consultation and feedback, where the directive has been that the product should be no larger than the rough dimensions of a 2L milk bottle.

2.3 The product will be highly versatile to ensure it suits as many use cases as possible. This will be achieved by ensuring the opening at the top of the product is designed to suit as many shapes and sizes of peg as possible, while still preventing unwanted ingress of objects and egress of water while in operation. Further, the product will be designed to work with a variety of water source systems.

2.4 The product will be intuitive and easy to use, with labelled and well-designed user inputs, to ensure a smooth user experience.

2.5 The product will be economical in its water and power consumption. This will be achieved through ensuring an efficient use of water with high pressure but low volume water jets, and power efficient components that are automatically turned off if not in use.

2.6 The product will be constructed out of a lightweight, cheap but versatile material such as 3D printed plastic. This will ensure a cost effective product that is easily developed and iterated.

Desirable

3.1 The product is to be user friendly, with easily removed battery and water source connectors. This will be achieved using universal connectors and well-designed layouts that are intuitive and easy to operate.

3.2 The product is to require minimal set-up and assembly to ensure a smooth user experience, with the user only needing to connect a charged battery and connect the product to a water source. This will be met by ensuring the product is fully functional prior to delivery through comprehensive testing.

3.3 The product is to have a professional appearance and design, with no messy wiring. To fulfil this specification, I will frequently contact my stakeholder for feedback and input on design decisions, and by ensuring components are tidily laid out in an enclosure where possible.

3.4 The product is to be blue, grey or black in colour to fulfil my stakeholder's requests. To best meet this specification, I will create a small scaled mock-up for each colour available to me to show my stakeholder how each colour will look, and obtain a final directive for which colour to proceed with.

Minor

4.1 The product should be easily maintained by the user, with easy access to the battery for a smooth recharging process. It should also offer easy access to electronic components and circuitry to allow for easy troubleshooting.

4.2 The product should be portable, allowing the user to store it away inside their house and easily move it around. This will involve ensuring the product is lightweight and easily held.

These final specifications have been derived following initial stakeholder consultation regarding his issue and a conceptual phase exploring potential issues, followed by ongoing stakeholder feedback discussing their needs and requirements, and researching the location where the product will most frequently be used. This process has also involved speaking to his parents as secondary stakeholders to ascertain their requirements for the product, namely with a focus on the environmental and monetary impact of its operation. Following this process, I have drawn a list of attributes the product must have to best address my stakeholder's issue, resulting in my final list of specifications to ensure the best possible outcome. I have then taken this finalised list of specifications to my stakeholder for feedback, including discussing the value of each specification. Following this feedback, I have prioritised each specification to ensure the final product is the best possible outcome to address his issue, with the most focus placed on the most essential specifications. Generally speaking, the specifications have been prioritised with the highest emphasis on ensuring an intuitive, smooth user experience by placing specifications focussing on functionality the highest, with less emphasis on aesthetic and other minor details. Again, this is to ensure the best product that best addresses my stakeholder's issue.