Gardens for the Wellness of the Body and Mind

Note. The five students from Worcester Polytechnic Institute working with The Hope Exchange on a healing garden and vegetable garden. Pictured From left to right, Sarah LaRusso, Tristan Andrew, Keelan Boyle, Daniel Ouellette, and Jena Taubert.

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Gardens for the Wellness of the Body and Mind

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Abstract

The Hope Exchange, a nonprofit organization in Cape Town, provides temporary housing to men who are at risk of homelessness at the Geoff Burton House with the goal of reintegration back into society. To support this cause, our team designed and implemented sustainable and effective garden spaces to promote healing, hope, and nourishment. We conducted resident and expert interviews at local gardens to determine the most efficient ways to develop these gardens. We designed and implemented the gardens based on the needs of the residents and incorporated elements that promote healing. We further developed recommendations for the maintenance and sustainability of the garden. We believe that with continued maintenance and improvements, the gardens will achieve our goal of providing healing, hope, and nourishment.

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Executive Summary

The Hope Exchange, Helping the Homeless:

The apartheid practice of forceful eviction and relocation of District Six's original inhabitants to the city's outskirts destabilized a prospering black and colored cultural hub (South African History Online, 2022). These evictions left many residents dispossessed and on the streets. Even after 30 years, Old District Six is still recovering from those evictions, with roughly 8,000 homeless people within its borders (The Hope Exchange, 2021). The Hope Exchange is a nonprofit organization that dedicated itself to **"bring[ing] hope for the homeless, through dignity and opportunities for change"** (The Hope Exchange, 2021). There are free ablutions, health clinics, and social services at The Hope Exchange to aid in this process. To further its mission, the organization formed the Geoff Burton House for men in the exit stages of homelessness. In support of the Geoff Burton residents during this transition period, our team collaborated with The Hope Exchange to design sustainable and effective garden spaces to promote **healing, hope, and nourishment**.

These garden spaces will consist of a healing garden in front of the residency and a vertical vegetable garden in the back. Healing gardens provide a space for residents to become one with their thoughts and feel physically and mentally distanced from demanding tasks (Stigsdotter & Grahn, n.d.). While the healing garden would be a space of serenity, the vegetable garden could bring forth healing through physical gardening and organic nourishment. Urban community gardens are an effective way for residents to farm fresh, organic fruits and vegetables. However, a city space can be a limiting factor for growing vegetables because of its natural space limitations. Because of this, vertical gardening strategies thrive in urban communities such as District 6 in Cape Town, South Africa. Our goal for the design of the two gardens was to provide the most health and social benefits for Geoff Burton House residents.

Our Approach:

To achieve our goal of designing and **implementing sustainable and effective garden spaces** to promote healing, hope, and nourishment, we developed the following objectives:

1. Assess the needs and preferences of the residents for the gardens.
2. Identify materials, garden components, and other resources to support the healing and vegetable gardens.
3. Design and implement an upgraded healing garden and a vertical structure for the vegetable garden, with a maintenance plan that best fits the needs of the Geoff Burton House.

We interviewed residents at the Geoff Burton House in small focus groups. In these interviews, we gained knowledge about the concerns and preferences of each garden. Our team also interviewed local experts at Kirstenbosch National Botanical Garden and Khulisa Community Garden to gain professional expertise and recommendations on healing and vegetable gardens. Additionally, we conducted a site assessment to see the previous garden spaces and identify recyclable resources.

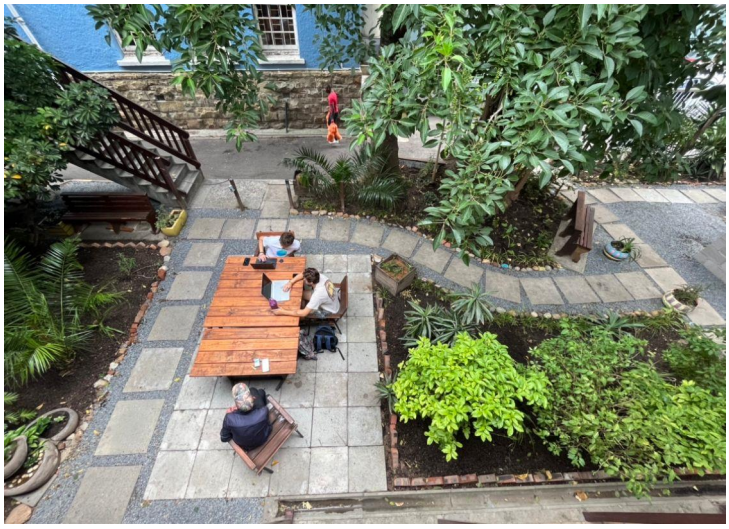

Figure E1. Completed Healing Garden (LaRusso, 2022)

Note. The images show the completed healing garden in front of the Geoff Burton House at The Hope Exchange.

We were able to design the healing and vegetable gardens based on recommendations from the interviews and professional advice. To finance most of the project, we set up a GoFundMe donation page and were fortunate enough to raise **R20.506,97** (USD 1,195) for materials. We then were able to design our gardens on a budget and implement them based on the interview information. To ensure the maintenance and sustainability of our work, we developed a maintenance manual that describes the necessary information for repairs, cleaning, and plant preservation.

A Healing Garden for Wellbeing:

From the small group interviews, we learned that residents wanted a braai stand, new tables and chairs, sturdy ground cover, and the garden to be transformed into a healing space (Figure E1). A major concern was that the garden was considered a smoking area, which gave us more incentive to transform that area into a healing garden and implement a designated smoking area in the final design. Through our expert interview at Kirstenbosch National Botanical Garden, we gained insight into ideas for the healing garden. Some of their recommendations included planting native plants, having a natural ground cover, and incorporating a water feature which we unfortunately determined would not be feasible. Instead, we incorporated a waterfall mural as natural art increases security and reduces anxiety.

The final design for the healing garden incorporated a **mural** as a focal point, a **braai stand**, **soil** and **gravel**, new **plants**, and fixed-up **tables** and **chairs**; each element contributed uniquely to the healing effect (Figure E2).

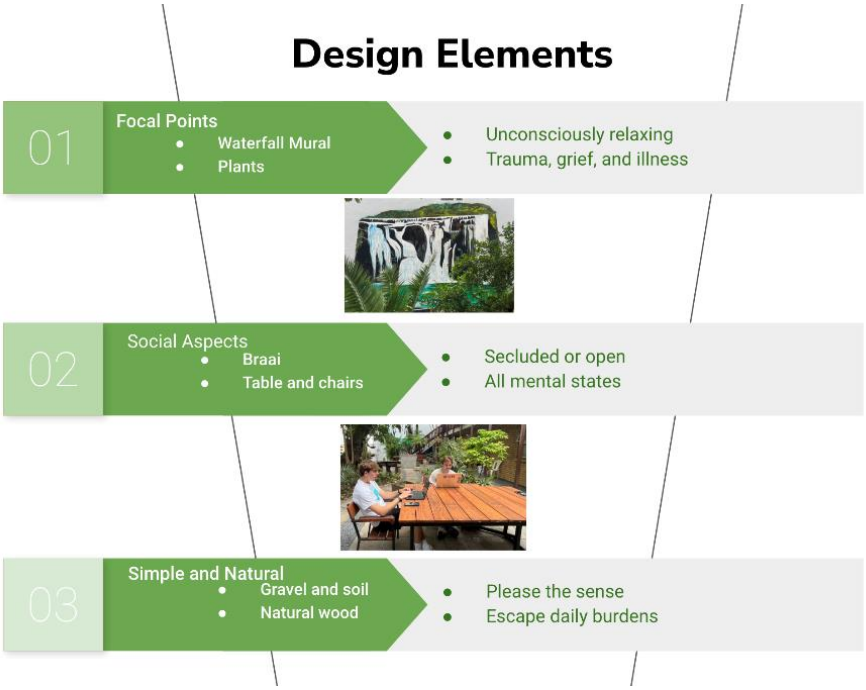

Figure E2. Design Elements for Healing

Note. The diagram above demonstrates different design elements of a healing garden and describes how it they help to create an effective healing space.

The mural and plants encourage a sense of relaxation and reduced stress for the garden user. The soil and gravel combine to create a visually pleasing contrast of texture with similar effects. The incorporation of a braai stand, tables, and chairs promotes socialization by bringing together the members of the Geoff Burton House and creating a stronger community.

A Vegetable Garden for Nourishment:

The vegetable garden was also designed based on information and recommendations from the residents and local experts. From the interviews, we learned that the residents wanted the following vegetables in the garden: **chilis**, **cabbage**, **kale**, **carrots**, and **potatoes**. As for the physical design of the vertical aspect, there were no outstanding favorites between shelves, trellises, garden boxes, and hanging pots. This left the decision up to our team, and we ultimately decided to build **shelves** and **garden boxes**. The shelving was selected based on maximizing sunlight and space given in the area we had to work with. Some of the challenges residents raised during the interviews included a lack of motivation to maintain the gardens and the problem of pests and rats eating the produce. It was recommended by Khulisa Community Garden that we incorporate vertical gardening strategies, companion planting, and general rat and pest deterrent approaches. Making the garden vertical will help provide more room for additional vegetables and protect them, as it would be harder for rats and pests to get to plants.

Figure E3. Completed Vertical Garden (Taubert, 2022)

Note. The images show the completed shelving and garden boxes in the vertical vegetable garden at The Hope Exchange.

The finalized design for the vegetable garden included shelving, garden boxes, and recycled pots (Figure E3). The shelving and boxes will help produce a higher quantity of fresh vegetables and encourage healthier lifestyle choices for the residents. The vegetable garden provides rehabilitation through collaboration, ownership, and maintenance. The daily maintenance and interactions will help create a safe space at the shelter and allow for unconscious healing and stability.

Conclusion:

The process of implementing the gardens **brought the community together and sparked interest in the gardens.** These spaces will provide healing, nourishment, and work skills to the current and future residents at the Geoff Burton House which we hope will ultimately assist them with their transition period back into society.

Recommendations:

For the future development of the gardens, we recommend

- ***that the residents follow the maintenance guide and schedule to maintain the gardens:*** By following these documents, they will be able to upkeep the gardens through watering and plant harvesting, as well as table, shelving, and braai stand repairs.

- ***adding a compost system:*** Composting will nourish the plants, promoting a more beautiful healing space and a higher quality vegetable yield.
- ***incorporating a greywater system to promote an eco-friendly garden:*** As a feature our group hoped to include, incorporating a greywater system would make use of the drainage water at The Hope Exchange from the car wash and its ablution facilities.
- ***implementing a supplemental hydroponics vegetable garden:*** Based on the results from our expert interview at Khulisa Community Garden, we recommend adding hydroponics to the vertical garden. Hydroponics is a space and soil-effective way to grow herbs in a vertical environment and is self-watering. To create this addition, we recommend continuing to use as many recycled materials as possible.

Chapter 1. Introduction

District Six was once the cultural hub of Cape Town's colored and black populations (Figure 1) (South African History Online, n.d.). During apartheid, new laws stripped the district of political power and economic resources. This was due to the apartheid practice of forceful eviction and relocation of District Six's original inhabitants to the outskirts of the city, which became townships and informal housing. Consequently, the district has become a shell of its former culture and creativity. Those who remained live in poverty, abandoned buildings, and as dispossessed or unhoused residents looking for a better life. The Hope Exchange was created to alleviate these struggles and to foster positive action in the community (The Hope Exchange, 2022, South African History Online, n.d.).

Figure 1. District 6 in Cape Town, South Africa (https://www.sahistory.org.za/image/district-six-looking-hanover-street-tennant-street-going-right)

Note. View of District 6 in Cape Town, South Africa during the 1950's looking up Hanover St and Tenant St.

Formerly known as The Carpenter's Shop, The Hope Exchange was established in 1981 with two main purposes: homeless activism and transitional support. In order to do this, they began providing homeless community members with jobs, and in 1999, they created a transitional housing support system behind their offices, known as the Geoff Burton House. As their work in the community has deepened, The Hope Exchange would like to broaden its impact on the well-being of local residents. Their vision is to transform their outside space to implement a vertical food garden and a healing garden that would create a safe and therapeutic environment for the personal development of the Geoff Burton House residents. The food gardens would provide vegetables, while the healing garden would provide healing and relaxation experiences for the clients. These two gardens will give the residents gardening skills while supporting the first three Sustainable Development Goals: no poverty, zero hunger, and good health and well-being (United Nations, 2015). Therefore, this project aims to collaborate with The Hope Exchange to design sustainable and effective garden spaces to promote healing, hope, and nourishment. To meet that goal, our objectives include 1. Assess the needs and preferences of the residents for the gardens; 2. Identify supporting

materials, garden components, and other resources to support the healing and vertical vegetable gardens; 3. Design and implement an upgraded healing garden and a vertical structure for the vegetable garden, with a maintenance plan that best fits the needs of the Geoff Burton House. We developed a design for the gardens based on the available materials in Cape Town, the space provided, and the collaborative contributions from our partners in the area. We then implemented the new garden plans for The Hope Exchange.

Chapter 2. Understanding Homelessness, The Hope Exchange, and the Benefits of Garden Spaces

This chapter presents background information about the work of The Hope Exchange, its clients, and other key stakeholders involved in addressing homelessness. The section starts with describing the issues with homelessness in Cape Town and how The Hope Exchange works to combat some of these problems. Next, the organization's needs for these gardens and their current garden situations are explained. Afterward, we present a literature review on the healing aspects of gardens, the benefits of food gardens, and garden design elements that could benefit the Geoff Burton House community.

2.1: The Crisis of Homelessness in Cape Town

Around the world, Cape Town is most known for its history, beautiful geography, and diverse culture. Buried beneath the glamour is the reality that there is a large homeless population struggling to survive in the city. As of 2021, there were 14,357 homeless individuals in Cape Town, and that number is rapidly increasing (The Hope Exchange, 2021). Estimates suggest that 12,000 unhoused residents sleep on the streets every night, with 73% coming from District Six. The increase in homelessness is considered one of Cape Town's "slow-moving" tragedies (Schenck, et al., 2010). The numbers continue to grow with the rise in urban migration due to the increase in unemployment.

To understand the high numbers of homelessness in Cape Town, it is necessary to understand how South African history has affected this issue. Commonly cited factors that contribute to homelessness "include long-standing poverty, unemployment, difficult family life, little or no schooling, substance use/abuse, and health and mental health problems, which prevent residents from moving out of poverty and off the streets" (Schenck, et al., 2010). In the larger picture, however, Cape Town's struggle comes as part of recovery from its history of colonial racism and unrest. The homeless are often misunderstood and stereotyped negatively for their economic situation without regard to the history behind their situation (The Hope Exchange, 2022). The reality for the homeless community is that they have lost privileges and typically are families struggling to stay on their feet. Many are forced to take last-resort measures like working in the sex trades for food, while some are fortunate enough to find meals at community centers. The Covid-19 pandemic also contributed to the increase in the homeless population, exacerbating many health and economic problems in the Western Cape including The Hope Exchange. (The Hope Exchange, 2021). The Hope Exchange itself was forced to temporarily

shut down its care services when restrictions, due to the pandemic, heightened. This left many unhoused individuals on the streets fending for themselves.

2.2: The Hope Exchange: A Changemaker for the Homeless

With its mission to help rebuild the lives of the homeless in Cape Town, The Hope Exchange has been one of the local community centers that distributes meals and ablution facilities for unhoused residents (The Hope Exchange, 2022). The organization has the vision to provide “hope for the homeless, through dignity and opportunities for change” (The Hope Exchange, 2022). In 2009, The Carpenter’s Shop became a car wash and a charity shop. The two enterprises now offer part-time and full-time positions to those who need an income. Beyond employment, the organization also offers access to toilets, showers, laundry, nutritional meals, social work services, monthly wellness visits, life skills training, and short-term housing. The housing facility, known as the Geoff Burton House, serves as a reintegration home for men allowing time to adjust back into society before finding a permanent residence. The Geoff Burton House accommodates up to 40 men for three to twelve months until they have reached a point where the risk of becoming homeless is no longer lingering. During that period, the social workers at The Hope Exchange assist the residents in creating personal and financial development plans. The main goal is to support and then enable men at risk of being homeless to reintegrate into society.

In 2021, The Hope Exchange was able to reintegrate 27 members of the Geoff Burton House back into society and reunified nine members with their families. All of this was made possible due to donations, government funding, and their own enterprises (The Hope Exchange, 2021). The Hope Exchange's efforts give the residents a feeling of belonging and purpose. The organization understands that this path to wellness requires a multidimensional approach which includes counseling, job training, and provision of ablutions (washrooms) and meals. With its services, the organization strives to change misconceptions about the outcomes of the homeless by providing opportunities for better lives and restored dignity. Beyond job training and housing, The Hope Exchange hopes that members of the Geoff Burton House can also feel restored through nature and find a purpose in gardening by adding a healing and food garden. To this end, our team collaborated with the Geoff Burton House residents and The Hope Exchange to design and build a healing garden and a vegetable garden that can help with the healing process and feed those living in the shelter.

When we arrived, The Hope Exchange had two existing gardens: the vegetable garden in the back behind the ablution areas and the healing garden in the front of Geoff Burton House. Both gardens were not being optimally used.

2.3: How Healing Gardens Support Social and Environmental Wellbeing

A healing garden provides therapeutic benefits and can take many forms (Pouya & Demirel, 2015). It can be an environment that brings forth the factors needed for increased well-being while excluding disease-promoting aspects (Reeve et al., 2017). Food gardens are healing because they supply organic foods, reduce stress, and encourage physical activity and social interaction (Stigsdotter & Grahn, n.d.).

Stigsdotter and Grahn's studies described three theories on the benefits of healing gardens. The first is that nature and the environment of a healing garden "have restorative influence on the emotional center in the limbic system" (Stigsdotter & Grahn, n.d., p. 62). The limbic system of the brain is the section that controls behavioral and emotional responses (*The Limbic System*, 2017). Danger and fear are controlled by stimuli that promote unpleasant feelings, while stimuli such as water or an open meadow encourage feelings of ease (Stigsdotter & Grahn, n.d.; *The Limbic System*, 2017). Urban areas can be overstimulating, leading to increased stress, while natural spaces are more restorative to the body and mind (Pouya & DemiRel, 2015). The feeling one gets from natural environments, such as natural light and savannah-like areas, produce the fastest effects on the body, as these are thought to resemble "man's original home," leading to unconscious relaxation (Stigsdotter & Grahn, n.d., p. 62). Stigsdotter & Grahn's second theory is that the health effects of a healing garden are caused by "the restorative influence of verdure on cognitive functions" (Stigsdotter & Grahn, n.d., p. 62).

Figure 2. Rooftop Healing Garden (Reeve et al., 2017)

Note. Example of a healing space on top of a roof, with an enclosed area where people can relax.

They theorized that natural environments have qualities that restore the ability to sustain direct concentration and call this "The Attention Restoration Theory" (Reeve et al., 2017, p. 50). It was found that four characteristics promote recovery from attention fatigue. The first point is that natural environments "engage the mind in inquiry and exploration" (Reeve et al., 2017, p. 50).

The second characteristic states that the gardens can give a sense of fascination that one's

attention is effortlessly captured. Thirdly, these environments allow the user to become one with their thoughts, leading to increased "compatibility with an individual's purpose" (Reeve et al., 2017, p. 50). This allows them to feel relaxed and not overly attentive to demands. Finally, a healing garden provides a space for the user to feel physically and mentally distanced from demanding tasks.

Stigsdotter and Grahn's third theory states that natural escapes provide balance to one's ability and control over situations (Stigsdotter & Grahn, n.d.). Many individuals have past trauma, grief, or an illness, and being surrounded by a demanding environment is not beneficial. Sitting and watching in a garden can produce this escape from fast-paced environments, as these actions promote passive participation. While there is no direct physical interaction between the garden and the user, this type of stationary participation will relieve demands, reduce stress, and improve well-being (Ozkan & Cilek, 2021). Therefore, the position of seating within the garden is pertinent. For instance, chairs or benches should be situated so that there is a focal point that can be easily viewed, meaning that the furniture should have "an attractive view, allow private or collective seating, and be ergonomic" (Özkan & Çilek, 2021, p. 88). An example of such seating can be seen in Figures 2 and 3 Both these images show an ergonomic seating area surrounded by vegetation while also providing a view where one can participate without physical demands.

Figure 3. Proper Bench Placement (How to create a healing garden, 2020)

Note. Bench placement is very important in the creation of a healing garden, and this photo shows good placement of a bench within a healing space.

Another way to create an escape from one's environment is to develop an attractive view in the form of paintings and sculptures. More specifically, simple paintings that depict nature to some extent are shown to decrease stress, increase well-being, and promote relaxation (Stuckey and Nobel, 2009). Just incorporating art into a garden space is not enough due to the topic of the artwork evoking different responses. For example, murals representing nature tend to have positive reactions, like reducing anxiety, while those portraying

negative themes elicit adverse reactions. (Landro, 2017). To maximize the effectiveness of these murals, they can be placed anywhere from healing gardens to medical facilities.

The idea that natural healing spaces positively affect individuals using the area is supported according to a study conducted by Dr. Joanne Westphal; natural environments significantly impacted Alzheimer patients. Two groups were evaluated in Westphals experiment. The first group was exposed to a garden for up to five minutes a day, while the second group was exposed to a garden for more than ten minutes a day. She found that the group who spent more time in the garden had significant positive changes in pulse rate, blood pressure, and weight. In contrast, the only characteristic that stayed the same between the two groups was medication use (Pouya & DemiRel, 2015). Dr. Westphal's study concluded that relaxation in a garden for at least ten minutes every day could provide many benefits, such as social support, a sense of control, positive distractions, reduced mental fatigue, and even exercise. Many of these effects can also help the homeless community because the garden design can promote a healthy recovery from various illnesses, including substance abuse (Pouya & DemiRel, 2015). Another way to aid in recovery is to be around people trying to recover from similar situations. Therefore, having a healing garden open to peers to practice reflection, as well as share physical activity together, can serve as a big step towards recovery.

To create a healing garden, a garden planner must understand the current mental state of the users to best suit their needs. For example, someone who needs a place for quiet contemplation may enjoy a secluded garden where they can be alone with their thoughts, while others who prefer to relax around other people may want a more open space with plenty of seating (Stigsdotter, Grahn, n.d.). Having bright, warm colors such as reds and oranges in the garden may also be the best fit for the residents since these colors encourage activity and are friendly to those with limited vision (*Design a Healing Garden,* n.d.). Additionally powerful healing tools include sight and smells which present calmness and wellness to a healing garden. Smells can promote positive mood changes, as with clary sage, peppermint, rosemary, rose, and thyme (Eckerling, 1996). Healing gardens feature plants that appeal to the senses, emphasizing sight, smell, and touch. To do this most effectively, these plants should have bold, warm colors with various sizes, smells, and textures like red hot pokers (Figure 4).

2.4: Designs for Effective Community Gardens in an Urban Environment

Community gardens can be designed with various purposes in mind. At the shelter, there is potential for a vegetable garden and a healing garden. A way to build such a community is through a community garden, which is shared land that multiple users collaborate on to grow flowers and vegetables while encouraging social and economic benefits through human interaction and food production (Hosking et al., 2016). These gardens can "provide rehabilitation and mentorship" to those in need as well as assist others "in the form of vegetables and encouragement" (Hosking et al., 2016). After a 1970's economic crisis in New York, thousands of houses were demolished, and 70% of the population of Loisaida was displaced (Schmelzkopf, 1995). Community gardens soon popped up and were viewed as "safe havens that provide[d] residents with a sense of nature, community, rootedness, and power" in these low-income areas (Schmelzkopf, 1995, p. 364). Today, in Cape Town, community gardens still contribute to the well-being of their users while also providing a sense of togetherness and healing to community members (Hosking et al., 2016). With combined efforts from residents and nonprofit organizations, community gardens can successfully supply socialization, self-restoration, and nutrients to those in need.

Figure 4. Red Hot Poker (Gardeners'World.com, 2018)

Note. Red hot poker plants are an example of a warm native flower.

Community food gardens can have many positive effects on their users. One such effect is access to local organic fruits and vegetables, which has significant economic, health, and social benefits. Local produce is a healthier option than supermarkets due to a higher concentration of nutrients and more control over what chemicals are used on the plants. This, in turn, can provide higher quality produce for cheaper (Klavinski, 2018). One thing to remember when building a vegetable garden is that you need plants that are right for the climate. Multiple

factors must be addressed to have a successful garden in the Cape Town region: temperature, precipitation, and wind speed. These three factors are major aspects of Cape Town's Mediterranean climate. The summers are roughly 20 °C and receive an average rainfall of approximately 2 cm a month, while the winters are around 17 °C and accumulate 11 cm a month of rain. During the summer months, the average wind speed is 22 km/h; during the calmer winter, the average wind speed is 17km/h (*Weather Spark*, n.d.). These weather patterns are important considerations because plants have specific temperature, water, and strength requirements. In addition, design elements for the garden should also account for the weather to protect the plants.

Further constraints depend on the type of garden to be built; most notable is the goal of a movable vertical garden that utilizes recycled planting materials, such as plastic containers for potting. Other concerns will focus on sourcing, price, ease of planting, maintenance, and feasibility of hanging the plants.

Vertical gardens are a good option for planting vegetables in a small space or urban environment. These gardens can be grown in a tier system which provides versatility and easy maintenance (Halgamuge et al., 2021). Popular plants used in vertical gardens include lettuce, tomatoes, spinach, baby greens, and herbs, and given the vertical nature of some areas, climbers such as beans, cucumbers, and squash could also be ideal options (*Vegetable Farming in South Africa*, n.d.). Along with specific types of plants, vertical gardens must be designed and structured to optimize space. There are many steps to building a vertical garden, starting with the wall, materials, and design. Recent trends have shown easy, sustainable garden designs, including hanging pots, standalone walls, and stacked shelving (Figure 5) (Lowin &

Figure 5. Chicken Wire Wall (Lowin & Sansone, 2021)

Note. The above image shows an example of a chicken wire wall, which is one of the vertical gardening strategies we looked into.

Sansone, 2021). These designs allow for each plant to have sunlight and for more significant amounts of plants to be planted than a typical garden on the ground.

2.5: Relevant Case Study: The Lady Cilento Children's Hospital

In years past, numerous case studies have been done that overlap with our current project and can offer insight into the benefits and important design elements of healing and food gardens. One example case study is horticulture healing gardens that have been implemented in many hospitals worldwide, such as the Khoo Teck Puat Hospital in Singapore, the University Medical Center Brackenridge in Austin, Texas, the Dell Children's Medical and The Lady Cilento Children's Hospital in Australia. The Lady Cilento Children's Hospital was opened in 2011 and featured eleven healing gardens providing various forms of patient and staff renewal. The purposes of these gardens can range from physical therapy to mental health (Reeve et al., 2017). The research and feedback from this hospital can offer insight to our team to maximize the effectiveness of our healing garden designed and built for the Geoff Burton House.

In the Lady Cilento Children's Hospital study, 61 hospital staff members were surveyed on their landscape preferences to determine the features of the final designs (Reeve et al., 2017). The results showed that people valued benches, creeks, running water, and privacy, which led to the inclusion of small tables seating one or two people. With this information and research on horticulture in mind, the gardens were designed and built. To assess the effectiveness, researchers left bench diaries in two of the gardens with the prompt, "Tell me, why are you here? How are you feeling? What do you enjoy? Tell me what is on your mind…?" After the responses were collected, they were analyzed to determine what people hoped to gain from being in the garden and its effectiveness. Some aspects that the staff valued included a place for time out of the hospital, a dose of nature, restoration, stress reduction, engagement of the senses, sunshine, and warmth. Due to the overwhelmingly positive responses, it was concluded that essential components of a healing garden are comfortable seating with good viewing options and a mostly stationary experience. These findings align with previous discoveries that preferences for certain natural environments are a result of our ancestral response to signs of survival such as running water, vegetation, flowering plants, shelter, and so forth (Ulrich et al., 1991).

2.6 Summary

A literature review helped us understand that healing gardens have positive health impacts on their users. Residents at The Hope Exchange were there for various reasons but were all working on themselves and their well-being to reintegrate into society. A healing garden could help them with this process because of its therapeutic effects. Whether healing gardens are

used for a break from everyday stressors or for physical and mental well-being, the gardens contribute to relaxation elements, responsibilities, and opportunities.

Community gardens can come in many forms to positively affect their users. The Hope Exchange's healing and vegetable gardens are the areas expected to positively affect the residents. The gardens could provide access to a variety of plants and fresh produce. To optimize space, making a vertical food garden was ideal as it allowed for more plants. With this in mind, the methods leading to our final design revolved directly around the needs of the Geoff Burton House community.

Chapter 3: Methodology

Our goal in working with The Hope Exchange was to collaborate on the design of sustainable and effective garden spaces to promote healing, hope, and nourishment. To accomplish this goal, we identified the following objectives:

1. Assess the needs and preferences of the residents for the gardens.
2. Identify materials, garden components, and other resources to support the healing and vegetable gardens.
3. Design and implement an upgraded healing garden and a vertical structure for the vegetable garden, with a maintenance plan that best fits the needs of the Geoff Burton House.

This chapter outlines, in greater depth, the methods we used to collect and analyze data for each objective.

3.1: Assess the Needs and Preferences of Residents for the Gardens

To identify the needs of the Geoff Burton residents for the gardens, we conducted three small focus group interviews, each with five to seven residents. All the participants were residents of the Geoff Burton House at the time, and the type of sample chosen was most similar to a convenience sample. Charity Pote (Social Work Manager) organized the interviews based on the residents' availability during the days. Since the residents work at various times throughout the week, the interviews were scheduled for times during the week in the morning as well as one session on Sunday in the afternoon. This allowed us to talk to as many residents as possible without limiting the participants based on availability. We asked open-ended questions for the interviews as they are effective in providing unexpected responses (Ward, 2014). Conducting the interviews would provide insight into what kind of space the residents could imagine for the healing garden and which vertical gardening designs they preferred for the vegetable garden. Our final sample contained opinions and ideas from a total of seventeen residents at the Geoff Burton House, 42.5% of the residents currently living there. These results allowed us to obtain deeper information about what they hoped to gain from being in the garden and what features they thought would achieve that vision. The consent form and questions used in the interviews can be found in Appendix A and B, and sample images of vertical garden designs shown to the residents during the focus group interviews are shown in Appendix C. Additionally, the dates for when the interviews occurred can be seen in Appendix D.

We analyzed the data from the interviews with a coding framework of the residents' responses, a recommended method of analysis for qualitative data (Ochieng et al., 2018). The first step of this method, *initial coding*, encapsulates the emerging ideas and preferences by placing them into groups, called codes, with a priority chart. Using these charts from each interview, we moved on to the second step in the coding process, *focused coding*, where we noted the most prominent ideas across all three interview groups. After analyzing the ideas developed in our interviews, we determined the cost and feasibility of the designs using a decision matrix. The priority chart and decision matrix allowed for a better understanding of the cost of upgrading the gardens and the materials needed.

3.2: Identify Materials, Garden Components, and Other Resources to Support the Healing and Vegetable Gardens

The second objective was to identify materials, garden components, and other resources to help support the food and healing gardens. To maximize the effectiveness of the project and have a lasting impact, it was vital to understand and meet the needs of the key stakeholders. Through meeting over video chat with Charity Pote, we gained a basic understanding of our project before our arrival in Cape Town. Photographs from Pote show a small area enclosed by concrete walls for the vegetable garden (Figure 6) and a larger area by the residential building for the healing garden (Figure 7).

Figure 6. Vertical Garden (Pote, 2022)

Note. Photograph shows the "before" state of the food garden behind the Geoff Burton House shelter along with materials that were later incorporated in the new vertical garden.

Figure 7. Healing Garden (Pote, 2022)

Note. Shows two angles of the "before" state of the healing garden at the Geoff Burton House.

We also contacted a University of Cape Town student who already begun the process of building the organic garden. The student surveyed the residents on their vegetable preferences, and based on the results, she utilized plastic jugs and containers accumulated from the car wash enterprise to plant spinach, onions, beetroot, green pepper, tomatoes, and mint. Photos of the existing vegetable garden space can be seen in Figure 6. In addition to the space, the existing plants and components available before we arrived are listed below (see Table 1).

Upon arrival in Cape Town, we conducted a site assessment to observe the available space for the project. We measured the area and evaluated seasonal daylight and temperature conditions which helped us plan for the kinds of plants and features that could thrive within the provided space.

We interviewed garden experts and building material suppliers to create a list of viable materials. We identified four institutions that could provide expert advice on garden design and management: Kirstenbosch Botanical Garden (South Africa's National Botanical Garden with designs that incorporate scientific research), Khulisa Community Garden (supports the homeless population and has worked with WPI teams in the past), Stodels Garden Centre (one of the leading garden plant suppliers in South Africa) and Builder's Warehouse (leading construction materials supplier in the country). These interviews allowed us to gain new contacts within Cape Town who are willing to help with the garden materials and designs.

Table 1. Existing Materials

Vegetable Garden	Healing Garden
24+ recycled liter bottles (5-liter, 2-liter, and 25-liter) with dirt	Roughly 60ft x 25ft area
Three walls	Three tables
Spinach seedlings	Six chairs
Onion seedlings	Three benches
Beetroot seedlings	Bird feeder
Green Pepper seedlings	Decorative pots
Tomatoes seedlings	Various bushes and trees planted
Mint seedlings	Decorative rocks
Old planks of wood	Stone paver walkways
2 in diameter PVC pipes	Hanging plants
Rusted table	

Note. The table shows the materials that are currently available at The Hope Exchange.

We spoke with Werner Voigt (Curator and Garden Manager), Alice Notten (Environmental Interpretive Officer), and Keenan Williams (Head Gardner at Conservatory) at Kirstenbosch Botanical Gardens. They provided us with information on sustainability and types of plants that would work best given the garden's mix of shady and arid conditions. Questions asked during the interview at Kirstenbosch are found in Appendix E. To gain more insight into the vertical vegetable garden, we reached out to a local community garden, Khulisa. We talked to the project manager Johan Steenkamp who provided his insight on the best types of vertical gardens, what kind of plants would work in them, and effective pest control (see Appendix F for interview questions). While visiting Builder's Warehouse and Stodels, we did informal open-ended interviews with garden employees to learn about the cost,

construction time, and sustainability of potential building materials. We chose to conduct interviews as they "enabl[e] people to discuss their own experience [and] their own position" (Ward, 2014, p. 49). Although interviews are a good source of information, they should be used in accordance with other in-depth means of research (Noyes et al., n.d.). Therefore, this combination of research with expert and resident interviews proved to be helpful to our overall goal, as it allowed local experts to express their ideas and knowledge on gardening in Cape Town.

To incorporate resident participation, Charity and our WPI advisors arranged for two residents from the Geoff Burton House to join our team as co-researchers. The purpose of co-researchers is to build local relationships, increase participation in the project and create community involvement (Jiusto & Vaz 2015). Khotso and Morné, the two resident researchers, gained interest in the garden project through our interviews and were excited to join the group. They assisted with interviews, material selection, designs, and construction. We also asked the rest of the residents to physically participate in implementing the designs of the gardens while we exchanged knowledge about natural planting techniques and design elements. This allowed those who already had plants in the gardens to have more control over where their plants went while also getting involved in the gardens' creation.

After talking with Charity, we learned that The Hope Exchange did not have any specific funding for the garden designs and upgrades. To secure funds for the project, we met with The Hope Exchange's head of marketing, Marie Slundt, to start a GoFundMe, a donation platform to spread awareness and gaining donations from people back in the United States. We also reached out to the owner of Atlantic Point Backpackers Hostel, where we stayed, who kindly lent tools to us, including a circular saw, power drill, trowel, bucket for mixing, sandpaper, and paintbrushes. These tools allowed us to implement our designs using raw materials without needing to use the budget on tools.

3.3: Design and Implement an Upgraded Healing Garden and a Vertical Structure for the Vegetable Garden, with a Maintenance Plan that Best Fits the Needs of the Geoff Burton House

The last objective was designing sketches for the vertical component of the vegetable garden and the reorganization and adding of healing elements to the garden before implementation. To complete this objective, we combined our background research on healing gardens, interview data from the residents, and collection of recycled and available resources to sketch out a design for each garden. Once we decided on the materials based on demand, availability, and budget, we sketched the designs with pencil and paper according to the

dimensions of the gardens. After we finalized the mechanics of the designs, we sketched out the layout of the healing garden using OneNote. For the vertical garden, we kept the designs on paper to be able to change and adapt them as new obstacles arose.

To sustain the gardens, we developed a maintenance plan for the residents in the Geoff Burton House, which will be managed by our resident researchers once we leave. This manual included information about each plant and watering criteria, job descriptions, and skillsets for participants in the garden upkeep. For maintenance requirements, refer to Appendix G. Included are skillsets with aspects for residents in need of experience to transition into steady jobs. Furthermore, partnering with local nurseries and other experts built lasting networks to assist with maintaining the gardens at The Hope Exchange. For a timeline of our weekly project goals, refer to Appendix H.

Chapter 4. Findings and Deliverables

This chapter describes the findings and outcomes from the completed methodology and further explains how we achieved our objectives to create a healing and a vertical garden that benefit the residents. To further the implementation, it describes a garden sustainability framework for plants and structural maintenance.

4.1: Needs and Preferences of Residents for the Gardens

Our analysis of focus group interviews with residents at the Geoff Burton House provided valuable information about their views of the healing and vegetable gardens, as well as ideas to help improve the gardens. The residents had a range of experiences and interests in helping with the gardens.

During the interviews, several problems were discussed regarding the existing healing garden. A few residents said the space was used as a smoking area rather than a garden; to prevent this, we wanted to incorporate a designated smoking zone. Another problem was that the trees in the healing garden had a plethora of leaves that were constantly falling, causing more work for the residents because they had to rake up the leaves every day. They requested that we find a ground cover that would allow for an easier cleanup of the garden. The residents also informed us that the current ground cover on the healing garden was a thin layer of dirt above concrete. Therefore, plants cannot be planted straight into the ground if we want them to survive. Additionally, residents, particularly those on the second floor, admitted to only using the space about once a week or less due to the garden being dull and boring. This reiterated a need to upgrade the current garden to give those residents an incentive to use the space. These results allowed us to conclude that the residents did not want anything complicated, and they opened our eyes to the undesirable aspects of the gardens. The residents preferred simple and realistic healing upgrades.

The most notable additions suggested from these focus group interviews were adding a braai stand (South African barbeque), colorful flowers, new or renovated seating, new tables, and adding fake grass (Table 2). The residents mentioned that they currently host braais in the garden but use a wheelbarrow and metal grate as a makeshift braai stand (Figure 8). The wheelbarrow was broken and rusting through at the bottom, creating the need for a new and more permanent braai stand.

These results showed us that residents liked implementations that directly benefit them, particularly physical objects they could use, like the braai stand, tables, chairs, and benches. To see all the initial and focused coding results, see Appendix I and Appendix J. The upgrades suggested by the residents, such as colorful flowers and purposeful seating, provide significant

and valuable healing qualities. Other discussed ideas included adding an ashtray, leveling the ground for ease of walking and safety, and implementing a water feature or mural.

While discussing the vertical organic garden, a lack of motivation was a clear issue that needed to be addressed. Throughout the Geoff Burton House, there was a lack of interest in taking care of the garden as it was far away and did not provide enough incentive for many residents. It became an additional task for us to upgrade the gardens to a beautiful state where the residents would want to take care of them. One resident brought up the idea of implementing a per-unit watering schedule to address this issue. Each unit, a group of eight residents, would take ownership of the gardens for different days. Furthermore, the problem of pests and rats was brought to our attention. Making the garden vertical will help protect the vegetables as it would be harder for rats and pests to get to plants higher up.

Figure 8. The Old Makeshift Braai stand (Taubert, 2022)

Note. Pictured is the wheelbarrow that was previously used as a braai at The Hope Exchange.

Table 2. Table of Resident Ideas on the Healing and Vegetable Gardens

Vegetable Garden	Healing Garden
Chilis	Braai
Potatoes	Flowers
Basil	New furniture
Cabbage	Fake grass
Beans	Birdbath/birdfeeders
Carrots	Rock paths
Garden boxes	Waterfall mural
Trellis	Different areas/section (a.k.a. garden rooms, smoking area)
Hanging pots	History of Geoff Burton House
Shelves	Trim/prune plants
Chicken wire	Painted pots

Note. A table of results from our focus group interviews with more prominent ideas listed first (ideas mentioned in all three focus groups) and less prominent ideas listed thereafter. The table shows only ideas from the focused coding section of the analysis.

Additionally, residents mentioned that cultivating their preferred vegetables, namely, chilies and potatoes (Table 2), could incentivize them to take care of the garden. During the interviews, many residents lit up at the idea of having fresh vegetables. This benefits the residents directly and once implemented, will help increase interest in the garden. There was not, however, a standout vertical design. Four ideas were brought up in the majority of the interview sessions: garden boxes, shelving, trellis, and hanging pots. These designs were simple enough to build, structurally sound, and easy to maintain. The residents seemed interested in the simple

designs that would make the plants easy to access. For the complete list of analyzed interview results, see Appendix J.

From the interview results, we were able to finalize our ideas for the garden and determine the healing elements seen in Table 2. The seating elements requested by the residents will add areas to socialize and can be rearranged to face focal points in the garden. The braai stand will act as the main socialization area and aid in physical health by allowing the residents to barbecue for themselves. The water feature or mural is one of the focal points that will add calming effects to the garden and please the eyes. The ground cover adds different textures to the garden's pathways and adds to the natural feeling of the garden. The vegetable garden will give the residents responsibility and ownership by allowing them to grow their own food. The food will also possess financial and health benefits.

4.2: Materials, Garden Components, and Other Resources to Support the Healing and Vegetable Gardens

To begin the design process of the healing and vertical gardens, three major factors had to be considered: budget, impact, and sustainability. From the Kirstenbosch Botanical Garden interviews, we received recommendations for the type of succulent, flowering, and fragrance plants that should be included in a healing garden. These ranged from sturdy ground covers like sour fig (a low-growing succulent) to flowering succulents like *Crassula rubricaulis*. Voigt and Notten recommended that plants in the garden should be suitable for the garden's shady and partially windy climate while also considering how different plants of the garden affect each other in terms of shading, water consumption, and wind shielding. Adding to this, they advised us to use local South African plants as they can be easier to find, are more natural, and work well in the overall climate. They also suggested planting flowers that have an appealing scent, as it can help with the healing aspect of our design.

In addition to plants, we discussed the impact of water in a healing garden. The curator of Kirstenbosch Botanical Garden, Werner Voigt, recommended the addition of running water because it creates a divertissement for participants. A running water feature was not a possibility at The Hope Exchange due to a lack of water dispensary options and financial concerns, but adding water to art was feasible, and from research, we learned that natural art increases the feeling of security and reduces anxiety. Therefore, positioning the provided benches to view the art and other focal points in the garden was crucial. Voigt mentioned that the garden must look organic, which can be done with mulch pathways and raised beds lined with materials such as natural rocks or wood. Voigt recommended that the rocks allow for a much more natural look than wood or imitation linings. Using his advice, we decided against installing fake grass to keep

the garden all-natural. The remaining elements from Table 2 were kept and incorporated into the healing designs. Other ideas discussed can be found in Appendix K. These ideas helped us plan our healing garden design and find ways to use ideas the residents proposed.

While interviewing the Khulisa Community Garden project manager, Johan Steenkamp, we learned that vegetables would thrive if planted in dirt with compost, and the best times to plant for summer is in September, while March and April are preferred for the winter season. In addition, he recommended that 20 to 30 cm of soil be used for each vegetable plant. He also recommended hydroponics as a space efficient way to vertically garden, but we decided not to pursue this method due to a lack of funding and high weekly maintenance requirements. Using these recommendations, we decided that vegetable garden boxes would be a good addition as they allow for deeper soil as opposed to the existing liter jug pots in the garden. He also mentioned that companion planting can help deter pests in the garden. As for the rats, he suggested putting tomato plants up high on the shelves to protect them due to rats preferring fruit-like plants. Rats can also be handled with poison traps, which The Hope Exchange has already implemented. Keeping this in mind, we investigated raising the shelving off the ground to prevent rats and planting herbs next to vegetables. A list of our interview results can be found in Appendix L.

While conducting interviews, we also learned that the repurposing of recycled materials was the number one aspect that Charity Pote wanted to incorporate into the designs. We took that into consideration when creating our garden mockups. However, fundraising became a large constraint due to the small number of materials that were able to be recycled from the gardens. The Hope Exchange did not have an existing budget for this project. Using the GoFundMe we started, we were able to raise $1,173.39 or R20,506,97 to carry out the project (see list of materials purchased in Appendix M). To promote sustainability and save money, we incorporated rocks and bricks found around the garden to create the part of the braai stand and outlined flower beds in the healing garden.

The vegetable garden used repurposed liter bottles sourced by the car wash that is run by The Hope Exchange. However, because the vegetable garden is in a relatively tight space, Charity Pote wanted the garden to have a moveable design. To incorporate this moveability aspect, we designed shelves that would be able to hold the recycled pots and be easily moveable, as well as included moveable garden boxes in the design. These ideas were supported by Steenkamp after hearing our budget concerns. Furthermore, we designed a shelving structure to create a way to incorporate adequate spacing for plants and a movable design.

After gaining insight into gardens from professionals and defining the recycled materials we had access to, we were able to create a rough budget for the gardens. Using the results from the residential interviews, we looked up the costs of every potential idea and how much it would

cost to implement in Cape Town. Most pricing came from Builder's warehouse and garden suppliers in the area. The original pricing and materials list can be seen in Appendix N. This budget list helped us gain an idea of available materials in the area and expenses and was an easy list to check when creating the final designs. We also were able to use this list to refer to the dimensions and volumes of materials that we would need.

4.3: Healing and Vertical Vegetable Garden Designs

Our next step, after the interviews and researching the materials available in Cape Town and at The Hope Exchange, was to finalize our design for the gardens. These designs were based on the material the gardens are currently made of and what we were able to move and restructure. In some cases, we had to work around objects and structures that we could not move.

4.3.1 Healing Garden Design

The healing garden design was determined based on recommendations from interviews with residents and experts. Initially, we drew out a basic dimension sketch (Appendix O) to determine how much of each material we would need and then drew a more in-depth sketch with the structure placements.

We created the designs of the gardens along with our co-researchers and improved them with our sponsor's recommendations. To keep the garden and pathways clean and simple, we decided on gravel around the cement pavers and garden beds outside of the lined paths. We were able to recycle rocks from the vertical garden and healing garden to edge the paths and add a natural feel. A board member from The Hope Exchange was kind enough to donate many plants for the healing garden. The idea of filling the existing pavers pathway with gravel was enforced by our interview with Steenkamp because gravel was a cost and time-effective way to create the paths.

To further expand on our design and incorporate the suggestions of the residents we implemented a space for a braai stand into our design. The South African barbeque was designed to be built using recycled bricks from the garden, concrete, cinder blocks, and lintel. To supplement our limited masonry experience, we met with The Hope Exchange's contracted builder to discuss a design and implementation plan for the braai stand. In this meeting, he talked us through the instructions for pouring a foundation and recommended materials. He later provided us with a printed blueprint consisting of a list of materials, as well as detailed design drawings which can be found in Figure 9 below.

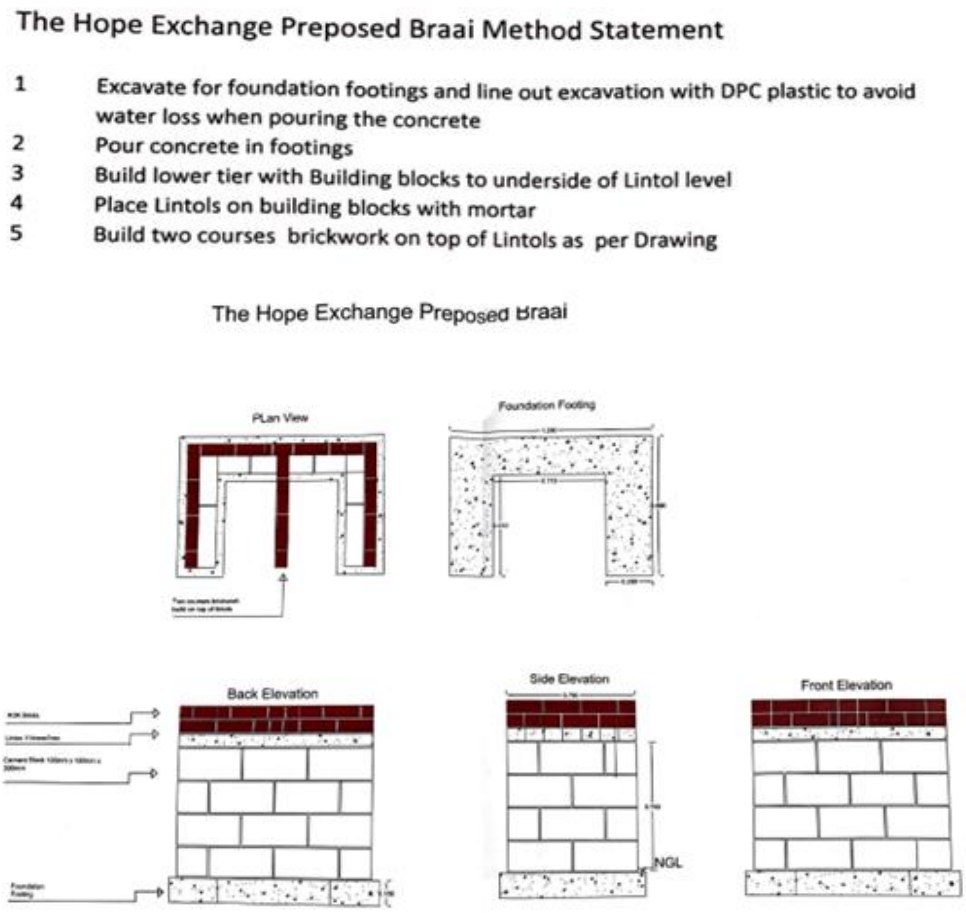

Figure 9. The Hope Exchange Proposed Braai Method Statement

Note. Design of the braai that we received from The Hope Exchanges builder.

To complement the braai stand, the team restored the furniture by replacing wood and screws, sanding, staining, sealing, and rearranging to improve functionality. This made the space into an area that was usable by the residents. The restored furniture included three benches, three chairs, and two tabletops. The plants in the healing garden consisted of plants that already existed, ones moved from other areas of The Hope Exchange, and donations from a board member are going along with the goal of using recycled materials and trying to minimize expenses. The donated plants consisted of *Alstromeria, Arum Lilly, Cupea Ignea, Chlorophytum Sandersiae, Liriope Muscari, Toad Lilly, Salvia Leucantha, Ruella, Angelica, Plectranthus* groundcover, and *Watsonia* bulbs. To make watering the new plants and garden more convenient, we bought a hose that can connect to the rainwater tap nearby. The rest of the design consisted of paver pathways filled with gravel and soil for the ground cover, new plastic chairs, ashtrays, a trash bin, a sign, and fairy lights. Our original design contained a birdbath as the water feature and a birdfeeder to attract birds. However, after further evaluation, the maintenance would outweigh the benefits, so we agreed upon adding a faux water feature in the form of a

mural. Additionally, the mural was strategically located on the wall closest to the parking lot as a focal point. We hired an artist, a current resident at The Hope Exchange, to paint the mural. He designed the mural based off the consensus of residents: colorful and waterfall. All these implementations improved safety, created a cohesive color pallet for the garden, and had high approval amongst residents.

We used the illustrated design to explain our plans to everyone in the organization and as our base plan on where to start (Figure 10). The braai stand is in the most open area with no trees above it which will also be made the smoking area to keep the residents' cigarette butts in the ashtrays and out of the gardens. We designed the garden plans for the largest and most important tasks to be done first due to our 4-week time constraint. After the designs were finalized on paper, we proceeded to research and buy materials to build the gardens.

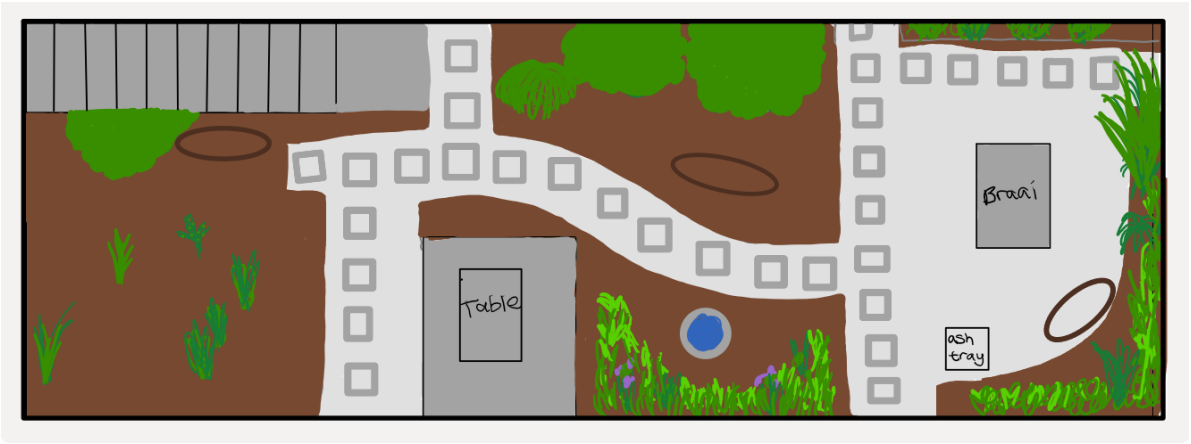

Figure 10. Simple Healing Garden Design (LaRusso, 2022)

Note. A simple drawing design of the healing garden with existing pathway pavers, gravel around the pavers (colored light gray), raised beds of soil (in brown), and a designated smoking area with a braai stand on the right.

The garden's design was built taking into consideration the healing requirement in our proposal (Figure 11). In our design, we used natural materials for grounding, improved arrangement for functionality and socialization, and refurbished the table for safety. The garden design allows for quiet secluded areas for residents to contemplate their thoughts and larger areas to socialize. The entirely natural garden will help unconsciously relax the residents' brains through the smells and visual appeal the added plants and soil bring to the area. For example, the garden already contains a plant called yesterday today and tomorrow, which provides purple flowers and pleasant smells. The braai area will allow the residents to socialize, cook their own food, and enjoy the gardening space. The pre-existing patio allows for additional space for community gatherings, where the residents can eat, socialize, and work together.

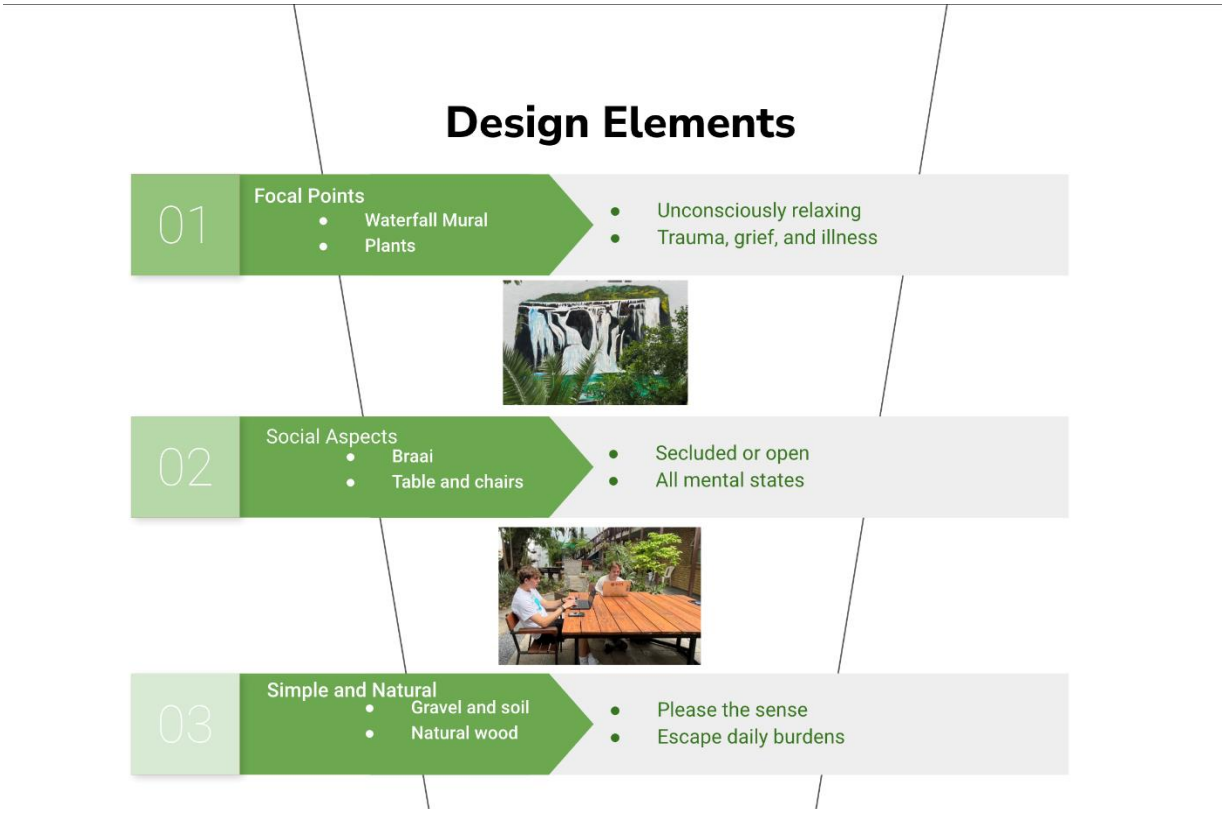

Figure 11. Design Elements for Healing

Note. The diagram above demonstrates different design elements of a healing garden and describes how it they help to create an effective healing space.

Along with providing social areas, the garden pathways and braai area will be lined with cement slabs and gravel while the soil will fill garden beds in the rest of the areas providing different colors and textures to please the senses. Smaller garden boxes and hanging plants help attract attention to the area and add distractions for one walking through the garden. The winding paths throughout the garden lead to secluded bench areas and open areas giving the residents options of where they want to spend their time. Having options and specific areas in the gardens can help account for all residents and mental states depending on their needs for social or quiet areas. The mural adds to the color in the garden, water feature and is beautiful to look at when sitting below. Access to a less demanding environment will help treat trauma, grief, illness and have positive impacts on the brain without the residents even knowing. This less demanding environment encapsulates an escape from their lives at the residency and brings them into a small piece of natural paradise (Figure 12).

Figure 12. Completed Healing Garden (LaRusso, 2022)

Note. The images show the completed healing garden in front of the Geoff Burton House at The Hope Exchange.

4.3.2 Vertical Vegetable Garden Design

The vegetable garden design is based on the researched designs and residents' recommendations consisting of shelving, garden boxes, and recycled pots. When creating the vegetable garden, the residents cared more about which vegetables were to be added rather than which vertical structures were used. This led us to create a design that works for existing and additional plants. We did have a major setback with the garden because we could not figure out who owned

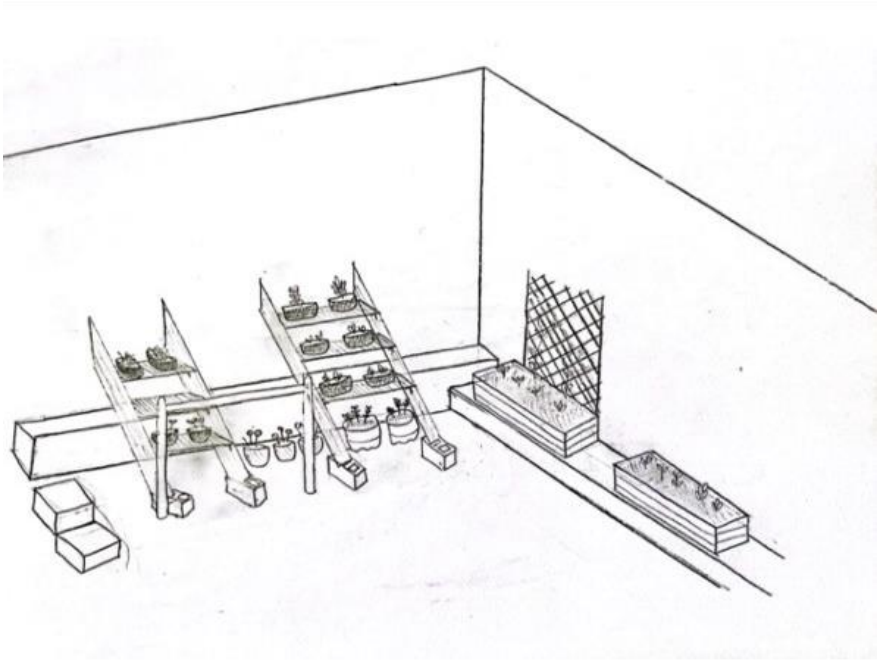

Figure 13. Vertical Garden Design (LaRusso, 2022)

Note. A simple drawing design of the vertical garden with shelves, garden boxes, and a trellis.

the walls to get permission to drill into them. We had to change our original design because we could no longer use permanent attachments in the walls. This ended up being a leaning shelf-based approach like a ladder. At first, we drew a rough sketch and designed the shelf spacing based on the height of plants and dimensions of the area, which can be seen in Appendix O. The garden wall next to the entrance was assessed to be most suitable for the shelves (Figure 13). The main factors in this decision were wall structure, space, and dimensions requirements. It also receives the most sunlight, so it would be ideal to add more space for plants to grow there.

The wall on the left, or the far side from the entrance, was not structurally sound due to chipping and general decay. Our team decided against using a trellis since a lot of the plants already planted and recommended didn't require it. It was then decided that the garden boxes would sit on the shelf below (Figure 13). The shelving was designed using screws, brackets, wood planks, and cinder blocks to hold the bases for the shelves to stand alone on the wall. The original size of the shelves was two meters, but it was determined to be too big for the length of one shelf. Therefore, we built two sets of shelves, each one meter in length and three shelves high (Figure 14). The garden boxes that we researched were pre-built with wood and nails. These were cheaper and more time effective than buying all the materials and tools necessary to build them on our own.

Red cabbage and kale were planted in the garden boxes because they needed a deeper base to grow. The shelving on the wall hosts beetroot, mint, onions, and tomato plants that are already planted in the five-liter bottles, along with chilis, spinach, and herbs that we added. We also bought watering cans to make it easier to water the garden. This allows the residents to use the nearby faucet and reach the plants along the walls easier, saving them time and making maintenance easier.

The vegetable garden is another form of rehabilitation through providing residents with collaboration and control. We hope that the completed garden will motivate the residents to maintain it and contribute something of their own. The shelving and boxes allow the residents to produce high-quality vegetables through organic gardening. This would allow for healthier and more flavorful food options than buying from the grocery store. Not only will the garden produce economic benefits, but it will also allow for social interaction through the daily maintenance of the garden. The vegetable garden will also be a safe space for the residents allowing for another secluded area to work on themselves and provide a distraction from their daily lives. This garden could provide unconscious healing and stability to the residents.

Figure 14. Completed Vertical Garden (Taubert, 2022)

Note. The images show the completed shelving and garden box designs for the vertical vegetable garden at The Hope Exchange.

4.4: Maintenance Plan for the Healing and Food gardens

To ensure the continuation of our project, we have been working with two co-researchers, namely Khotso and Morné, who showed interest in the gardens from the start. They will be the main source of information on the gardens and responsible for the upkeep of the gardens after we leave. We also left two maintenance plans with our co-researchers, The Hope Exchange management, and the residents at the Geoff Burton House (Appendix G). These documents inform the readers of our building process, materials, plants, and necessary maintenance in one concise manual. The manual has job and task details for garden care; it includes what plants are planted and their corresponding water, sunlight, and other care requirements. These plans are meant to inform any new residents about the garden and allow anyone to learn about the landscaping and gardening process. This allows the men to gain new skills while helping keep the gardens beautiful. Along with the maintenance manual, we created a daily and weekly maintenance schedule for the residents, which will be printed and implemented in every unit at The Geoff Burton House. The maintenance manual can be found in Appendix F.

Chapter 5. Conclusions and Recommendations

This section reviews our key findings before producing our results on the completed gardens. We also leave recommendations about the gardens for The Hope Exchange and residents.

5.1 Conclusion

Over the eight weeks we spent working with The Hope Exchange, we were able to successfully implement the vertical garden and upgrade the healing garden. The finalized design of the healing garden included a mural, braai stand, soil and gravel, new plants, and restored tables and chairs (Figure 12). The vegetable garden contained vertical shelving, garden boxes, and newly potted vegetables (Figure 14). These completed gardens contain elements for healing the body and mind of their users. The photos of the gardens before and after the implementation of our project, as seen below, show a calming, serene, healing garden and a vegetable garden with plenty of space for cultivating nourishing food.

Our project was open to all and promoted collaboration among the residents. This open collaboration brought the community together and sparked interest in the gardens. While interacting with the residents, staff, and our team, we collaborated to implement well-established principles and elements of garden design while fitting the residents' needs. We encouraged collaboration by planning interviews, meetings, weekly building schedules, and undertaking tasks such as spreading soil and planting vegetables. In collaboration with The Hope Exchange, we hosted an American braai to celebrate our project's completion and to break in the newly built braai stand with the residents (Figure 15). Through this event, we were able to socialize with the residents and hear how the gardens were impacting them.

Noticeable healing effects for the residents and The Hope Exchange staff were provided by building the gardens. The process included tasks that improved the residents' current home and gave them a place of hope. After implementing the gardens, we found that many residents enjoyed working with us or watching us work as we played music in the gardens, which provided a new light and positive energy to the gardens and the community. This was an unexpected healing factor that came out of our interactions with everyone at The Hope Exchange. Charity Pote and the board members were proud of the project and its impact on the

residents. They pointed out the positive shift in attitude the more we upgraded the healing garden. One of the board members mentioned that the area used to be depressing for him and now brings forth feelings of joy. They were also ecstatic with the success of increasing the vertical space to provide more vegetables for meal supplementation. Along with the vegetables, the gardens offered unconscious relaxation, calming and pleasing views, and mental healing, which led to more interaction between the residents.

Figure 15. American Braai (Taubert, 2022)

Note. The image shows the newly built braai being put to use during an American barbeque hosted by the students.

These elements demonstrated the benefits of incorporating local resources and experts for the project's success. After our interviews at Kirstenbosch National Botanical Garden and Khulisa Community Garden, we used their local expertise and advice to improve our knowledge of gardens further and utilized information from the interviews to aid our designs. The staff at Kirstenbosch's recommendations enhanced the healing garden materials and design by defining components and elements needed for recuperation while also being adaptable. Like the healing garden, we planted and built the vegetable garden to be resilient against the Cape Town conditions, considering the advice from the experts at Khulisa Community Garden. Another significant factor in the garden's success was due to the kind donation of additional plants from Stuart McLeod, a board member at The Hope Exchange. He helped us plant them and taught the residents and us new gardening skills that we did not previously possess (Figure 16).

Figure 16. Hard at Work (Somasse, 2022)

Note. Student workers and co-researchers working together to add new plants into the healing garden.

Our two co-researchers also contributed to the success of the project. The two were members of our team involved in organizing and designing both gardens. Working side-by-side with these residents taught us about the program and provided access to socialization within the community. More importantly, it offered an opportunity to sustain the garden, as the two co-researchers continued to manage and maintain the garden (with the involvement of other residents) after we had left Cape Town. The co-researchers also gained carpentry, masonry, landscaping, and gardening skills through this project. We hope that the maintenance of the gardens will also provide these skills to any residents involved through repairs, weeding, and cleaning. Working on these gardens will impart lifelong skills and responsibilities, which will help residents reintegrate back into society.

5.2 Recommendations

With the final garden implementations in place, we have a few recommendations to maintain and further improve each garden. Following the maintenance guide and schedule will keep the gardens from disrepair. For future projects or garden improvements, we recommend composting, greywater systems, and hydroponics. More details can be found below.

Follow the maintenance guide for the gardens:

To keep the gardens in a polished state, we suggest that the residents of the Geoff Burton House and the staff of The Hope Exchange follow the attached maintenance guidelines and implement the unit schedule (see Appendix G). If followed, the plants will stay healthy, garden furniture and wooden structures will be protected, and the ground cover will be cared for. In

addition, it provides valuable information on when to pick the vegetables and how to replant them next season so that the garden can be continued in future years.

Develop a composting system:

We recommend developing a composting system with the Geoff Burton House residents that can fertilize the gardens since composting is essential for plant growth. Both gardens need compost at least once a year to support the growth of the plants. We suggest reaching out to the Khulisa Community Garden because they have an existing composting system. View Appendix Q for more information on composting techniques.

Incorporate a greywater filtration system:

An additional future recommendation for the garden is implementing a greywater filtration system. To implement this addition, we recommend researching existing greywater systems and reaching out to Khulisa Community Garden because they are starting to develop a system of their own. The addition of a greywater system will support the gardens at the Geoff Burton House by minimizing the cost of water by reusing dirty water from the car wash.

Add hydroponics to the vertical garden:

Based on the results from our expert interview with Steenkamp, we recommend adding hydroponics to the vertical garden. He strongly suggested this idea because hydroponics is a space and soil-effective way to grow herbs in a vertical environment and is self-watering; however, they require a power source to cycle the water. We suggest considering the pros and cons of implementing this design, particularly the ongoing energy cost needed to support it. To create this addition, we recommend continuing to use as many recycled materials as possible. The PVC pipes in the vertical garden area and old liter jugs can be reused for this design. Adding this unit will provide herbs for the residents of the Geoff Burton House and create more shelf space for other vegetables by removing the herbs from the shelves.

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Tools:

Drill with Phillips head bit (don't put hands near drill bit)oHand Saw or circular saw if available (wear safety goggles, keep fingers away from saw) Penciluhapter-21" \h https://training.cochrane.org/handbook/current/chapter-21

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Appendices

Appendix A: Media Consent Form

We are a team of undergraduate students from Worcester Polytechnic Institute (WPI) in the United States. We are participating in a project to enhance the Goeff Burton House Gardens. If you are willing to participate in this project, please read and note your preferences on this form. The final results will be made public, and can be found at the following link:

Do we have your permission to audio record an interview?

Yes ☐ | No ☐

Do we have your permission to video record an interview?

Yes ☐ | No ☐

Will you allow us to use your words for use on public website platforms?

Yes ☐ | No ☐

Will you allow us to use your image for use on public website platforms?

Yes ☐ | No ☐

I understand that these interviews will be published at WPI for educational purposes and made available to the public. Images and film clips may also be shared to social media platforms including Instagram and other outlets designed to amplify the experiences of climate change.

Sign: Print: Date:

Appendix B: Small Group Interview Questions for the Geoff Burton House Residents

General

What is your experience with gardening?
What did you plant? How was that process?
If not, are you interested in learning?
How does winter weather compare to summer weather here?
If you have been here during the winter, how does the weather affect the gardens?

Healing Garden

How often do you currently use the garden space? Why or why not?
How/what do you use in the gardens?
What do you like and dislike in the existing garden?
What do you notice most when you sit in the garden? (i.e., quietness, nice smells, seating?)
What type of seating would you like to have in the garden (chairs, tables, stumps, hammocks, rocks, and benches)?
How do you feel about the ground cover?
Would you like to change it? (i.e., gravel, mulch, grass, moss)
Maybe a small rock garden?
What colors would you like to see added to the garden if any?
What colors make you feel relaxed?
Which colors would you not like to see?
What garden features can be added to make you want to use it more?

Vegetable Garden

How much do you use the vegetable garden space?
Which vegetables, fruits, or herbs would you like added in the garden?
(We have spinach, onions, beetroot, green paper, tomatoes, and mint)
What would you like the garden to look like?
(Show images of design ideas)
Any features that you would like to see? (Shelving, using more walls, trellis: vine wall, etc.)
Anything else that you would like us to do to the vegetable garden space?

Final Question

In what ways would you like to participate in the development and maintenance of these gardens?

Appendix C: Vertical Garden Design Ideas Used in the Residential Interview

Figure 17. Trellis Design

Note. From Common Sense Home [Photograph], 2022., (https://commonsensehome.com/vertical-garden-advantages).

Figure 18. Chicken Wire Wall Design

Note. From Rebekah Lowin , Arricca Elin SanSone [Photograph], 2021., (https://www.countryliving.com/gardening/garden-ideas/how-to/g1274/how-to-plant-a-vertical-garden/).

Figure 19. Shelving Design

Note. From instructibles living [Photograph], n.d., (https://www.instructables.com/Self-watering-vertical-garden-with-recycled-water-/).

Figure 20. Organic Hanging Design

Note. From Rebekah Lowin, Arricca Elin SanSone [Photograph], 2021., (https://www.countryliving.com/gardening/garden-ideas/how-to/g1274/how-to-plant-a-vertical-garden/).

Appendix D: Interviews

Table 3. Table of Interviews

Interview	Name	Date
The Hope Exchange residents Focus Group	Group 1 (5 residents)	11/01/2022
The Hope Exchange residents Focus Group	Group 2 (6 residents)	11/03/2022
Kirstenbosch National Botanical Garden walking interview	Keenan Williams (Head Conservatory Gardener)	11/03/2022
Kirstenbosch National Botanical Garden walking interview	Alice Notten (Environmental Interpretive Officer)	11/03/2022
Kirstenbosch National Botanical Garden walking interview	Werner Voigt (Curator and Director)	11/03/2022
The Hope Exchange residents Focus Group	Group 3 (6 residents)	11/06/2022
The Hope Exchange fundraising meeting	Marie Slundt (Head of Marketing)	11/07/2022
Streetscapes (Khulisa Community Garden)	Rudie Rudolf (Social Manager)	11/08/2022
Streetscapes (Khulisa Community Garden)	Johan Steenkamp (Garden Manager)	11/22/2022

Note. The table above shows the interviews that we had conducted, including the organization, the individuals we spoke with, and the date in which the interview was conducted.

Appendix E: Healing Interview Questions for Kirstenbosch National Botanical Garden Experts

What are you responsible for at the botanical gardens?

What designs make a garden healing?

Particularly for a small area

Would an archway be a good option to add to a healing garden?

How should one organize a healing garden?

What materials are best to use in this type of garden?

What plants would be best for year-round growth in a healing garden?

What plants grow best with minimal sunlight?

Specifically, flowers

What types of plants would you rebucked for beginner gardeners?

What plants grow best in pots?

Any recommendations for ground cover over dirt?

Any low light solutions

How do we integrate a wall mural into a healing garden

Appendix F: Vegetable Interview Questions for Khulisa Community Garden Expert

What is an effective way of composting in urban and public spaces?

What greywater strategies can be implemented for a vegetable garden that is healthy for the plants?

Which vegetables can be grown in this region?

Which of those can grow in recycled liter jugs?

How deep must the soil bbrblocker requirements for those plants?

What types of vegetables and herbs would you recommend for beginner gardeners?

What vertical gardening techniques do you recommend?

How can we prevent pests without using pesticides?

How can we prevent rats?

Why did your company choose this design (small stone paths and raised beds) for the garden.

Appendix G: Maintenance Guide

2022

Garden Maintenance Guide

Tristan Andrew, Keelan Boyle, Sarah LaRusso, Daniel Ouellette, Jena Taubert
WORCESTER POLYTECHNIC INSTITUTE
12/15/2022

Maintenance Guide Table of Contents

Healing Garden and Vegetable Garden Maintenance Guide

The maintenance guide provided here is for the upkeep of the healing and vegetable gardens at The Hope Exchange. This guide includes instructions on how to take care of the gardens, including repairs. It also highlights the necessary tools and contents of the garden and skills that can be learned from taking care of the gardens. When using the tools, care should be taken, and safety precautions should be followed.

MAINTAINING THE VEGETABLE GARDEN

A. Vegetable/Herb Maintenance and Picking Schedule

Many of the plants in the garden need direct sunlight and should be watered every other day, preferably in the morning. The plants should be watered if the soil starts to feel dry. For instructions on when to harvest the plants and how to harvest, view the table below.

Table M1. Table of Plant Information

Name	Sun needs	Watering	Picking (when)	Picking (how)	Mature Height
Chilis	Full sun	Every other day	5 months after planting (when red)	Pull off by the stem of the pepper	1 m
Green Pepper	Full sun	Daily	When peppers are large	Pull off by the stem of the pepper	1 m
Beetroot	Full sun	Every other day	When roots are slightly larger than a golf ball size	Leverage out with a fork, while gently holding the leaves	7-12 cm
Spring onions	Full sun	Daily in the morning	When leaves fall over and start to die	Pull out of the ground from base of onion	25-75 cm
Mint	Sun or partial shade	Every other day	Frequently when leaves	Cut stems one inch from ground when harvesting	30-60 cm

			are size of R5 coin		
Red cabbage	Partial shade	Every other day	Harvest when heads forms: head is firm but not cracking	Cut head off with sharp knife	50 cm
Spinach	Sun or partial shade	Every other day	When leaves are large enough to eat	Cut stem of leaf 1 cm from soil edge (allows for regrowth)	15-30 cm
Kale	Full sun, can do partial shade	Every other day	In the fall	Pick older leaves that are lower down	1 m
Herbs	Full sun	In the morning when soil feels dry	Dependent on herb	Dependent on herb	30-60m

Note. This table illustrates the information including, sun necessity, water needs, harvesting instructions, and size, of each vegetable in the vertical garden.

B. Seasonal Replanting Guide:

Many of the vegetables need to be replanted each season. To do this, visit a local garden center such as Stodels to buy seedling 6-packs. Plants can also be started from seeds like chilis for example. Planting from seeds will take more care and attention than seedlings. When planting, make sure to space seedlings the appropriate distance apart from one another based on the type of plant. Additionally, when replanting for the following season, add compost into the soil.

Overall upkeep tasks to be performed daily or when needed:

- Check plants that need watering (most are once every other day)
- Check for any damaged plants
- Harvest ready produce
- Weed the garden
- Sweep clothesline area
- Remove trash

- Check if repairs to shelves or garden boxes are needed

C. Building additional vertical shelves:

Materials:

- 80 mm x 12 mm L brackets (12)
- 1 wood plank (2400 mm x 300 mm x 20 mm)
- 2 wood plank (1800 mm x 300 mm x 20 mm)
- 25mm wood screws (48)
- 190 cement blocks (2)
- 1 L Wood Sealer (recommended Woodoc Totim)
- 1 L Wood Stain (recommended Harlequins Warm Walnut color)

Tools:

- Drill with Phillips head bit (don't put hands near drill bit)
- Hand Saw or circular saw if available (wear safety goggles, keep fingers away from saw)
- Pencil
- Tape measure
- Mutton cloth (rag)
- Paint Brush
- Level/Straight edge
- Sandpaper (60 grit and 120 grit)
- Painting Tray

Skills needed:

- No prior skills are necessary
- An understanding of how each tool works required
- You will need to be comfortable with a saw

Instructions:

Steps for replacing a shelf:

1. Cut the 2.4 m board into three 80 cm shelves.
2. Using sandpaper, sand down the ends of the plank as well as the edges and surfaces of the plank to ensure that the wood is smooth and ready for staining.
3. Once the wood is sanded down, pour the wood stain into a painting tray.

4. Refer to section E to stain the wood.
5. Refer to section F to seal the wood.
6. If not all the shelves are needed, store them in a dry place. If not all the shelves are needed, store them in a dry place.

Side panel instructions:

1. First, take a 1.8m board and rest the top corner of the board against the wall at the desired shelf angle.
2. Using a level, mark a vertical line approximately 6 cm off the wall (the line should be about 15 cm long).
3. Cut along the mark using a saw.
4. Using sandpaper, sand down the ends of the plank as well as the edges and faces of the plank to ensure that the wood is smooth and ready for staining.
5. Once the wood is sanded down, pour the wood stain into a painting tray.
6. Refer to section E to stain the wood.
7. Refer to section F to seal the wood.

Assembly:

1. Lean the side boards against the wall with the corner cut facing the wall.
2. Using a tape measure, find the vertical distance from the ground to the bottom cut, and then mark the board halfway up from the ground.
3. With a pencil, draw a line parallel to the ground at this position (same angle as step 1 of sides).
    a. We recommend using a level as this will help ensure a horizontal surface.
4. Mark 2 more lines at a perpendicular distance 45 cm above and below the line drawn in step 3.
5. Align both side boards so that the cuts are aligned and are placed back-to-back.
6. Using a level, copy the 3 lines to the second board.
7. Starting with any of the lines, screw in 2 brackets so that the top is flush with the line (one end should point down, and the other should point inwards towards the other sideboard).
    a. The brackets should be evenly spaced along the line and no closer than 6 cm to each other.
8. Starting with the middle shelf, put it in place between the two sides and screw up into the shelves through the brackets.
9. Repeat step 8 for the top and bottom shelves (no particular order).
10. Refer to section E to stain the wood.

11. Refer to section F to seal the wood.

D. Repairing vegetable boxes:

The garden boxes are made of wood panel grids and enhanced by weed guard or black plastic bags with holes for the water to drain. When replacing the wood make sure the liners are in place and hold the soil in the box.

Materials:

- Four 4 cm nail
- Wood
- One 1 L Wood Sealer (recommended Woodoc Totim)
- Mutton cloth
- Sandpaper (100 grit recommended)

Tools:

- Saw
- Hammer
- Straight edge
- Writing utensil

Instructions:

1. Take a measurement of the garden box to determine the length of the replacement board.
2. Cut the board to the length measured.
3. Using sandpaper, sand down the ends of the plank as well as the edges and faces of the plank to ensure that the wood is smooth and ready for staining.
4. Refer to section E to stain the wood.
5. Refer to section F to seal the wood.
6. Set the board approximately one pencil (~.5cm) width from the last board.
7. Using the drill, screw the boards into the posts roughly 3-4 cm from the edges of the wood.

If a board on the underside of the garden box needs to be repaired, follow steps 1-6 in the instructions above. Then follow the instructions below:

1. Take the measuring board and place it inside or under the box where the replacement is necessary.
2. Mark where the center of the frame intersects the new board.

3. Hammer in two nails at least 2 cm from board's edge and on marked line.
4. Boards can be placed in perpendicular directions if the spaces have become too big.

E. Staining the wood:

1. With a paintbrush, apply an excess amount of stain to a small area of the wood.
2. Using a mutton cloth, wipe off the excess.
    a. This should leave the wood almost completely dry to the touch.
3. Repeat steps 1 & 2 until all surfaces of the wood are stained.
4. Allow to fully dry and cure for 12 hours.

F. Sealing the wood:

1. With a paintbrush, apply an even coat of wood seal to all exposed surfaces of the wood.
2. Allow it to dry for 6 hours.
3. Repeat step 1.
4. Allow to dry and cure for 12 hours.

MAINTAINING THE HEALING GARDEN

A. List of plants in the healing garden

There was a multitude of plants added to the healing garden. These include *Alstroemeria, Arum Lily, Cupea Ignea, Chlorophytum Saundersiae, Liriope Muscari, Toad Lily, Salvia Leucantha, Ruella, Angelica, Plectranthus Groundcover, and Watsonia Bulbs.*

B. Overall upkeep tasks to be performed daily or when needed:

- Water the plants: All plants in the healing garden should be watered once a week with less water given to the succulents. The preferred time of day to water is in the morning.
- Rake leaves
- Clean garden beds and gravel paths
- Clean the braai stand
- Repair garden furniture when necessary
- Wipe down the table

C. Restoring wood tables and benches

Materials:

- 4mm x 50mm Screws
- 1 L Wood Sealer (Used Woodoc Totim)
- 1 L Wood Stain (Used Harlequins Warm Walnut color)
- 7 Wood Planks (22mm x 144mm x 3m)
- 3 Wood Planks (32mm x 44mm x 1.8m)

Tools:

- Circular saw (wear safety goggles, keep fingers away from saw)
- Power drill with the Phillips head bit (do not put hands near drill bit)
- Paint Brush
- Mutton Cloth (rag)
- Phillips Head Drill Bit
- Sandpaper Multipack
- Painting Tray

Skills needed:

- No prior skills are necessary
- An understanding of how each tool works required

Instructions:

If one plank needs to be replaced on the table, follow these steps:

1. Cut a wood plank to 120 cm, starting from one end of the plank.
2. Using sandpaper, sand down the ends of the plank as well as the edges and faces of the plank to ensure that the wood is smooth and ready for staining.
3. Refer to section E to stain the wood
4. Finally, once the stain is dry, gather 6 screws to connect the plank to the table frame.
5. Place the fully stained plank in the required space, perpendicular to the wood frame below, leaving space between the plank and the planks next to it (about a pencil's thickness of space).
6. Draw lines on the boards to make sure the center of the screws will be in line with the rest of the screws, and make sure there is a 6 cm width in between the screws (should be six screws on each board, 2 on each end, and 2 in the middle).
7. Mark where the screws should be placed with a pencil.
8. Using the drill, with a Phillips head drill bit, screw in the screws at the measured locations on the plank.
9. Refer to section F to seal the wood
10. If more than one plank needs to be replaced, repeat steps 1-14.

If the wood frame that had been built for the table needs to be restored or replaced, follow the steps below:

1. Take one of the 1.8m planks and cut to 110cm starting from one end of the timber.
2. Using sandpaper, sand down the ends of the wood as well as the edges and faces of the wood to ensure that the wood is smooth and ready for staining.
3. Refer to section E to stain the wood.
4. Repeat steps 1-3 three more times for the complete prepping of the wood.
5. Gather 3 screws to connect the wood pieces to the table frame.
6. Place one of the new pieces of wood on top of the metal frame.
    a. Make sure that the piece of wood is flush with the edges of the metal frame.
7. Using 3 screws, drill from the bottom of the metal frame up through the screw holes and into the wood to secure it in place.
8. Repeat steps 6 & 7 until all 4 pieces of wood are attached to the metal frame.
9. Refer to section F to seal the wood.

D. To Restore the Braai Stand:

This section describes, in detail, what to do if there is a crack in the braai stand or if one of the bricks, slabs, or cement blocks becomes loose or broken. It will begin by describing how to prepare the mortar mix, as the mix is needed in all those scenarios.

Materials:

- Any additional 190 Cement blocks, Bricks, or Lintel slabs as necessary (if needing to replace one of them)
- Mortar mix
- Water

Tools:

- Trowel
- Wheelbarrow or bucket for mixing
- Level
- Shovel
- Hammer

Instructions:

To prepare the mortar mix:

1. Pour the sand and cement mix from the bag into a wheelbarrow.
2. Using a shovel, mix the sand and cement together until it is evenly distributed.
3. If you are using the whole bag, you can mix the water in the wheelbarrow with the shovel.
    a. If you are only using a little bit, put some of the dry mortar mix in a bucket and mix with the trowel.
4. Add water **slowly** until it reaches the right consistency.
    a. Rule of thumb: if you put some of the mix on the trowel and turn it 90 degrees, it should not fall off immediately. If it does, adjust water levels accordingly.

If there is a crack in the braai:

1. Take some of the mortar mix either on the trowel or in your hand.
2. Work the mortar mix into the crack and smooth it over.
3. Get rid of any excess mortar mix on the braai.

If a brick, 190 block, or lintel slab comes loose:

1. Using a hammer, disassemble the braai to the infracted brick, cement block, or lintel so that a new one can be properly placed.
2. Place mortar mix on all points of contact in a thick layer (you will be removing some later).
3. Place the brick, block, or lintel in place and using the blunt end of a hammer (handle side of the hammer), tap the new brick, block, or lintel into place. This will press out excess mortar mix which can be wiped away.
4. Using the level, make sure the newly placed brick, block, or lintel is level and in line with the rest of the braai.
5. Smooth out the mortar mix between the blocks and get rid of any excess.
6. Repeat all steps if there is another impacted brick, block, or lintel.
7. Repeat steps 2 through 5 to rebuild the braai of any material you removed from step 1.

E. Staining the wood:

1. With a paintbrush, apply an excess amount of stain to a small area of the wood.
2. Using a mutton cloth, wipe off the excess.
    a. This should leave the wood almost completely dry to the touch.
3. Repeat steps 1 & 2 until all surfaces of the wood are stained.
4. Allow to fully dry and cure for 12 hours.

F. Sealing the wood:

1. With a paintbrush, apply an even coat of wood seal to all exposed surfaces of the wood.
2. Allow it to dry for 6 hours.
3. Repeat step 1.
4. Allow to dry and cure for 12 hours.

MAINTENANCE SCHEDULE FOR THE GARDENS

The maintenance schedule involves all five of the units at the Geoff Burton House (groups of residents based on where they live) and it cycles through these units so that each unit is only in charge of each garden one day a week. The unit can work together on maintaining the garden or designate a person each week.

Maintenance Schedule and Details

	Monday	Tuesday	Wednesday	Thursday	Friday	Weekends
Healing	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	All units
Vegetable	Unit 4	Unit 5	Unit 1	Unit 2	Unit 3	All units

Healing Garden:

Daily Maintenance:

- Water the plants thoroughly once a day (can be every other day during the rainy season).
- Sweeps the patio area.
- Clean the table, chairs, and benches.

Weekly Maintenance:

- Rake the leaves on the paths and in the garden beds.
- Clean out any leftover charcoal in the braai.
- Turn the soil lightly (be careful not to rip up any roots, especially of new plants)

Vegetable Garden:

Daily maintenance:

- Check plants that need watering (most are once a day)
- Check for any damaged plants
- Clip buds for required plants
- Check for weeds
- Check for produce

Weekly maintenance:

- Weeding
- Sweep clothesline area
- Remove trash
- Check if repairs are needed

Figure M1. Maintenance Schedule

Note. The image shows the maintenance schedule that our group created to ensure both gardens are upkept.

LIST OF SKILLS THAT THE RESIDENTS CAN OBTAIN

Through different tasks, residents will learn about

- Vegetable care in the garden
- Physical construction and repairs
- How to use gardening tools

Gardeners:

As a gardener at the Geoff Burton House, the residents will learn about the vegetables in the garden and how to take care of a garden. While gardening, you develop responsibility for a job and keep up with a consistent daily task. The residents can consider themselves volunteers for the gardens as they use their own time to take care of the gardens.

Maintenance/Replanting crew:

The task of maintenance and replanting will be more of a weekly or monthly task. In this job, the residents will learn about the design of the healing garden and how to fix any physical materials

used in the gardens. They will also learn about which plants need to be replanted and what grows back seasonally. The residents will develop gardening skills along with organization and handy work skills that can be used throughout life.

Landscaping:

The garden requires a larger amount of landscaping, from the ground covers to cleaning up the plants and fallen leaves. Residents will be able to work with gardening tools to help maintain the gardens in their current state.

Carpentry:

Following the guide provided above, carpentry skills can be gained by building an additional shelf or providing repairs on the current shelves when necessary.

Masonry:

Following the guide above, masonry skills can be gained from working on the braai stand. The braai's built using cement and following a blueprint provides basic cooperation and instruction skillsets.

Appendix H: Timeline

Table 4. Timeline

Timeline	Week 1 10/24 – 10/28	Week 2 10/31 – 11/04	Week 3 11/07 – 11/11	Week 4 11/14 – 11/18	Week 5 11/21 – 11/25	Week 6 11/28 – 12/02	Week 7 12/05 – 12/09	Week 8 12/12 – 12/16
Site assessment of The Geoff Burton House								
Interview residents and experts								
Data analysis of interview responses								
Resource gathering and design feedback								
Prototyping the gardens								
Building the gardens								
Develop media for maintenance information								

Note. The table shows the schedule in which we followed to ensure we stayed on task and finished the gardens before our departure.

Appendix I: Results from Initial Coding

Interview 11/1

Residents Gardening Experience:

Resident 1 - Into gardening (can lay bricks)

Resident 2 - Never gardened not interested (seemed more interested by the end)

Resident 3 - Would like to gain experience

Resident 4 - Landscaping and is interested

Resident 5 - Passionate about gardening (wants to be a farmer)

Overall:

- Rainy in winter
- Dry in the summer
- The time it takes to take care of
- Maintenance and watering
- Point people to check up on the gardens
- Everything must be permanent and strong
- Enjoy taking pictures of gardens

Problems:

- Rats
- No motivation to take care of gardens
- Leaves fall everywhere
- Vertical is difficult to get to
- People may not stick to the watering schedule
- Upper floors less likely to use it
- Dark at night - for people who may want to work on the gardens later on

Healing Garden

- History of GBH house
- Barbeque
- Flowers

- Trim trees
- Trim plants into a nice shape
- Reconstruct
- Pots
- Plants
- Move benches
- Add things that can last/permanent
- Need new benches! Nails sticking out
- New table
- Bigger bird houses
- Painted pots
- Colors
- Brick paths
- Level land
- Smoking area
- Flower area
- Pavement ground
- Fake grass area
- Rock paths area with individuals unique painted rock to mark they were there
- Bird area
- New garden garbage bins
- Sand benches and garnish
- No crushed rock or stuff that would make it hard to rake

Vegetable Garden:

- Want fresh vegetables (chilis, beans, potatoes, carrots, spinach, parsley, basil, ginger, cinnamon, green pepper)
- Shelving
- Garden boxes
- Domes to cover sun?
- Fence on ground
- Ways to water
- Plants maintenance
- Recycled shelves

- Incentive to want to stay in the veggie garden

Interview 11/3

Residents Gardening Experience:

Resident 1 - No experience (maybe wants to learn)

Resident 2 - Farmer (lots of seeds)

Resident 3 - Little experience

Resident 4 - No experience

Resident 5 - Wants experience

Resident 6 - Depends on schedule (depended on it when they were younger)

Overall:

- Gardening is a way of living for them
- Believe that farming is good
- Bipolar weather
- Lots of rain in the winter (dark around 5pm)
- December to March is very hot
- Lots of wind
- Per unit schedule to take care of the veggie garden
- Need to get them involved
- Veggie garden will need to be changed season to season

Problems:

- Must be made self-sustainable (people are always coming and going)
- There is a lack of maintenance
- Healing garden is cement under dirt
- People upstairs don’t use the healing garden
- It is just a smoke spot to them
- Hanging clothes are in the way of the vegetable gardens
- Healing is small but good Wi-Fi

- Is turf affordable?
- Birdfeeders don’t get used
- Having ownership will be incentive to take care of the veggies
- Healing Garden
- Don't bring bees
- Leaves from the tree are annoying when wet
- Want to keep all trees
- New chairs (tires and pallets)
- New table
- Grass will not be maintenance (long term problem)
- Waterfall mural
- Bright plants, colors
- Archways were laughed at (entrance already exists we don’t need more)
- Wind chimes (might be too much in high winds)
- Barbeque
- Stick with the dirt
- Specific areas
- Must be organized color
- People sometimes read and watch videos in it
- Good unwinding environment
- Quiet spots where they can do their own thing
- Ash trays
- Rock garden (they had one before)

Vegetable Garden:

- Spinach will grow year round
- One resident planted beetroot, mint leaves were used
- Kale, cabbage, spring onion, chilis, peppers, beetroot, broccoli
- Trellis (good for pumpkin and mint)
- Hanging pots (good for chilis)

Interview 11/6

Residents gardening experience:

Resident 1 - Used to garden, thinks it good to have more veggies

Resident 2 - Had a veggie garden when he was young, his upbringing was working in gardens, has his own small garden

Resident 3 -No experience but is willing to learn

Resident 4 - Experience with indigenous plants in community gardens

Resident 5 - Gardened with grandmother with flowers

Resident 6 - Basics of gardening and watering is interested in learning

Overall:

- Regular basis, sit to smoke and chill
- Sit outside and see the garden
- Second floor watches the garden from the top
- Very rainy, very windy, very cold
- Start planting in September, things will die off in May

Problems:

- Doesn’t use the space much, sits and smokes
- Garden is seen as a working space
- Soil is not deeps, one foot of sand to concrete
- Flies
- Irrigation
- Healing Garden
- Not appealing
- No attraction
- Its bland
- Not much to its appearance
- Add flowers
- Add colors (purple, variety, different flowers)
- Water feature
- Fairy lights
- Trees help with the wind
- Makes it colder

- More sitting area
- Benches are natural
- Garden be cared for
- Fly problem
- Pebbles or soil
- Fake grass
- Succulents for ground color
- Firepit or hangout area
- Barbeque again so they can have a braai
- Ideas of areas sounded nice
- Waterfall mural
- Yes to archway keep it simple
- Cape honey suckle
- Birdbath, for birds, and feeder
- Raised beds and a water feature
- Colors and shades
- Vegetable Garden
- More veggies will motivate them
- Goes to it to hang laundry
- Tomato bushes
- Raised beds are a good idea
- Duty list in unit
- Some water it once a week
- Deeper pots
- Add more vegetables
- Having a want
- Herbs and chilis, thyme, basil, chilo, Korea, Cabbage, spinach, green pepper and chilis
- Hanging pots are cool
- Shelving
- Curtail rows of the bags
- Tires to make a garden with potatoes
- Hose drip
- Charity about water
- Soil,

- Later on Sundays
- Truck for transporting materials

Appendix J: Results from Focused Coding

Overall Facts

- The Garden is used as a smoking area
- The weather is bipolar
    - Rainy, cold, and windy in winter
    - Dry in the summer
    - Hot December to march
    - Plant September, things die in May
- Per unit, schedule to take care of the gardens
    - Appoint leaders to check up on the gardens
- The veggie garden will need to change from season to season
- Everything must be permanent and strong
- Ownership of plants may be an incentive

Problems

- The garden is a working space
- Soil is not deep/there is no soil
- Rats, flies
- No motivation/lack of maintenance
- Leaves fall everywhere
- The upper floor is less likely to use the space
- The vertical garden is difficult to access
- Irrigation
- Hanging clothes are in the way of the veggie garden

Healing Garden Enhancement Ideas

All groups

- BBQ
    - Oil barrel
    - Stone
    - Pre-made
- Flowers

    - Soil
    - Planters
    - Where plants come from
- New furniture (fixed benches, new chairs and table)
    - Repair the table and benches
        - New bench 6k
        - New chair ~2k
- Add colors (bright and organized)
- Fake grass

Two groups

- Bird feeders (make them bigger)
    - Not a real one here
    - No squirrels
- Rocks paths/garden
- Waterfall Mural
- Different areas/sections

One group

- Add the history of GBH to the garden
- Trim trees
- Prune the plants
- Painted pots
- Brick paths
- Level out the ground
- Smoking area
- Birdbath
- Pebbles/crushed rock
- Soil
- Garden garbage bin
- Water feature
- Fairy lights
- More seating
- Succulents
- Simple archway

- Name the garden
- Cape Honeysuckle
- Raised beds for planting
- Windchimes
- Ashtrays

Vegetable Garden Ideas

All Groups

- Chilis
- Spinach (will grow year-round)
- Peppers

Two Groups

- Potatoes (use tires to grow)
- Basil
- Cabbage
- Garden boxes/deep pots
- Shelving design
- Trellis (good for pumpkin and mint)
- Hanging pots

One Group

- Beans
- Carrots
- Parsley
- Ginger
- Kale
- Broccoli
- Tomato bushes
- Thyme
- Curtain rows for gardening

Appendix K: Kirstenbosch National Botanical Garden Interview Notes

Path and walkways:

- Mulch as a walkway would be nice
- Symmetry is good
- Winding pathways are good
- Do not change pathways material halfway though

Seating

- Needs to be restful and or have a good view

Garden beds/planting advice

- Succulents
    - Need good drainage
    - Sandy soil
    - Arid environment
- Use Native plants
    - Look at local plant life around the block
- Soil matters
    - Depth, drainage, composition
- How do other plants affect shade, moister…
- Raised beds give sense of paths (Voigot recommends)
- April starts planting season
- Plant based on watering needs
    - Watering season
- Keep simple

General healing garden advice

- Have signs with facts and names
- Combined art and plants
- When possible, use organic
    - paths/edging
- Archways are an effective and healing way to enter
    - Blend into environment, have plants
    - Have people “bow”

- Use alien wood in garden, it is stronger and cheaper
- Visual and physical textures are important
- Focal points are good but don't make too overwhelming

Maintenance

- Buy compost from store
    - Apply once a year

Plant recommendations:

- Wormwood, copper brotus (bees), sour fig grow well in shade -Alice
- Birds of paradise
    - Needs water
    - Can function in shade but not well
- Aloe
- Portulacaria afra
    - Low maintenance as good as a tree in arid environment for carbon sequestration
    - Edible
    - Succulent
    - Can just take piece of stem and plant again (we got some)
- Umhlonyane (good anywhere)
- Arborescence
- Fragrance Plants: Intelezi, rough artosis, sweet wild garlic, red stem crassiola, golden sage, wild freesia, rasp-leaved pelagonium

Appendix L: Khulisa Community Garden Interview Notes

- They have an existing compost area and are working on a greywater system
- Recommends hydroponics for vertical garden
    - Good with herbs
    - Needs a power source to keep water running
    - Use rock wool to put seeds into
- Soil
    - Mix soil and compost for the soil
    - Most need 20 - 30 cm of soil
    - Onions and beetroot need a large bed
    - Carrots and beetroot need more soil
- Pest and rat control
    - Companion planting can keep pests away
    - Use poison and traps for rats
    - Rats like fruity vegetables like tomatoes
- Plants
    - Time of year matters
    - Most are easy to grow
    - Water once a day
    - Rotate plots of land each year
    - Planting seasons: September and March
- Other
    - Chose gravel for ground because it was easy

Appendix M: List of Purchased Materials

Table 5. Purchased Materials

Material Name	Quantity	Cost (Rand)	Cost (USD)
Cement Blocks	10 Blocks	R139,90	$8.13
Mortar Mix 40 kg	4 Bags	R260,00	$15.11
Wood Planks	7 Planks	R2009,00	$116.78
Wood Posts	3 Posts	R261,00	$15.17
Wood Stain	2 Cans	R339,00	$19.47
Outdoor Wood Sealer	1 Can	R199,00	$11.57
Screws	100 Screws	R80,00	$4.65
Fairy Lights	1 Box	R219,00	$12.73
100 mm Paint Brush	1 Brush	R75,00	$4.36
50 mm Paint Brush	1 Brush	R47,00	$2.73
Sandpaper	1 Multipack	R95,00	$5.52
Paint Tray	1 Tray	R20,00	$1.15
Mutton Cloth	1 Pack	R39,00	$2.24
Drill Bits	1 Set	R119,00	$6.85
Gravel	2 m^3	R560,00	$32.23
Phillips Head Drill Bit	1 Bit	R34,00	$1.96
Soil	6 m^3	R5050,00	$290.72
Cement blocks	12 Blocks	R167,88	$9.83
Lintel	7 Slabs	R462,00	$27.04
Mortar Mix 40 kg	2 Bags	R130,00	$7.61
Watering Cans	2 Cans	R100,00	$5.85
DPC Plastic	1 Sheet	R49,00	$2.87

L Brackets	6 Brackets	R78,00	$4.57
Screws	135 Screws	R82,95	$4.85
Wood for Shelves	3 Planks	R987,00	$57.77
Planter Box	1 Box	R499,00	$29.20
Wood Sealer	1 Can	R119,00	$6.95
Wood Stain	1 Jug	R129,00	$7.53
Mutton Cloth	1 Cloth	R39,00	$2.30
Wood for Shelves	3 Planks	R1,047	$61.12
Fairy Lights	1 Box	R199,00	$11.62
Nails	50 Nails	R20,00	$1.17
Screws	200 Screws	R85,00	$4.96
Bucket (Ash Tray)	1 Bucket	R99,00	$5.78
L Brackets	18 Brackets	R234,00	$13.66
Thinner	2 Cans	R79,97	$4.72
Paint	9 Cans	R1,381,87	$81.54
Brush	2 Brushes	R199,98	$11.80
Spray Paint	2 Cans	R144,98	$8.55
Chairs	3 Chairs	R598,24	$35.26
Compost	3 Bags	R179,97	$10.48
Hose and Fittings	Variety Pack	R874,97	$50.96
Bamboo Stakes	1 Pack	R59,99	$3.49
Spinach Seedlings	6 Pack	R33,99	$1.98
Mixed Herb Seedlings	(2) 6 Packs	R67,98	$3.96
Chili Seedlings	6 Pack	R33,99	$1.98
Kale Seedlings	6 Pack	R33,99	$1.98

Coir	1 Pack (200g)	R24,99	$1.46
Total:		R17,802,64	$1,035.23

Note. This tables gives a visual representation of our budget and the cost of our materials.

Appendix N: Rough Materials and Dimensions Budget List

Estimated Costs $375 plus ground cover

Ground Cover

- Pebbles for around walking tiles
    - Area size: 96,570 cm^2
    - Depth: 4 cm
    - R310
- Pebbles for Braai area
    - Area size: 91,498 cm^2
    - Depth: 3 cm
- Soil
- Area: 6.1 m^3 with 10 cm depth

Table $170

Table 1

- Width across 110cm
- Length 115m

Table 2

- Width across 110cm
- Length 125cm

Cape Lumber Marketing (30 mins away)

- Pine timber 2mx2m R130?

Builders Warehouse

- Laminated pine shelving R1796
- (2.4mx.3m ea)
- Indoor/Outdoor seal R239
- Nails R25 ea
- Twisted steal nails R85 ea

Braai $13

- Concrete R79 ea per 40kg
- Cinder blocks R11
- Two slabs
- Bricks

Chairs $50-$150

- Textile Chair R550 ea for 5 $150
- Gold sun protea rattan armchair R399 ea for 5 $110
- Napoli Chair R249 ea for 5 $69
- Ruby Armchair R199 ea for 5 $55

Fix the broken one

- Col timbers hardwood cover strip R89
- Nails R25 ea
- Twisted steel nails R85 ea

Mural $15

- Ask Chancey
- Paint supplies
- Acrylic paint R25 ea (for 75ml)
- Brushes R30 ea

Plants

- From Kirstenbosch
- Ask Stuart
- Use already existing

Birdbath $33

- Use old one to make pots
- Birdbath from peppino cement R600
- Birdbath from Stodels R700-R900

Ash Trays $15

- Buckets (R139 each)

Trash bin

- Use a current one?
- Building a wood one would be expensive

Water feature

- Build it out of old pot

Fix benches $10

- Paint brush R70 per 75mm
- Sandpaper R28 per 30x100cm

Birdfeeder $14

Birdfeeder (R120 each)

Sign/entrance

- Use recycled material

Fairy lights $15

- 2 of these should cover the perimeter upstairs (solar) (R249 each)

Bamboo Wall $12

- Bamboo wall
    - At Stodels
    - R216.99

Vegetable Garden Design $258 plus soil

Borrow materials

- Hammer
- Power Drill
- Saw
- Tree Trimmers
- Ladder

Suspended chain shelving (materials per 1 of 3 shelving units) $130

- Hinges
- Shelf wood (2 meters long each)
- Eye bolts
- Sleeve anchors
    - Nail in anchors
- Chain
- Spring hooks

Shelving found (380mm X 19mm X 3m) (temporary for price estimate)

Materials	Link	Quantity	Price (R)	How many units?	Price per item
Spring hooks	Link	4	20	4	80
Eye bolts	Link	4	20	1	20
Sleeve anchors	Link	2	95	1	95
Chain	Link	~1200mm	25	1.2	30
Hinges	Link	4	45	2	90
Smaller anchors	Link	9	100	1	100
Shelving wood	Link	1	365	1	365
Total Price (R):	780				
Total Price (USD):	43.79562044	(per shelf)			
	131.3868613	(for 3 shelves)			

Figure 21. Initial Shelving Materials

Note. Above is a screenshot of the shelving materials for our initial design.

Trellis $26

- First Dutch wooden expandable trellis from Builders (Diamond, 1000 x 2500mm, 39.3 x 98.4 in)
    - Price per unit: R459

    - Total Units: 1
- Bamboo trellis from Stodel's (1000 x 1500 mm)
    - Price per unit: R370

Plants $25

- Beetroot, Tomatoes, Onions, Green pepper, spinach, cabbage, potatoes, chilis, kale, broccoli, thyme, parsley, carrots
- R35 each
- One of each yields R455

Soil

- Ask experts -> it's a lot

Garden Boxes $55

- Large wooden planter from Builders (900 x 400 x 390mm)
    - Price per unit: R499
    - Total Units: 2
    - Total Price: R998

Weed Guard $22

- Weed gard landscaping fabric from Builders (1 x 10m)
    - Price per unit: R199
    - Total Units: ?
    - Total Price:

Watering Can $4

- R80 at Stodels

Appendix O: Rough Dimension Sketches

Healing Garden Dimensions Sketch

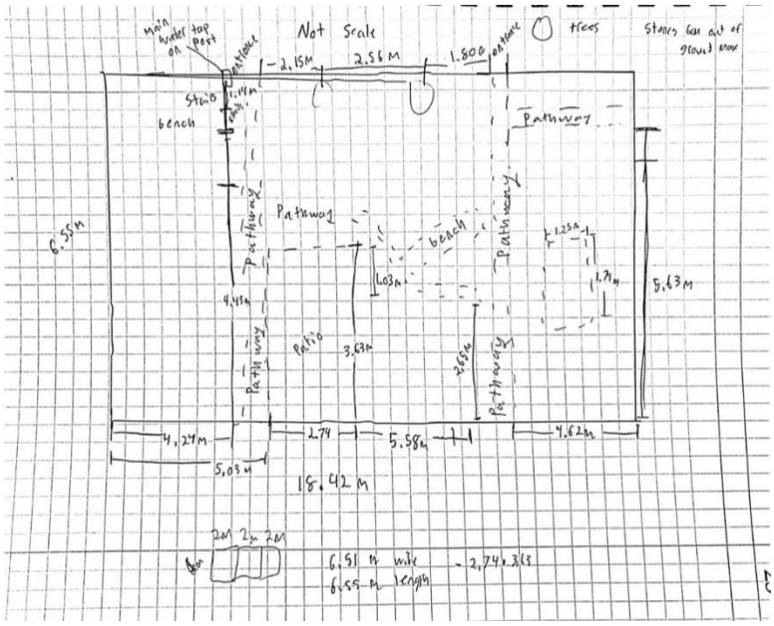

Figure 22. Initial Healing Garden Dimensions

Vertical Garden Dimensions Sketch

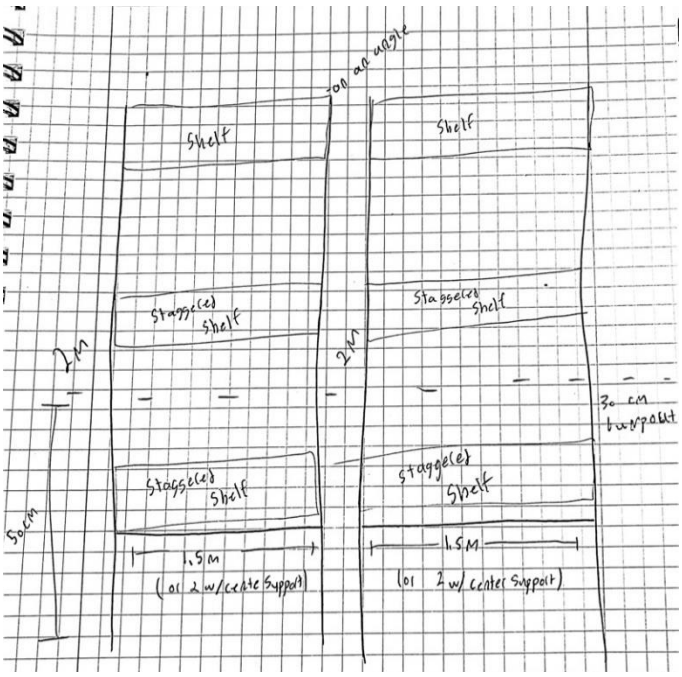

Figure 23. Initial Vertical Garden Dimensions

Appendix P: Before and After Comparison of the Healing and Vegetable Gardens

Figure 24. Before Pictures of the Healing Garden (Taubert, 2022)

Note. The images show the pictures of the healing garden, outside the Geoff Burton House, before our implementation process.

Figure 25. After Pictures of the Healing Garden (Taubert, 2022)

Note. The images show the healing garden, in front of the Geoff Burton House, after our designs had been implemented.

Figure 26. Before Pictures of the Vertical Garden (Taubert, 2022)

Note. The images show the pictures of the vertical vegetable garden before our implementation process.

Figure 27. After Pictures of the Vertical Garden (Taubert, 2022)

Note. The images show the vertical vegetable garden after our designs had been implemented.

Appendix Q: Case Study on Composting in South Africa

A team of researchers in 2020 worked on a project at Monwabisi Park to implement sustainable agriculture systems that provided both aesthetic and nutritional benefits. Many of the obstacles that they ran into have a high likelihood of overlapping with our project (Madden et al., 2020). Research has been done to show the positive effects that earthworms have on plant growth. Their impact comes in many forms such as burrows and castings, causing increased soil drainage and minimized surface water erosion, changes in nutrient availability, and the dispersion of beneficial microorganisms (Edwards, 2004).

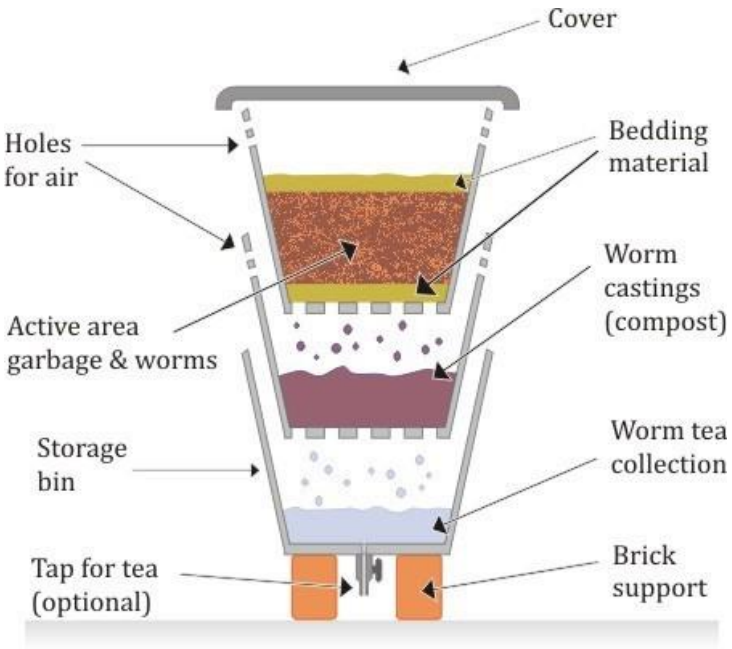

Figure 28. Worm Garden Design (How to make your own worm farm, n.d.)

Note. The illustration shows the steps to implement your own worm

The team designed an earthworm farm which produced high-quality compost to supplement the dry land and to provide a circular relationship between food production and composting. In fact, making a functional worm garden for composting is a relatively simple procedure (with their design shown in figure 8). Most commercial designs involve a system of three plastic bins which could be recreated very easily from recycled materials in any garden setting (*How to Make Your Own Worm Farm - Vermiculture*, 2022). Utilizing the Monwabisi Park design could inform prototype planning for a composting system.