Chapter 3:
Facilitating exchanges

PROGRAM

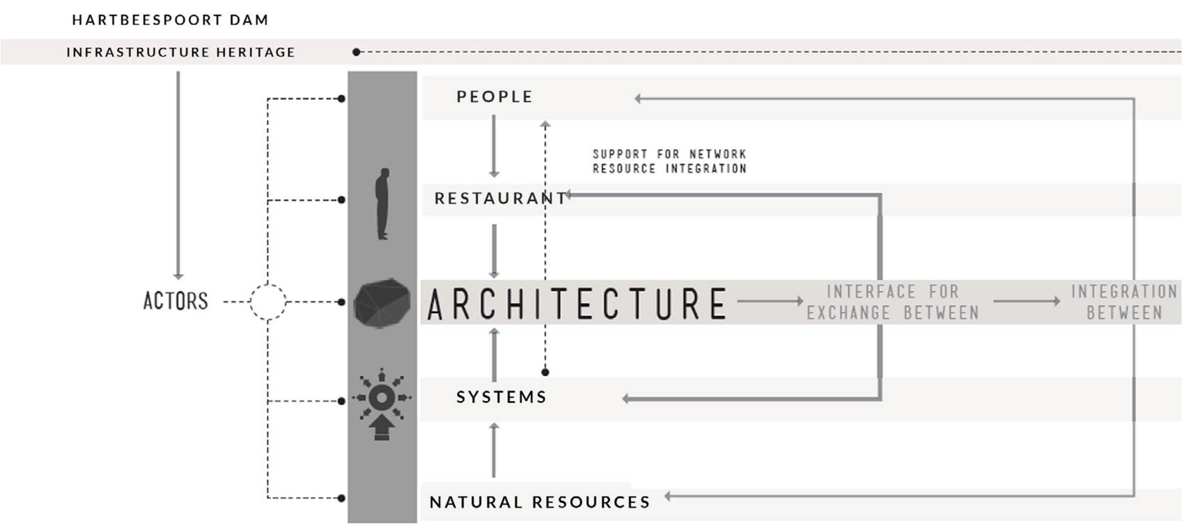


Fig 3.1 Program flow through site and program (Adapted by Author 2016 from Buchner, 2013).

3.1 Celebration of water

3.1.1 Primary program

The primary aim is to create a public interface along the Hartbeespoort dam infrastructure that celebrates one of our natural resources, water. Secondary functions will be to create closed loop systems to rehabilitate the dam.

The programs aim to reintroduce urban communities to natural processes by integrating people and natural productive systems within the context of Hartbeespoort dam's infrastructure.

The primary program is to create a space of celebration that fosters a new water identity. The space needs to remind people of their water heritage and that we are dependent on our water source to survive.

3.1.2 Secondary program

Secondary programs will create closed loops between the site, infrastructure and the user. The secondary programs will create exchanges between the "polluted water" and the needs of the user. In this way the user will be in constant contact with water and nature, this will make them aware of the state that it is in and therefore take care of it.

A restaurant and bar area was proposed in order to draw the users back to the site and continue engagement with the exchanges. The restaurant being 100 m^2 and bar being 100 m^2 in size would cater for approximately 120 users. This means that the kitchen space would be need to be quite significant in size, 100 m^2, approximately 1/3 of the restaurant. Approximately 15 staff would be needed in order to run this kitchen, to be run correctly there would also need to be officers and staff room. This staffroom would also be used for the retail workers. Integrated into this could be the management of the centre as well as safe rooms.

Boardrooms are integrated next to the restaurant space and will also be serviced by the kitchen. The space would be in total 45 m^2 but will be able to be divided into two smaller boardrooms consisting of approximately 15 m^2 and 30 m^2.

A retail space would be used to sell the products created on sites such as miniature vermiculture systems as well as plants growing on the vertical wetland. The space would also sell picnic baskets for the public space in order to engage with all classes. This space would be approximately 45 m^2 plus storage space that would be required for this space.

The vermiculture and wetland creation space would be brought into full view of the public and create a new building for both these activities. By bringing all these different systems together it will facilitate exchanges between one another. The wetland creation space would need good lighting and tables and chairs in order for the existing workers to construct the floating wetlands. There would also need to be storage for raw materials such as steel mesh and foam. They would also need to tend to the plants growing above the space or nearby. These plants will be set in to the wetland and launched along the floating boardwalks.

A public space in this building will be necessary for presentations and public interaction. Officers and staff quarters would also need to be integrated into the building as there are approximately 30 staff members working in this centre.

Vermiculture was introduced by the remediating program, to biodegrade the Hyacinth, which is removed from the dam, into compost that could be sold or used to rehabilitate the shoreline. This activity already exists on site at the dam wall, but the system is crippled and ineffective. There is simply not enough capital to make the system effective and there is often theft that causes the system to be obsolete. There is a real potential to emphasise this program and intensify it.

Vermiculture is the first step to rehabilitate the dam. The compost that is generated from the Vermiculture could then be used to grow water plants that would be placed onto the floating wetlands. In turn this floating wetland can be used to collect more Hyacinth and remove more nutrients from the water, creating a positive closed loop system. This compost will also be used to grow crops and vegetables that will be sold in a restaurant that is open to the public.

In the future, when the Hyacinth has lessened, vermiculture will shift from biodegrading material from the dam, to organic matter brought in by the public. The worms will be used as worm meal to create aquaponics. This will encourage desirable fish species in the dam. This fish could eventually be harvested and sold again, in turn, in the restaurant.

All new programs will facilitate rehabilitation of the site through exchanges. As the site and water is regenerated, programs will have to shift. The vermiculture system will no longer have as much Hyacinth, as the dam will no longer be in a state of eutrophication, and therefore will not produce as much compost. Aquaponics will be introduced as an additional program so the fish and vegetables can be produced and used in the restaurant. The vermiculture system will be scaled down to simply produce compost for the growth of vegetables for the restaurant and worms will be fed to the fish in the aquaponics. Other organic material could be brought in from local factories and residents.

Figure 3.2 shows the flow of materials moving from one program into the next and how they all become interlinked. It can be seen in the diagram how aquaponics would eventually feed into the system once the dam has become balanced. It is clear from the diagram that the water becomes the major feeder into the five programs.

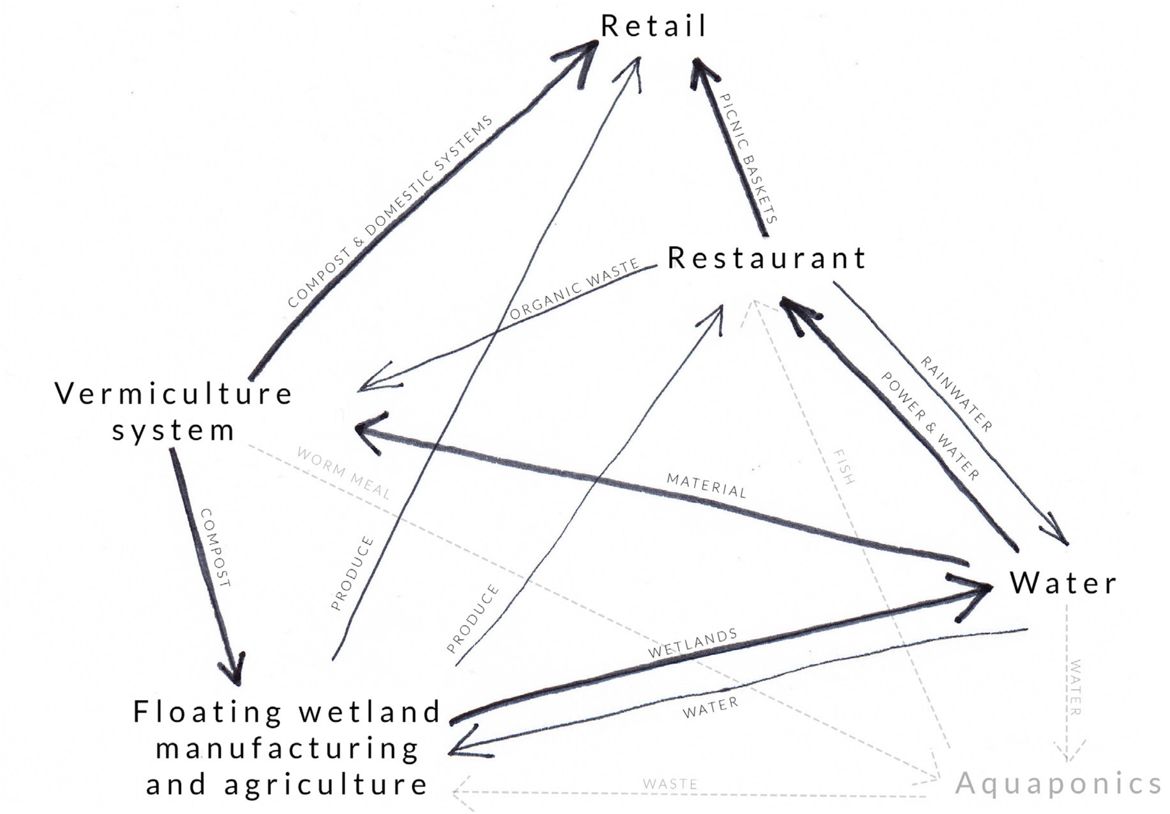


Fig 3.2 Flow of exchanges between programs (Author, 2016).

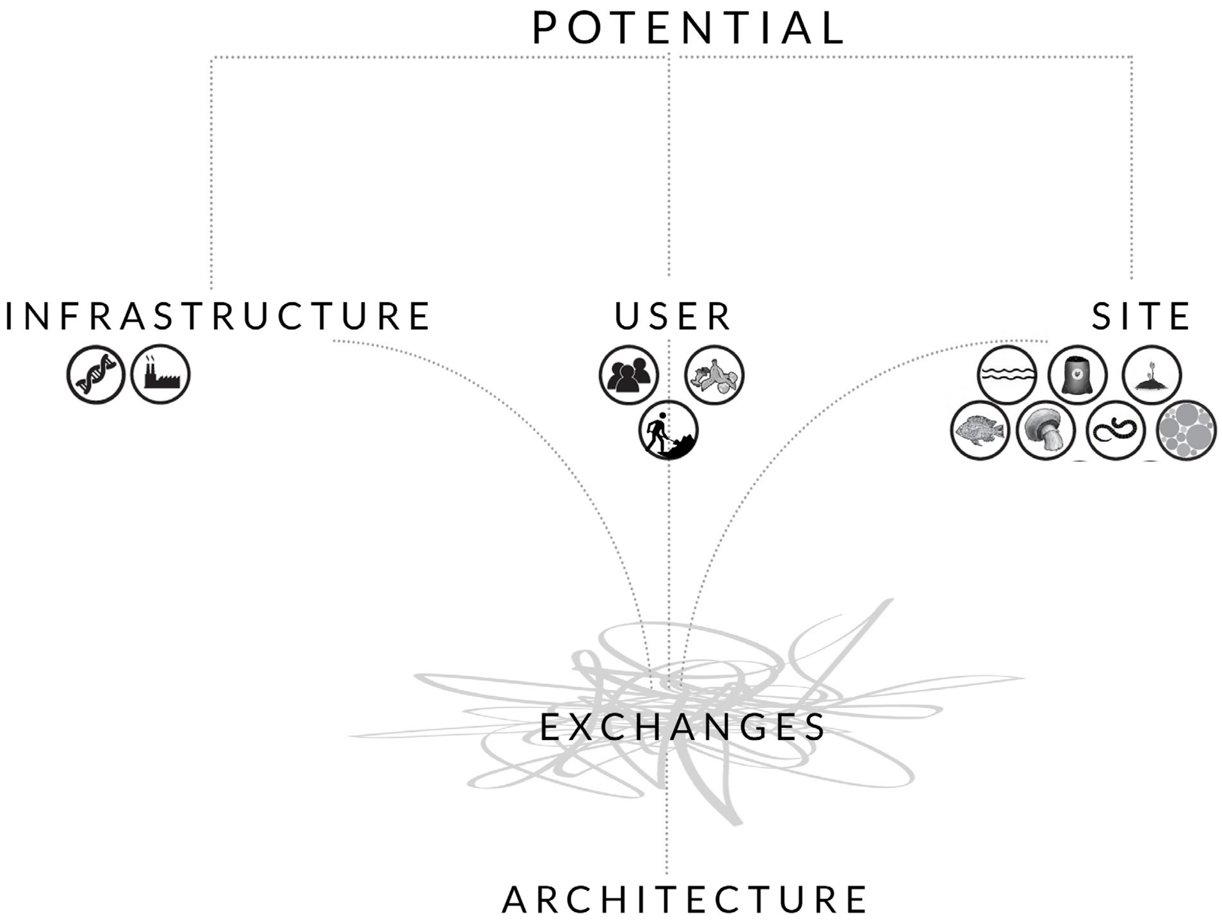


Fig 3.3 Exchanges between site, infrastrucure and user (Author, 2016).

Fig 3.4. Vermiculture turning of soil (Wormculture, 2015).

3.2 Vermiculture

The permaculture research institute (2016) states that "Vermiculture is the process of using worms to decompose organic food waste, turning the waste into a nutrient-rich material capable of supplying necessary nutrients to help sustain plant growth. This method is simple, effective, convenient, and noiseless. It saves water, energy, landfills, and helps rebuild the soil. The worms ability to convert organic waste into nutrient-rich material reduces the need for synthetic fertilizers."

Worms are a very important part of nature as they help to decompose organic matter and turn it into rich organic soil that we commonly see as topsoil. This happens naturally, but when it occurs in a controlled system, this process is called vermiculture (Permaculture research institute, 2016).

In this system decomposing organic matter is replaced with food and garden waste. The worms then consume this and creates vermicompost, that could be used to replace nutrients in the soil for plants and improve the texture of the soil. This process is extremely effective with fruit plants, vegetables and herbs as these plants quickly draw the nutrients out of the soil and need to be replaced in order for more harvests to occur. This is a more effective system then fertiliser as it is more readily available for the plants to utilize (WormFarm, 2009).

"Vermicompost improves soil structure, texture, and aeration as well as increasing its water-holding capacity. Plants will grow stronger and have deeper root systems for better drought tolerance and disease resistance.

Vermicomposting adds beneficial organisms to the soil as well. These microorganisms and soil fauna help break down organic materials and convert nutrients into a more available food form for plants" (Vermiculture Composting. 2008).

The vermiculture process is a natural way that nature recycles, creating close loops with in itself. This system can be integrated into every household to recycle garden and food waste (Vermiculture Composting. 2008).

The worms thrive in dark humid spaces that should be kept relatively warm. This means that the space needs to be well ventilated, to remove smell, but some kind of moisture needs to be released into the air. The space is to have limited windows to stop direct light and rather use indirect light. Thermal mass could be used to keep a constant temperature at night.

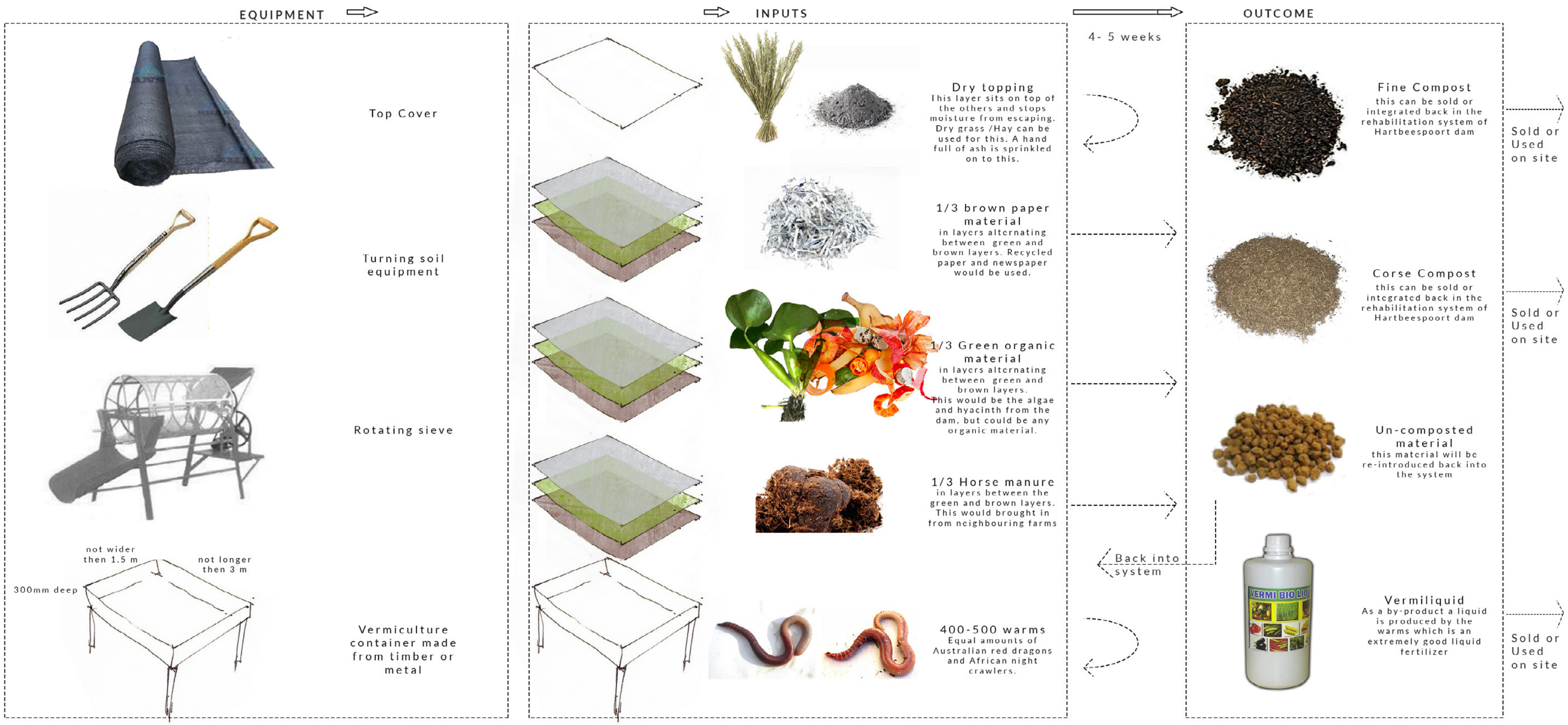


Fig 3.5 detailed flows of materials in system (Author, 2016).

Fig 3.6 Existing activities on site (Author, 2016).

The current program

Vermiculture is an existing activity on the site. It was introduced by the remediation program to deal with the eutrophication of the water. The system is inefficient as there is little capital and equipment available for the system to work. Another problem is theft of the worms that happens over the weekends. This cripples the entire system and therefore makes it unproductive.

The system has great potential though and if managed correctly and secured, a real difference can be made. There is the possibility of not only rehabilitating the site but also creating an income through selling of products such as compost and vermiliquid. Public access is crucial to the understanding of the problems on site. As the public starts to understand the situation better they will take more care of it.

The current vermiculture system has 18 composting beds, which are 2m by 1m and made from timber with a steel frame. Eight of the beds are covered with shade cloth as capital ran out and they were unable to cover the cost of the rest. As capital they have had to use other methods of creating beds such as tyres which were donated and used to construct vertical beds. These are good for reproducing the worms but ineffective for creating compost. There is an abundance of Hyacinth removed from the dam, this is stored on site but unable to be converted into compost because of the lack of beds. There have been attempts to grow vegetables and crops but only for the works and on a very small scale.

There is an existing conference centre with a small public interface where presentations of the system are made. The program employs a total of 47 permanent employees which work across the entire dam. 25 of these 47 are permanently located at the dam wall. They turn the soil in the vermiculture system and remove Hyacinth from the dam.

There is very little understanding of the vermiculture process by the public as the site is hidden from the road and there is little, to no, expression of the rehabilitation of the dam in public spaces. The public spaces that are created are unused and derelict. The spaces have also been repurposed as informal retail by the locals.

Fig 3.7 Example of potable vermiculture system (Wormculture, 2015).

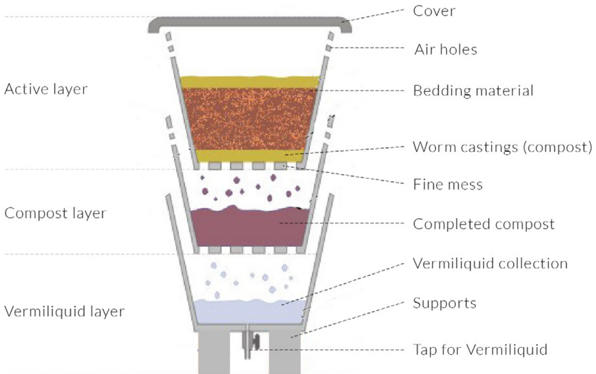


Fig 3.8 Section diagram explaining system (Author, 2016).

Fig 3.9 outputs of vermiculture system (Wormculture, 2015).

Retail Space

Retail spaces would be integrated into the design as there will be many spin-offs from the closed loop systems. The abundance of Hyacinth will mean that there will be a surplus of compost. This compost could be sold to the public or be used to grow plants that could then be sold to the public.

The storage of the compost bags can be placed in the outdoor retail space in large mesh benches that can be used for seating by the public. This will create a more open and free retail space, allowing public to engage with it weather they are indoors or outdoors.

Crops and vegetables will also be grown from the compost that will be manufactured into food at the restaurant. The restaurant could also produce picnic baskets to be sold at the retail spaces that the public could take to the picnic area.

Small vermiculture systems could be created that are spread around the dam where Hyacinth is being removed from the floating wetland barriers. This will create a catalytic approach to equalizing the eutrophication. These systems could also be manufactured for selling to the public. This will allow the public to change the way that they live their lives at home and therefore the way that they view waste. An educational tool that can be taken with them (quotidian application).

Fig 3.10 Existing activities on site (Author, 2016).

Fig 3.11 Existing activities on site (Author, 2016).

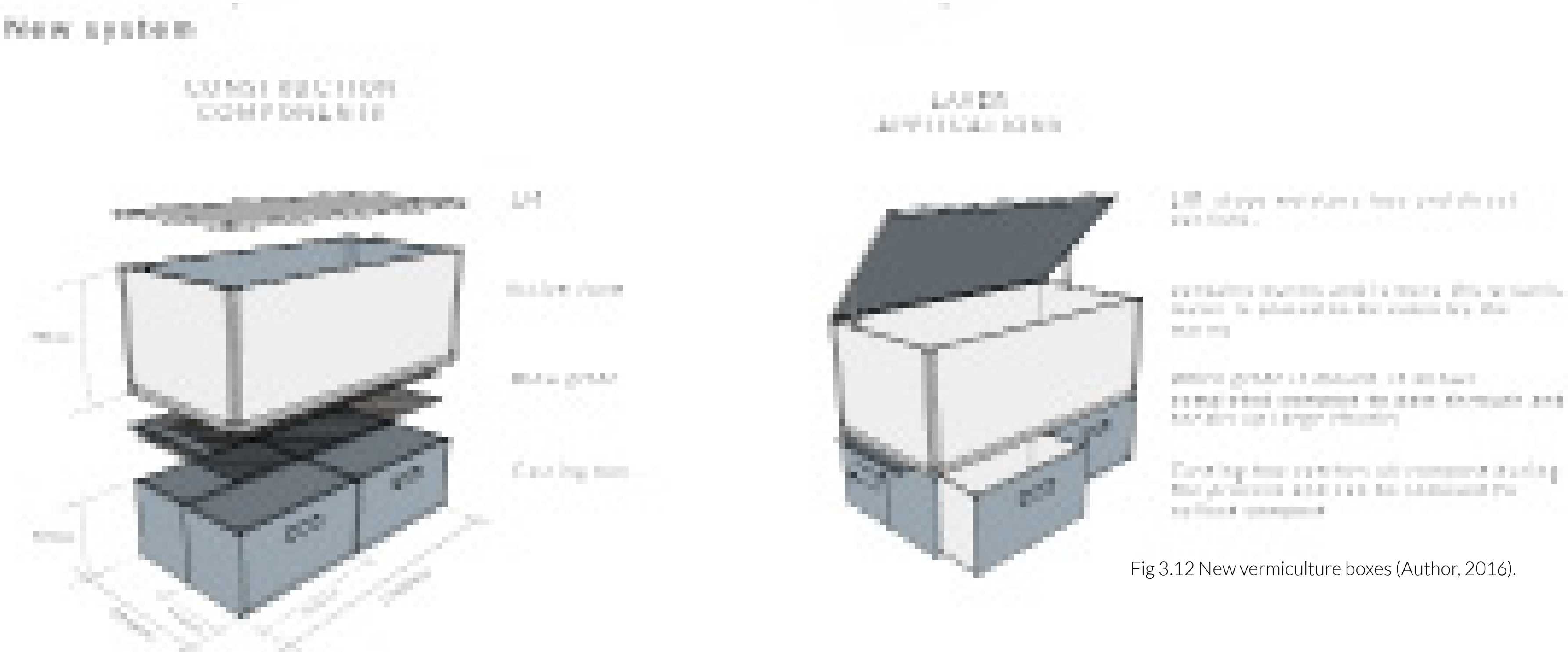


Fig 3.12 New vermiculture boxes (Author, 2016).

Fig 3.13 Vision Perspective (Author, 2016).

COMPOST INGREDIENT.

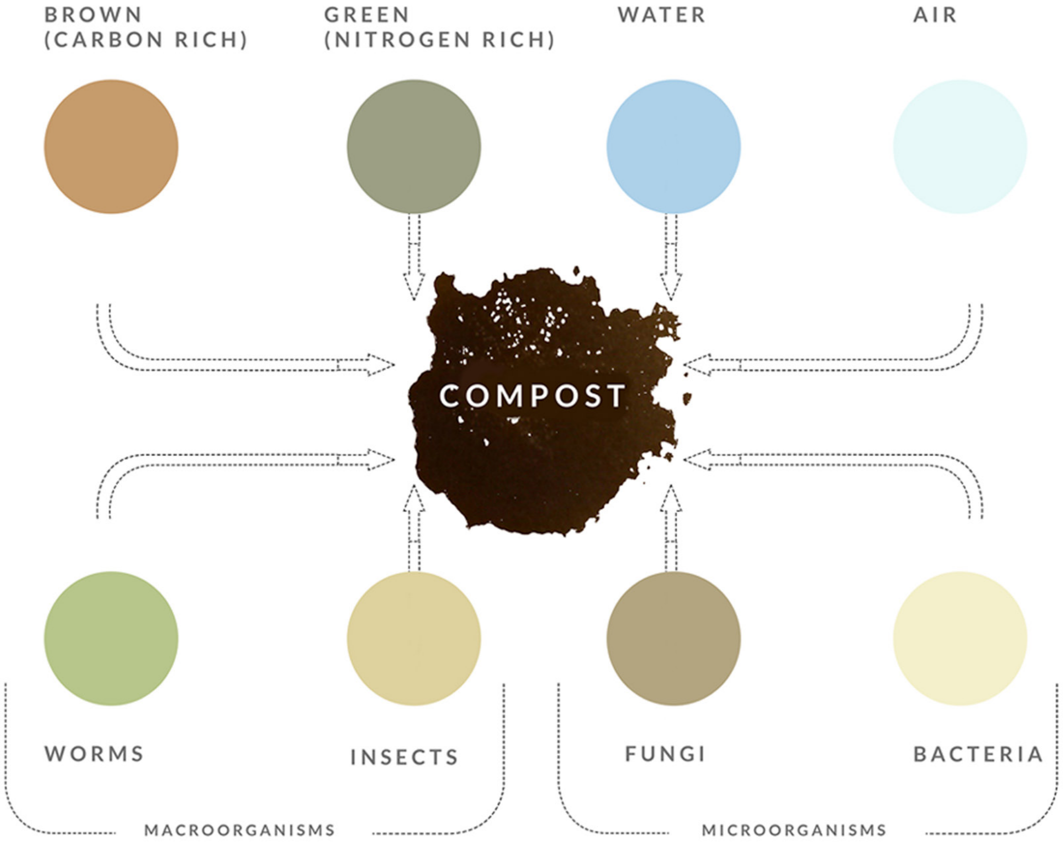
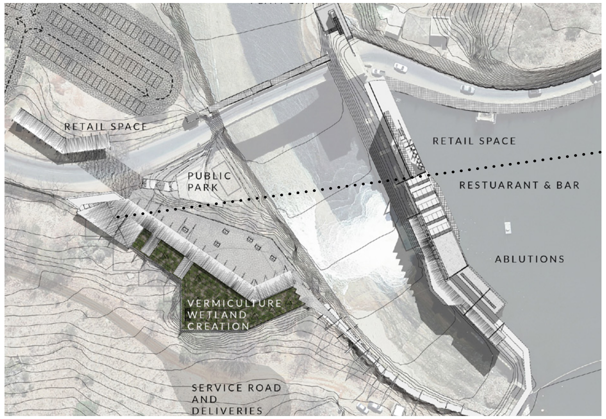


Fig 3.14 inputs and outputs of vermiculture process (Author, 2016).



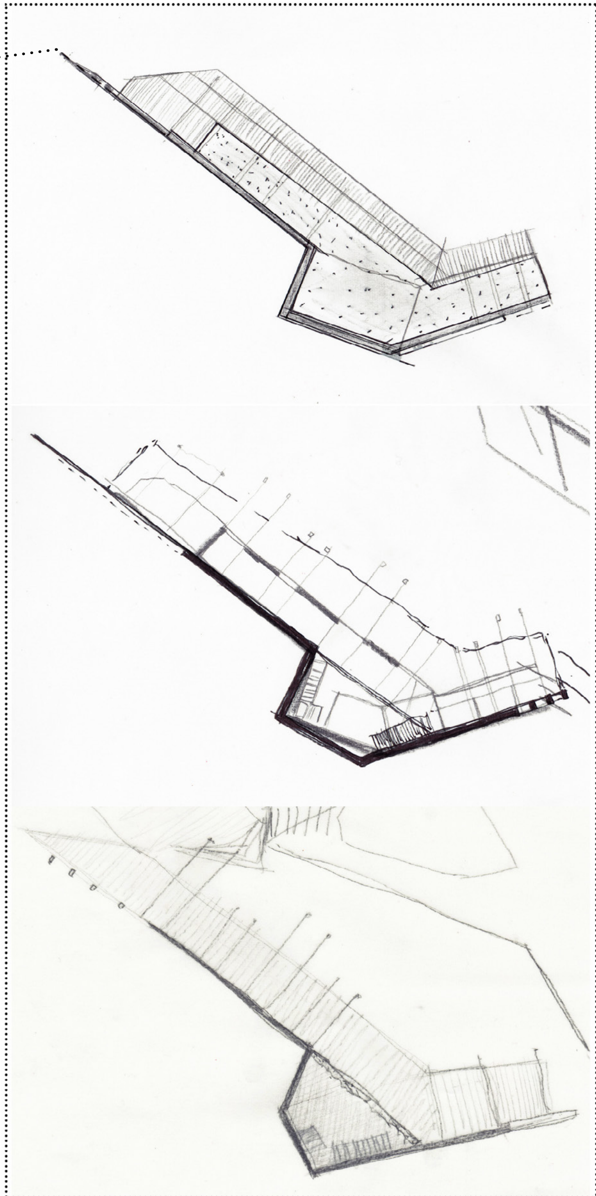


Fig 3.15 Vermiculture space development (Author, 2016).

3.3 Program space requirements

120 tons of Hyacinth is removed every year from Hartbeespoort dam. 12 000 worms can break down 1 ton of waste in one year to create 1 ton of compost. To break down 120 ton, 1 440 000 warms would be needed and each new vermiculture bed can hold 10 000. This means to turn all the Hyacinth into compost, 144 new vermiculture beds would be required.

This would require a very large space which would quickly become redundant as the problem rectifies itself over the next few years. The Hyacinth is also removed in many different locations and it would be inefficient to transport it to one location.

It is proposed to rather have five smaller vermiculture systems placed around the dam. These could be phased out slowly as the Hyacinth is reduced. Smaller systems can be monitored through the collection of organic waste in the urban areas. The buildings could become communal areas that create spaces with connections to the water.

The current vermiculture system receives 20 tons of Hyacinth every year and they are unable to convert this all to compost. The new system will require 24 vermiculture beds in order to deal with the load.

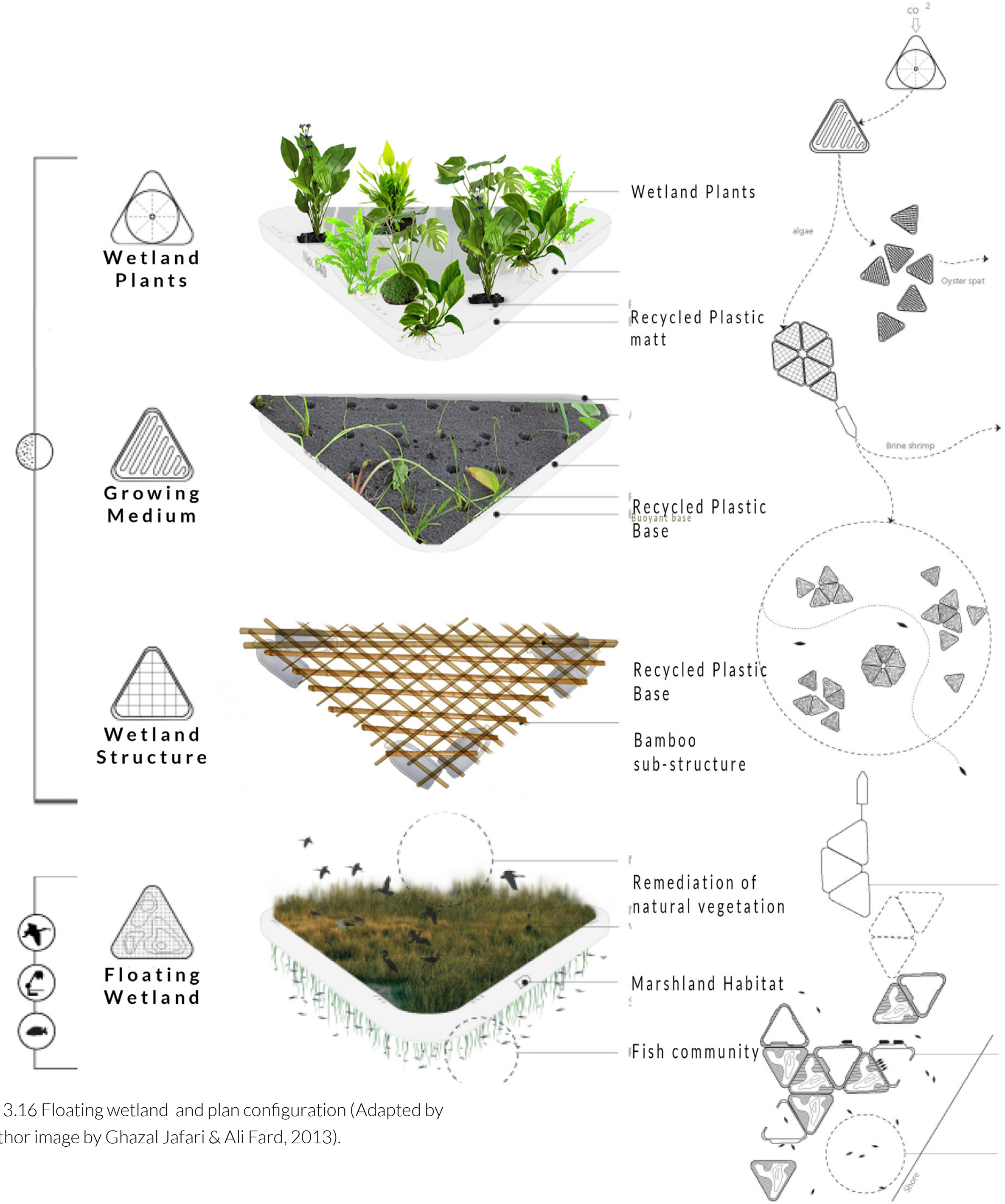


Fig 3.16 Floating wetland and plan configuration (Adapted by Author image by Ghazal Jafari & Ali Fard, 2013).

Wetland creation requirements

The creation of floating wetlands at Hartbeespoort dam were introduced through the remediation program in order to recreate the natural vegetation lost on the shorelines due to the eutrophication of the water.

Construction of new floating wetlands will allow flora to flourish as well as rehabilitate the desirable fish environments. This will as filter out the nutrients that cause eutrophication and create a balance in the water. The floating wetlands act as barriers to stop and collect the algae and hyacinth.

Where the wetland barriers are connected to the shoreline, workers can collect the organic material and used in the vermiculture process. The algae and hyacinth will be broken down to compost and in turn the compost will be used to rehabilitate the shoreline.

The materials required and construction method to create the floating wetlands are as follows;

Recycled plastic bottles and bamboo stems which are tied together with wire. This creates a buoyant base. Then a recycled plastic mat (made elsewhere) will be strapped on top of the bamboo. Young plants will be uprooted and, their soil removed,placed into the plastic mats. The wetlands are then placed and tied to the shoreline and connected together to create barriers.

This would require a staff of 15 workers. These workers would create the floating wetlands as well as grow the plants required to be placed inside them. It will also be their job to grow the fresh produce for the restaurant space which would be a constant task.

3.4 Spatial requirements

Vermiculture building

Vermiculture

• Production	$50m^2$
• Worm boxes	$200m^2$
• Storage	$25m^2$
• Collection	$50m^2$
• Bagging & sorting	$30m^2$

Wetland Manufacturing

• Production	$50m^2$
• Storage	$25m^2$
• Growing of plants	$300m^2$

Public interface

Restaurant

• Seating area	$100m^2$
• Bar area	$100m^2$

Kitchen

• Production	$80m^2$
• Storage	$15m^2$
• Cold Storage	$10m^2$

Retail

• Outdoor	$80m^2$
• Indoor	$60m^2$
• Storage	$20m^2$

3.5 SANS requirements

All programs need to be analysed with regards to the South African National Standards regulations (SANS), and where possible, the design must take these requirements further specifically looking at sustainability.

The Building and Construction Authority (BCA) Green Mark Scheme was launched in January 2005 as an initiative to shape a more environmentally friendly and sustainable built environment. It has been updated through the years as technology has advanced and was one of the first to create specific criteria for restaurants. The BCA green mark will be used in this project to add input to SANS for more sustainable design (BCA. 2012: 1).

The programs fall into three main classes of occupancy;

- The restaurant space falls under (A1) entertainment and public assembly. A place where people gather to eat, drink.
- The retail space will fall under (F2) small shop, as the floor area does not exceed 250 m^2.
- The office spaces that are needed in order to run the other programs fall under (G1) offices.

Each of these has their own unique requirements with regards to ablutions, lighting, population, air change rate and fire (SANS. 2012: 43).

Restaurant space A1

Population

The site would allow for approximately 100 m² to be allocated to the restaurant program, accordance to the SANS building regulations (see fig 6.23) this space could be used by 100 people. This would make for a very crowded space and would not be the norm. The restaurant space above will have tables and chairs for 60 uses as the average but could be increased to 100 users for large functions if needed.

The more informal bar area could incorporate a higher design population; the space would be approximately 100 m² and would allow for 60-80 users.

Due to the restaurant and bar area being 200 m² together, the kitchen would need to be approximately one third of this-66 m². The kitchen would also need to provide the food for the picnic baskets in the retail space as well any functions in the conference room this means that the kitchen space would need to be considerably larger (SANS. 2012: 45).

Lighting

The restaurant space is made up of two main areas, the kitchen space which needs high lux (750-1000 lux) for food preparation and the restaurant space which needs a lower lux level (300-750 lux) but it needs to be a constant light (SANS. 2012: 101).

Using large amounts of natural light will help to create an energy efficient building. In the kitchen this may not be possible throughout the day as it requires a high lux level and artificial lighting will need to be introduced. This lighting will need to be energy efficient such as LED lights throughout the spaces.

The BCA green mark assessment tool also encourages automated lighting systems such as motion sensors and light sensor switches to turn on the lights when lux levels are too low (BCA. 2012: 5).

Air change

The air change rate for the kitchen was significant at 20 air changes per hour, with approximately 15 staff members there would need to be 250 L per second of air (SANS. 2012: 101).

The seating area of the restaurant would be half of this at 10 air changes per hour, with approximately 60 users there would need to be 450 L per second of air. (SANS. 2012: 101).

Due to the longitudinal form of this building it would be possible to obtain this air change rate through natural cross ventilation if correctly designed. The kitchen space will need additional ventilation.

Ablutions

The restaurant and bar area combined population would be approximately 120 people. The ablutions required for this number of people are;

3WC's, 6urinals and 5 Whb's for males,

9 WC's and 5 Whb's for females

SANS allows for 20 L of sewage per person per day in a restaurant space. This is a significant amount of sewage. The first step to changing this is to use low water fixtures such as waterless urinals, secondary to implement a grey water harvesting system that could reuse this water for irrigation (SANS. 2012: 64).

The use of private water meters to track the water usage by the staff is encouraged by BCA. This will keep the staff conscious about their water usage and will also allow for leak monitoring. The adoption of water efficient practices by staff as well as visitors is most important especially in this project (BCA. 2012: 7).

Smoking area

A smoking area would need to be created for the restaurant space. The smoking area will need to be vented separately from the rest of the restaurant so as not to contaminate the fresh air entering into the rest of the building. The boardroom space, when not in use, could be closed off in such a way as to form a smoking room. There are also outdoor seating spaces that could be used by smoker (SANS. 2012: 117).

Cooking equipment

Energy consumption of a standard kitchen is extremely high and the BCA tool encourages the use of energy efficient kitchen equipment to save power. The key kitchen equipment to focus on are; deep fryers, grills, ovens, freezers and cold rooms. Correct lighting also helps lower energy usage. (BCA. 2012: 6).

Retail space F2

Population

The retail space is divided into approximately 60 m² of indoor retail space and 80 m² of outdoor retail space. This outdoor retail space is scattered through the public platform, creating benches for storage boxes and greenery from plant produce.

The regulations state that there can be a total population of 14 people in the space. This is an excessive amount of space for very few people. Due to limited space on site it is not possible to increase the retail size. Keeping a flow of people moving through will avoid over crowding as well as utilizing the outdoor space for storage and product browsing (SANS. 2012: 45).

Lighting

The retail area for the picnic baskets will require good lighting, as to display the food in the baskets to the best advantage. The light however will not need to be controlled in order to sell the plant and vermiculture systems, and therefore they can be in the outdoor space (SANS. 2012: 101).

Air change

The air change rate is relatively low compared to the restaurant space with 2 air changes per hour. The space is very shallow and it would be possible to achieve this through cross ventilation (SANS. 2012: 101).

Ablutions

The retail space's population would be approximately 14 people. The ablutions required for this space would be joined to the restaurant's ablutions;

1WC's, 1urinals and 1 Whb's for males,

2 WC's and 1 Whb's for females

Office G1

Population

Officers were needed in order to manage the programs on site such as the vermiculture process and the restaurant space. The office spaces would be split between the following spaces;

The restaurant building consisting of two offices (restaurant and the retail managers), a reception space and a safe room (60 m²).

And the vermiculture building, consisting of one office, a reception space and a safe room (114 m²) (SANS. 2012: 45).

Lighting

Like requirements for a standard office space range between 300 to 500 lx. With a relatively narrow space and deep penetration of light this can be achieved. If this is not possible then skylights could be looked at as a secondary option (SANS. 2012: 101).

Ablutions

The ablution requirements for the offices will be added to the existing ablution block of the public interface of the vermiculture building and the ablution block of the restaurant space. The requirements for offices are as follows (SANS. 2012: 65);

1WC's, 1urinals and 1 Whb's for males,

2 WC's and 1 Whb's for females

Inclusive design

Inclusive design is extremely important in this project in order for all people to engage with this new celebration of water. It was necessary to make ease of access possible, ramps would need to be introduced as there are large changes in height when moving from the proposed vermiculture space to the restaurant and public platform. Moving up into the second story of the restaurant space will also need to be thought through. Disabled toilets also need to be integrated on both sites according to the regulations.

Fire

All the types of occupancy have to have one emergency route and 2 feeder routes, but due to the fact that the route will be longer than 45 m, there will need to be an additional route added. NO emergency route shall be longer then 45m to the exit door(SANS. 2012: 158).

There will need to be a 60 min occupancy separator between the restaurant space and retail or office space. A Class 2 fire door will be required between the two occupancy (SANS. 2012: 162).

Any other structural element or component needs a 60 min fire rating in these occupancies.

All wall, floors and ceilings in the emergency route shall have a fire rating of 120 mins and be wider than 1200mm due to a possibility of there being 130 people.

Provision of hose reels, hydrants and portable fire extinguishers (every 200 m²) will be necessary (SANS. 2012: 162).