9. TECHNICAL INVESTIGATION

1. Hydrology
   - Irrigation and maintenance strategy
   - Stormwater detention feature
   - Water feature

2. Information tower and vertical garden

3. Street Furniture

4. Edge details

10. Conclusion
9. TECHNICAL INVESTIGATION

The technical investigation will be discussed along the following categories:

1. Hydrology and systems
   - Maintenance strategy
   - Stormwater detention facility
   - Water feature
2. Vertical garden and kiosk
3. Street furniture
4. Edge details
9.1 Hydrology

The hydrology consists of three systems:

1. The retention of stormwater for irrigational purposes (Refer to Master Plan)
2. Stormwater detention structures that double up as sunken seating areas (in Dr. Savage Plaza)
3. Water feature (Dr. Savage Plaza)

9.1.1 Irrigation and maintenance strategy

The success of the open space system is closely related to adequate maintenance. The proposed spaces will require lots of water. Stormwater will be used to irrigate the site. The following options were considered:

- Detaining water as it enters the site and gravity feeding it towards the open spaces
- Treating the water in an open system while it filters through the site.
- Using the existing stormwater network and storing the water in low lying areas.

Fig. 9.1: Areas zoned in the restorative open space framework which would require water for irrigational purposes. (Author, 2008)
The third option was identified as the most feasible for the site. To determine if enough water would be available, the process below was followed:

1. Determining the catchment areas.
2. Determining the amount of water needed for irrigation purposes per time period, per catchment area. (based on type of coverage and average water requirement of 25mm per week).
3. Determining the amount of water available per catchment area.

From the above steps of the process, it was determined that two irrigation dams should be adequate for the storage of water. The dams should be located close to the lowest point of the main stormwater pipe, and preferably on under-utilised land.

Table 2: Water requirements for maintenance strategy (Author, 2008)

<table>
<thead>
<tr>
<th>Dam</th>
<th>Catchments</th>
<th>Combined areas</th>
<th>Area to be irrigated</th>
<th>Volume needed per week</th>
<th>Volume needed per month</th>
<th>Volume need per year</th>
<th>Volume need per day m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dam 1</td>
<td>A1 + A2</td>
<td>78089</td>
<td>11638</td>
<td>131.5</td>
<td>1260</td>
<td>15129</td>
<td>41.6</td>
</tr>
<tr>
<td>Dam 2</td>
<td>A3 + A4 + A4b</td>
<td>125911</td>
<td>12542</td>
<td>335.7</td>
<td>1342</td>
<td>16297</td>
<td>44.6</td>
</tr>
</tbody>
</table>

Fig. 9.2: Existing Stormwater drainage network and catchment areas. (Author, 2008)
In order to determine the volume of the respective dams, the following steps were taken:

1. Determining the combined catchment area for each dam.
2. Assuming a surface area for the dam.
3. Determining the rainfall spread. The mean annual precipitation for the sub-catchment area is 683mm. The inflow for the dam was calculated by determining the rainfall spread per month (rain on the dam; and rain that enters the dam via stormwater system). The spread takes into account water losses due to evaporation.
4. Determining the extent of evaporation. The mean annual evaporation (MAE) for the area is 1600mm and this was taken into account during calculations.
5. Determining the runoff factor, which is 0.85.
6. Determining abstraction/outflows. This is based on the amount of water needed for the ring system per week.
7. Calculating the proposed volume is the amount of excess water that needs to be stored to ensure that there is always enough water during the drier seasons.
8. Designing edge details according to conditions. Edge details are dependant on the slope at which the stormwater
pipe system enters the dam area. The pipe cannot enter the dam at a level that is lower than the water level. This results in a large transitional area and gradual slope. Thus the maximum capacity which the dams have to provide are as follows:

- Dam 1 = 3822.7 m³
- Dam 2 = 4984 m³

Also refer to Table 2, p 143.

9.1.1 a) Irrigation system

The stormwater drainage network is used to convey the water to the low lying areas. Water enters each dam via a stormwater inlet. Water will be filtered and pumped through a series of alternating smaller closed ring systems. Each dam’s ring systems is operated with one pump, separated by a manifold and valve. With this strategy, a smaller pump can be used and maintenance of the system is easier. The system will, however, have many valves in different areas, so that overlapping systems can be used optimally. This means that all ring systems will not necessarily commence at the pump chamber, a section of one ring can be used reach another ring system.

Fig. 9.4: Conceptual placement of irrigation zones. These should be connected through a series of valves to the pump and to other rings to form a network of overlapping ring systems. (Author, 2008)
9. TECHNICAL INVESTIGATION - Maintenance Strategy

Fig. 9.5: Typical north-south section through Dam 1 during spring and autumn. Scale 1:500 (Author, 2008)

Fig. 9.6: Typical north-south section through Dam 1 during summer. Scale 1:500 (Author, 2008)

Fig. 9.7: Typical north-south section through Dam 1 during winter. Scale 1:500 (Author, 2008)
9.1.1b) Inflow and outflow

Although the dams were designed to accommodate all the stormwater that the network could contain up to the point of inlet into the dam, each dam should also have an overflow structure to deal with excess water in case of emergency. Such an overflow structure should be located at a high point in the dam wall and be connected to the main stormwater network downstream of the dam. The overflow structure was not detailed.
Fig. 9.9: Section through dam linings Scale 1:10 (Author, 2008)
9. TECHNICAL INVESTIGATION - Maintenance Strategy

Fig. 9.10: Section through pump chamber. Scale 1: 25 (Author, 2008)
### 9.1.2 Stormwater detention feature

Sunken seating areas act as a stormwater detention feature during the rainy season. Rainwater is channelled in furrows towards beds of crushed rock. The water drains through the medium and through the wire mesh and steel structure packed with crushed rock. Infiltration is prevented through an impermeable poly-olephyn layer. Water trickles slowly through the wall, over the little weir and into the channel that slopes at 4% towards a series of sunken areas. The system is conceptually divided into three parts:

1. **Channels**
   - The size of the channels was determined and verified using the Manning equation.
   - The time of concentration (Tc) for water reaching the bed of crushed rock was determined with the Kirpich formula: 3.7 minutes
   - \( Q = 0.013 \text{m}^3/\text{s} \)

2. **Bed of crushed rock and feature wall**
   - The depth of the bed is related to the maximum level difference which could be achieved between the upper and the lower terrace.

3. **Sunken seating areas/detention structures**
   - The sunken area is graded to form a slight channel that flows from one detention facility towards the next. A drain is located on the highest point of the lowest step of the sunken seating area to cut-off excess water, from where it enters the existing stormwater system.
   - Surface characteristics of the sunken seating areas were chosen to present different effects according to different amounts of rainfall.

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**Fig. 9.11 Components of the stormwater detention system. (Author, 2008)**
9. TECHNICAL INVESTIGATION - Stormwater Detention Feature

Fig. 9.12: Diagrammatic description of stormwater feature-system. (Author, 2008)

- Erratic fountain
- Channel
- Bed of crushed gravel
- Stormwater feature wall
- Channel
- Stormwater detention structures/ sunken seating areas
- Connection to municipal stormwater system
9. TECHNICAL INVESTIGATION - Stormwater Detention Feature

Fig. 9.13: Typical section of drainage channels toward stormwater feature. (Author, 2008) Scale 1: 25

Fig. 9.14: Plan of drainage channels toward stormwater feature. (Author, 2008) Scale 1: 25
9. TECHNICAL INVESTIGATION - Stormwater Detention Feature

Fig. 9.15: Plan of the feature wall. (Author, 2008)

Fig. 9.16: Rock-filled wiremesh and steel structure. (Author, 2008)

Fig. 9.17: Stone clad walls and veldgrass. (Author, 2008)

Fig. 9.18: Rock-filled wiremesh and steel structure. (Asensio, 2005)

Channel

Terraced steps to lawn

Chlorophytum saundersiae
and Crocosmia aurea

Bench

Channel to sunken seating areas

Bed of crushed rock

2 - Bed of crushed rock and feature wall
Crocosmia aurea and Chlorphytum saundersiae

40 x 40 2000 square tube steel structure lined with wire mesh welded to edges and packed with dry rock

500mm bed of crushed rock with geotextile and waterproofing layer on compacted soil, sloped towards feature wall

Rock in mortar with raked joints

Channel: slope 4% towards sunken seating/stormwater detention areas

Uplight

Paving as specified

Surface: not a high use pedestrian area

Fig. 9.19: Section through stone packed wire-mesh and steel structure: feature wall (Author, 2008) Scale 1: 20
15. TECHNICAL INVESTIGATION - Stormwater Detention Feature

- Lamppost: refer to Street Furniture
- Crocosmia aurea and Chlorphytum saundersiae
- Steel frame with bench
- 40 x 40 2000 square tube steel structure lined with wire mesh welded to edges and packed with dry rock
- Channel sloped 4% towards sunken seating area
- Paving as specified
- Red-brick and stone-clad wall
- Steps down to lawn

Fig. 9.20: Elevation of feature wall connection to walls, steps and ramps. (Author, 2008) Scale 1:20
Fig. 9.21: Perspective of sunken seating areas: channels. (Author, 2008) Scale 1: 20
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1. TECHNICAL INVESTIGATION - Stormwater Detention Feature

Fig. 9.22: Drainage of water from one detention structure to the next. (Author, 2008) Scale 1: 20

Sunken seating area/stormwater detention feature - refer to Fig. 9.24

Coloured ceramic tiles (colour coding) as per master plan area (elevation)

Typical longitudinal section of drainage furrow. Also see Fig. 9.13
Coloured ceramic tiles as per master plan reference area

400 x 400 x 0.5 cast in-situ concrete treads
100 mm 20 MPA in-situ cast concrete base

100 mm aggregate base

rock in mortar

300 dia cast iron grating and frame
overflow drain connected to municipal stormwater system

paving as specified

Fig. 9.23: Sunken seating area and stormwater detention structure. (Author, 2008) Scale 1: 20
9.1.2 Water feature

An erratic fountain with 12 spouts is one of the main features of the transitional terrace. The spouts are connected in a circular fashion with a distributor pipe which runs through a series of channels. A suction pipe with chlorine tablets in the suction strainer will purify the water, before it is pumped through a centrifugal pump and 150 kg sand filter that is located in a pump room. The pump room is accessible from the service area of the information tower. (Refer to section 9.2, Fig. 9.30) The system is activated with an electrical control panel inside the pump chamber.

- The volume of the water in the channels is 0.5 m³ per channel or 3.5 m³ in total
- The volume of the water in the air = 0.37 m³

Therefore the total system requirement, with allowance for the difference between static and operating levels is 7 m³. A 0.75 kW·H pump should be adequate.

Fig. 9. 24: Erratic fountain supply system. (Author, 2008)
75 concrete with exposed aggregate finish
Granite slab with perforated slats. Textured finish
65mm Mentis grating with opening cut flush to nozzle
stainless steel central jet nozzle with "Ocean mist" LED
light fitting
overflow armature
Concrete basin

Fig. 9.25: Typical section of erratic fountain. (Author, 2008) Scale 1:25

Fig. 9.26: Interactive water features. (Asensio, 2005)

Fig. 9.27: Feature lighting (Asensio, 2005)
Fig. 9. 28: Plan - Erratic fountain. (Author, 2008) Scale 1: 25

Mentis grating cut flush to stainless steel nozzle
Dark granite with texturised (non-slippery) finish and perforated slats.
75 concrete with exposed aggregate finish and red-brick detail
9.2 Vertical garden and information kiosk

The vertical garden in the information tower is fed by a pump system from the same pump chamber as the erratic fountain, toward a tank on the top of the tower. This results in a pressure of 1.2 bar, which is adequate for drip irrigation of the plants on the platforms containing growth medium.

Each of the three vegetated levels will contain approximately 2.3 m³ of growth medium. Pre-cast containers containing the soil are placed on a steel platform. The plants will require 0.15 m³ of water per level per week. Therefore a tank with a capacity of 500l should be adequate.

Fig. 9.29: Vertical vegetation structure. (Abelho, 2007)

Fig. 9.30: Green tower and information kiosk. Southern elevation. (Author, 2008) Scale 1: 20
Access to top levels

Fig. 9.31: Diagrammatic plan view; information kiosk (Author, 2008) Scale: Not to scale

Fig. 9.32: Thunbergia alata (Joffe, 2001)

Fig. 9.33 Senecio macroglossus (Joffe, 2001)

Fig. 9.34: Clemantis bracheata (Joffe, 2001)
Fig. 9.35: Section of green tower and information kiosk. Southern elevation. (Author, 2008) Scale 1: 100
Pre-cast concrete planters
3 mm steel chequered plate base
Drip irrigation ring (from tank)

150 x 150 mm steel H-Column
Steel ladder

9. TECHNICAL INVESTIGATION - Vertical Garden

6mm steel cable
Gravel layer
Compacted soil

Senecio macroglossus
150 x 150 mm steel H-Column

Fig. 9.36 : Plan view of green platforms (Author, 2008) Scale 1: 50
Fig. 9.38 : Detail: Vertical garden (Author, 2008) Scale 1: 20

Fig. 9.37 : Section: Green platform (Author, 2008) Scale 1: 50
9.3 Street furniture

Design guidelines were listed in Chapter 8. The design palette will be used to strengthen the imageability of particularly the Dr. Savage Plaza, but also the Hospital Hill in general. Material use include; polished concrete, standard steel H-profiles, galvanised afterwards, and galvanised IBR sheet metal. The range includes a bollard, bollard with light, bench, bench with backrest, shelter, shade structure and trade stall.
9. TECHNICAL INVESTIGATION - Street Furniture

Fig. 9.43: Bollard with light, sectional perspective. Scale: not to scale (Author, 2008)

Fig. 9.44: Coloured, glazed ceramic tiles in concrete. Scale: not to scale (Author, 2008)

Fig. 9.45: Litter Bin Part elevation. Scale: 1:25 (Author, 2008)

Fig. 9.46: Litter Bin Plan. Scale: 1:25 (Author, 2008)

Fig. 9.47: Litter Bin Perspective. Scale: not to scale (Author, 2008)
150 mm re-inforced, pre-cast concrete bench with polished finish.

pre-cast concrete bench without backrest fixed to concrete footing with bolt cage

2mm perforated sheet metal, edges bent to specification. Welded to 45mm steel support bars fixed to concrete with bolt and nut

150mm pre-cast concrete bench with drainage gaps

Fig. 9.48: Bench without backrest. Part elevation. Scale 1:25  (Author, 2008)

Fig. 9.49: Bench without backrest. Section. Scale 1:25  (Author, 2008)

9. TECHNICAL INVESTIGATION - Street furniture
2mm perforated sheet metal, edges bended to specification. Welded to 45mm steel support bars fixed to concrete with bolt and nut.

150 mm re-inforced, pre-cast concrete bench with polished finish.

Fig. 9.50: Bench without backrest. Plan. Scale:1:25 (Author, 2008)

Fig. 9.51: Bench without backrest. Perspective. (Author, 2008)

Fig. 9.52: Bench without backrest. Detail. (Author, 2008)
Fig. 9.53: Bench with backrest Part elevation. Scale 1:25 (Author, 2008)

40 dia hollow steel section bent to specification and fixed to concrete bollard with bolt and nut. 2mm perforated sheet metal bent to specification and welded to steel frame.

2mm perforated sheet metal, edges bent to specification. Welded to 45mm steel support bars fixed to concrete with bolt and nut.

0.15 pre-cast concrete bench with polished finish

Fig. 9.54: Bench with backrest. Section. Scale 1:25 (Author, 2008)

40 dia hollow steel section bent to specification and fixed to concrete bollard with bolt and nut. 2mm perforated sheet metal bent to specification and welded to steel frame.

150mm pre-cast concrete bench with drainage gaps.
2mm perforated sheet metal, edges bent to specification. Welded to 45mm steel support bars fixed to concrete with bolt and nut.

40 dia hollow steel section bent to specification and fixed to concrete bollard with bolt and nut.

Pre-cast concrete bench with drainage gaps.
25.4 mm hot rolled hollow steel sections, galvanised and welded to inner base plate of H-steel profile.
25mm x 4.5xx fusion welded grating, welded flush to H-profile and closed at top end

2mm hot-rolled mild steel bar welded to H-profile and galvanised afterwards.

150 x 150 x 10 steel H-Profile, bent to specifications. Galvanised afterwards.

50 mm inspection hole with 2mm galvanised steel cover fixed with galvanised steel self tapping screws

500 MM Dia by 1000 20MPA in-situ cast concrete footing, lamp post fixed to footing with M20 steel bolt cage

25mm dia PVC conduit cast into concrete footing

Fig. 9.61: LAMP POST
Section Scale 1:25 (Author, 2008)

Fig. 9.62: Inspection hole and conduit channeled behind 2mm steel flange welded to inside of H-Section. Scale: Not to scale (Author, 2008)

Fig. 9.63: Mentsis grating bent to specification and welded flush to outer edge of H-profile and overlapping flange by 50 mm. Scale: Not to scale (Author, 2008)
Fig. 9.64: Shelter. Elevation. Scale 1:25 (Author, 2008)
76 dia hollow, round steel sections supporting 0.6 mm galvanised IBR roof sheeting, fixed to steel section on indicated intervals.

Steel profile bent to specification. Galvanised afterwards.

Wire-mesh screen fixed behind 25mm angle iron, galvanised and welded to main structure.

“Bench with backrest” supported on 76 dia round hollow steel section, welded to inner web of 150 x 150 steel H-Profile. Galvanised.
9. TECHNICAL INVESTIGATION - Street Furniture

Fig. 9.66: Steel bench. 76 dia. round, hollow steel sections welded to main structure with 2mm perforated metal sheet seating bent to specification and, welded to frame frame. Galvanised afterwards. Scale: Not to scale (Author, 2008)

Fig. 9.67: Connection between H-profile (main structure), IBR-sheeting and wire-mesh screen. Scale: Not to scale (Author, 2008)

Fig. 9.68: Shelter Plan view. Scale 1:25 (Author, 2008)

150 x 150 x 8 Steel H-Profile column. Bent to specification and galvanised afterwards.

0.6 IBR roof sheeting fit between H-Profile and 76 dia round, hollow steel section beams.

2mm perforated metal sheeted bent to specification and welded to 76mm dia hollow, round section frame.
Fig. 9.69: Trade stall
Elevation. Scale 1:25 (Author, 2008)
Perforated, locable ‘Xpanda door’ shutter with tracks fixed to inside of H-column main structure

40 x 40 steel frame

Fig. 9.70: Fixing of IBR sheeting to steel structure. View from outside Scale: not to scale (Author, 2008)

Fig. 9.71: Fixing of IBR sheeting to steel structure. View from inside Scale: not to scale (Author, 2008)

Fig. 9.72: Trade stall Plan. Scale 1: 25 (Author, 2008)
Perforated, locable ‘Xpanda door’ shutter with tracks fixed to inside of H-column main structure
25mm conduit connected to luminaire
40 x 40 square steel section frame welded to main structure with 2mm sheet metal sides welded flush to frame
2mm sheet metal wall fixed in front of 40 x 40 square tube support frame, galvanised and welded to 150 x 150 steel column

2mm sheet metal wall fixed in to and in of front 40 x 40 square tube support frame, galvanised.

40 x 40 steel frame

Perforated sheet metal shelves bended to specification and welded to 76 dia round, hollow tube sections. Solid sheet metal to front of stall

Perforated sheet metal seat bended to specification and welded to 76 dia round, hollow tube sections.
25.4 mm hot rolled hollow round steel sections welded to inside centre plate of H-profile columns. Galvanised afterwards.

Clematis bracheata

Pre-cast concrete seats
9. TECHNICAL INVESTIGATION - Street furniture

25.4 mm hot rolled hollow round steel sections welded to inside centre plate of H-profile columns. Galvanised afterwards.

Fig. 9.76: Trellis. Elevation. Scale 1:25 (Author, 2008)
9.4 Edge details

Pre-cast concrete edges are used in most of the step details. The facing of the riser alternates between redbrick close to building edges, and dry packed stone in the terraced lawn areas leading up to the feature wall, which is constructed of the same material. The plinth in front of the main entrance to the T.R.H is constructed from redbrick.
Fig. 9.80: Transition of public space to semi-private space of formal and public buildings.
Section  Scale 1:20 (Author, 2008)

Paving as specified

Fig. 9.81: Red brick seating walls
Not to scale. (Author, 2008)

Concrete seating steps with pre-cast concrete tread and red brick riser.
9. TECHNICAL INVESTIGATION - Edge details

Fig. 9.82: Perspective of plinth and seating areas of main admin building (Author, 2008)
Drainage channel towards stormwater feature
3mm perforated sheet metal bench - refer to street furniture.
Growth medium
Gravel layer
30mm drainage pipe
Compacted soil

Fig. 9.83: Plinth to Main Administration building Section  Scale 1:25 (Author, 2008)