9 Technical Resolution

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Illus. 9.2: Plan indicating the location of each detail. For the wetland's position, see Illus. 7.8 (Author, October 2011)

Illus. 9.3: Packed gabions to be used as seating walls (www/gabionbaskets.co.za)

Illus. 9.4: Corobrik Champagne clay pavers (www.corobrik.co.za)

Illus. 9.5: Coarse sand (Author, June 2011)

This chapter discusses materials used, water systems, general technical details and how the design drivers were incorporated on a detail level. Illus. 9.2 indicates where each detail discussed is located.

9.1 Material palette

Man-made materials were restricted as much as possible, rather using plants, boulders, mounds, sand and water to construct the landscape. Materials were chosen to facilitate easy dismantling and re-use elsewhere. Labour-intensive construction methods are used, such as hand-packing the gabion seating walls. This creates employment opportunities and cuts costs. A similar hard material palette is used throughout the park, while the planting palettes differ from area to area.

9.1.1 Champagne clay pavers

These are readily available from Corobrik (Springs factory). They were chosen for their uniform light colour and are also recyclable.

9.1.2 Boulders and stone

Dolorite stone (to be used in the gabion seating walls, as edging for planted areas, and boulders for seating) can be sourced from excavation rubble from various building sites in the Pretoria area, or from the Willow and Donkerhoek Quarries, both within a radius of 20km from the site.

9.1.3 Sand

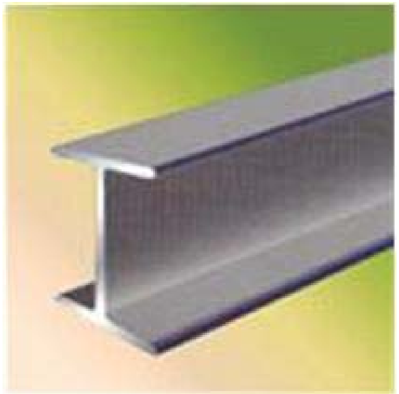
Coarse sand to be used in the play areas can be sourced from Donkerhoek quarries as well.

9.1.4 Logs

Untreated *Eucalyptus* logs to be used for the Tunnel area and as edging can be sourced from sites in Pretoria (such as the Faerie Glen Nature Reserve, from where they should be removed.)

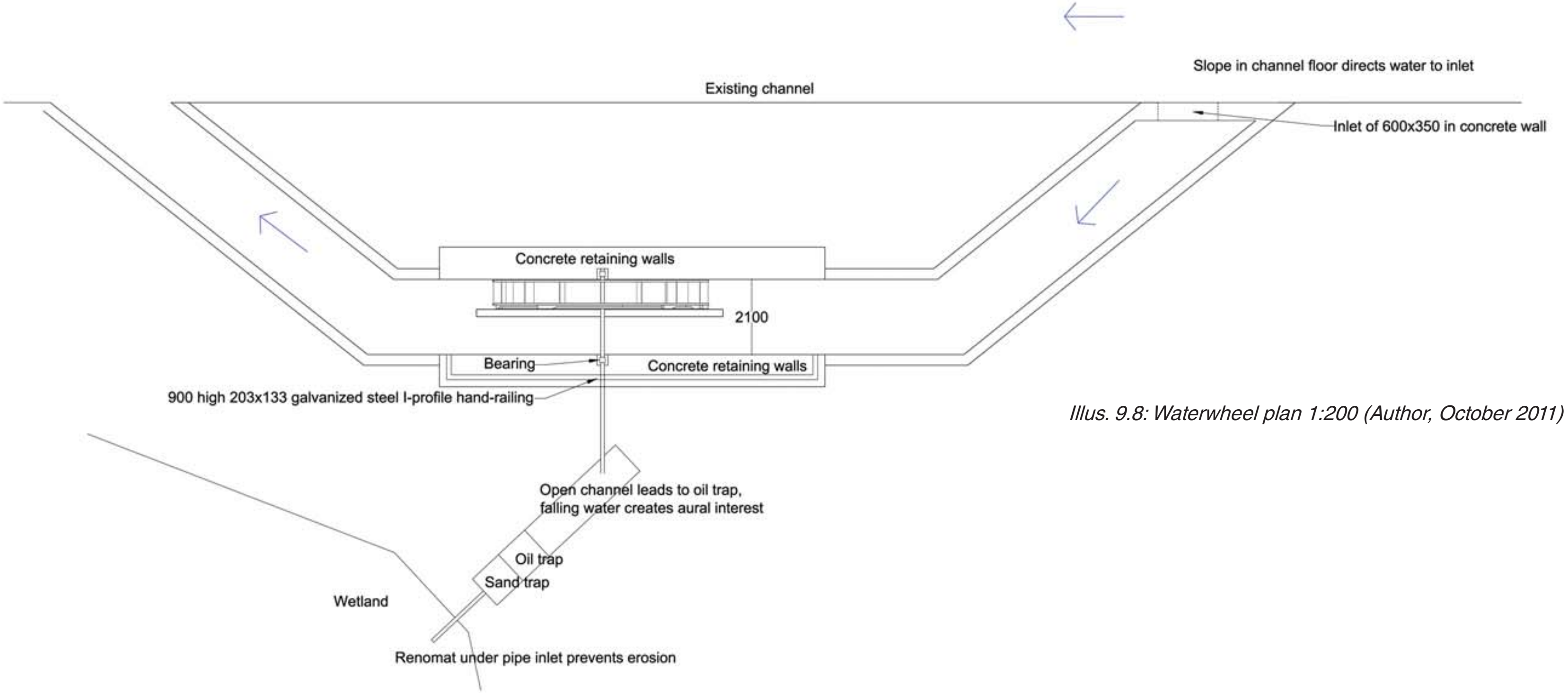
9.1.5 Steel profiles

Steel profiles provide a light-weight structure for the climbing tower.

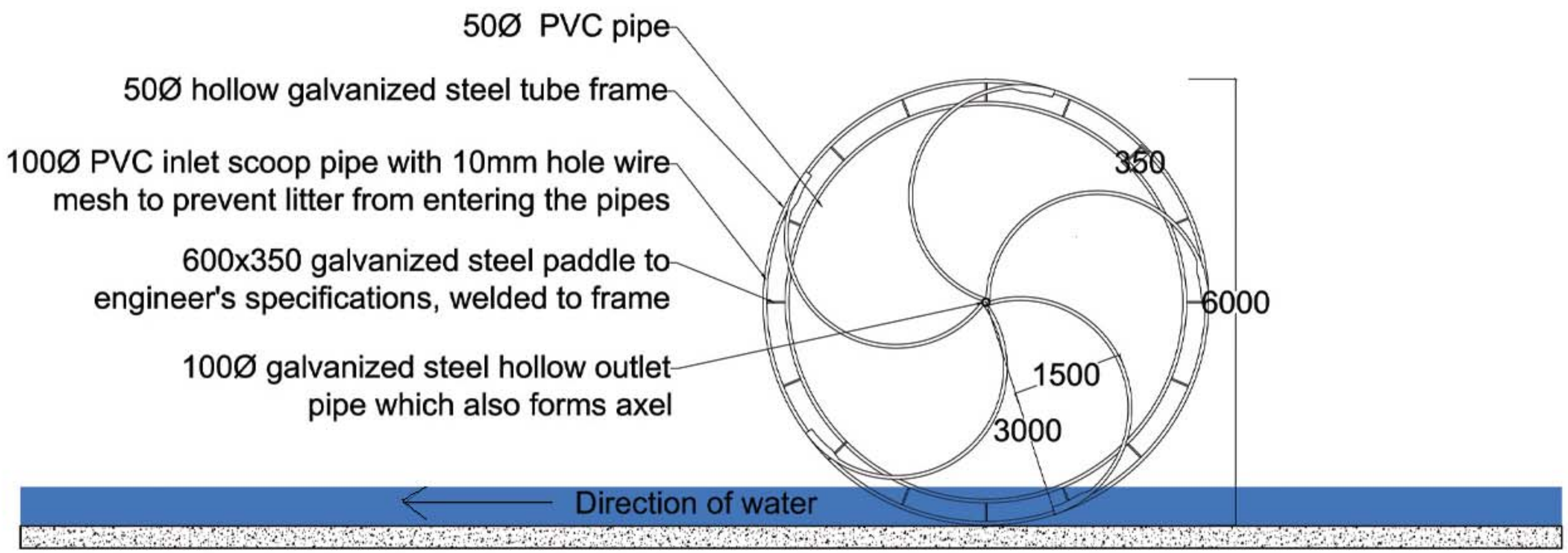


Illus. 9.6: Galvanized steel I-profile (www. http://ruiyinsteel.en.nobodybuy.com/)

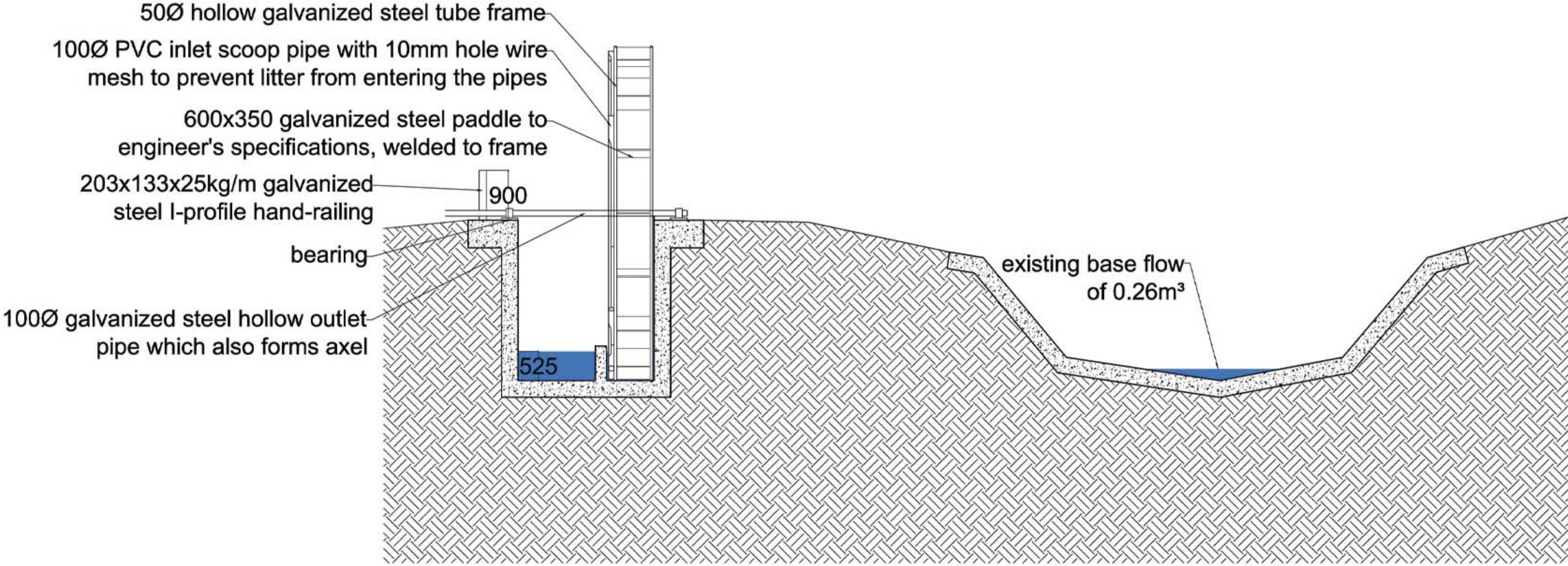
Illus. 9.7: Exposed aggregate concrete (Author, March 2009)



Illus. 9.8: Waterwheel plan 1:200 (Author, October 2011)



Illus. 9.9: Waterwheel elevation 1:100 (Author, October 2011)



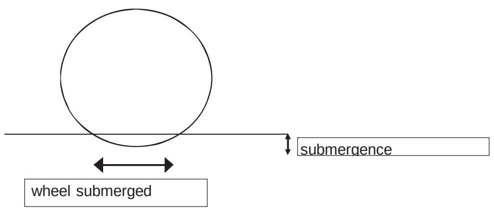
Illus. 9.10: Waterwheel and channel section 1:100 (Author, October 2011)

9.2 Waterwheel

A coil waterwheel is used as an alternative to a waterwheel with buckets. As the water is collected within pipes it is easy to transport it to where it is needed as opposed to a bucket waterwheel which needs a collection channel into which to empty the buckets. The waterwheel is designed to deliver 4l/s.

The water from the main channel will be taken into a side channel to ensure the right speed and amount of water, and to prevent damage to the wheel during a flood event.

spiral to be made of 50mm pipe

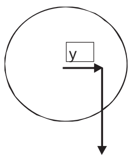


this section is only important for pumps where the head is greater than the wheel diameter
select number of coils from head required

H	3	delivery head
D	6	wheel diameter or outer coil diameter
d	0.05	pipe diameter
Patm	9.8	atmospheric pressure
hn=	7.40625	
n=	0.447552	number of coils
add 20%	0.537063	total number of coils

each scoop should half fill one coil.
length of 1 coil

D= 6		m
length of 1 coil	18.85	m
half coil length	9.424778	m
required coil fraction	0.25	
coil length	4.71	m
pipe diameter (m)	0.05	m
volume of half coil	0.009253	m³
number of coils	1	
mass of water in whee	9.25	kg
moment that must be overcome		
	173.357	N.m



y=2r/pi

velocity of water through flume (n	1.8529	m/s
efficiency	0.9	
velocity of rim of wheel)	1.66761	m/s
kinetic head (m)	0.141739	m
pressure pgh	1390.462	Pa (N/m²) assume only one paddle submerged at a time.
submergence (m)	0.35	m
width of paddle required	0.118739	m

length of coil submerged

angle	0.48787	rad
2xangle	0.97574	rad
submerged length	2.93	m
length to be filled	1.79	m
volume that must be filled by scoop		
0.003505	0.003505	
diameter of scoop	0.1	m
length of scoop	0.446	m

for multiple spirals

number of separate spirals	5	
paddle width	0.593695	m
output in m³/s	0.004093	m³/s
output l/s	4.092931	l/s
output m/s	245.5758	l/min
output l/hour	14734.55	l/hour

quantity to be pumped by 1 coil

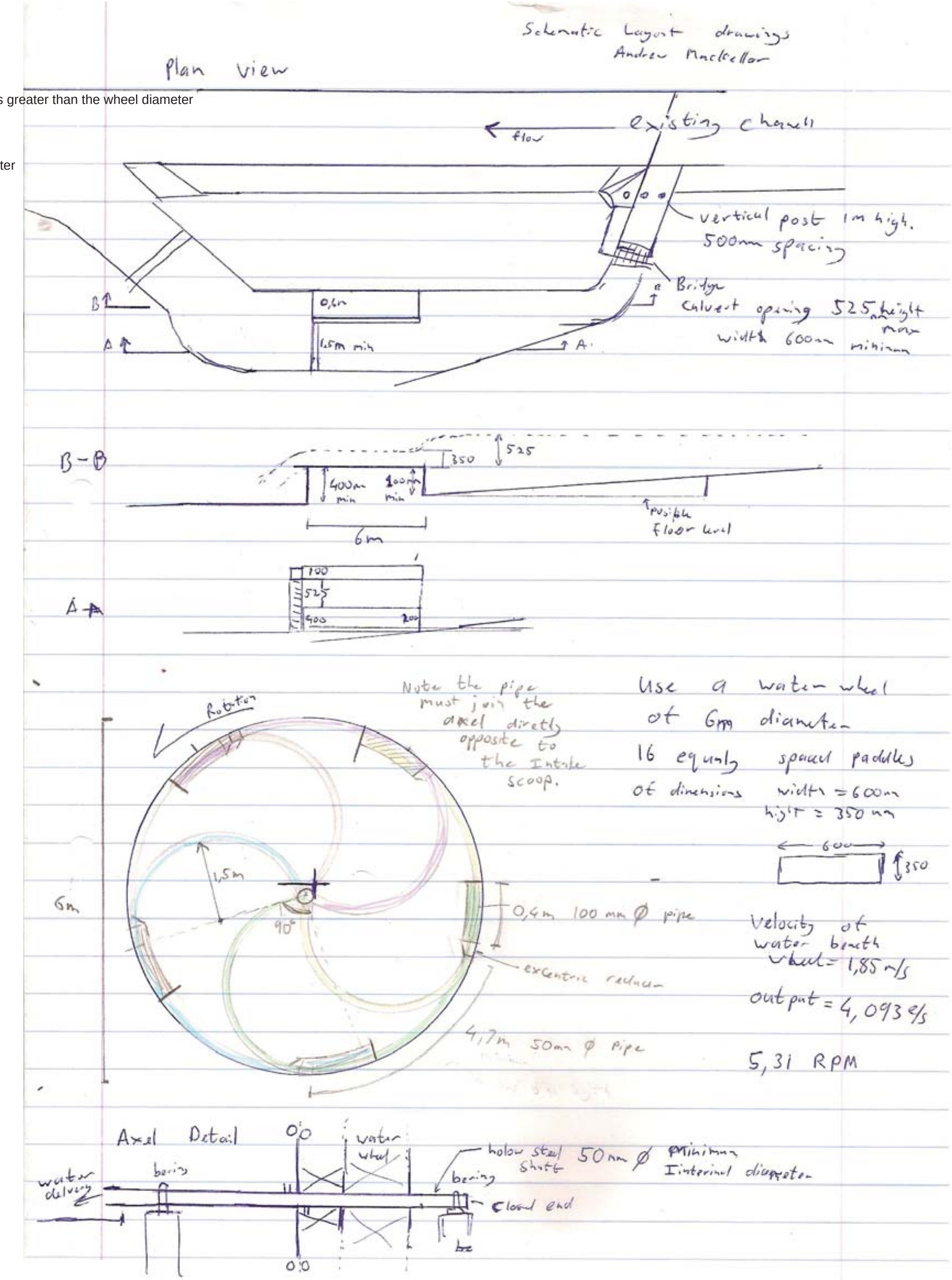
time for one revolutior	11.30	seconds
water pumped per revolution	0.009253	
output in m³/s	0.000819	
output l/s	0.818586	
output l/hour	2946.91	

5.31 RPM
maxRPM =18

Figure 9.1: Design calculations for a coil waterwheel where the water is lifted to the height of the wheel axis. (MacKellar, July 2011)

Right: Figure 9.2: Schematic design of water-wheel and channel (MacKellar, July 2011)

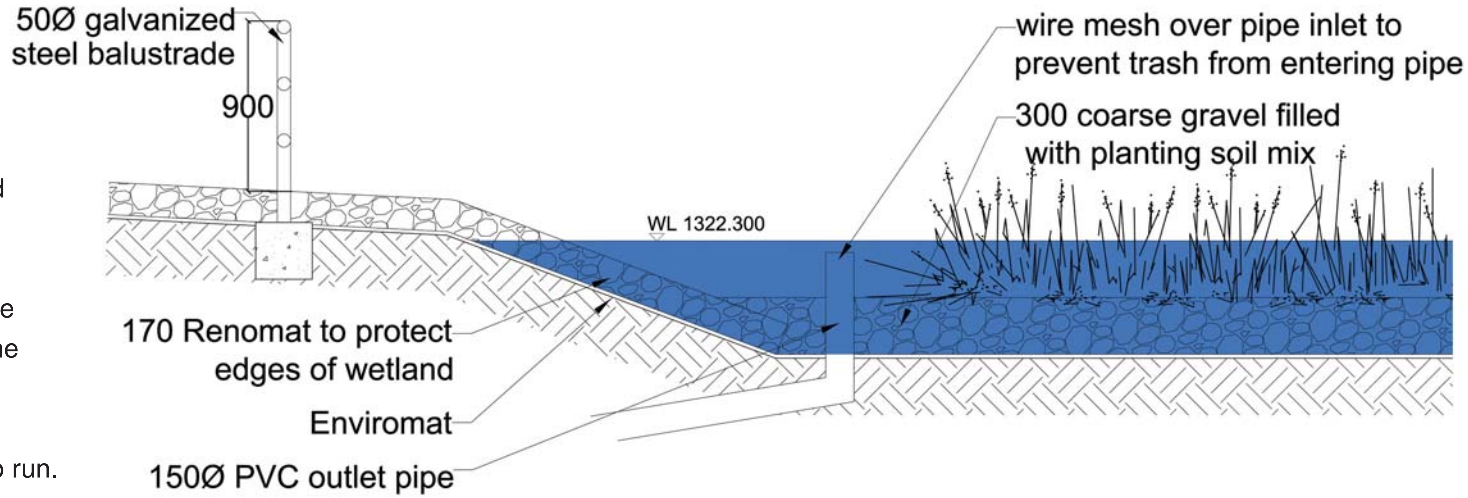
Left: Illus 9.11: Example of a coil waterwheel used in Zimbabwe. (http://aquamor.tripod.com/Wheel.htm)



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

9.3 Wetland

The water from the Walker Spruit is mostly polluted with petrochemicals. This will be removed by an oil trap. The wetland only needs to remove nutrients such as nitrates and phosphates, of which there are not much in an area with few gardens. To ensure the water is sufficiently cleaned, the water has to stay at least 2 days in the wetland. At a flow rate of 4l/s, 345.6m^3 of water is needed per day for the River to run. The wetland will thus be 2304m^2, at a water depth of 300mm to ensure optimum plant growth.

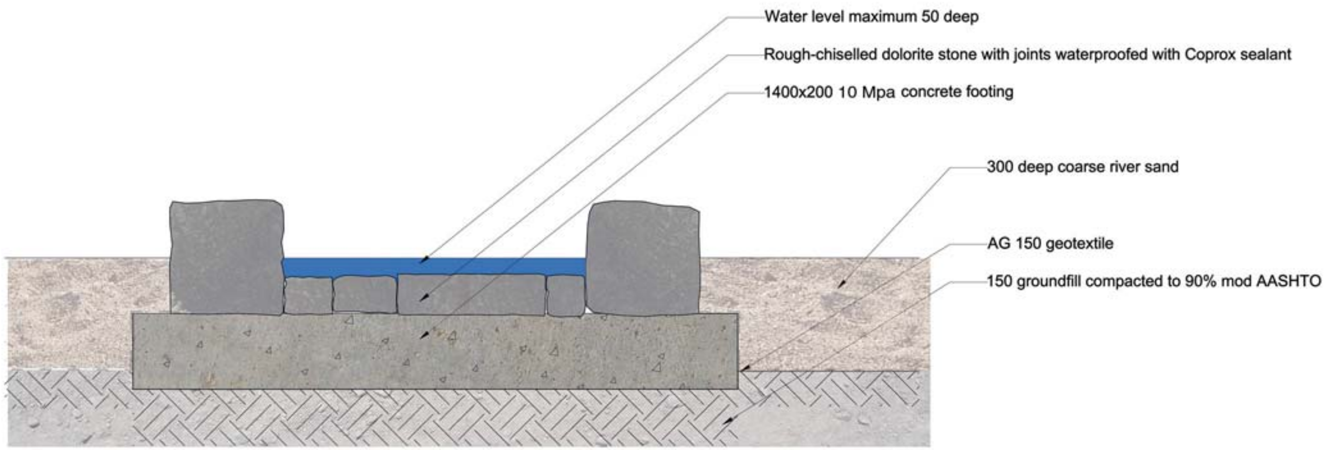


Illus. 9.12: Wetland outlet detail 1:20. People will be discourage from entering the wetland by a railing. (Author, October 2011)

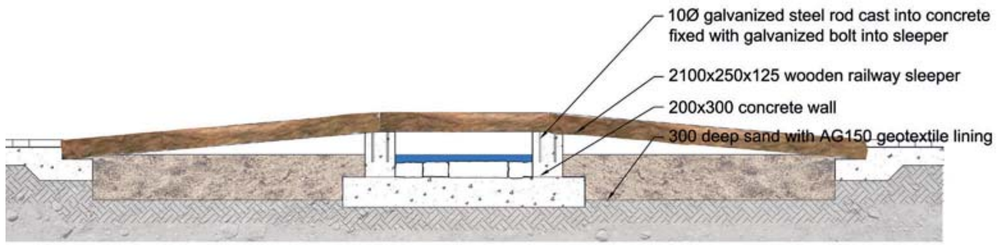
9.4 Water

Due to the space constraints of the wetland (see Illus. 7.8), only 4l/s of water is available for use in the River. To keep the channel of average depth 50 mm and width 800 mm filled, the water has to flow at a rate of 0.1m/s. The slope of the channel has to be almost horizontal to maintain such a slow speed, and the roughness coefficient has to be large. The total length of the River is 88.5m with a drop of 1.7m over the slope of the site.

To cater for the above-mentioned aspects, a roughness coefficient (Manning's *n*) of 0.15 is used, together with a series of five cascades which would enable the slope to be almost horizontal throughout the River. The cascades will range in height from 200 to 400 mm, adding aural interest and more complex play opportunities. To achieve such a high *n* value, the channel is constructed of rough stone, with stones jutting out of the water to further obstruct the water's flow.

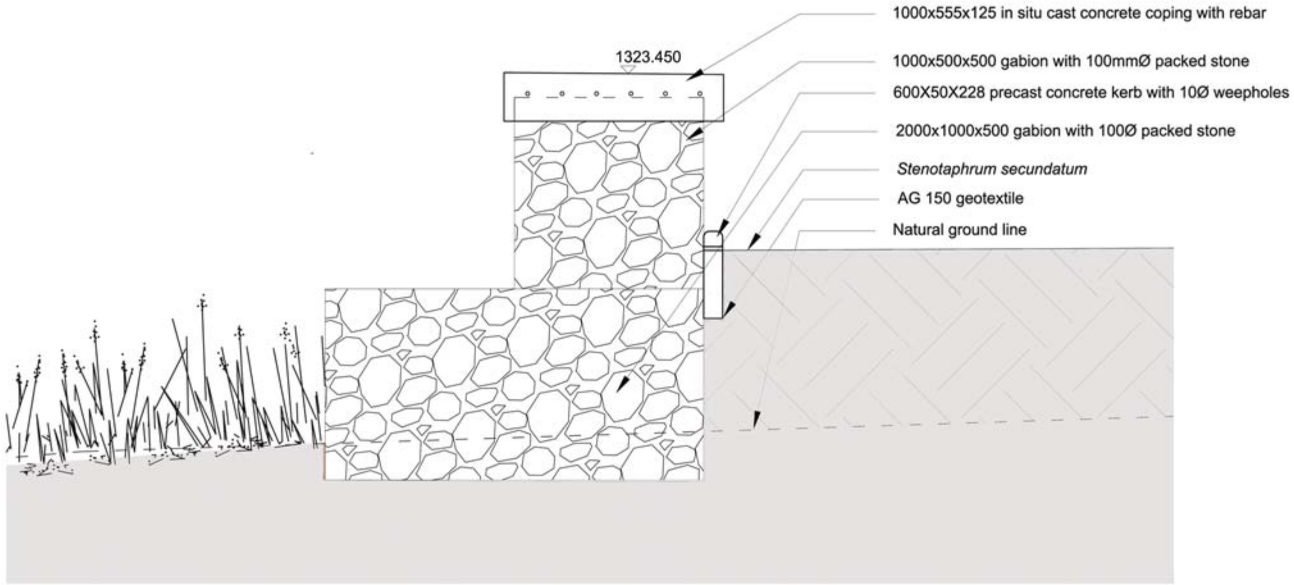


Illus. 9.13: Detail A 1:20: River section (Author, October 2011)



Illus. 9.14: Detail B 1:50: River section with railway sleeper bridge (Author, October 2011)

Illus. 9.15: Stormwater plan. See also 9.4. (Author, October 2011)

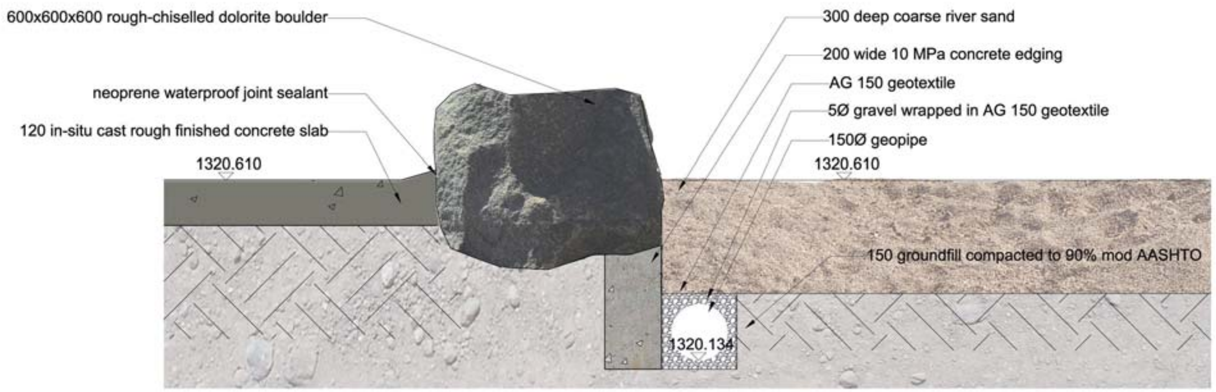


Illus. 9.16: Detail C 1:20: Gabion seating wall around edge of kick about. The precast kerbs create a detention dam. Small outlets slowly release the water from where it flows into the Spruit. (Author, October 2011)

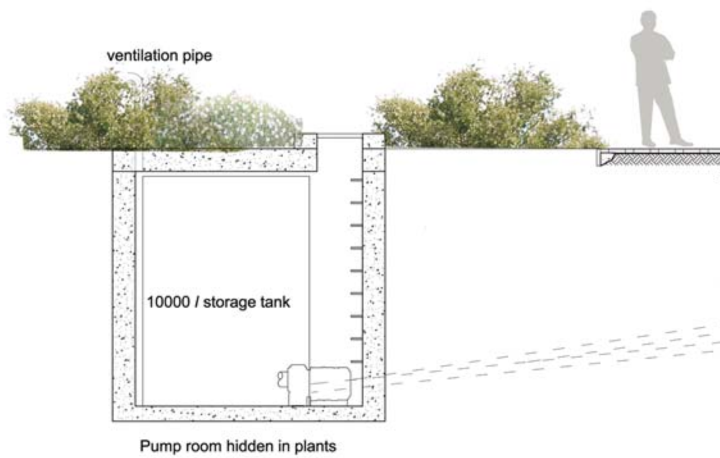
9.4.1 Other water features

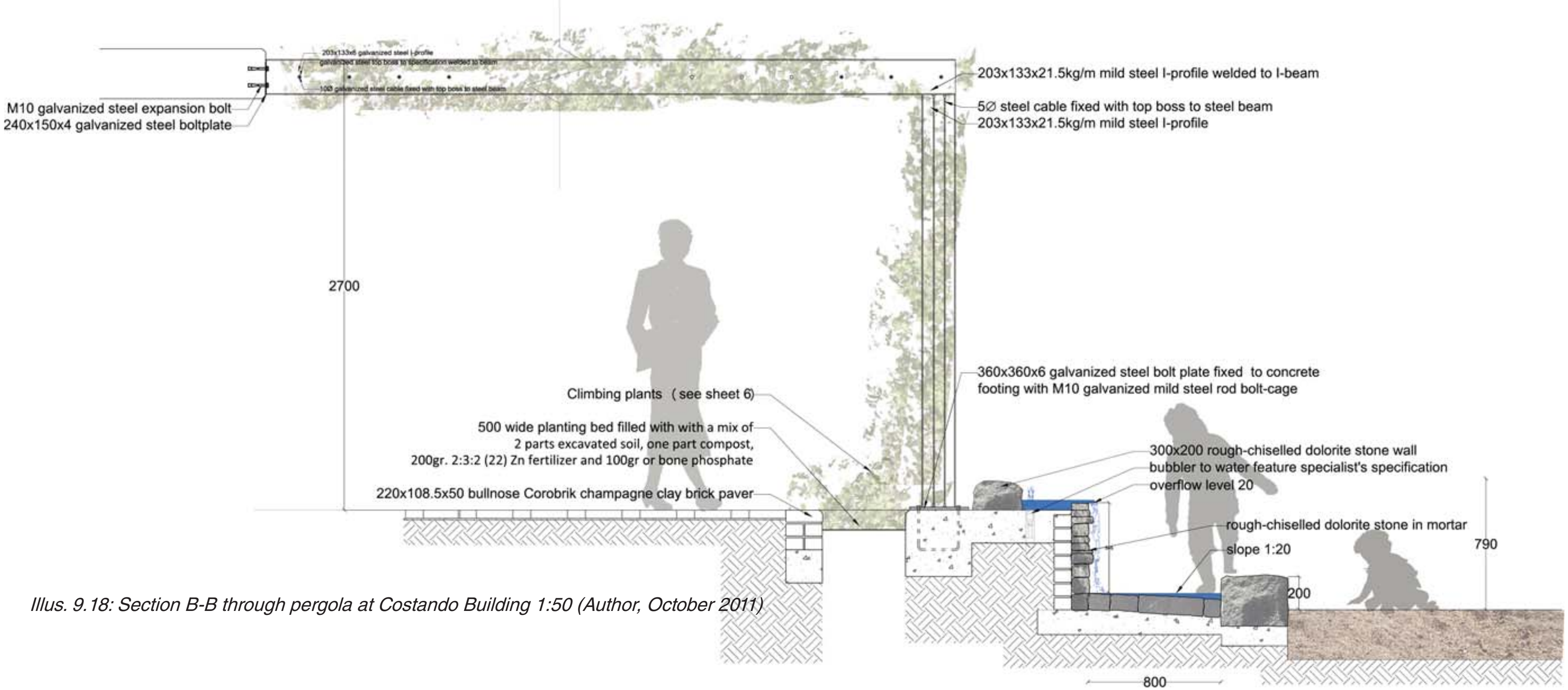
The water feature at the Costando Building provides a level difference between the public area next to the shops and the 3-6 year zone, enhacing safety. A rough stone wall ensures that the water creates aural interest. The water could be used by the children to play in, and for using elsewhere. Utensils to scoop it out with could be brought along from home or borrowed from the toy library. A small pump room contains a storage tank of 1500 litres and a pump.

The zero-depth water feature has an exposed aggregate concrete surface to ensure a good grip. The water is chlorinated to prevent any algae growth which could make the surface slippery. The water drains to a sump and is recirculated in the system.

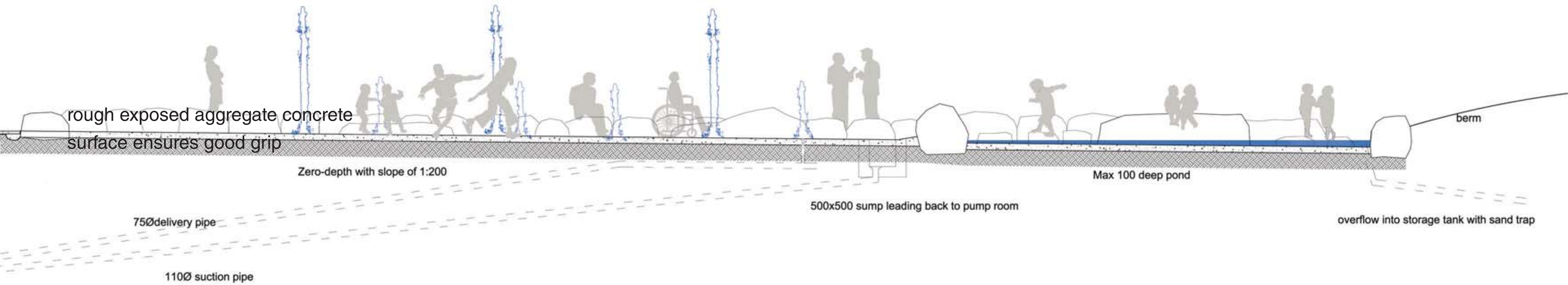


Illus. 9.17: Detail D 1:20. Edge detail of zero-depth water feature. (Author, October 2011)





Illus. 9.18: Section B-B through pergola at Costando Building 1:50 (Author, October 2011)



Illus. 9.19: Section C-C through zero-depth water feature and pond 1:100 (Author, October 2011)

9.5 Irrigation budget

The park is zoned into three areas with different irrigation requirements: the forests and riverine areas, the lawn, and all other planting areas. The savanna area will not receive any irrigation.

The plants will not be able to survive on rainfall alone (Figure 9.4) , and therefore run-off from paving will be directed into the planted areas.

From Figure 9.4 it can be seen that the highest total water deficit per month is 136.4 m^3 in July. It was decided to use the water that has passed through the River and pond, as it has already been cleaned by various filters and is therefore fit for irrigation use save for some minor filtering. Therefore no water will be harvested for storage from paving areas.

A storage tank of 6x6x3 m under the lawn on the southern side of the Spruit holds 108 m^3 of water. Due to continuous inflow right through the year, it is unnecessary to have larger holding tanks. Irrigation will be controlled manually to ensure that plants are not irrigated unnecessarily, and in times of extreme drought, that the lawn will not receive water.

Irrigation requirements	Weeks	Lawn (m^3)	Need/week	m^3/month	All other planting (	Need	m^3/month	River &forest (	Need	m^3/month	Montly totals
January	4.43	2476	0.025	274.217	724	0.01	32.0732	1181	0.016	83.70928	**389.99948**
February	4.14	2476	0.025	256.266	724	0.01	29.9736	1181	0.016	78.22944	**364.46904**
March	4.43	2476	0.025	274.217	724	0.01	32.0732	1181	0.016	83.70928	**389.99948**
April	4.3	2476	0.00625	66.5425	724	0.005	15.566	1181	0.008	40.6264	**122.7349**
May	4.43	2476	0.00625	68.55425	724	0.005	16.0366	1181	0.008	41.85464	**126.44549**
June	4.3	2476	0.00625	66.5425	724	0.005	15.566	1181	0.008	40.6264	**122.7349**
July	4.43	2476	0.00625	68.55425	724	0.005	16.0366	1181	0.008	41.85464	**126.44549**
August	4.43	2476	0.00625	68.55425	724	0.005	16.0366	1181	0.008	41.85464	**126.44549**
September	4.3	2476	0.00625	66.5425	724	0.005	15.566	1181	0.008	40.6264	**122.7349**
October	4.43	2476	0.025	274.217	724	0.01	32.0732	1181	0.016	83.70928	**389.99948**
November	4.3	2476	0.025	266.17	724	0.01	31.132	1181	0.016	81.2528	**378.5548**
December	4.43	2476	0.025	274.217	724	0.01	32.0732	1181	0.016	83.70928	**389.99948**
				2024.59			**284.206**			**741.76248**	**3050.56293**

Figure 9.3: Irrigation requirements for the various planting areas (Author, October 2011)

	Lawn			Forest and river			All other planting		
	Rain	Irrigation	Balance	Rain	Irrigation	Balance	Rain	Irrigation	Balance
January	402.956	274.217	128.74	94.844	32.0732	62.7708	154.711	83.70928	71.0017
February	215.32	256.266	-40.946	50.68	29.9736	20.7064	82.67	78.22944	4.44056
March	236.852	274.217	-37.365	55.748	32.0732	23.6748	90.937	83.70928	7.22772
April	141.496	66.5425	74.954	33.304	15.566	17.738	54.326	40.6264	13.6996
May	24.608	68.55425	-43.946	5.792	16.0366	-10.2446	9.448	41.85464	-32.407
June	6.152	66.5425	-60.391	1.448	15.566	-14.118	2.362	40.6264	-38.264
July	-6.152	68.55425	-74.706	-1.448	16.0366	-17.4846	-2.362	41.85464	-44.217
August	3.076	68.55425	-65.478	0.724	16.0366	-15.3126	1.181	41.85464	-40.674
September	52.292	66.5425	-14.251	12.308	15.566	-3.258	20.077	40.6264	-20.549
October	203.016	274.217	-71.201	47.784	32.0732	15.7108	77.946	83.70928	-5.7633
November	286.068	266.17	19.898	67.332	31.132	36.2	109.833	81.2528	28.5802
December	322.98	274.217	48.763	76.02	32.0732	43.9468	124.005	83.70928	40.2957
Totals	**1888.664**	**2024.594**	**-135.93**	**444.536**	**284.2062**	**160.3298**	**725.134**	**741.76248**	**-16.628**

Figure 9.4: Water budget (Author, October 2011)

Illus. 9.20: Planting legend (Author, October 2011)

9.6 Channel sizing calculations

As was already discussed in the urban framework, it was found to be impossible to widen the channel or to naturalize it, due to the high flood line (See Illus. 5.14). Adding mosaic tiles was the option that had the least impact on the flood line, as some excavation was already needed to balance out infill in the kick about area, for example.

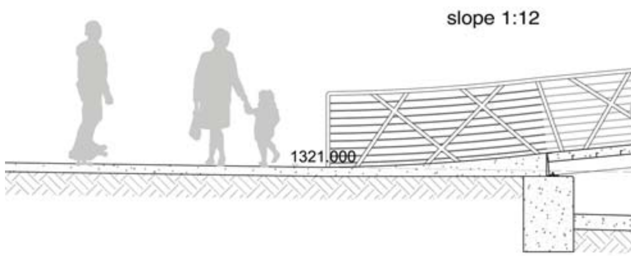
9.6.1 Channel design

The cross-sectional area of the channel needs to stay the same in order to not affect the 50-year floodline. The current channel of 1.5 m x 0.1 m deep discharges 0.26 m^3/s with a velocity of 2.61 m/s at a slope of 1:60 (if a roughness coefficient (*n*) of 0.011 for concrete is used). The new channel design with mosaic tiles will have a roughness coefficient of 0.013. To cater for the slower water (at a velocity 2.39 m/s), an area of 0.018 m^2 per m^2 of channel needs to be added to the cross-sectional area of the channel.

9.7 Cut and fill volumes

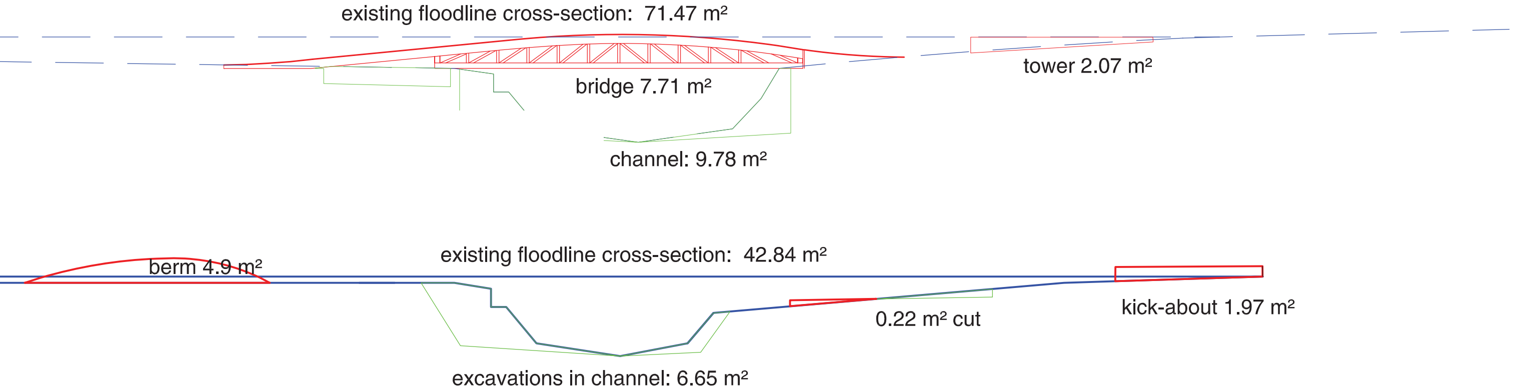
Illus. 9.12 shows the cut and fill needed to keep the floodline constant. Soil to create the three berms will be sourced from the cut needed to create a surface of slope 1:200 in the kick about area, as well as from the excavations needed for the sand-filled areas in the 6-12 year area. This will be more than enough soil to supply the following volumes needed:

Southern Berm volume: 118.00 m^3
Northern berm volume: 190.21 m^3
Berm in 3-6 year area: 61.74 m^3

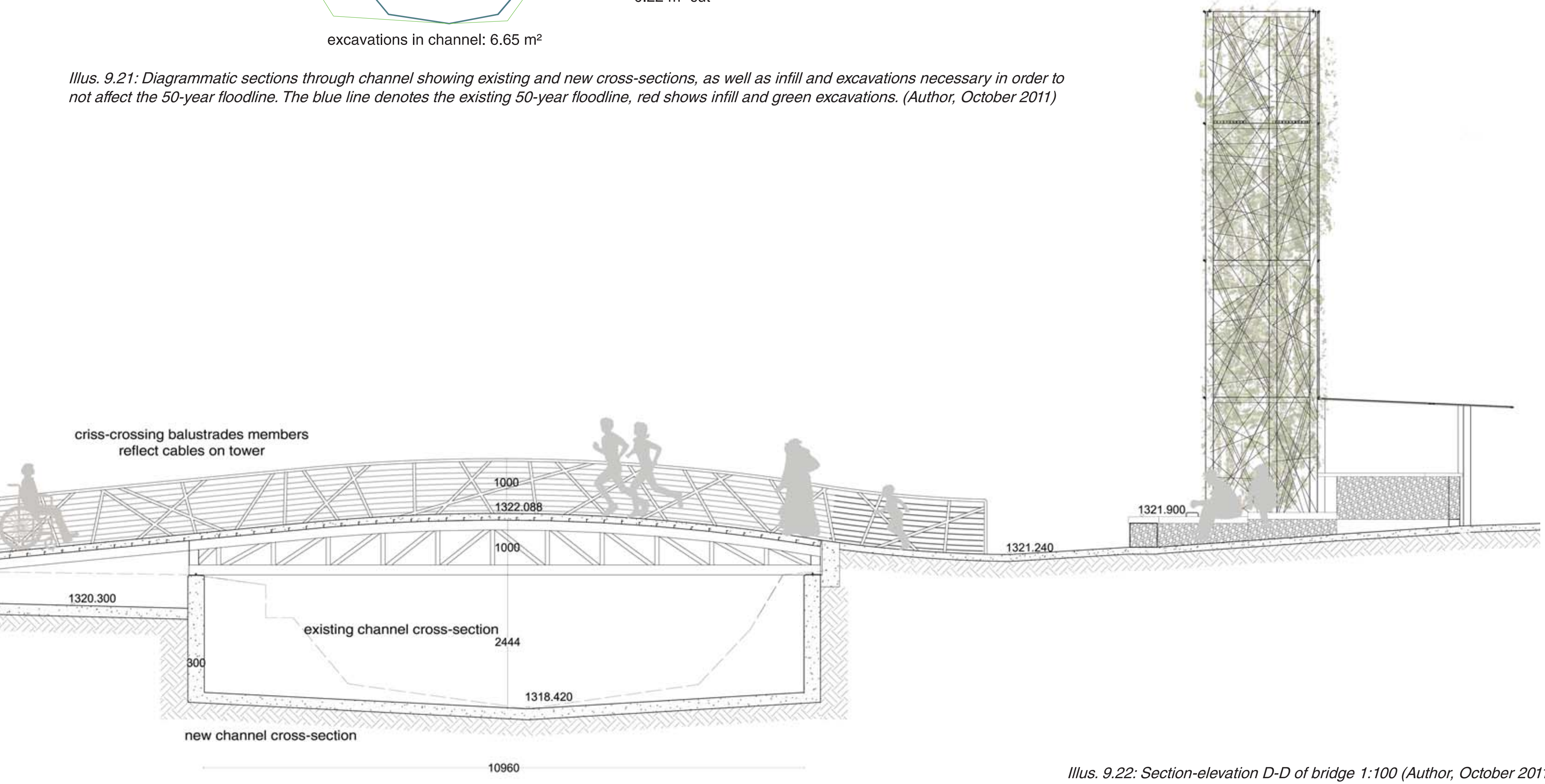


9.8 Bridge

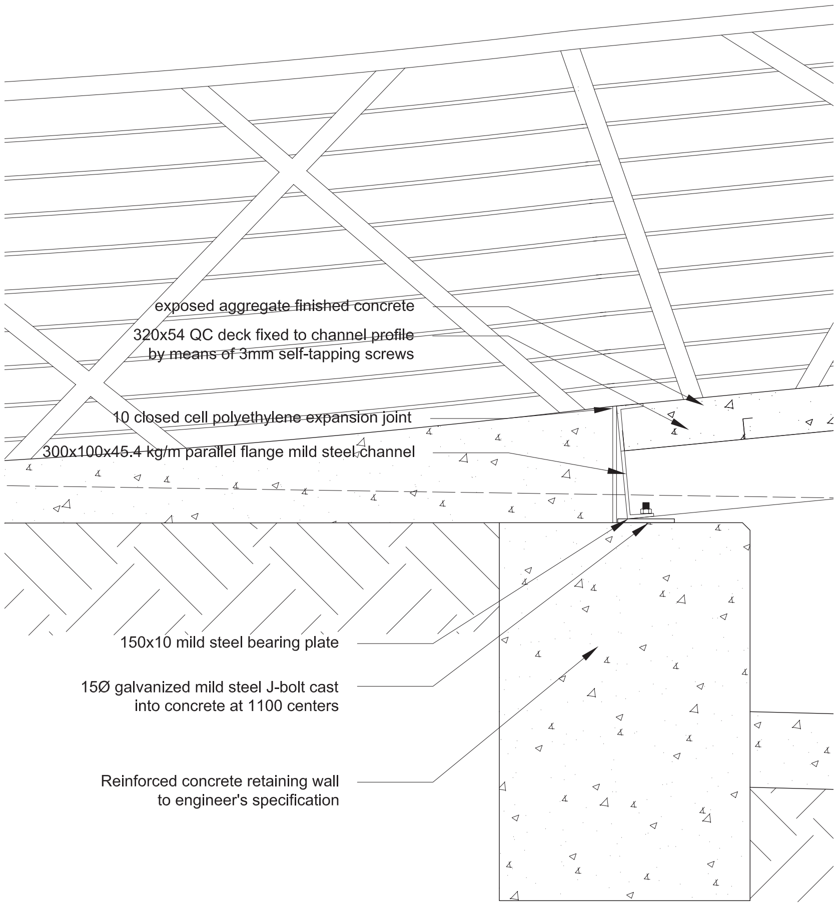
Creating a bridge across the river was problematic, as any bridge constructed would be well within the flood line unless it is lifted with more than 1.5 m. An 11 to 12 m span was also required. The bridge therefore had to use as little material as possible, yet be able to span the distance. It has a slope of 1:12 to cater for wheelchair users. Timber decking as a light-weight option was discarded as it requires too much maintenance. Q-deck was used instead to keep the material palette simplistic and to a minimum. The balustrade railing reflects the criss-crossing cables on the outside of the tower (see 9.9).



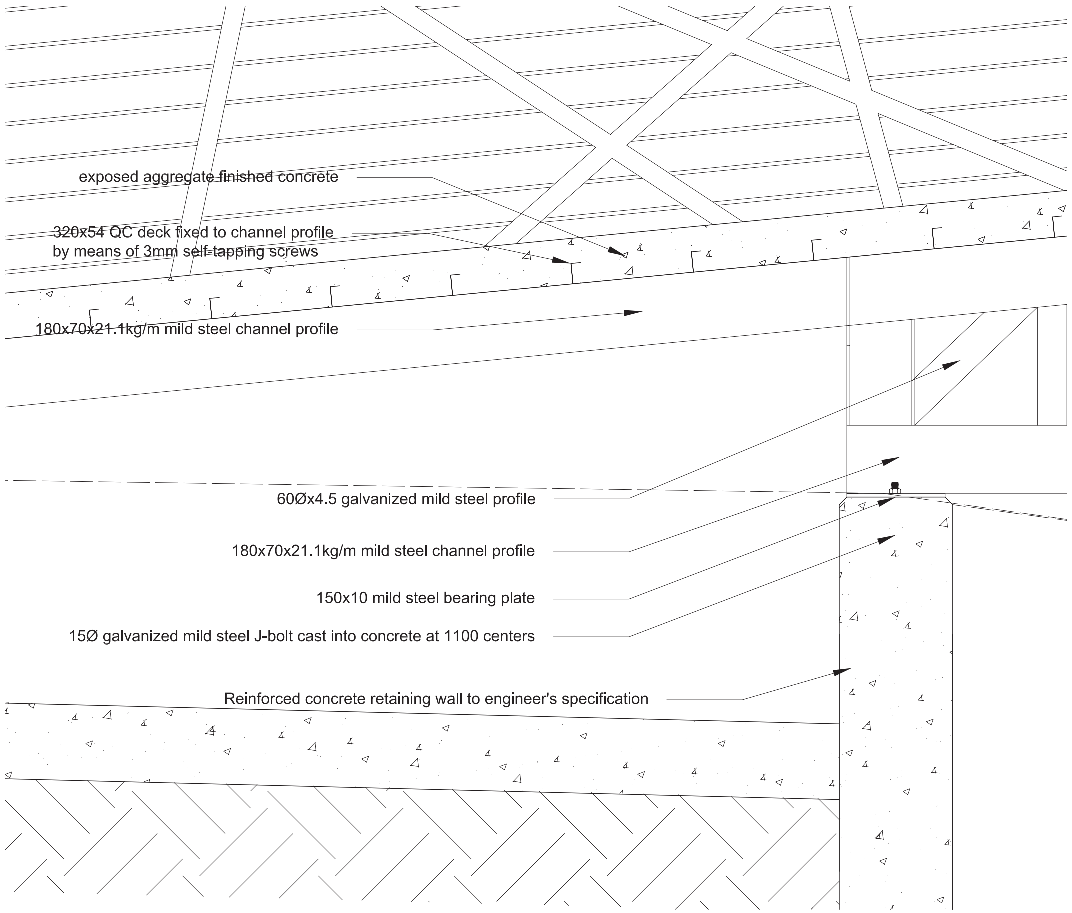
Illus. 9.21: Diagrammatic sections through channel showing existing and new cross-sections, as well as infill and excavations necessary in order to not affect the 50-year floodline. The blue line denotes the existing 50-year floodline, red shows infill and green excavations. (Author, October 2011)



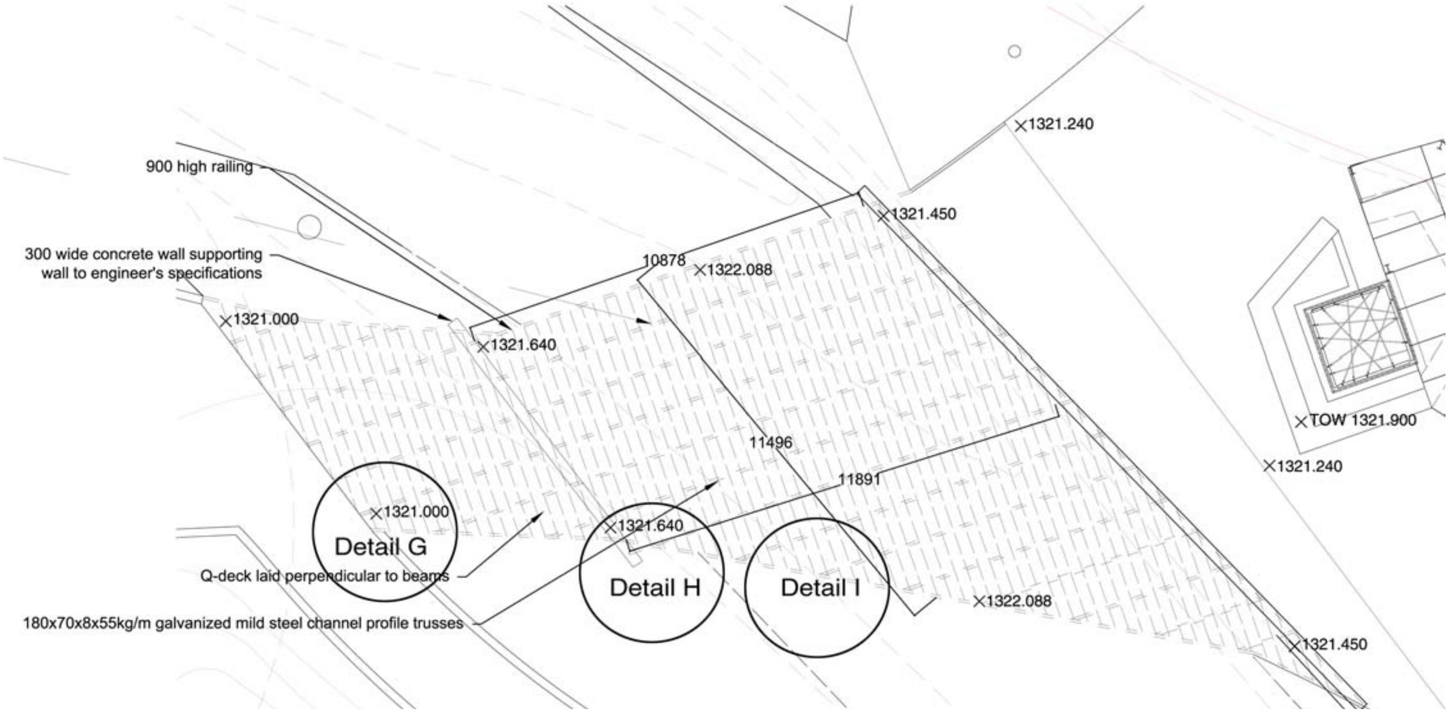
Illus. 9.22: Section-elevation D-D of bridge 1:100 (Author, October 2011)



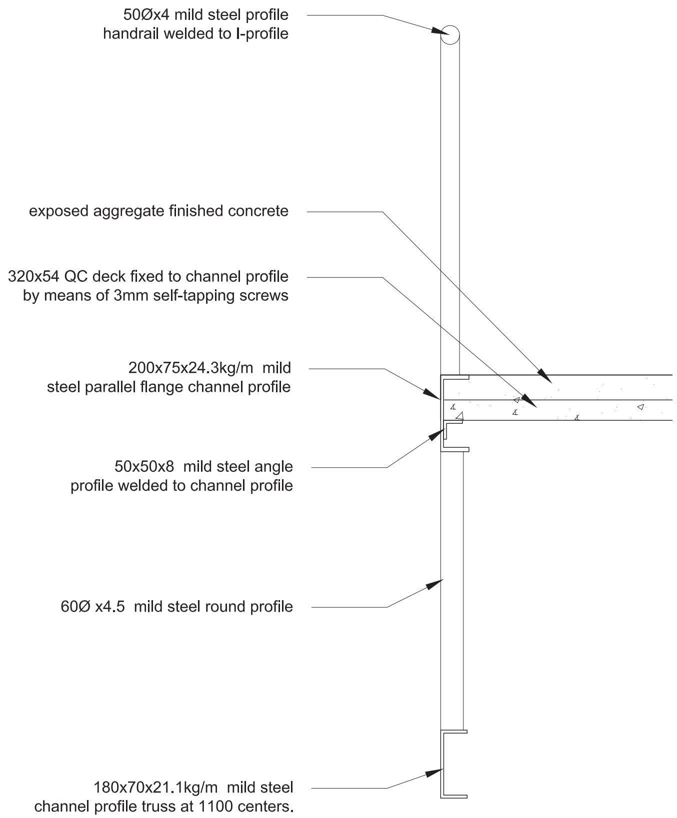
Illus. 9.23: Detail G 1:20 (Author, October 2011)



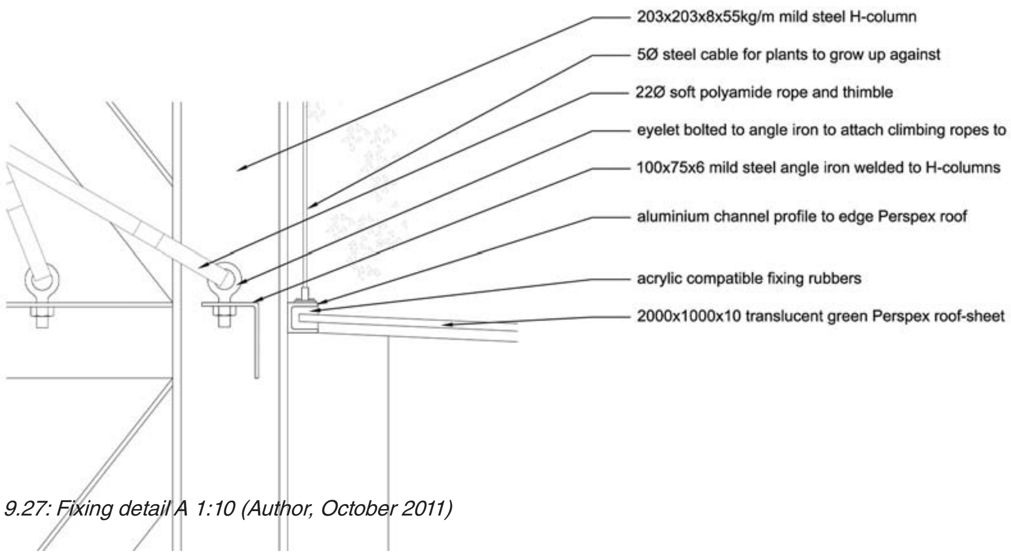
Illus. 9.24: Detail H 1:20 (Author, October 2011)



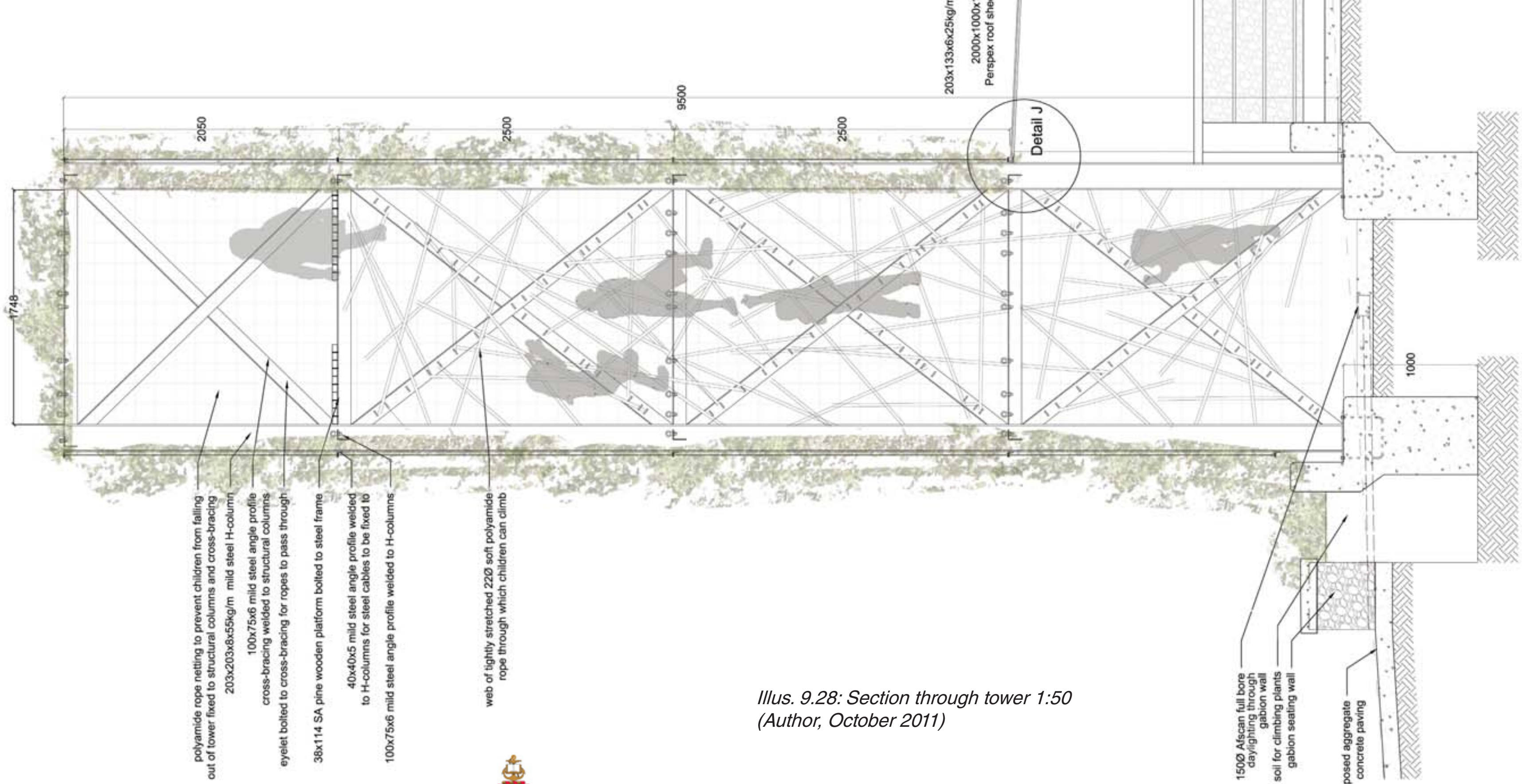
Illus. 9.26: Plan 1:200 of bridge structure showing location of structural beams and Q-deck. (Author, October 2011)



Illus. 9.25: Bridge edge and handrail section 1:20 (Author, October 2011)



Illus. 9.27: Fixing detail A 1:10 (Author, October 2011)



Illus. 9.28: Section through tower 1:50 (Author, October 2011)

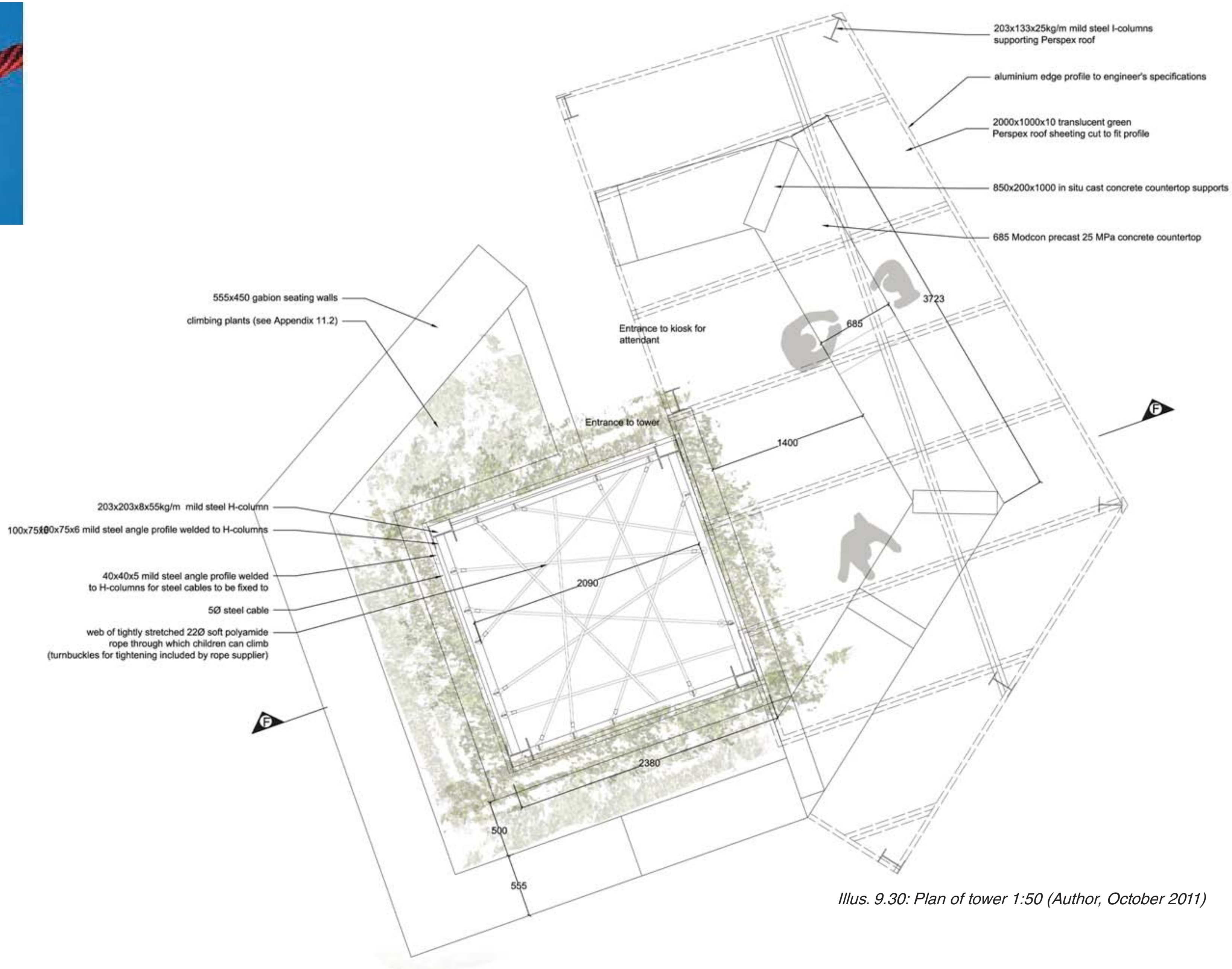
Illus. 9.29: Example of type of rope to be used in tower, such as Corocord (www.corocord.com)

9.9 Climbing tower and kiosk

The kiosk has lockable cupboards for the safety of the products.

The tower is oriented in such a way that the tower is on the west side of the kiosk, providing shade inside the kiosk.

Criss-crossing cables on the outside of the tower provide sufficient hold for climbing plants. A safety netting of polyamide rope between the outside cables and the inside web of ropes prevent children from falling out of the tower.



Illus. 9.30: Plan of tower 1:50 (Author, October 2011)

9.10 Lighting strategy

Illumination of the park is of utmost importance to ensure safety. Lights chosen are robust and vandalproof. Information from BEKA Lighting was used to determine light levels and spacings.

9.10.1 Five types of lights will be used:

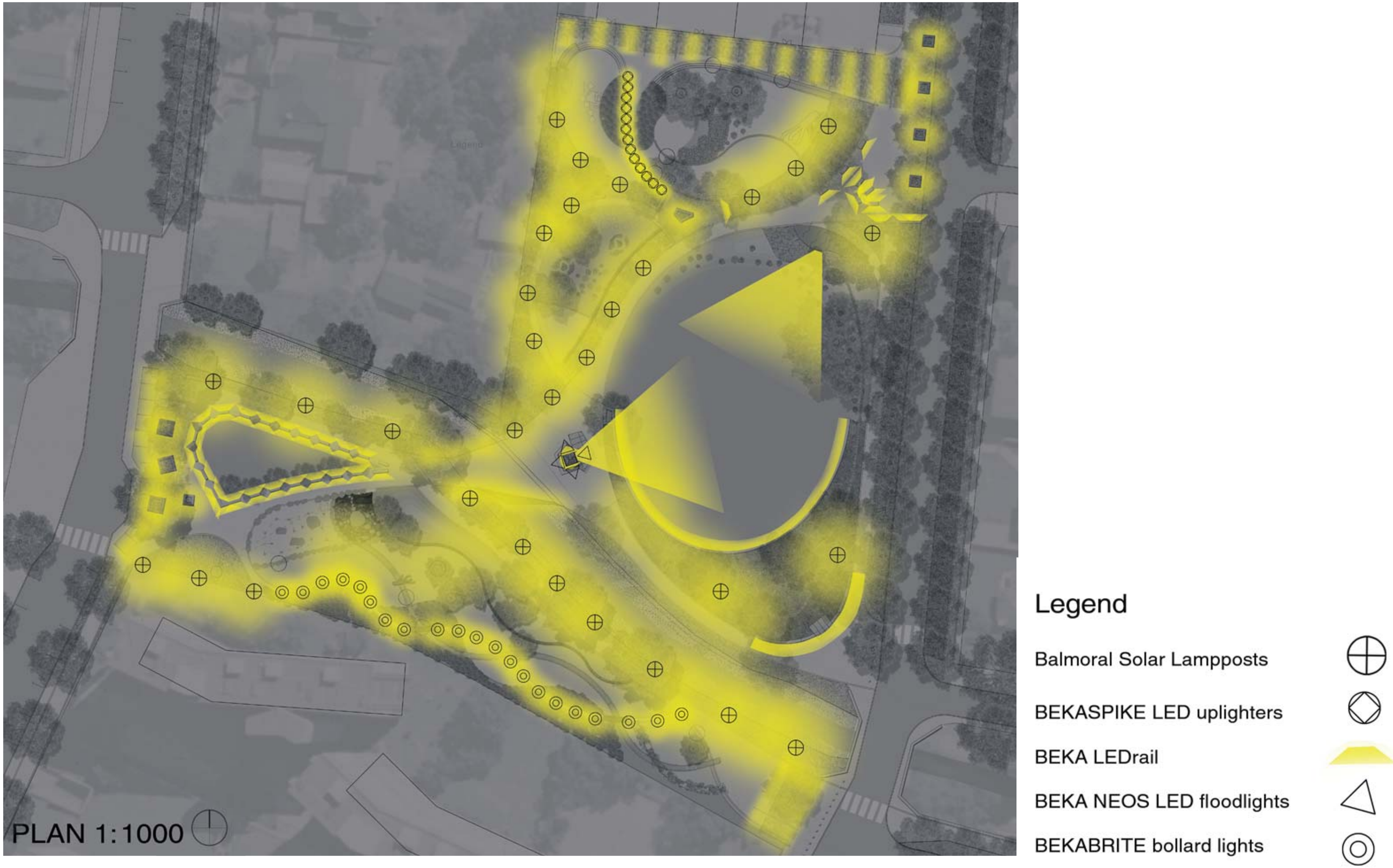
Balmoral Solar lampposts which can provide up to 12 hour illumination are used in areas which need to be well-lit. A 9W solar panel is fixed flush into the top of the luminaire. On cloudy days mains electricity will be used. They are on average 10 m apart, depending on the amount of trees and planting. They are used along the channel to ensure that one can see into the channel at night.

BEKASPIKE LED uplighters will light the way up the ramp at the toy library.

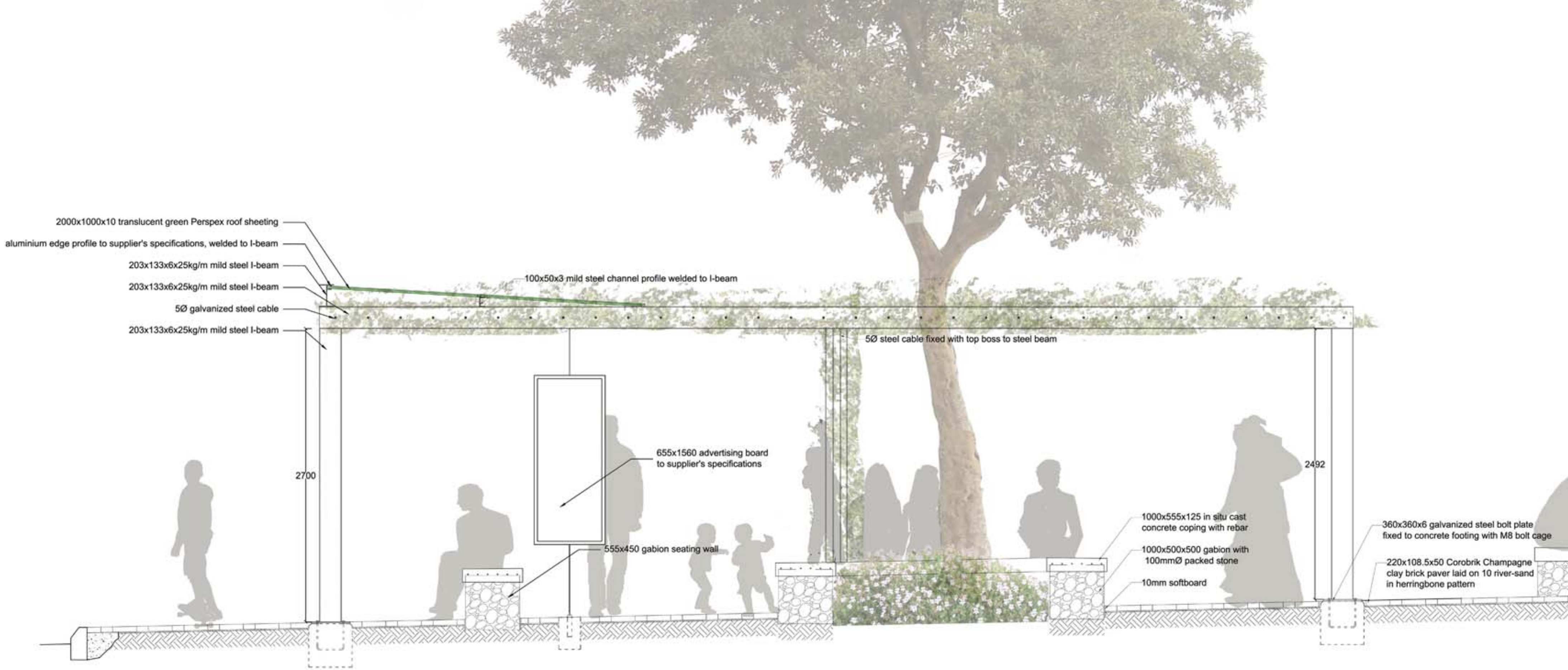
BEKA LEDrail are used at the pergolas, attached to the underside of the I-beams or to the supporting frame of the Perspex roofs of the taxi waiting area and the tower. They are also used within the gabion seating walls and at the bridge, creating a floating effect at night.

BEKA NEOS LED floodlights are used to light up the tower at night. From the top of the tower some also light up the kick about area.

BEKABRITE bollard lights are used in areas where tree canopies and shrubbery might obscure light from above or below. They are spaced 4 m apart.

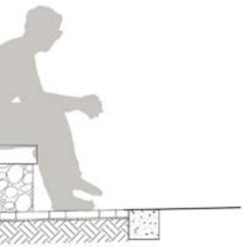


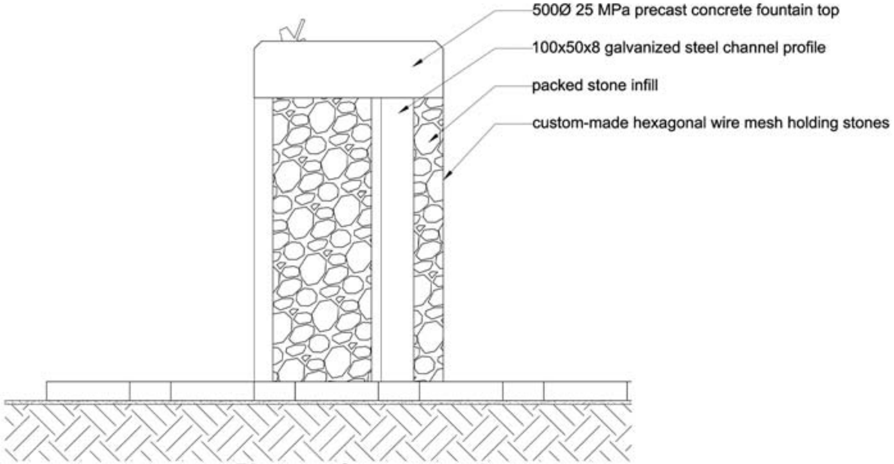
Illus. 9.31: Lighting plan (Author, October 2011)



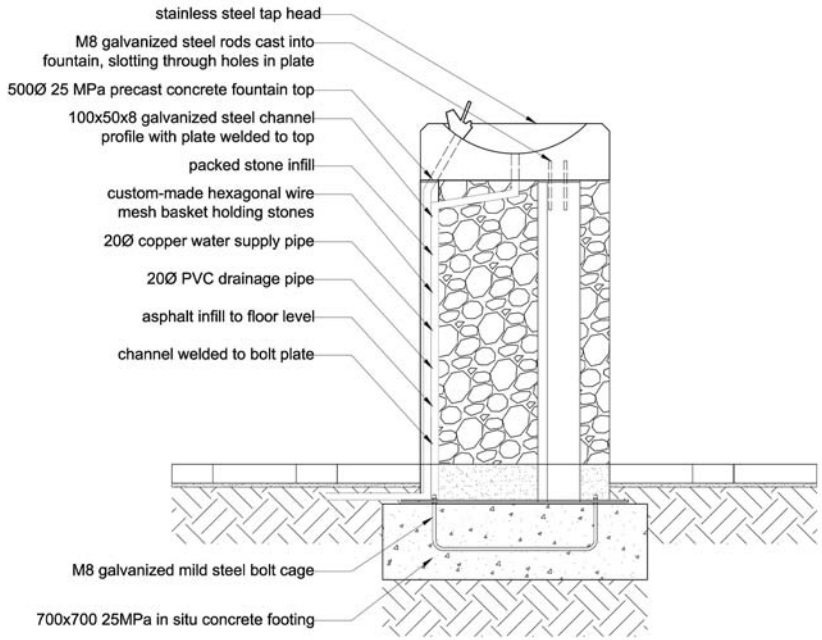
Illus. 9.32: Section E-E through taxi waiting area 1:50 (Author, October 2011)

Illus. 9.33: Detail E 1:20: Stone edgings around existing trees in 6-12 year old area (Author, October 2011)





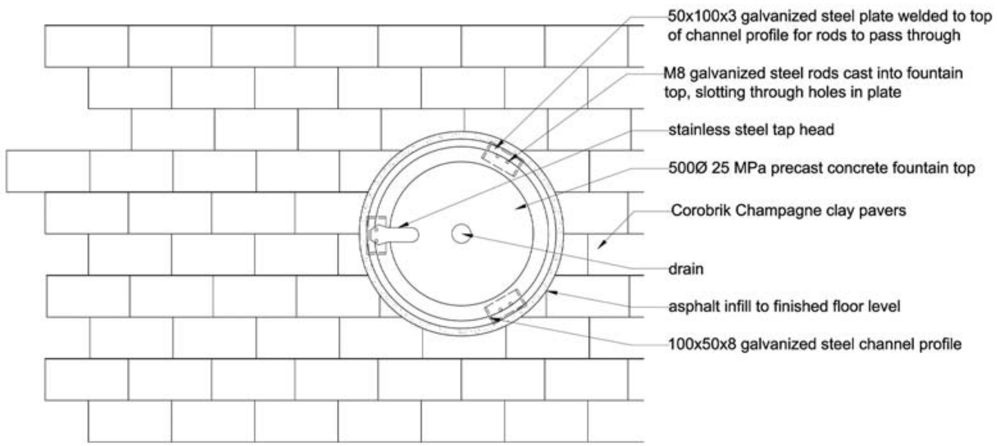
Illus. 9.34: Elevation 1:20 (Author, October 2011)



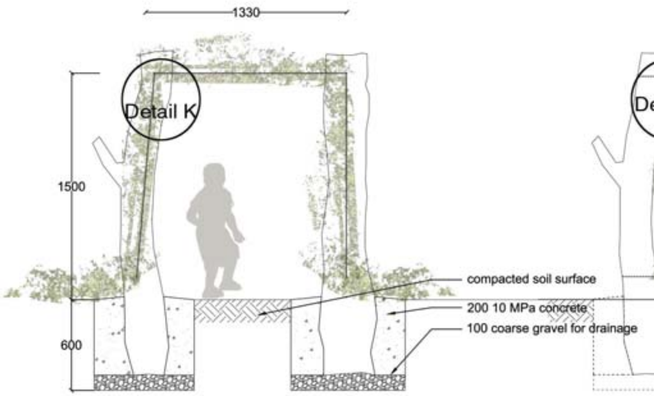
Illus. 9.35: Section 1:20 (Author, October 2011)

9.11 Drinking fountain (Detail F)

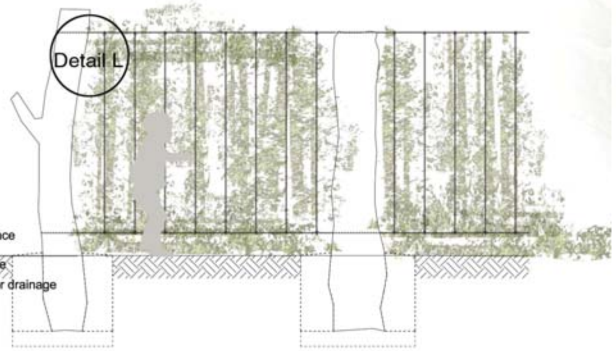
The drinking fountain reflects the material palette used in the rest of the park. The drainage pipe daylights into the nearest planting area.



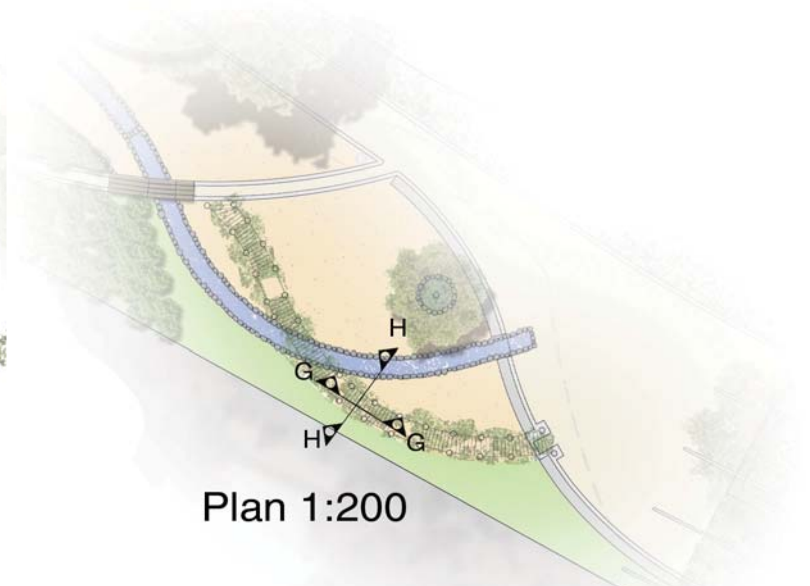
Illus. 9.36: Plan 1:20 (Author, October 2011)



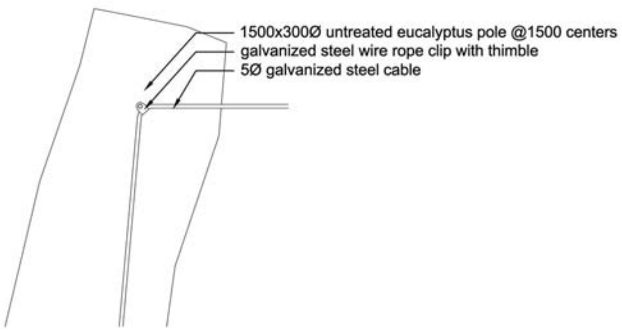
Illus. 9.37: Section H-H 1:50 (Author, October 2011)



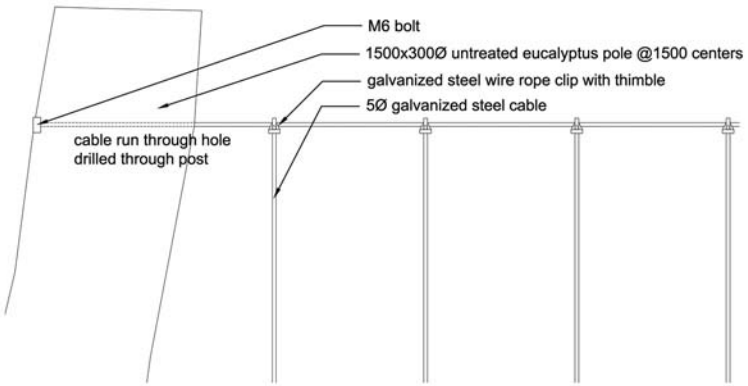
Illus. 9.38: Elevation G-G 1:50 (Author, October 2011)



Illus. 9.41: Location of section H-H and elevation G-G (Author, October 2011)



Illus. 9.39: Detail K 1:10 (Author, October 2011)



Illus. 9.40: Detail L 1:10 (Author, October 2011)