

“For He broke it for us in a garden  
Under the olive-trees  
Where the angel of strength was the warden  
And the soul of the world found ease.”

Dorothy Frances Gurney  
(Willis, 2006: 11)

*final presentation &  
appendix*

Chapter 10

children's developmental needs



socio-emotional development

groups for pretend play, cardinal to sustain play, small groups for fun, do as they see others do



cognitive development

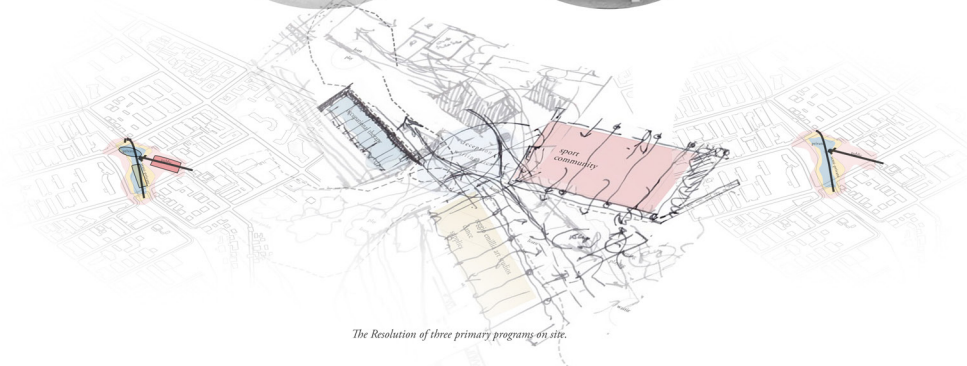
complexity, scope for alteration, construction with sand/other objects, collecting objects, interested in how things work, plans and animals



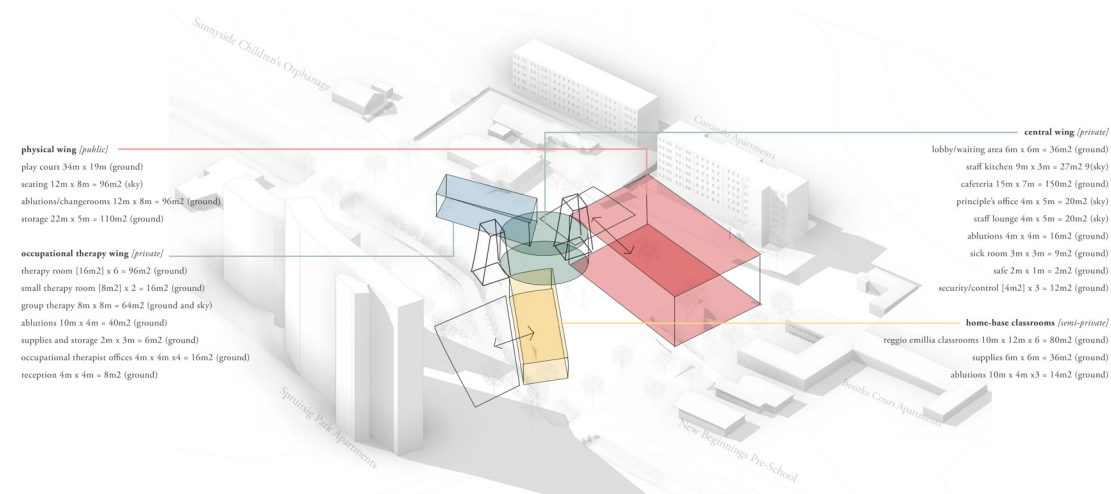
physical development

climbing games, climbing and jumping up and down, kicking balls, push/pull toys, balancing exercises, fine motor skills developed

what exists vs programmatic intentions



The Resolution of three primary programs on site.



**physical wing (public)**  
play court 34m x 19m (ground)  
seating 12m x 8m = 96m2 (sky)  
ablutions/changerooms 12m x 8m = 96m2 (ground)  
storage 22m x 5m = 110m2 (ground)

**occupational therapy wing (private)**  
therapy room [16m2] x 6 = 96m2 (ground)  
small therapy room [8m2] x 2 = 16m2 (ground)  
group therapy 8m x 8m = 64m2 (ground and sky)  
ablutions 10m x 4m = 40m2 (ground)  
supplies and storage 2m x 3m = 6m2 (ground)  
occupational therapist offices 4m x 4m x 4 = 16m2 (ground)  
reception 4m x 4m = 8m2 (ground)

**central wing (private)**  
lobby/waiting area 6m x 6m = 36m2 (ground)  
staff kitchen 9m x 3m = 27m2 9(sky)  
cafeteria 15m x 7m = 150m2 (ground)  
principal's office 4m x 5m = 20m2 (sky)  
staff lounge 4m x 5m = 20m2 (sky)  
ablutions 4m x 4m = 16m2 (ground)  
stick room 3m x 3m = 9m2 (ground)  
safe 2m x 1m = 2m2 (ground)  
security/control [4m2] x 3 = 12m2 (ground)

**home-base classrooms (semi-private)**  
reggio emilia classrooms 10m x 12m x 6 = 80m2 (ground)  
supplies 6m x 6m = 36m2 (ground)  
ablutions 10m x 4m x 3 = 14m2 (ground)



occupational therapy

deals with developmental setbacks in didactic community, addresses issues in today's culture where outdoor play is limited



reggio emilia home-baseclassrooms

the environment as third teacher, approach to learning from nature, biophilic in its nature



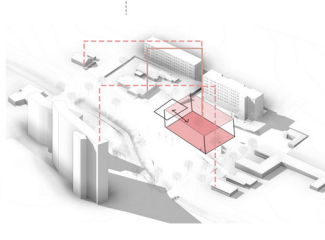
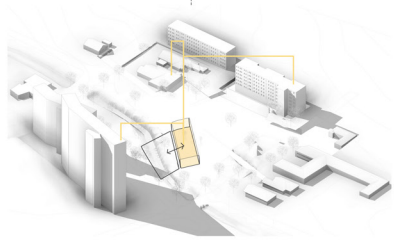
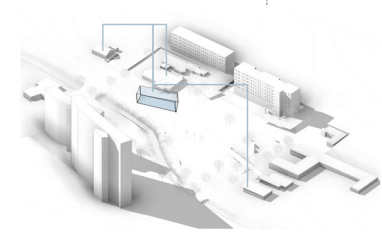
kinetic classrooms and play court

addresses gross motor skills development in environment connected to nature

**Users:**  
(During and after hours): Sunnyside Orphanage, Surrounding Residential Apartments, New Beginnings Pre-School, Ring Ting Pre-School

**Users:**  
(School Hours):  
100 New Children from surrounding residential apartments  
50 Ring Ting Pre-School Grade R students

**Users:**  
(School Hours):  
50 Ring Ting Pre-School Grade R students and 100 new children from surrounding residential apartments  
(After Hours):  
Sunnyside Orphanage, New Beginnings Pre-School, People from surrounding residential apartments



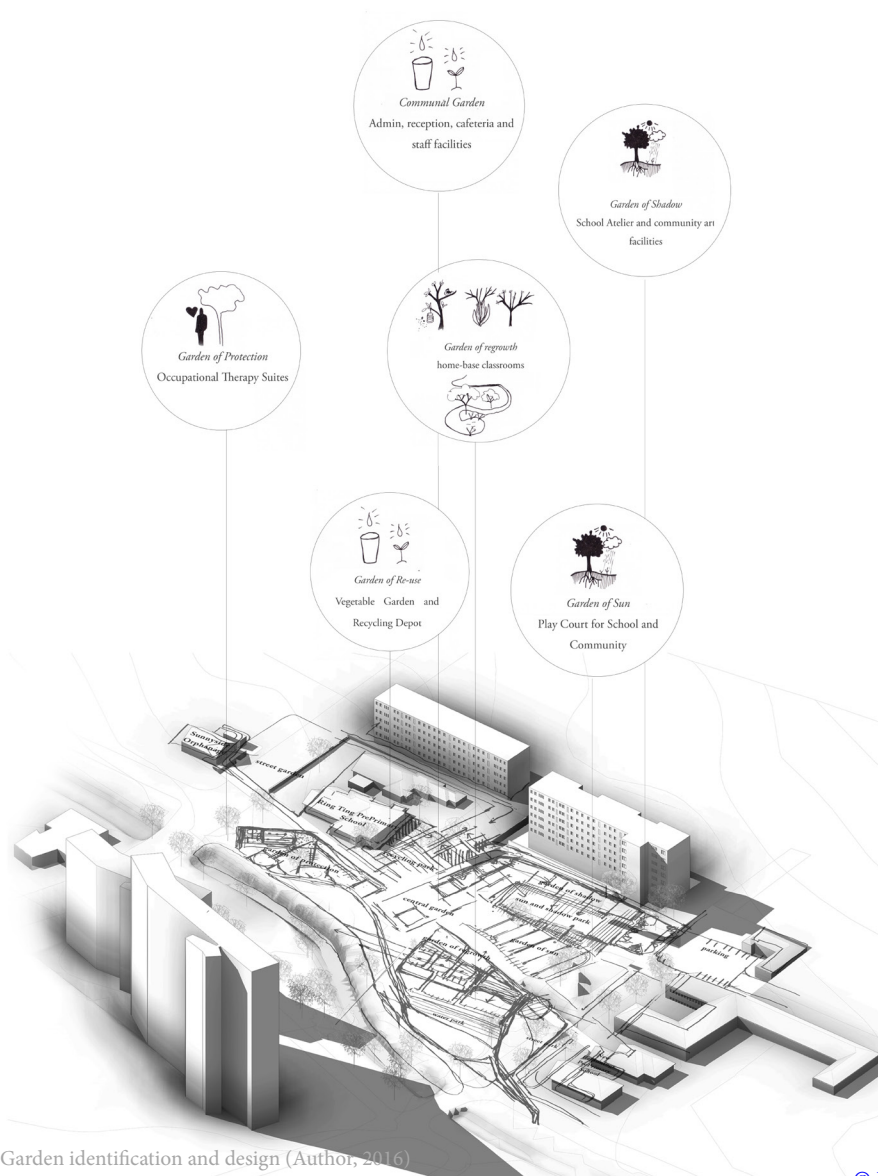
— During School Hours

- - - After School Hours

Fig 10.1 Programmatic Resolutions (Author, 2016)

garden identities

"Each space on site was identified as a garden and translated into a didactic concept through how and what can be learnt in each garden according to the identity it possesses."



**Communal Garden**  
Admin, reception, cafeteria and staff facilities

**Garden of Shadow**  
School Atelier and community art facilities

**Garden of Protection**  
Occupational Therapy Suites

**Garden of regrowth**  
home-base classrooms

**Garden of Re-use**  
Vegetable Garden and Recycling Depot

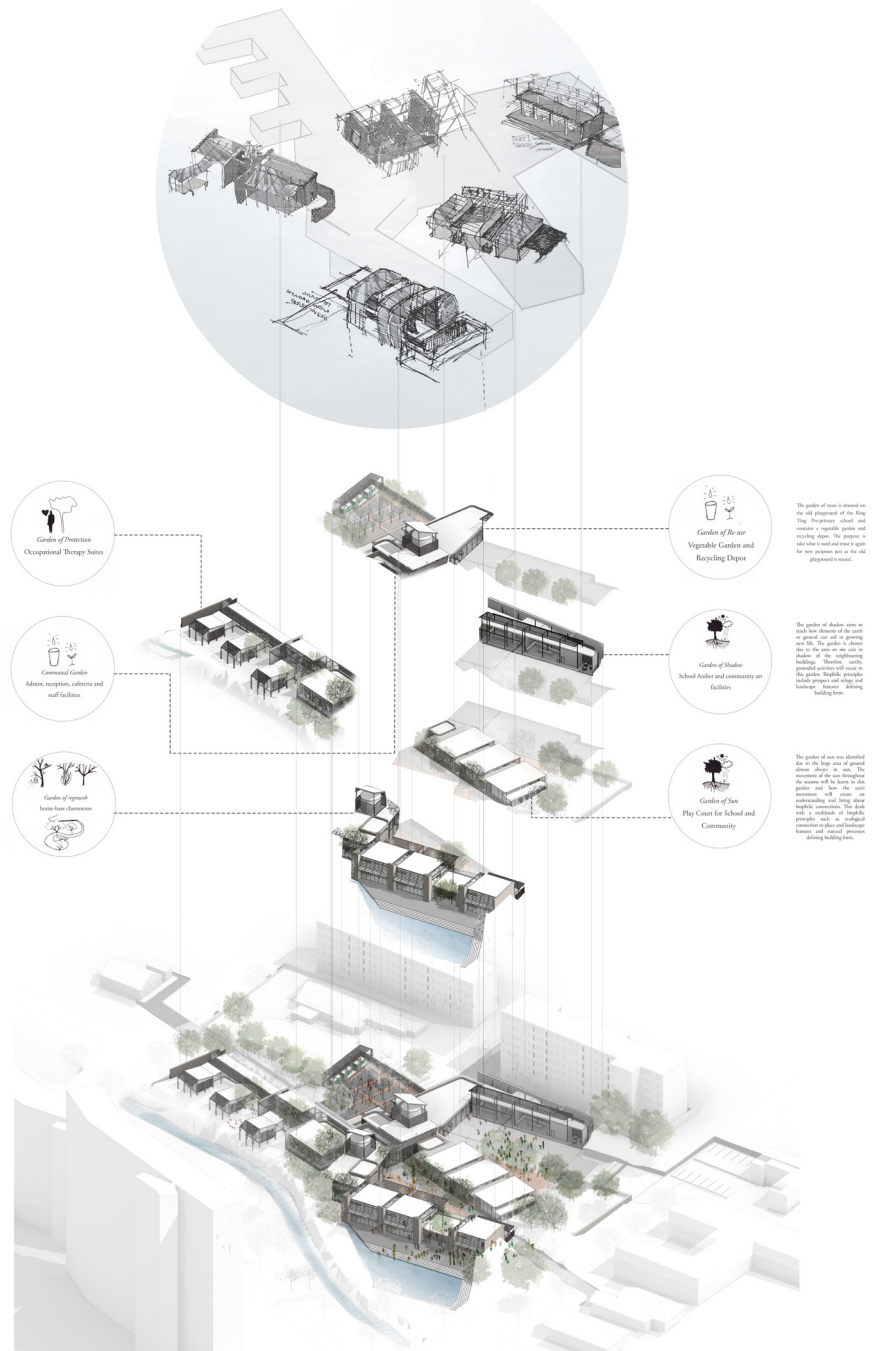
**Garden of Sun**  
Play Court for School and Community

This garden aims to make the school more of an open-plan environment. The main building is the central focus of the school. The main building is the central focus of the school. The main building is the central focus of the school.

This garden aims to enhance the school's image and to make it a more attractive place. The main building is the central focus of the school. The main building is the central focus of the school.

This garden was identified as a green space. The main building is the central focus of the school. The main building is the central focus of the school.

design translation



**Garden of Protection**  
Occupational Therapy Suites

**Communal Garden**  
Admin, reception, cafeteria and staff facilities

**Garden of regrowth**  
home-base classrooms

**Garden of Re-use**  
Vegetable Garden and Recycling Depot

**Garden of Shadow**  
School Atelier and community art facilities

**Garden of Sun**  
Play Court for School and Community

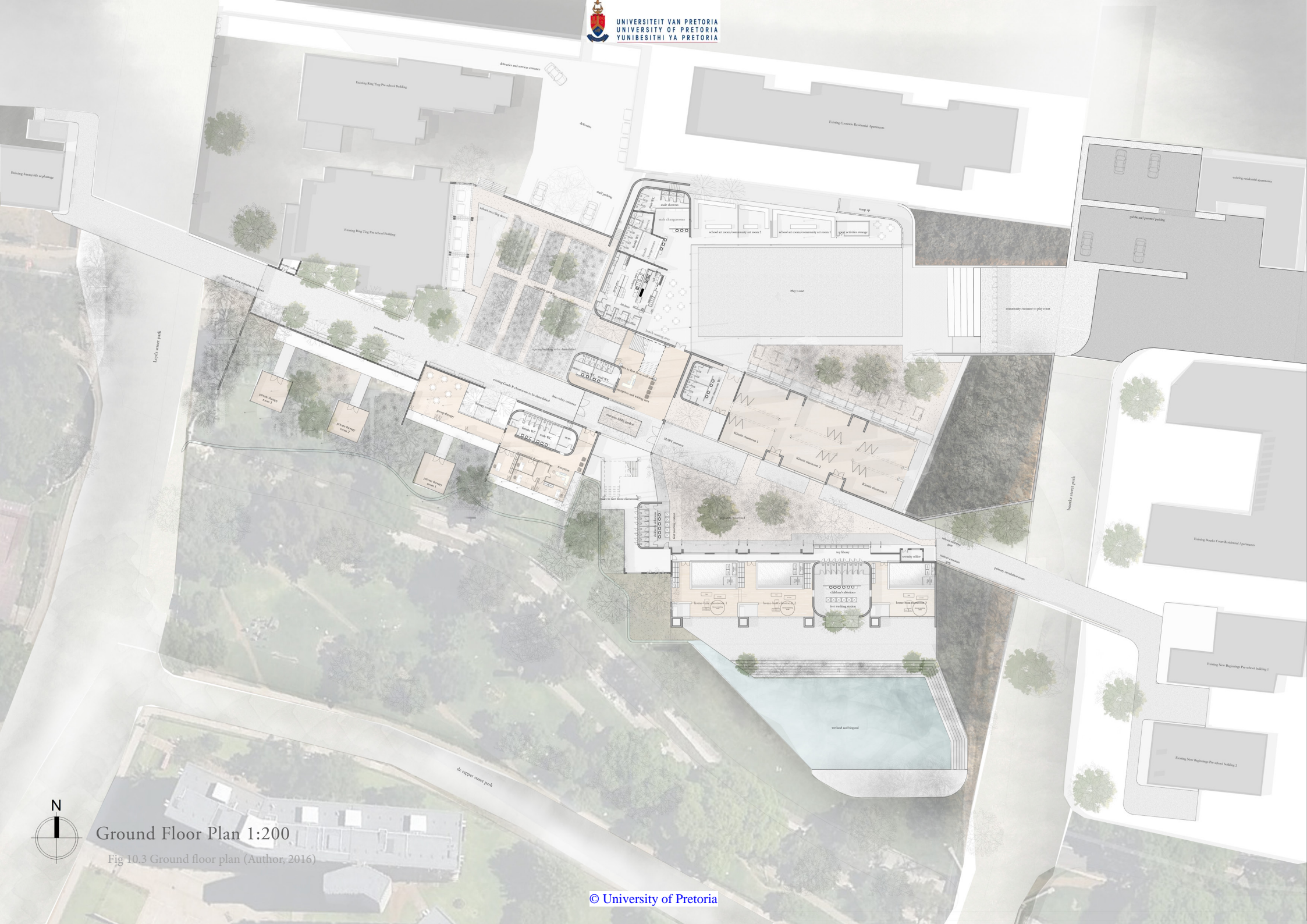
The garden of re-use is situated on the site of the old playground. The main building is the central focus of the school. The main building is the central focus of the school.

The garden of shadow aims to make the school more of an open-plan environment. The main building is the central focus of the school. The main building is the central focus of the school.

The garden of sun was identified as a green space. The main building is the central focus of the school. The main building is the central focus of the school.

Fig 10.2 Garden identification and design (Author, 2016)

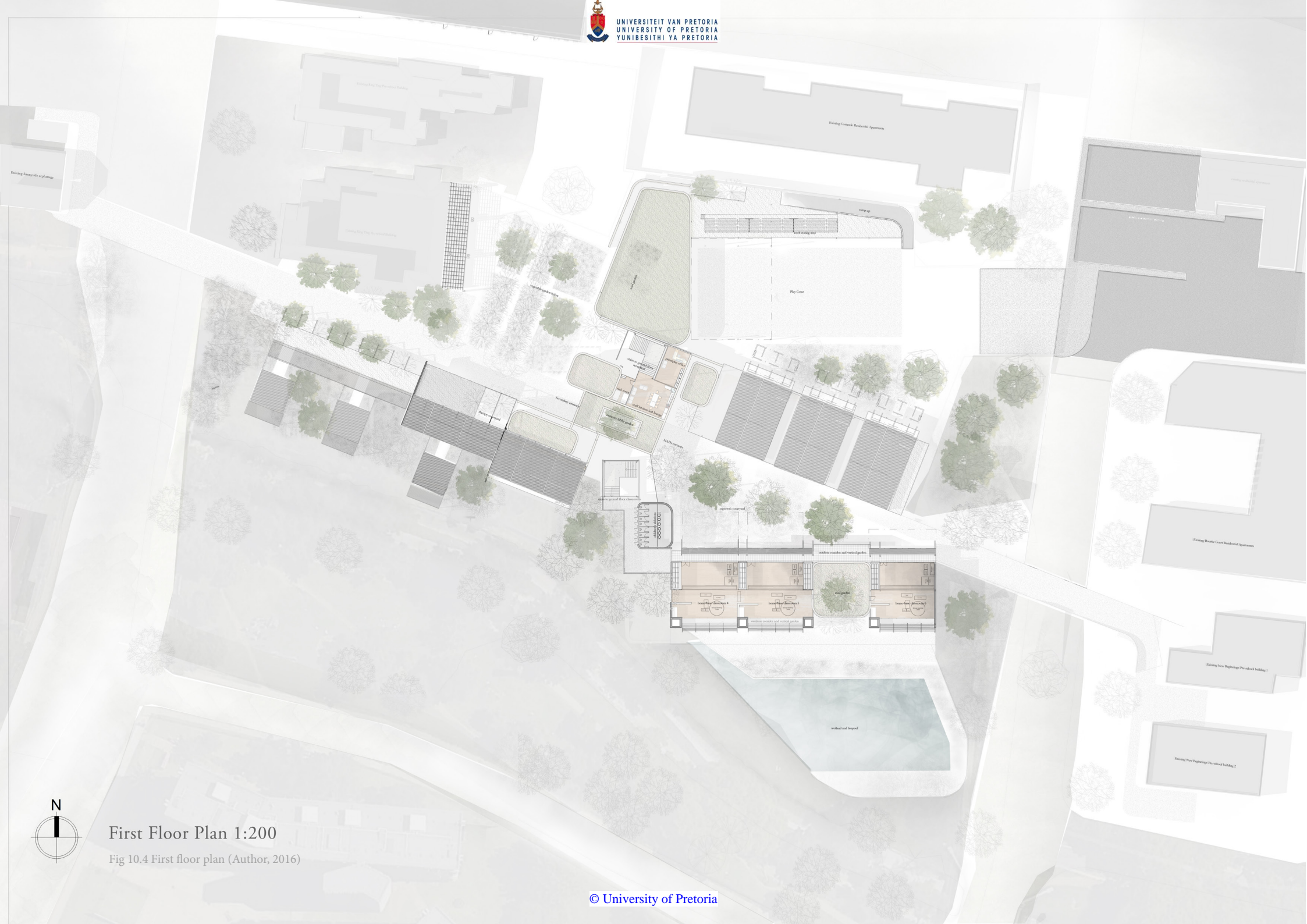




Ground Floor Plan 1:200

Fig 10.3 Ground floor plan (Author, 2016)





First Floor Plan 1:200

Fig 10.4 First floor plan (Author, 2016)

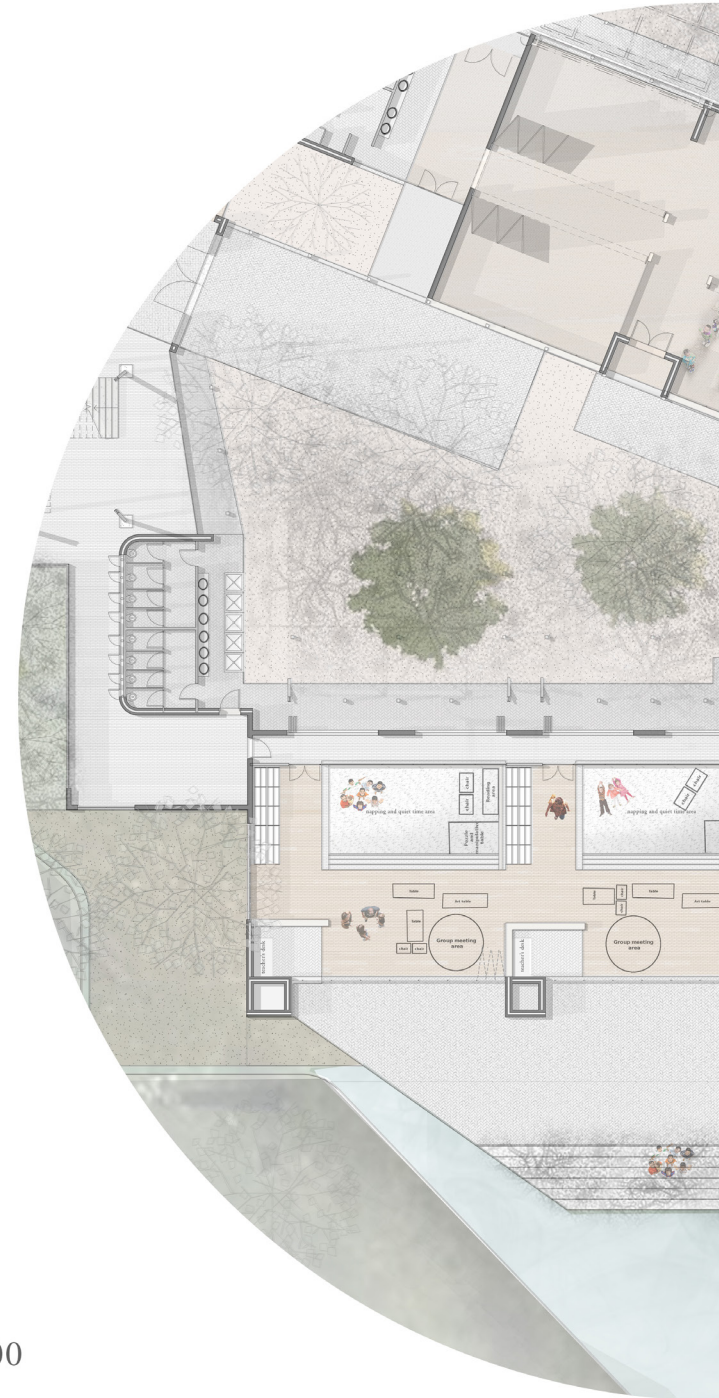
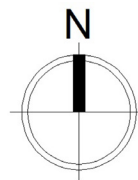
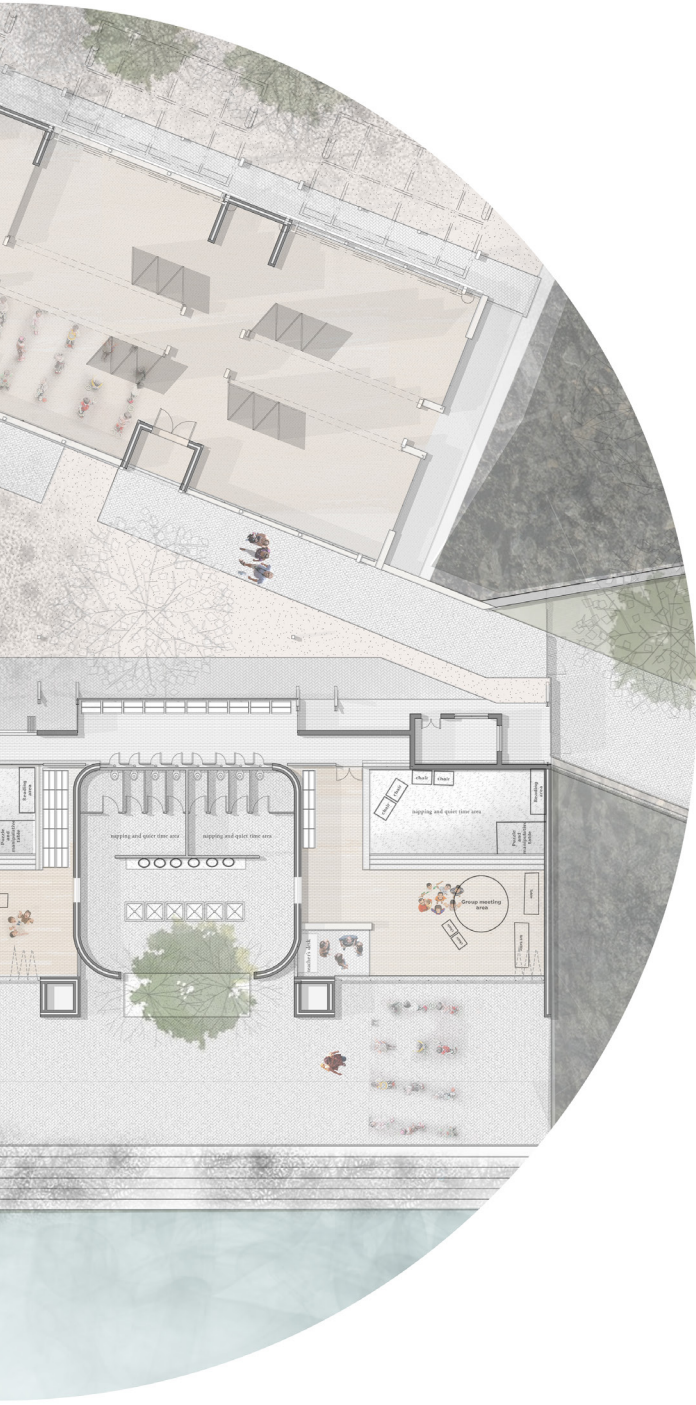


Fig 10.5 Ground floor classroom plan (Author, 2016)



Classroom Floor Plan 1:100



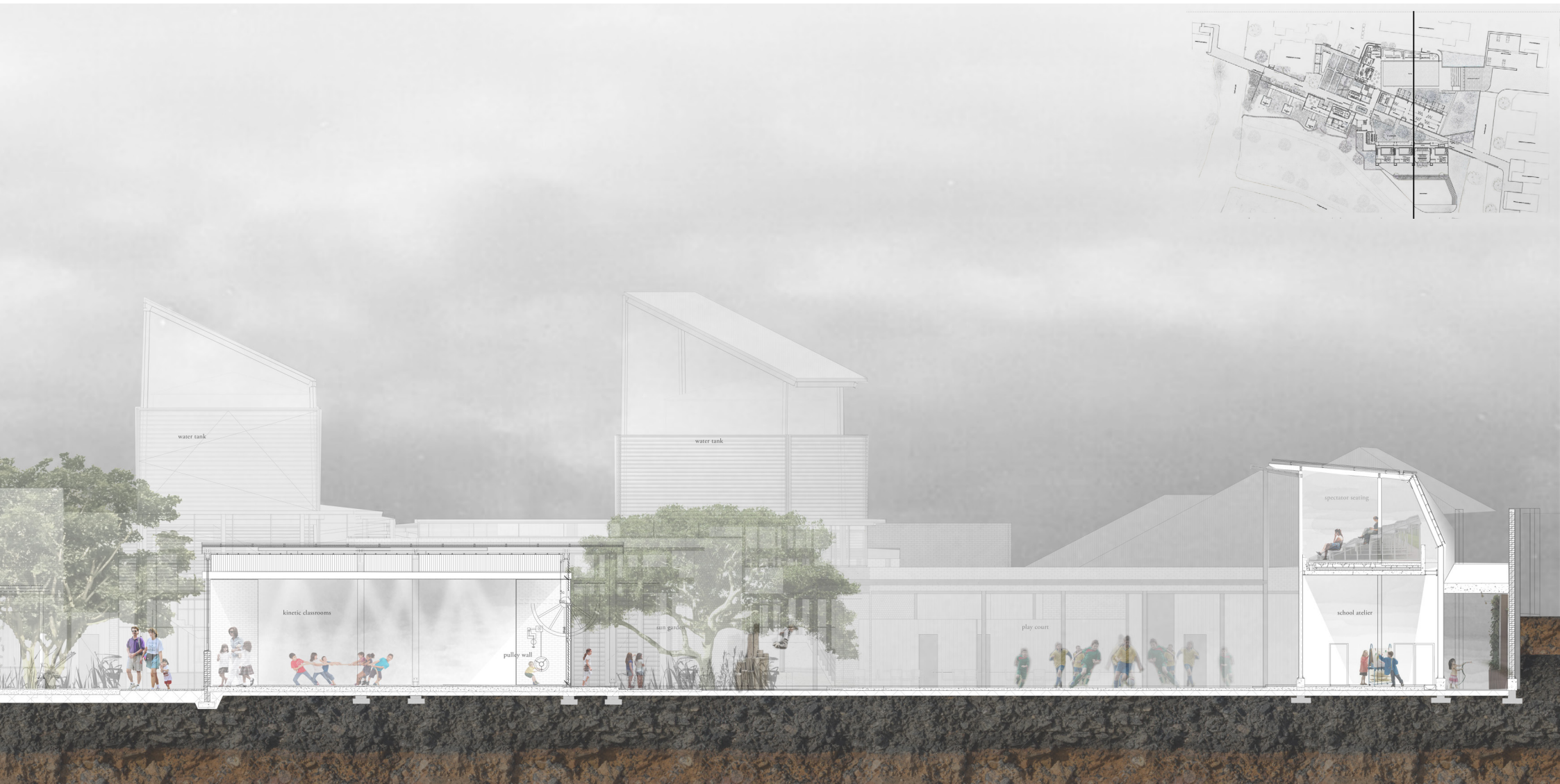


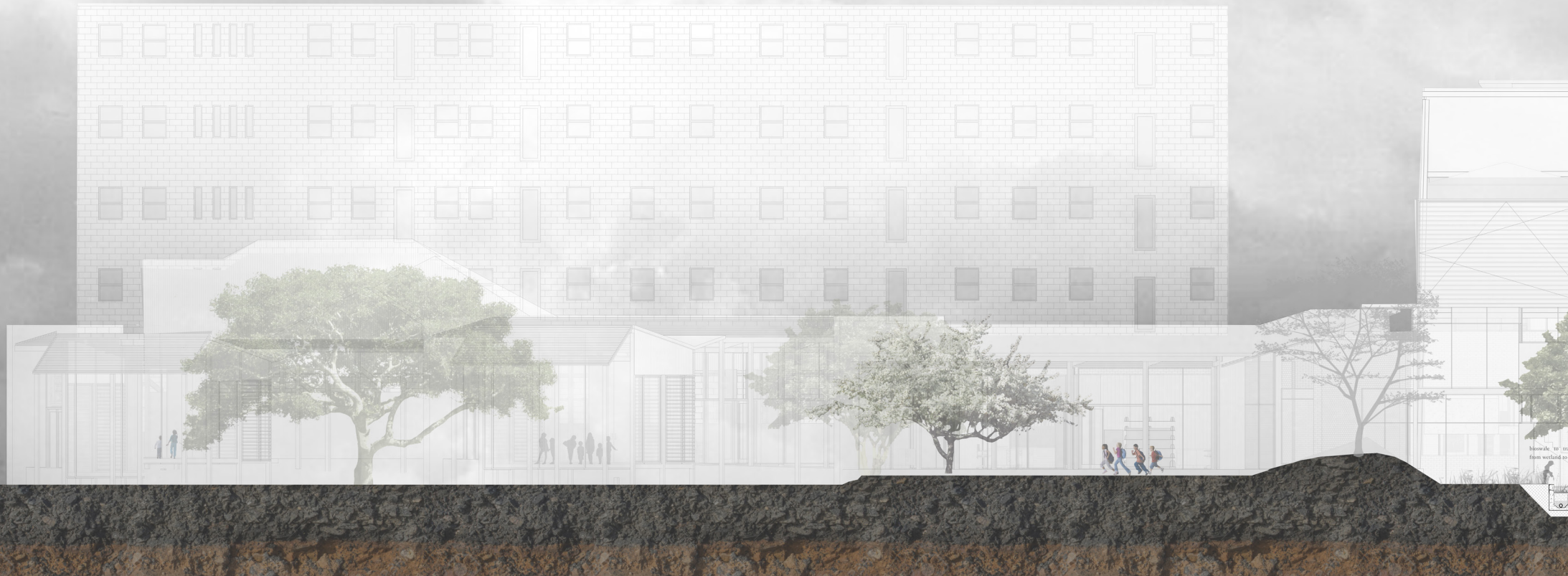
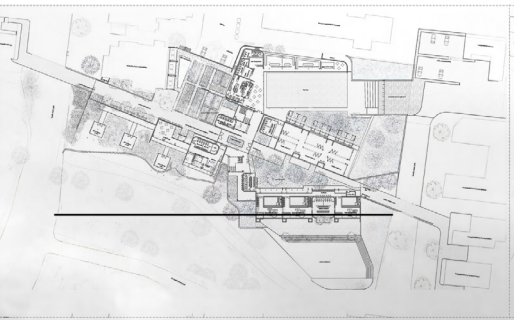


# south-north

Fig 10.6 south-north section(Author, 2016)







# west-east

Fig 10.7 west-east section(Author, 2016)





tectonic concept

The focus lies in the relationship between the characteristics of the existing garden and the tectonics of the architecture and how this relationship can facilitate learning. The primary tectonic concept is based on the biomimicry of the vertical and horizontal axis of the tree:

**Horizontal Axis:** The stereonomic, like the trunk of the tree, offers support as well as services to its branches. The plan is based on the relationship between learning spaces and service to learning showing the relationship between these. The placement of the serving and learning spaces are dependent on the nature of the garden.

**Vertical Axis:** The vertical axis forms a primary structural system of stereonomic floors and trunks (service spaces); and branches (support columns) all supporting the roof canopies. The secondary structure is dependent on the nature of the garden and how and what type of learning takes place in each.

**The Canopy:** The canopy or roofing system represents an overlay of protection over the functions and learning spaces. It is fragmented but in its language becomes an unified element over the site and building.

material palette

SYMBIOTIC QUALITIES ON SITE:

**SOIL:** The soil present on site is of shale rock and broken with a prominent reddish color.

**RED BRICK AND CONCRETE:** The surrounding fabric is mostly constituted from red brick and concrete finishes.

The predominant aesthetic material will be concrete and brick, however when the building is more part of the ground, gables walls will be used to blend with the ground material and support plant growth.

TECTONIC QUALITIES ON SITE:

**VEGETATION- TREE TRUNKS AND BRANCHES:** A variety of tree species exist on site. The majority of trees are more durable when the canopy of trees change and grow over time.

KEPLON™ TWIGGYS

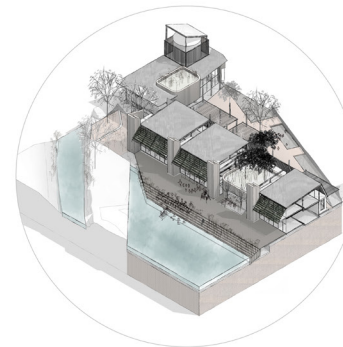
The surrounding learning structures have KEPLON™ creating an direct roofing language which was identified as an appropriate approach to the canopy of the tree and how the roof becomes the canopy over the learning that takes place.

TIMBER

Timber columns will be used as support systems to outdoor learning spaces as the structural system becomes part of a complete system, changing its condition from the indoor roof system.

An appropriate response to material is using roof which is faster to construct and being adaptive with ridge timber columns as support system for a roof system. BRG roof sheeting will be used as it merges with the surrounding fabric of the existing childrens center as well as allows for the roof to become a canopy encompassing the learning spaces.

classroom development



The exterior of the classrooms design was influenced by the identity of the garden that the classrooms frame. The garden of growth was centered around the classrooms having a living skin that becomes part of the building's facade as well as permeate into the classrooms spaces. The roof canopy developed from growing roofs to a more integrated roof and skin system that fully incorporated the skin with the roof to emphasize the continuity of the roof as a canopy. The solar stack became not only a passive climate control mechanism but a design resolution in the modularity between each classroom, serving as the service core between each classroom space.

The Roof (Canopy):

The roof canopy developed from growing roofs to a more integrated roof and skin system that fully incorporated the skin with the roof to emphasize the continuity of the roof as a canopy. The roof canopy is to enable activities below as a protective layer in the trunks and branches.

The Tectonic (The branches):

stereonomic trunks were juxtaposed alongside spaces made up of light concrete columns and light walls, leading to natural light from high level windows, timber columns and vegetation. stereonomic learning depends on stereonomic in terms of function and structural support. stereonomic library, some more areas became a recognizable element in the landscape.

The Stereonomic (The trunks):

relationship between learning spaces and service to learning. The placement of the serving and learning spaces are dependent on the nature of the garden. The services offered by these stereonomic made like objects on plan reflect positive climate control and facilitation of storage space for the classroom's needs as well as enhance facilities.

The Stereonomic (The Roots):

The base of the design establishes and unifies the landscape to facilitate learning and create learning spaces through the incorporation of the roofed and water channel as well as the land forms.

The Identified Gardens (The rooms):

The identified garden spaces are defined in the design and service mechanisms. These characteristics together with the primary design language determined the structural mechanisms.

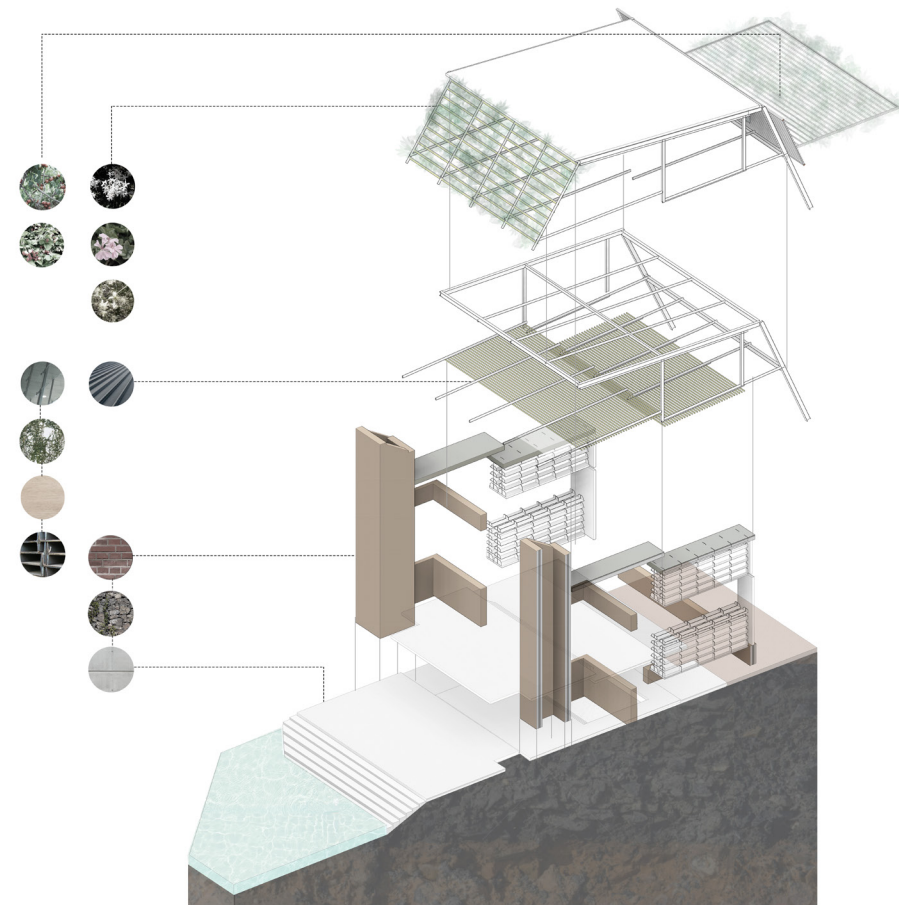
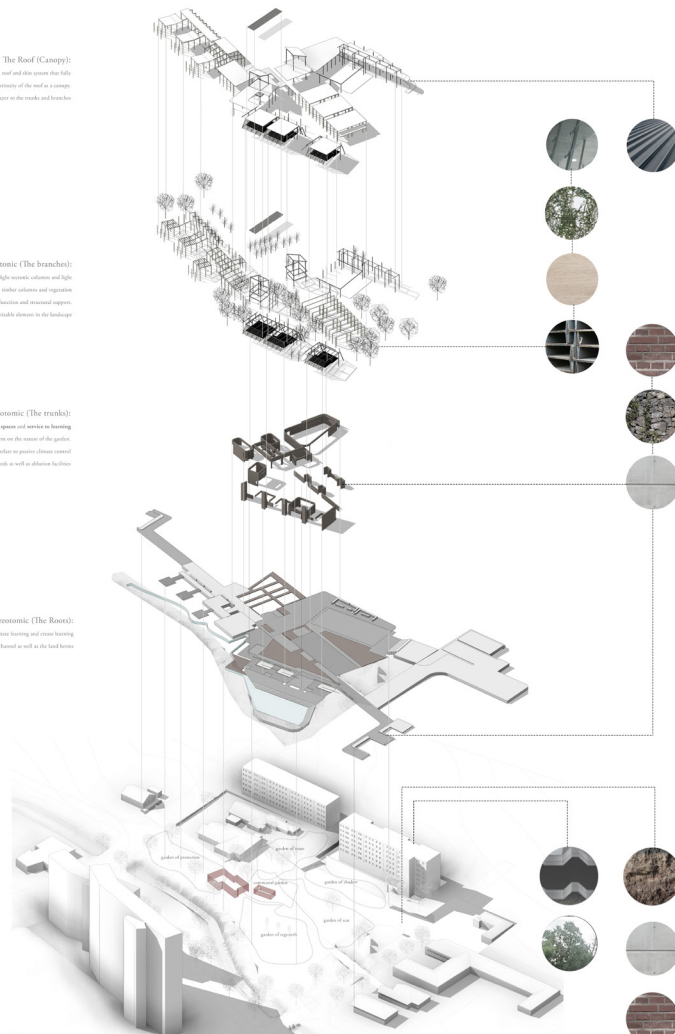
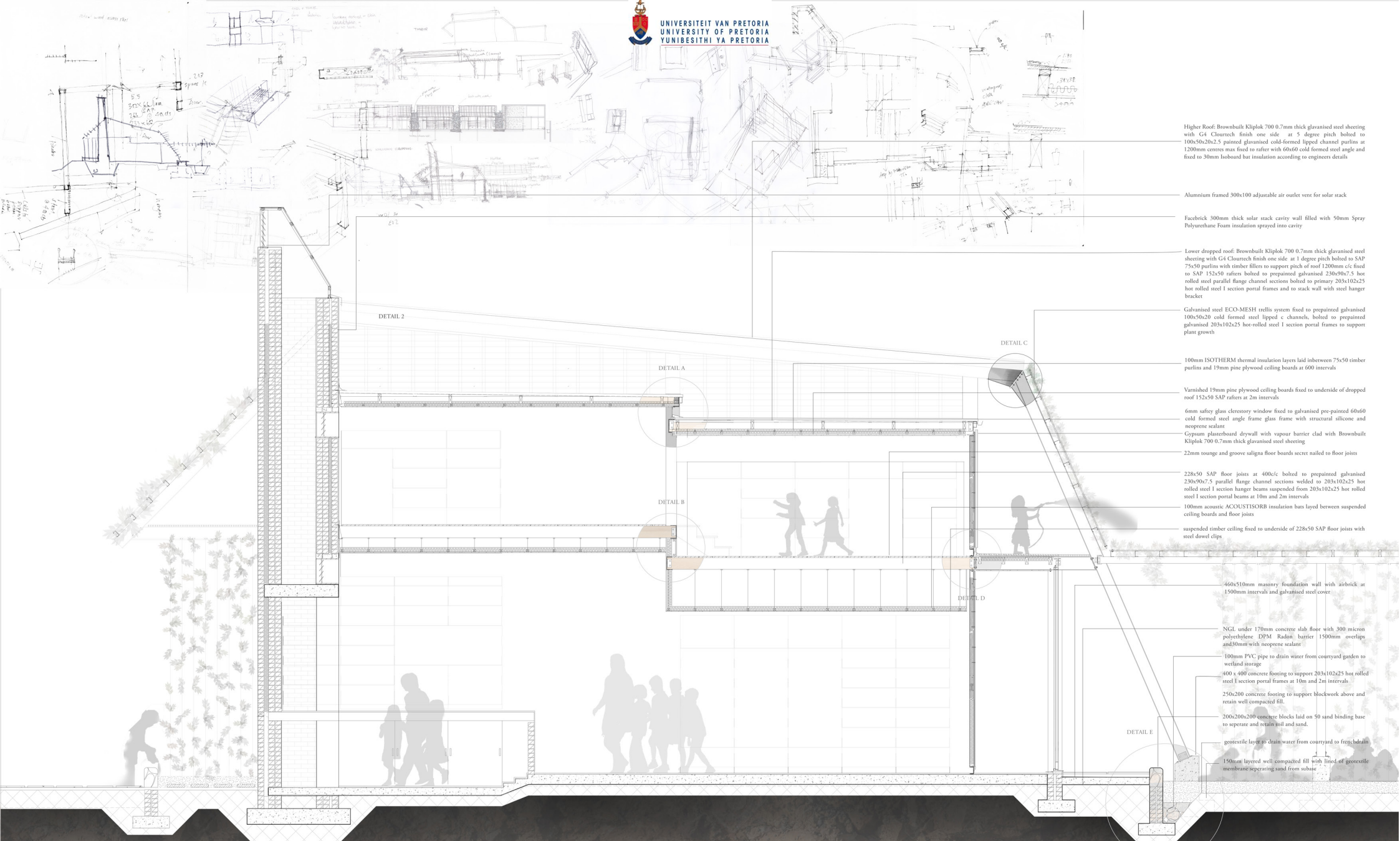


Fig 10.8 Technical axonometric explosions (Author, 2016)





Higher Roof: Brownbult Kliplok 700 0.7mm thick galvanised steel sheeting with G4 Cloutrtech finish one side at 5 degree pitch bolted to 100x50x20x2.5 painted galvanised cold-formed lipped channel purlins at 1200mm centres max fixed to rafters with 60x60 cold formed steel angle and fixed to 30mm lookout but insulation according to engineers details

Aluminium framed 300x100 adjustable air outlet vent for solar stack

Facebook 300mm thick solar stack cavity wall filled with 50mm Spray Polyurethane Foam insulation sprayed into cavity

Lower dropped roof: Brownbult Kliplok 700 0.7mm thick galvanised steel sheeting with G4 Cloutrtech finish one side at 1 degree pitch bolted to SAP 75x50 purlins with timber fillers to support pitch of roof 1200mm c/c fixed to SAP 152x50 rafters bolted to pre-painted galvanised 230x90x7.5 hot rolled steel parallel flange channel sections bolted to primary 203x102x25 hot rolled steel I section portal frames and to stack wall with steel hanger bracket

Galvanised steel ECO-MESH trellis system fixed to pre-painted galvanised 100x50x20 cold formed steel lipped c channels, bolted to pre-painted galvanised 203x102x25 hot-rolled steel I section portal frames to support plant growth

100mm ISOTHERM thermal insulation layers laid between 75x50 timber purlins and 19mm pine plywood ceiling boards at 600 intervals

Varnished 19mm pine plywood ceiling boards fixed to underside of dropped roof 152x50 SAP rafters at 2m intervals

6mm safety glass clerestory window fixed to galvanised pre-painted 60x60 cold formed steel angle frame glass frame with structural silicone and neoprene sealant  
Gypsum plasterboard drywall with vapour barrier clad with Brownbult Kliplok 700 0.7mm thick galvanised steel sheeting

22mm tongue and groove saligna floor boards secret nailed to floor joists

228x50 SAP floor joists at 400c/c bolted to pre-painted galvanised 230x90x7.5 parallel flange channel sections welded to 203x102x25 hot rolled steel I section hanger beams suspended from 203x102x25 hot rolled steel I section portal beams at 10m and 2m intervals

100mm acoustic ACOUSTISORB insulation bars layed between suspended ceiling boards and floor joists  
suspended timber ceiling fixed to underside of 228x50 SAP floor joists with steel dowel clips

460x510mm masonry foundation wall with airbrick at 1500mm intervals and galvanised steel cover

NGL under 170mm concrete slab floor with 300 micron polyethylene DPM Radon barrier 1500mm overlaps and 300mm with neoprene sealant

100mm PVC pipe to drain water from courtyard garden to wetland storage

400 x 400 concrete footing to support 203x102x25 hot rolled steel I section portal frames at 10m and 2m intervals

250x200 concrete footing to support blockwork above and retain well compacted fill

200x200x200 concrete blocks laid on 50 sand binding base to separate and retain soil and sand

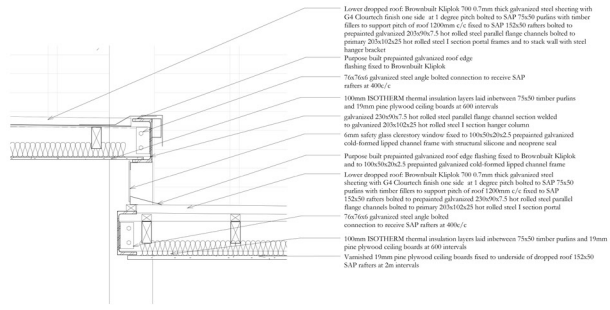
geotextile layer to drain water from courtyard to freyghdrain

150mm layered well compacted fill with lined of geotextile membrane separating sand from subsoil

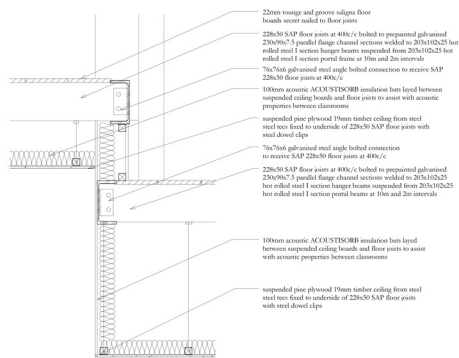
1:20 Section

Fig 10.9 Final 1:20 Section (Author, 2016)

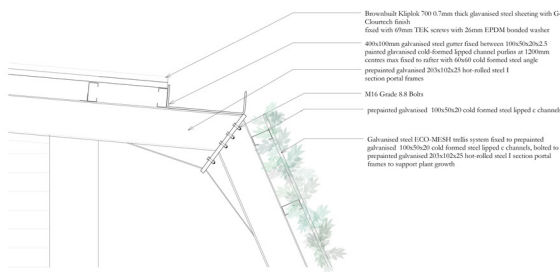




DETAIL A  
scale 1:10



DETAIL B  
scale 1:10



DETAIL C  
scale 1:10

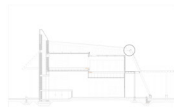
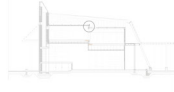
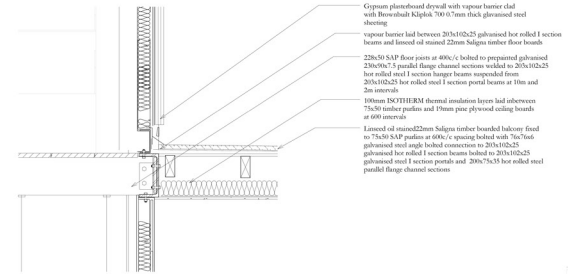
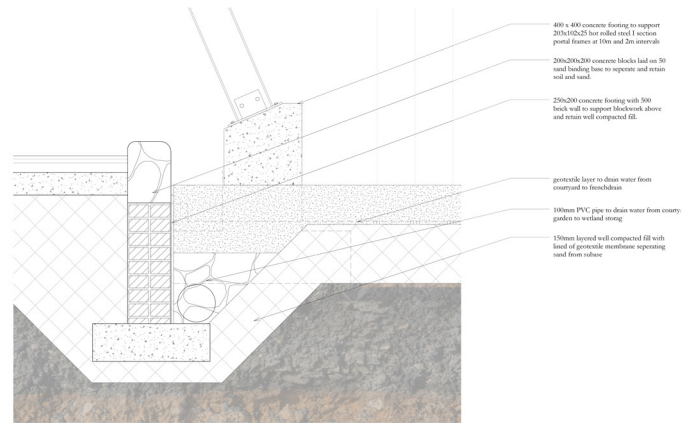


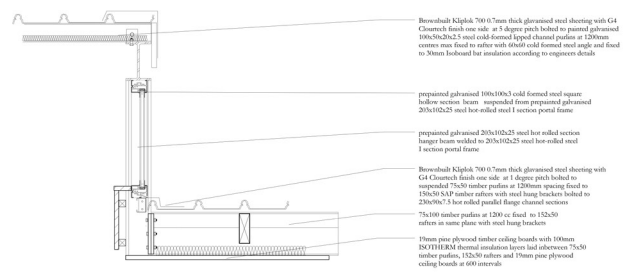
Fig 10.10 Details (Author, 2016)



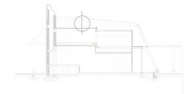
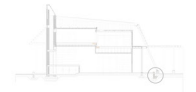
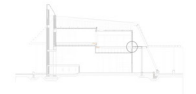
DETAIL D  
scale 1:10

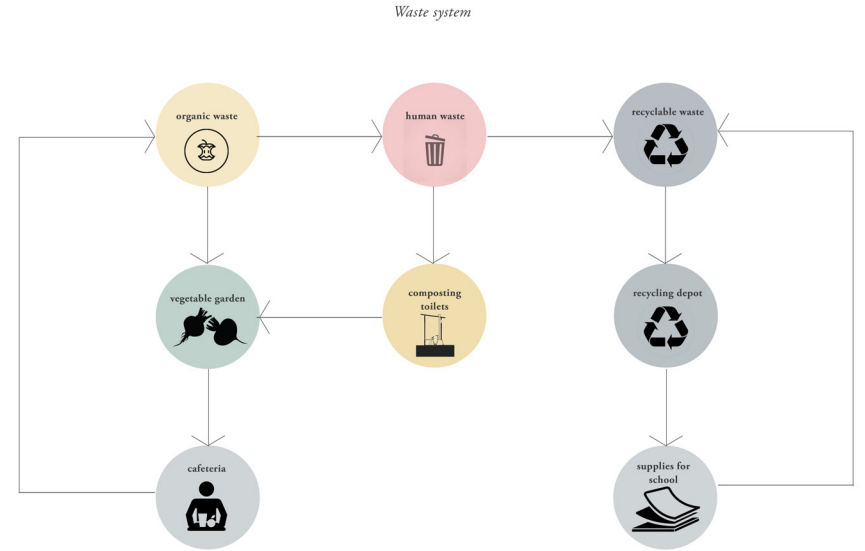
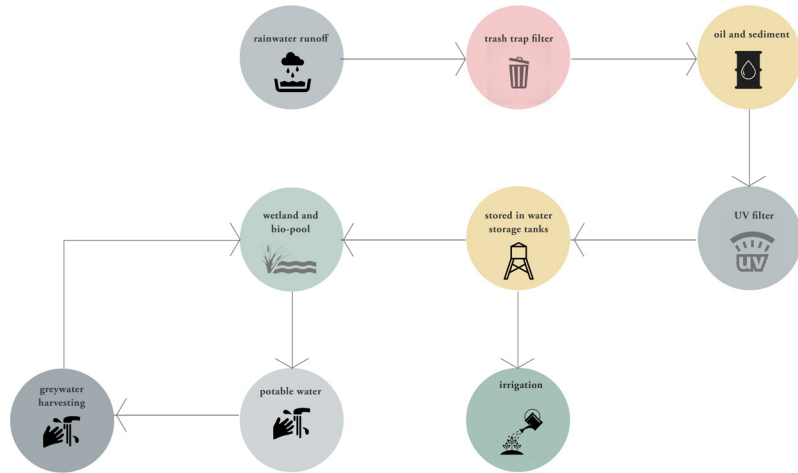


DETAIL E  
scale 1:10



DETAIL F  
scale 1:10





As a result of the investigation, a 500m<sup>3</sup> tank needs to be provided in order to support the demand. This is not possible due to space reasons, so 180m<sup>3</sup> will be stored in high level water towers.

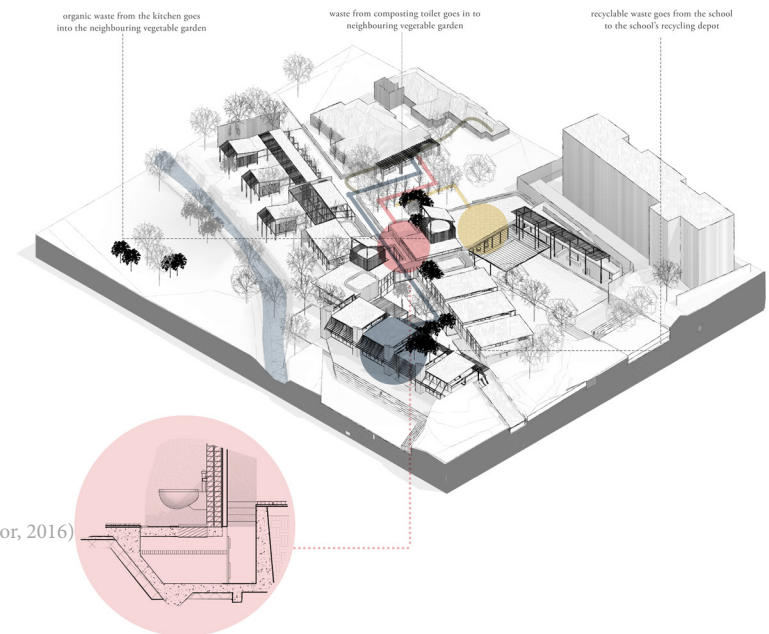
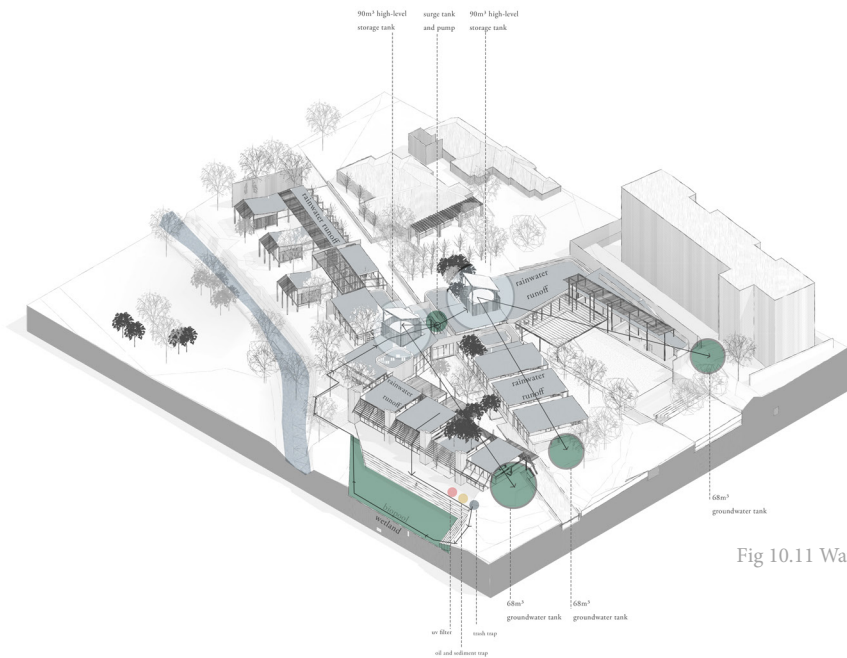
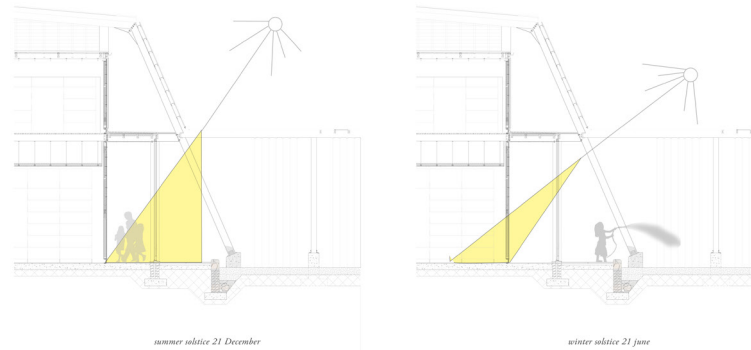
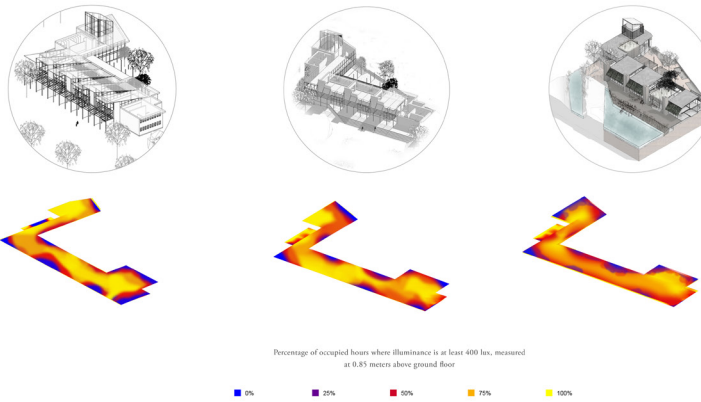


Fig 10.11 Water and Waste Passive Systems(Author, 2016)

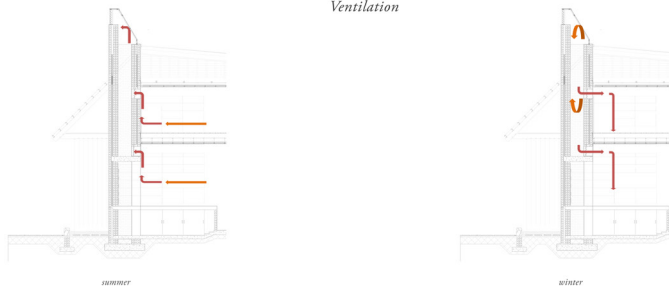
Daylighting



The pergola and deep set circulation corridor and balcony lets sun into the classrooms in winter and shades it in summer



Ventilation



During summer months, the stack aims to cool the space through an updraught created by the form of the stack, the glass on top of the stack, the glass on top of the stack, the glass on top of the stack to mitigate heat

Fig 10.12 Daylighting Resolutions (Author, 2016)

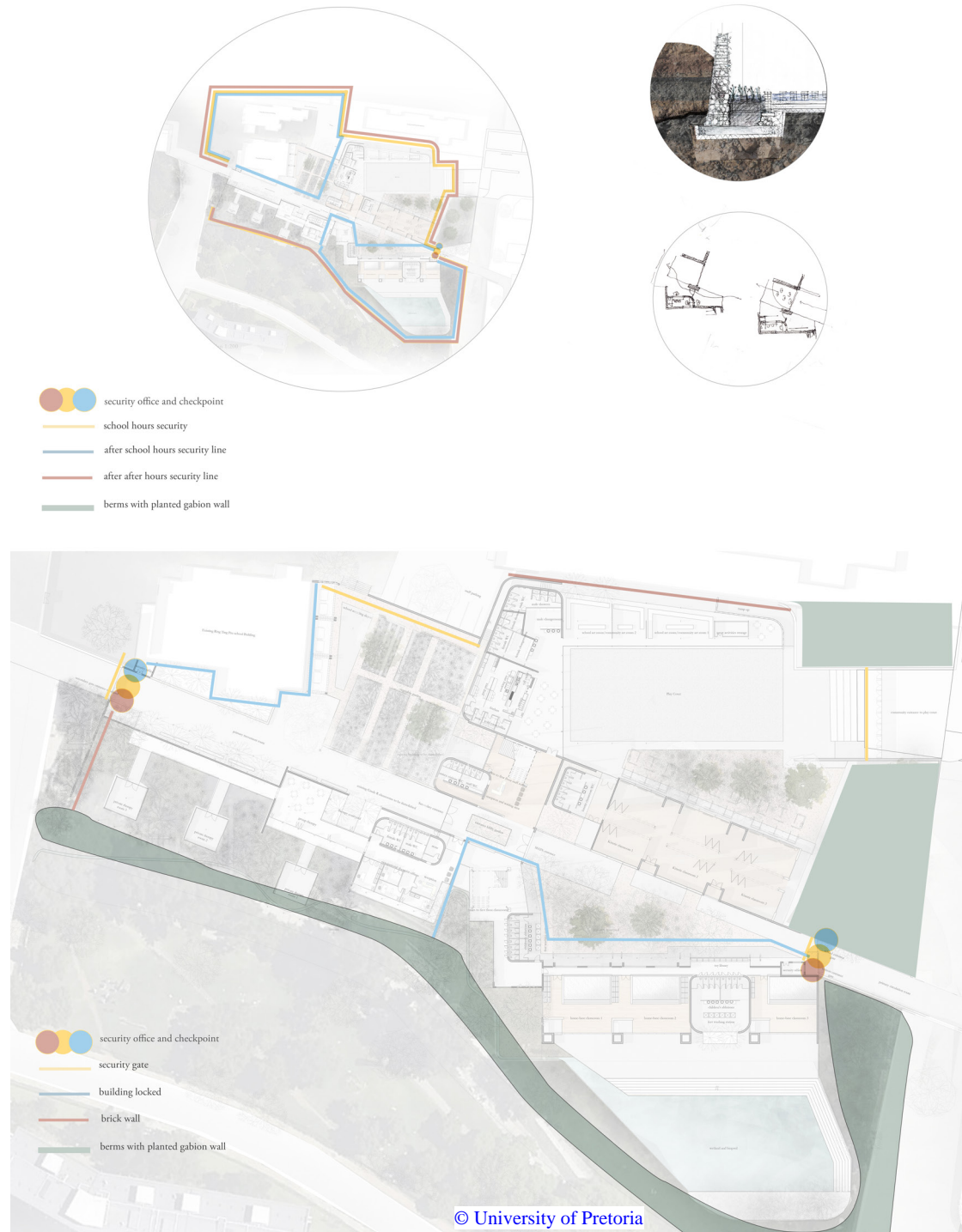


Fig 10.13 Child Safety Resolutions (Author, 2016)





Fig 10.14 Interior perspective of classrooms (Author, 2016)

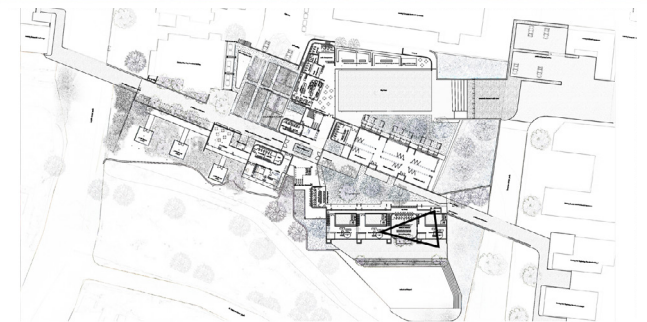






Fig 10.15 View over the Walkerspruit looking towards the classrooms and occupational therapy suites (Author, 2016)

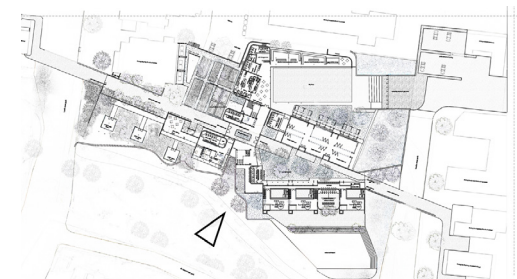
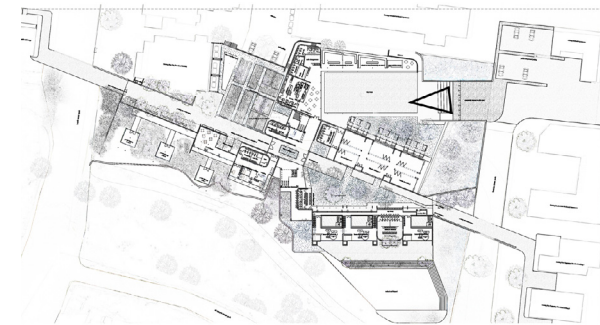






Fig 10.16 View of play court (Author, 2016)





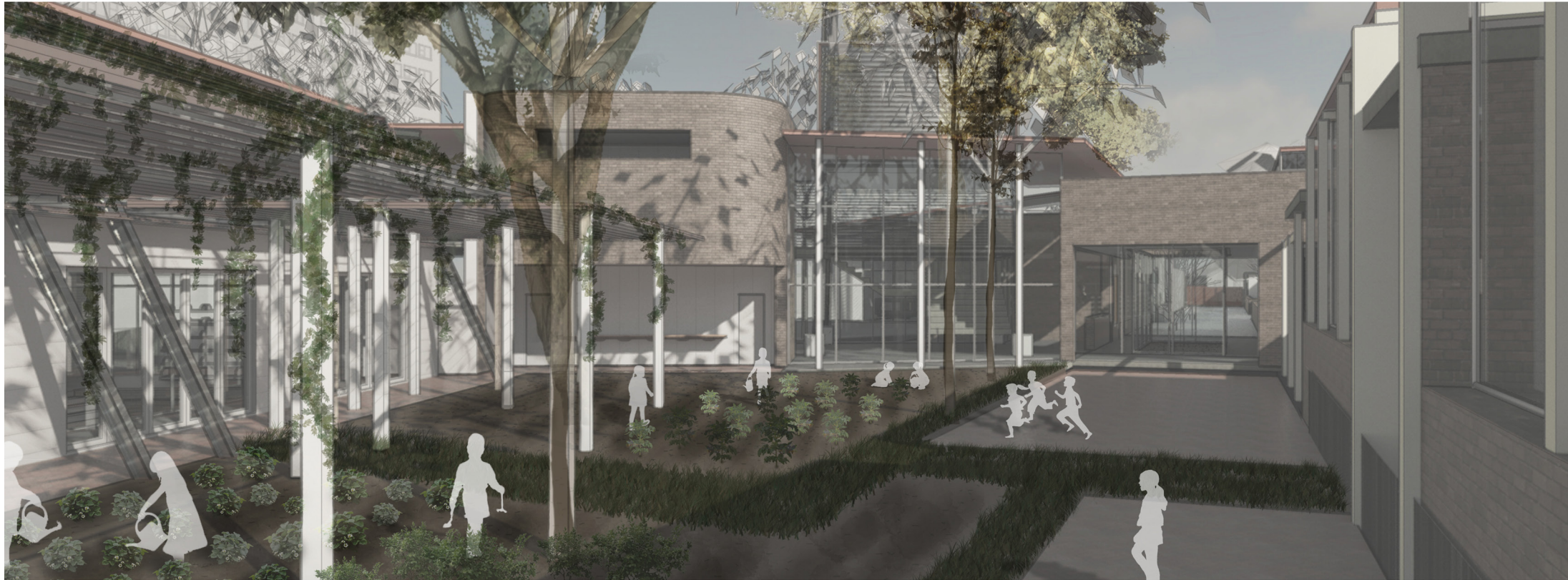
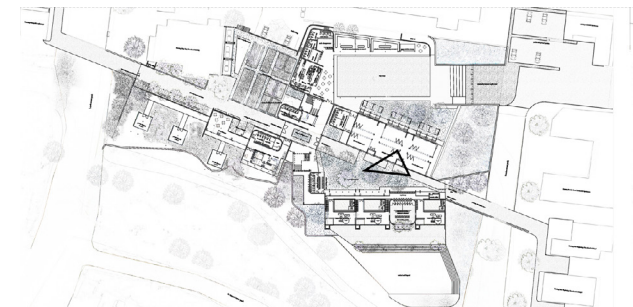


Fig 10.17 View of the garden of regrowth (Author, 2016)





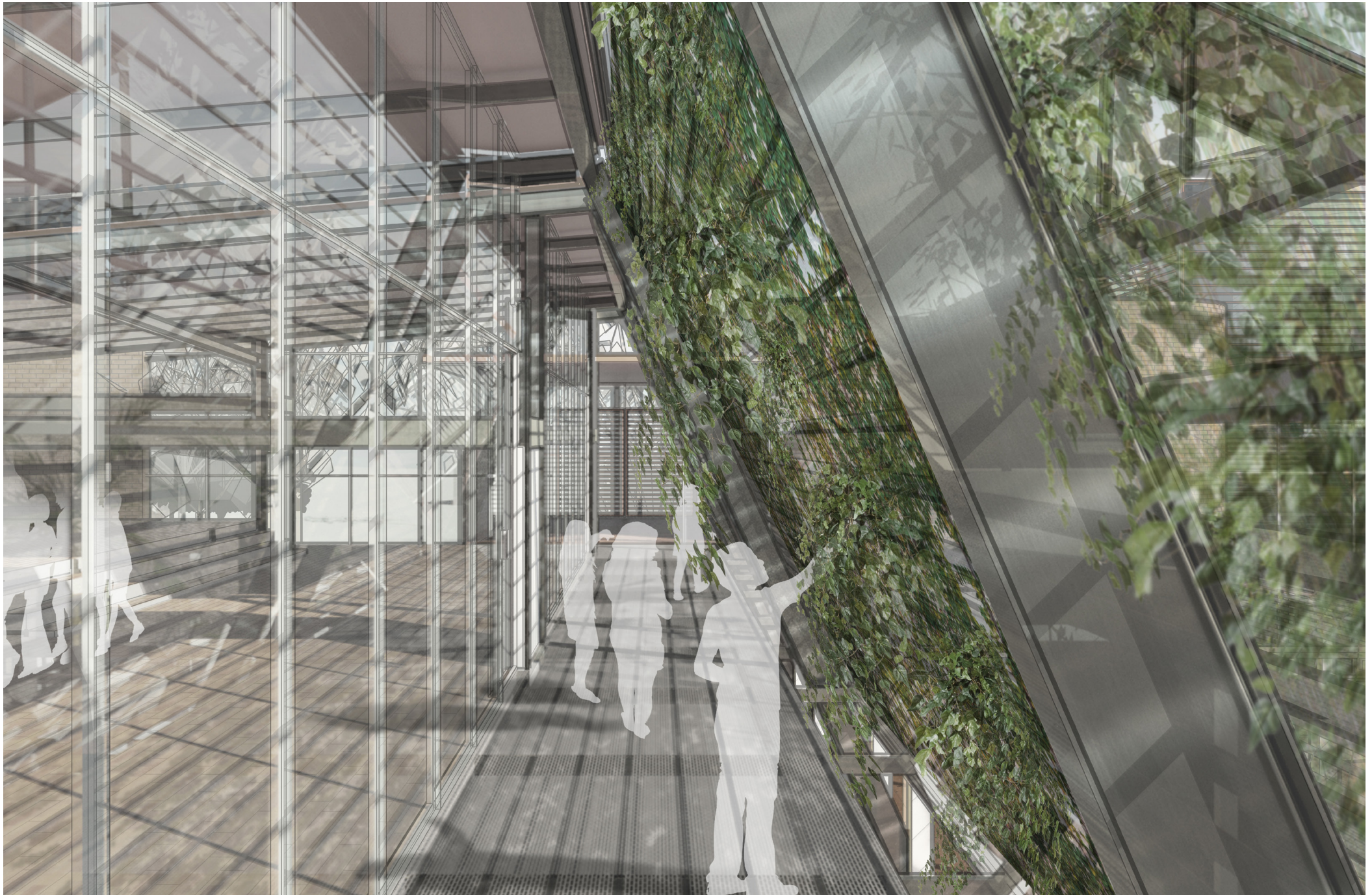


Fig 10.18 View of living skin and children maintaining it (Author, 2016)





Fig 10.19 View of the classroom threshold and bathroom entrance (Author, 2016)





Fig 10.20 Final Model, overlooking home-base classrooms (Author, 2016)



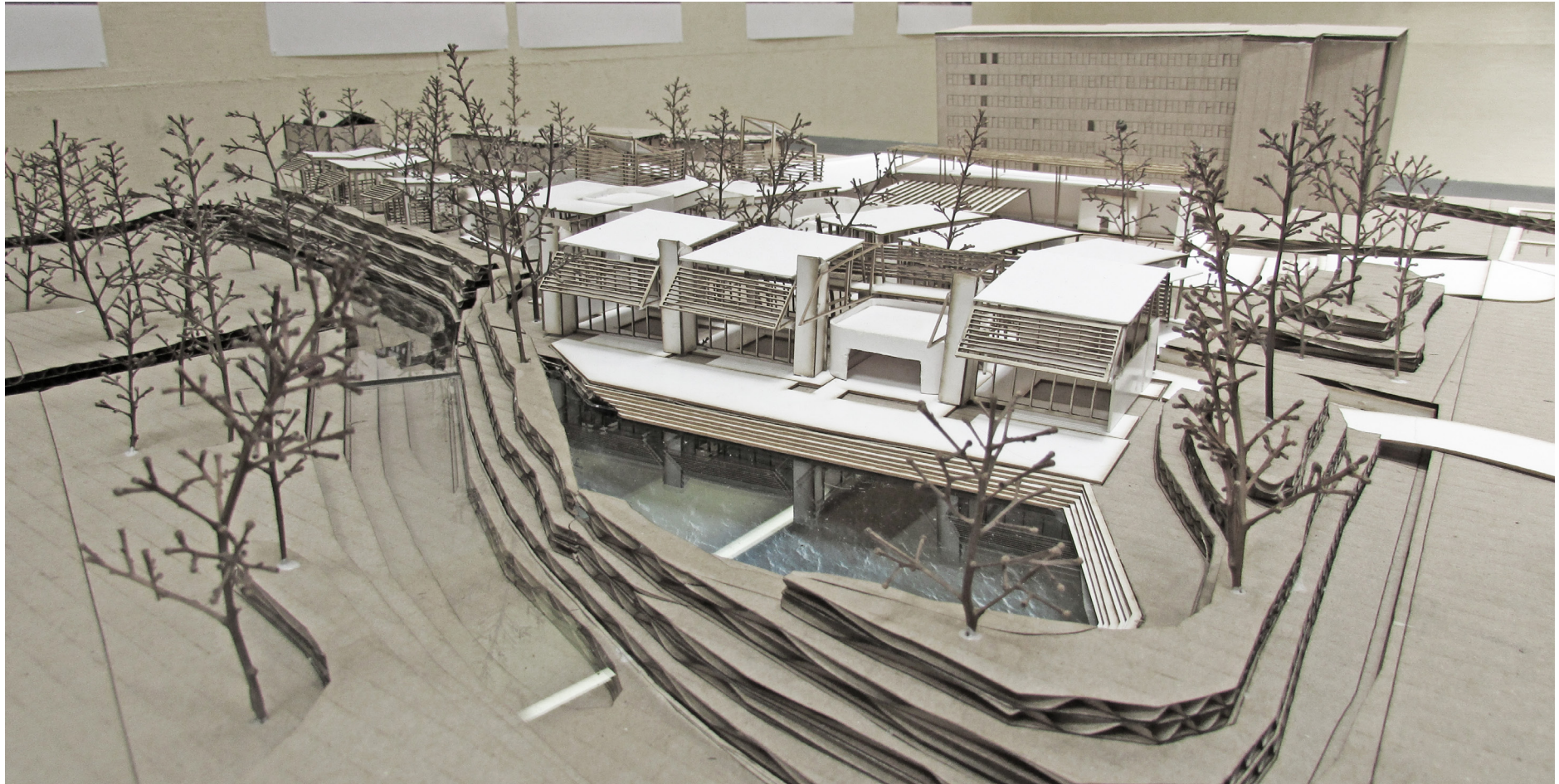


Fig 10.21 Final model, home-base classrooms and wetland and water park (Author, 2016)



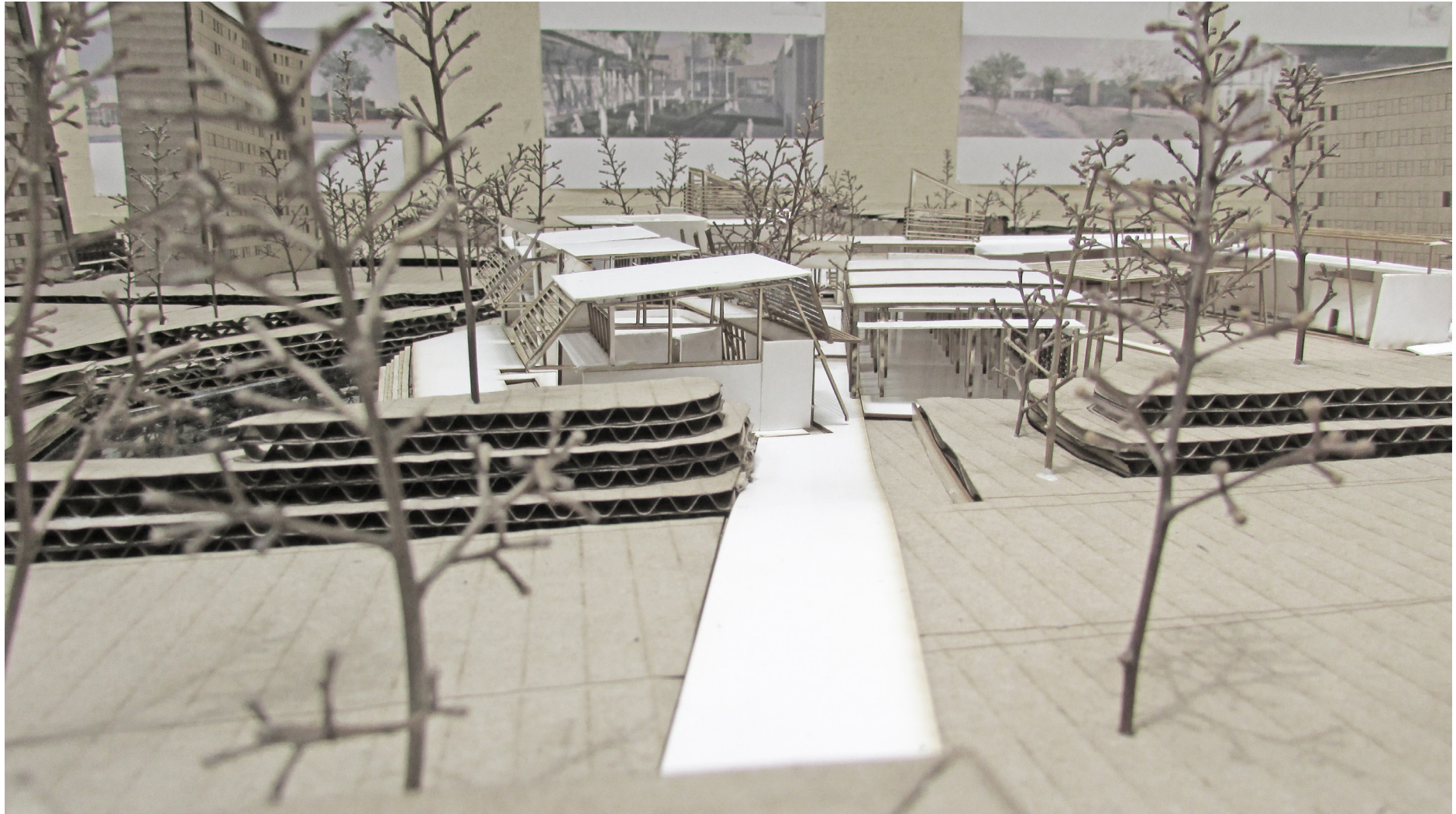


Fig 10.22 Final Model, en-route through school (Author, 2016)





Fig 10.23 Final Model, looking over Walkerspruit towards occupational therapy pods (Author, 2016)



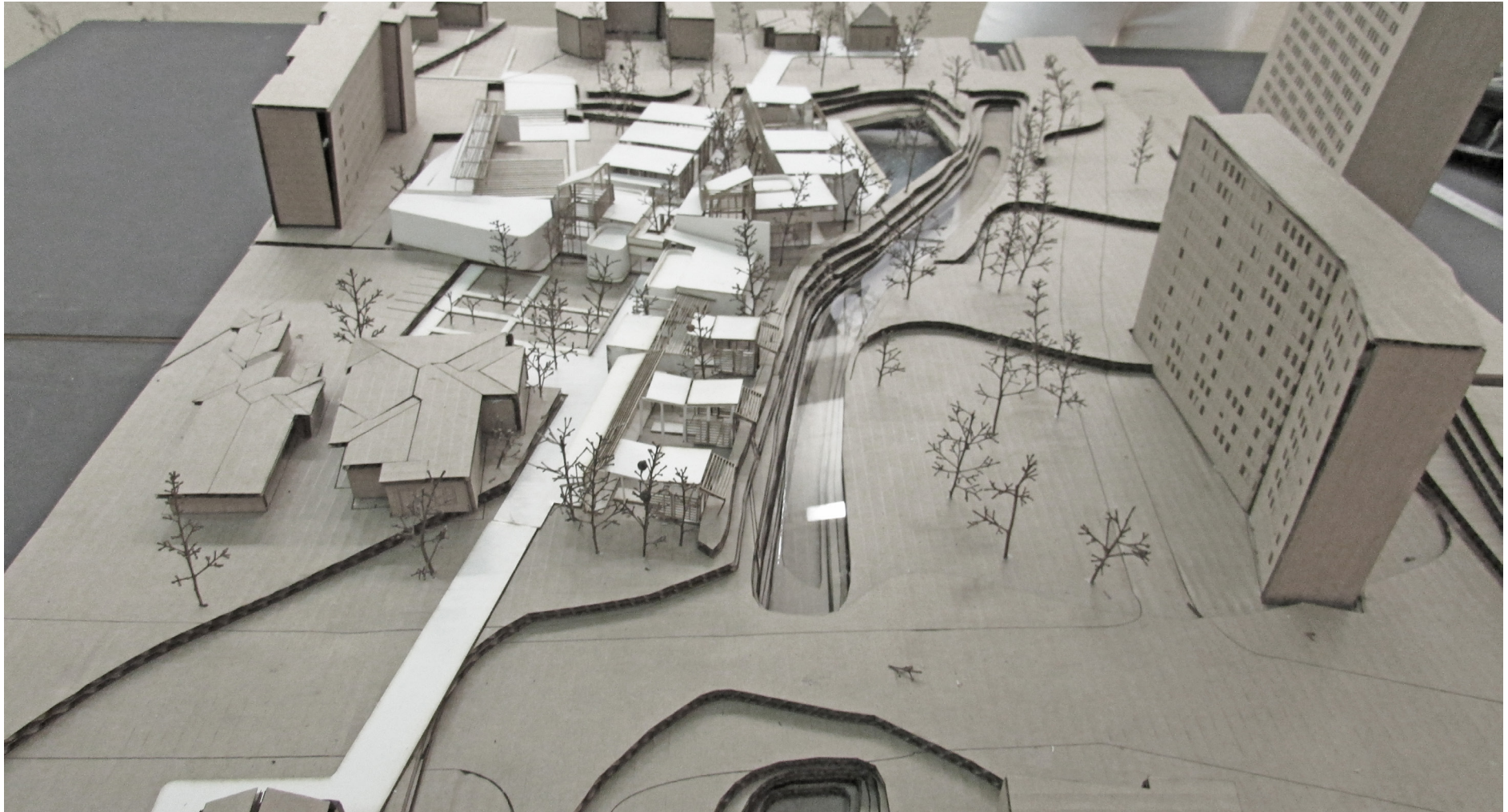


Fig 10.24 Final Model, overlooking entire site towards the East (Author, 2016)



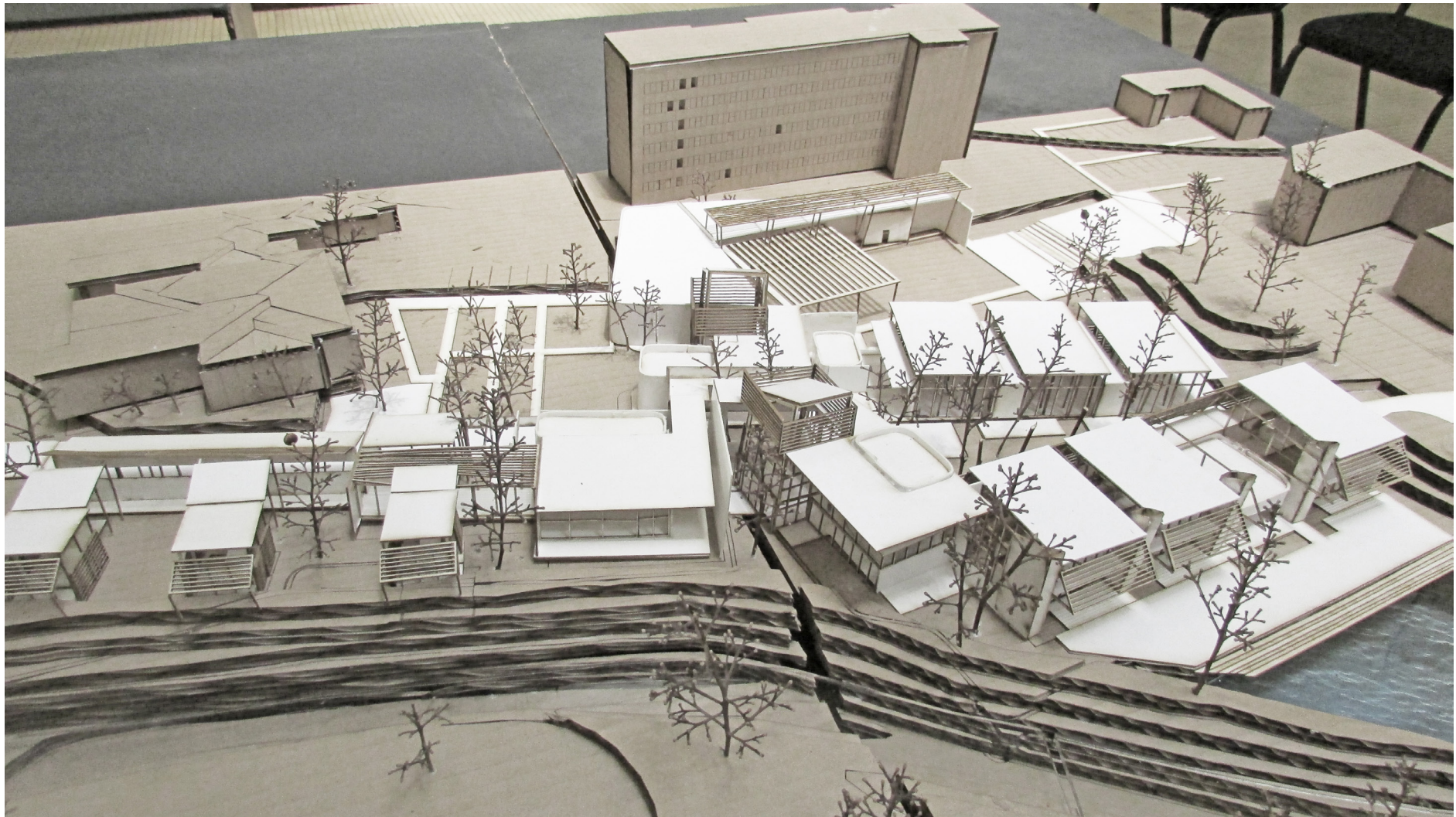


Fig 10.25 Final Model overlooking site towards the North (Author, 2016)





Fig 10.26 Final Presentation (Author, 2016)





Fig 10.27 Final Presentation (Author, 2016)



## Water Supply

### Rainwater yield calculation

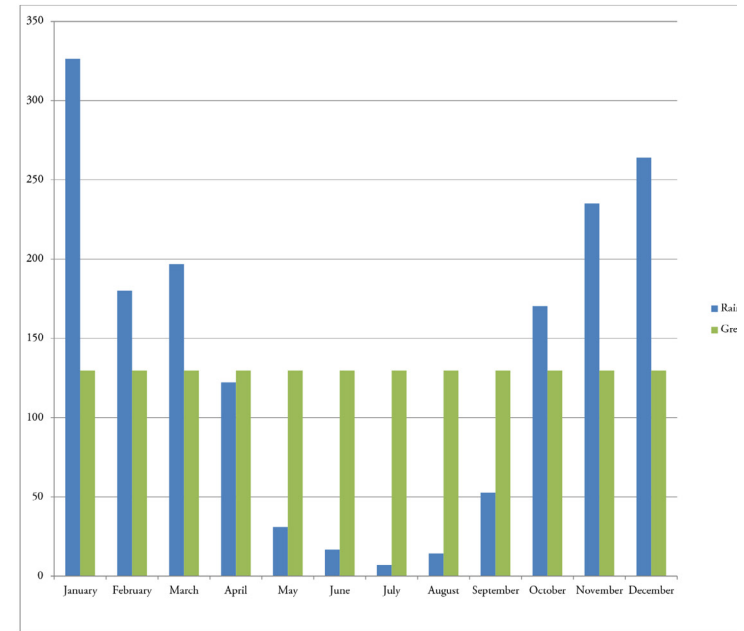
Catchment surface

Roof

Area (m <sup>2</sup> )	Runoff coefficient weighted	Area of catchment weighted	
2671	0.9	2403.9	
		2403.9	

### Rainwater yield calculation

Ave. monthly precipitation	Area of catchment weighted	Rain yield (m <sup>3</sup> )	
January	0.136	2400	326.4
February	0.075	2400	180
March	0.082	2400	196.8
April	0.051	2400	122.4
May	0.013	2400	31.2
June	0.007	2400	16.8
July	0.003	2400	7.2
August	0.006	2400	14.4
September	0.022	2400	52.8
October	0.071	2400	170.4
November	0.098	2400	235.2
December	0.11	2400	264
Total	0.674	6480	1617.6



### Grey Water Harvisting

children and staff

662 Handwashing:spray taps	1	662
1 Clothes washing machine	4	4
52 Dishwashing machine	3	156
17 Shower	25	425
262 Drinking, food preparation and cooking	15	3930
		5177

visitors

150 Handwashing:spray taps	1	150
0 Clothes washing machine	25	0
3 Dishwashing machine	3	9
17 Shower	50	850
26 Drinking, food preparation and cooking	15	390
		1399

Total grey water back as yeild 6576

### Grey Water Harvisting

Month	Days/month	Working days/month	Water capita/Day	Water capita/month	Greywater Domestic Harvisting		
January	15	1399	21	5177	6576	129702	129
February	15	1399	21	5177	6576	129702	129
March	15	1399	21	5177	6576	129702	129
April	15	1399	21	5177	6576	129702	129
May	15	1399	21	5177	6576	129702	129
June	15	1399	21	5177	6576	129702	129
July	15	1399	21	5177	6576	129702	129
August	15	1399	21	5177	6576	129702	129
September	15	1399	21	5177	6576	129702	129

Table 10.1 Water Budget (Author, 2016)

October	15	1399	21	5177	6576	129702	129702
November	15	1399	21	5177	6576	129702	129702
December	15	1399	21	5177	6576	129702	129702
						1556424	1556424

### Water Demand

#### Irrigation Demand

Vegetable Garden Irrigation

Month	Planting Area (m2)	Irr. Depth/ month	Agricultural Land Irrigation demand (m3 per month)	
January	500	0.12	60	
February	500	0.103	51.5	
March	500	0.101	50.5	
April	500	0.085	42.5	
May	500	0.085	42.5	
June	500	0.07	35	
July	500	0.06	30	
August	500	0.07	35	
September	500	0.1	50	
October	500	0.1	50	
November	500	0.115	57.5	
December	500	0.12	60	
		Total	564.5	

#### Irrigation Demand

Garden irrigation

Month	Planting Area (m2)	Irr. Depth/ month	Rehabilitated landscape demand (m3 per month)	
January	600	0.09	54	
February	600	0.08	48	
March	600	0.07	42	
April	600	0.05	30	
May	600	0.04	24	
June	600	0.04	24	
July	600	0.04	24	
August	600	0.04	24	
September	600	0.07	42	
October	600	0.08	48	
November	600	0.08	48	
December	600	0.09	54	
		Total	462	

### TOTAL WATER DEMAND

Month	Days/month	total demand per month	Working days/month	Water capita/Day	Water capita/month	Domestic demand/month (
January	21	5192	15	674	5866	119142
February	21	5192	15	674	5866	119142
March	21	5192	15	674	5866	119142
April	21	5192	15	674	5866	119142
May	21	5192	15	674	5866	119142
June	21	5192	15	674	5866	119142
July	21	5192	15	674	5866	119142
August	21	5192	15	674	5866	119142
September	21	5192	15	674	5866	119142

#### Domestic Demand

##### Permanent Users

Children and Teachers	Appliances	Litres/day/person served	total demand per day
662	Handwashingspray taps		1
1	Clothes Washing		4
52	Dishwashing machine		3
17	Shower		25
3	WC flushing-urinals provided		5
262	Drinking, food preparation and cooking		15

##### Visitors

Public People	Appliances	Litres/day/person served	total demand per day
150	Handwashingspray taps		1
10	Urinal flushing 8h day		0
3	Dishwashing machine		3
5	Showers		25
26	Drinking, food preparation and cooking		15

Table 10.1 Water Budget (Author, 2016)









## References

- Archdaily. 2013. *SFU UniverCity Childcare / HCMA*. <http://www.archdaily.com/390874/sfu-univercity-childcare-hcma> [3 September 2016]
- Beeld. 1984. “*Nou kan ‘n mens behoortlik wandel.*”
- Berry, P. 2001. *Playgrounds that work*. New South Wales: Pademelon Press.
- Berry, W. 1972. *A Continuous Harmony: essays Cultural and Agricultural*. New York: Harcourt.
- Bixler, R.D., and Floyd, M.F. 1997. *Nature is scary, disgusting and uncomfortable*. *Environment and Behaviour*, 29:443-467. [<http://0-find.galegroup.com.innopac.up.ac.za/>] [24 July 2011].
- Brown, G., Brown, B.B. and Perkins, D.D. 2004. *New Housing as Neighborhood Revitalization : Place Attachment and Confidence Among Residents*. *Environment and Behavior*, 36(6):749-775. [ONLINE] <http://eab.sagepub.com/content/36/6/749> [14 October 2016].
- Burns, G. W. 1998. *Nature-Guided Therapy—Brief Integrative Strategies for Health and Well-being*. Brunner/ Mazel, Philadelphia.
- Cadwell, L. B. 2003. *Bringing Learning to Life: The Reggio Approach to Early Childhood Education*. New York: Teacher’s College Press.
- Cadwell, L. B. 1997. *Bringing Reggio Emilia Home: An Innovative Approach to Early Childhood Education*. New York, NY: Teachers College Press
- Campbell, C. S. 1978. *Water in Landscape Architecture*. New York: Van Nostrand Reinhold.
- Capizzano, J., G. Adams, and F. Sonenstein. 2000. *Child Care Arrangements for Children Under Five: Variation Across States*. Washington, DC: The Urban Institute.
- Chawla, L. 2006. *Learning to Love the Natural World Enough to Protect It*. Barn.
- Coley, R.L., Kuo, F.E. And Sullivan, W.C. 1997. *Where does community grow: The social context created by nature in public housing*. *Environment and Behaviour*, 29(4): 468-495. <http://0-eab.sagepub.com.innopac.up.ac.za/content/29/4/468> [31 October 2016].
- Constantinidou, F. and Baker, S. (2002). *Stimulus modality and verbal learning performance in normal aging*. *Brain and Language*, 82(3), 296–311.
- Crace, J. 2006. “*Children Are Less Able Than They Used to Be.*” *Guardian*, January 24.
- Crain, W. 2003. *Reclaiming Childhood: Letting Children Be Children In Our Achievement-Orientated Society*. New York: Times Books/Henry Holt and Co.
- de Vries, S., I. Bakker, W. van Mechelen, and M. Hopmann-Rock. 2007. “*Determinants of Activity-Freindly Neighborhoods for Children: Results from the Space Study.*” *American Journal of Health Promotion* 21(4): 312-316
- Dudek, M. 2005. *Children’s Spaces*. Oxford: Architectural Press
- Edwards, C., Gandini, L. and Foreman, G. (eds) .1998. *The Hundred Languages of*

*Children: the Reggio Emilia approach to early childhood education*, 2nd edn. Norwood, NJ: Ablex.

-Fisher, R. C., le Roux, S., Mare, E. (eds.) 1998. *Architecture of the Transvaal*. University of South Africa: Pretoria

-Fourie, C. 1997. *Report on the January 1996 Flood in Pretoria*. Department of the City Engineer. City council of Pretoria.

-Fromm, Erich (1964). *The Heart of Man*. Harper & Row.

-Furnass, B. 1979. *Health values*. In: Messer, J. and Mosley, J. G. (eds) *The Value of National Parks to the Community: Values and Ways of Improving the Contribution of Australian National Parks to the Community*. University of Sydney, Australian Conservation Foundation.

-Glendinning, C. 1995. *Technology, trauma and the wild*. In Roszak, T., Gomes, M. E. and Kanner, A. D. (eds) *Eco psychology: Restoring the Earth, Healing the Mind*. Sierra Club Books, San Francisco

-Goodenough, E. 2003. *Secret spaces of childhood*. Michigan: University of Michigan.

-Gould, S. J. 1993. *Eight Little Piggies: Reflections in Natural History*. 1st Edition. W. W. Norton.

-Hurtwood, A. 1966. *New playgrounds*. London: Thames and Hudson.

-Hurtwood, A. 1969. *Planning for play*. London: Thames and Hudson.

-Jansen Van Vuuren, G. 2016. Interview with the engineer on 18 February 2016, City of Tshwane Metropolitan Municipality, Department of Roads and Storm water,

Pretoria.

-Kaduson, G.G. 2006. *Release play therapy for children with posttraumatic stress disorder*. In: Kaduson, H.G. & Schaefer, C.E. 2006.

-Katcher, A. and Beck, A. 1987. *Health and caring for living things*. *Anthrozoos*, 1, 175–183.

-Kellert, S. 2005. *Building for Life: Understanding and Designing the Human-Nature Connection*. Washington, DC: Island Press

-Kellert, S. R. 1997. *Kinship to Mastery: Biophilia in Human Evolution and Development*. Island Press, Washington, D.C.

-Kellert, S. R. and Wilson, E. O. (1993) *The Biophilia Hypothesis*. Shearwater Books/ Island Press, Washington, D.C.

-Kellert, S. R., Heerwagen, J., & Mador, M. 2008. *Biophilic design: The theory, science, and practice of bringing buildings to life*. Hoboken, N.J.: Wiley.

-Kim, J. and Kaplan, R. 2004. *Physical and psychological factors in sense of community : New urbanist Kentlands and nearby Orchard Village*. *Environment and Behavior*, 36: 313 <http://eab.sagepub.com/content/36/3/313> [1 November 2016].

-Koolhaas, R. 1995. *S M L XL*. New York: The Monticelli Press

-Kuo, F., M. Bacaicoa, and W. Sullivan. 1998. “*Transforming Inner-City Landscapes: Trees, Sense of Safety, and Preference*.” *Environment and Behavior* 30:28-59

-Kuo, F.E. and Taylor, A.F. 2004. *A potential natural treatment for attention-deficit/hyperactivity disorder: Evidence from a national study*. *American Journal of Public Health*, 94(9):1580-1586. <http://ajph.aphapublications.org/cgi/reprint/94/9/1580> [1



August 2016].

-Lambert, J. and Pearson, J. 1974. *Adventure playgrounds*. London: Penguin Books.

-Linden, J.H. 2003. *Playful metaphors*. American Journal of Clinical Hypnosis, 45(3):245-250. <http://www.asch.net/portals/0/journallibrary/articles/ajch-45/linden.pdf> [29 September 2016].

-Maller, C., Townsend, M., Pryor, A., Brown, D. & St Ledger, L. 2005. *Healthy Nature Healthy People: Contact with Nature as an Upstream Health Promotion Intervention for Populations*. Health Promotion International, 21(1). <http://heapro.oxfordjournals.org/content/21/1/45.full.pdf+html> [2 February 2016]

-Mallgrave, H. F. 2011. *An Introduction to Architectural Theory: 1968 to the Present*. Wiley-Blackwell, Malden

-Mang, P. and Reed, B. 2012. *Designing from place: a regenerative framework and methodology*. Building Research & Information, 40:1, 23-38

-McMichael, T. 2001. *Human frontiers, environments and disease. Past patterns, uncertain futures*. UK University Press, The Syndicate of the University of Cambridge, Cambridge.

-Merchant, C. 1996. *Reinventing Eden: Western culture as a recovery narrative*. In W. Cronon (ed.), *Uncommon Ground: Rethinking the Human Place in Nature*. W.W. Norton & Company, New York

-Meyer, E. 2011. *Playscape: A natural playground in the city*. Unpublished Masters Dissertation, University of Pretoria, Pretoria.

-Moore, R., and H. Wong. 1997. *Natural Learning: Creating Environments for Rediscovering Nature's Way of Teaching*. Berkeley, CA: MIG Communications

-Morrow, V. M., 2010. 'Dirty looks' and 'trampy places' in young people's accounts of community and neighbourhood: Implications for health inequalities. Critical Public Health, 10(2):141-152. <http://dx.doi.org/10.1080/713658244> [6 May 2016].

-Nasar, J. L. and Julian, D. A. 1995. *The psychological sense of community in the neighborhood*. Journal of the American Planning Association, 61(2):178-184. <http://dx.doi.org/10.1080/01944369508975631> [7 October 2016].

-Nesbitt, K. 1996. *Theorizing a New Agenda for Architecture. An Anthology of Architectural Theory 1965-1995*. New York: Princeton Architectural Press

-Noren-bjorn, E. 1982. *The impossible playground*. New York: Leisure Press.

-Orr, D. 1992. *Architecture as Pedagogy*. In *Reshaping the built environment*, edited by C. Kilbert. Washington, DC: Island Press.

-Oxford Dictionary. 2016. Sv 'didactic'. Oxford University Press

-Oxford Dictionary. 2016. Sv 'garden'. Oxford University Press

-Oxford Dictionary. 2016. Sv 'biophilia'. Oxford University Press

-Palacio-Quintin, E. 2000. "The Impact of Day Care on Child Development." ISUMA: Canadian Journal of Policy Research 1 (2)

-Palmer, J. A. (ed). 2000. *Fifty Key Thinkers on the Environment*. London: Routledge

-Peres, E. 2007. *Mindscape: A Centre for Creative Development in Sunnyside*. Unpublished Masters Dissertation, University of Pretoria. Pretoria.

-Presidents Medals. 2015. *Space as the Third Teacher: An Alternative Classroom Typology Promoting Creative Learning And Play*. <http://www.presidentsmedals.com/Entry-38471> [19 June 2016]

-Qvortrup, J., Bardy, M., Sgritta, G. and Wintersberger, H. (eds.) 1994. *Childhood Matters*. Vienna: European Centre.

-Raman, P.G. 2011. *Home away from home - School at Mamelodi*. Journal of the South African Institute of Architects, 49(3): 12-15

- Rourke, B., Ahmad S., Collins, D., Hayman-Abello, B., Hayman-Abello, S., and Warriner, E. (2002). *Child clinical/pediatric neuropsychology: some recent advances*. Annual Review of Psychology, 53, 309-339.
- Rupert Museum. 2016. *Pierneef*. <http://www.rupertmuseum.org/?m=5>. [28 February 2016].
- South Africa. Bureau of standards. 2012. The application of the national building regulations. Pretoria: government printer
- South Africa. Department of Social Development. 2006. *The Guidelines for Early Childhood Development Services*. Pretoria: Government Printer.
- SRK Consulting & MMM Consulting. 2002. *Integrated stormwater Management plan and prioritisation of upgrading projects along the Walkerspruit*. Greater Tshwane metropolitan municipality.
- Stats SA. 2010. *Mid-year population estimates, 2010*. Statistical release P0302. Pretoria : Statistics South Africa.
- Stilgoe, J. R. (2001) *Gone barefoot lately?*. American Journal of Preventative Medicine, 20.
- Tarr, P. 2001. *Aesthetic Codes in Early Childhood Classrooms: What Art Educators Can Learn from Reggio Emilia*. *Art Education*, 54 (3)
- The Burra Charter. 2013. *The Australia ICOMOS Charter for Places of Cultural Significance*. Australia: ICOMOS Inc.
- Unger, D.G. and Wandersman, A. 1985. *The importance of neighbors: the social, cognitive and affective components of neighbouring*. American Journal of Community Psychology, 13(2):139-169.
- United Nations Environment Programme. 2016. *Ecosystems*. <http://www.unep.org/dewa/assessments/ecosystems>. [07 March 2016]
- Van Der Merwe, T. 2013. The Garden Is Us. Unpublished Masters Dissertation, University of Pretoria, Pretoria.
- Van Der Waal Collection. 1989. *Pretoria as 'urbs quadrata'*. <http://repository.up.ac.za/handle/2263/22193>. [07 March 2016].
- Vining, J., Merrick, M. S., Price, E. A. 2008. *The Distinction between Humans and Nature: Human Perceptions of Connectedness to Nature and Elements of the Natural and Unnatural*. Human Ecology Review, 15(1). (eds) Short-term play therapy for children. New York: The Guilford Press.
- Vygotsky, L. 1987. *Collected works, Vol. 1. Problems of general psychology*. edited by R.W. Rieber, and A.S. Carton. New York: Plenum Press
- Weaver, L. 2000. *Learning Landscapes, Theoretical Issues and Design Considerations for the Development of Children's Educational Landscapes*. Unpublished ML (Prof) Thesis, Virginia Polytechnic Institute, Virginia.
- Wellhousen, K. 2002. *Outdoor play every day*. New York: Delmar.
- Wells, N. M., and W. Evans. 2003. "Nearly Nature: A Buffer of Life Stress Among Rural Children." *Environment Behavior* 35(3): 311-330
- Wells, N.M. 2000. "At Home with Nature. Effects of 'Greenness' on Children's Cognitive Functioning." *Environment and Behavior* 32(6): 775-795
- Willis, J.F. (ed). 2006. *Of Roses and Poets*, Volume 1. Washington: Xlibris Corporation
- Wilson, E. 1994. *The Diversity of Life*. New Ed Edition. Penguin Books Ltd.
- Wilson, E. O. 1984. *Biophilia: The human Bond with Other Species*. Cambridge, MA: Harvard University Press



-Unger, D.G. and Wandersman, A. 1985. The importance of neighbors: the social, cognitive and affective components of neighbouring. *American Journal of Community Psychology*, 13(2):139-169.

-Vygotsky, L. 1987. *Collected works, Vol. 1. Problems of general psychology.* edited by R.W. Rieber, and A.S. Carton. New York: Plenum Press

-Archdaily. 2013. SFU UniverCity Childcare / HCMA. <http://www.ArchDaily/390874/sfu-university-childcare-hcma> [Date accessed 3 September 2016]

-Presidents Medals. 2015. Space As The Third Teacher: An Alternative Classroom Typology Promoting Creative Learning And Play. <http://www.presidentsmedals.com/Entry-38471> [Date accessed 19 June 2016]

-Raman, P.G. 2011. Home away from home - School at Mamelodi. *Journal of the South African Institute of Architects*, 49(3): 12-15

# List of Figures

Fig 1.1 No man ever steps in the same river twice. (dailygarlic.com. 2016)	13
Fig 1.2: Natural River vs. Apies River Channel. (Author. 2016)	15
Fig 1.3: Drawing from conceptual development. (Author. March 2016)	16
Fig 1.4 Architecture and its movement away from nature. (Author. 2016)	17
Fig 1.5: Site location and informants. (Author. 2016)	19
Fig 1.6: An example of Green Architecture. Bosco Verticale, Stefano Boeri. (Bosco Verticale. Techinsider. 2014)	21
Fig 1.7: An example of Biophilic Design .Alvar Aalto's Villa Mairea in Noormarkku, Finland, 1939. (Villa Mairea. Ideasn.com. 2013)	21
Fig 1.8: Author's conceptual interpretations of the didactic garden. (Author. 2016)	25
Fig 2.1: The Seven Sisters Oak Tree. [Kellert, 2008: 34]	27
Fig 2.2: Author's interpretation of Architecture's return to biophilia. (Author. 2016)	31
Fig 2.3 The table illustrates all 70 attributes of biophilic design in their various categories. (Kellert, Heerwagen & Mador, 2008: 15)	34
Fig 2.4 What exists and what is intended on the site according to the dimensions, elements and attributes of biophilic design (Author, 2016)	35
Fig 2.5 The channelised Walkerspruit.(Author, 2016)	36
Fig 2.6: Pa Daet, Thailand. unpalsh.com. Photo: Keenan, A.	37
Fig 2.7 (left): The Seven Sisters Oak on Lake Pontchartrain has survived 1200 years due to its ability to withstand hurricane forces. (Kellert, 2008: 34)	38
Fig 2.8 (right): Eco-machines from John Todd Ecological Design, Inc. mimic the patterns of nature's water-purifying ecosystems to clean sewage to pure water (Kellert, 2008: 161)	38
Fig 2.9 (left): The children of Ring Ting Pre-primary School in Sunnyside adjacent to the site. (Facebook/ Ring-Ting Pre Primary School & baby care. 2012)	39
Fig 2.10 (right): Children enjoying early morning exercise (Kellert, 2008: 159)	39
Fig 2.11 (left): A group of toddlers play with fallen leaves, experience their sensory properties and explore their behaviour on the curved surface of a hollow log.	40
Fig 2.12 (right): Traffic-free urban trails and green-ways expose children to nature and help them learn the joy of bicycle riding at an early age.	40
Fig 2.13 Ground floor plan (Arch Daily. 2012)	42
Fig 2.14 Section through atrium of building showing cloud like light sources (Arch Daily. 2012)	42
Fig 2.15 Image showing the trees in the designed park like ground floor. (Arch Daily. 2012)	42
Fig 2.16 A labyrinth at a primary school in the UK where children interact with nature and each other. (Kellert, 2008:170)	43
Fig 2.17 Diagram the richer elements of biophilic design and what attributes can be applied to make the existing environmental features richer (Author, 2016)	44
Fig 3.1 Bourke Street Garden. [Author, 2016]	47
Fig 3.2 Aerial view of Site with initial program layout. (Author, 2016)	49



Fig 3.3 (right) Pretoria's development and shift in city grid due to the rivers. (University of Pretoria, Department of Architecture archives)	50
Fig 3.5 Cross-sections of the channels design. (City of Tshwane Metropolitan Municipality, Department of Roads and Storm water, Pretoria. 2016)	50
Fig 3.6 Groenkloof and Grootfontein Springs respectively. (Grewar. 2014) (Burger. 2014)	50
Fig 3.7 The current condition of the Walkerspruit channel (Author, 2016)	50
Fig 3.4 Engineering Drawings of the Apies River at Caledonian Sports Ground. (City of Tshwane Metropolitan Municipality, Department of Roads and Storm water, Pretoria. 2016)	51
Fig 3.8 Nolli map of water networks and surrounding urban fabric. [Author, 2016]	52
Fig 3.9 Mapping of river edge conditions. [Author, 2016]	54
Fig 3.10 Map of nodal acupuncture of water systems. [Water Group Framework, 2016]	56
Fig 3.11 Primary attributes of site: the child, the river and the natural ground. [Author, 2016]	57
Fig 3.12 Site location and informants. (Author. 2016)	58
Fig 3.13 Fig ground map of site with context. Edited by Author (2016) from Google Earth (2016)	58
Fig 3.14 Physical nature of site according to public and private spaces. (Author, 2016)	59
Fig 3.15 Section through site showing vast differences in scale between buildings and ground (Author, 2016)	59
Fig 3.16 Visionary images of street parks along Bourke and Leyds Streets. (Author, 2016)	60
Fig 3.17 Gateways, Nodes and activity and pedestrian movement. (Author, 2016)	61
Fig 3.18 Schools and green spaces. (Author, 2016)	61
Fig 3.19 Compilation of surrounding typologies. (Edited by Author (2016) from Google Earth (2016) and Peres, E. 2005)	62
Fig 3.20 Current condition of river, looking West. (Author, October 2016)	63
Fig 3.21 Current condition of site, looking South. (Author, October 2016)	63
Fig 3.22 Current condition of site, looking North-West. (Author, October 2016)	64
Fig 3.23 Current condition of site, looking South-West. (Author, October 2016)	64
Fig 3.24 Upgraded Walkerspruit trail [Beeld, 1984]	65
Fig 3.25 Different Angles of the Walkerspruit. Photo: Peres, E. 2005	65
Fig 3.26 Map indicating ecological arm that extends from Caledonia Sports Grounds to the site, changing in density and scale according to the surrounding urban fabric. (Author, 2016)	66
Fig 3.27 The 50 and 100 year Walkerspruit flood-lines between Bourke and Cilliers street. [Tshwane City Engineer, 2005]	67
Fig 3.28 Initial vision of the river landscape, reconnecting to the surrounding fabric. [Author 2016]	67
Fig 3.29 The profile of the trees on site, giving spatial qualities of each. (Author, 2016)	68
Fig 3.30 Mapping of different tree species on site. [Author, 2016]	69
Fig 3.31 Solar access for building spacing. [Holm, D. 1996: 71]	70
Fig 3.32 Window height, overhang and positioning for Pretoria. [Holm, D. 1996: 72]	70
Fig 3.33 Site Wind and shadow Study. (Author, 2016)	70
Fig 3.34 The slope of the site according to gradual or steel slopes [Author, 2016]	71
Fig 3.35 Contour Model of site [Author, 2016]	71
Fig 3.36 1990 Satellite Imagery of Site and old photos of Victorian House that once occupied the site [University of Pretoria, Department of Architecture Archives, 1990]	73
Fig 3.37 Compilation of adjacent schools in the area. (Google Earth, 2016)	74

Fig 3.38 Map showing position of schools and apartments in relation to site. (Author, 2016)	75
Fig 3.39 Project's intentions as interpreted through the attributes of biophilic design. (Author. 2016)	76
Fig 3.40 Diagram showing the different aspects of natural systems, and water that can be learnt on site. (Author, 2016)	77
Fig 3.41 Issues and vision diagrams (Author, 2016)	78
Fig 4.1: Children of Ring Ting Pre-primary. [Facebook.com, 2016]	81
Figure 4.2 Scale differences between child and adult. (drawinghowtodraw.com)	84
Fig 4.3 anthropometrics of a child (playscapes.com)	85
Fig 4.4 Needs of children in their cognitive, physical and emotional development. (Author, 2016, adapted from Berry, 2001)	86
Fig 4.5 Ring Ting Pre-primary School does not use the adjacent natural site to its full potential. (Google Earth, 2016)	87
Fig 4.6 My Childhood - Sveta Dorosheva.(kireei.com. 2016)	88
Fig 4.7 Ring Ting Pre-School with little connection to the outdoors and sensory stimulation (Facebook. 2012)	89
Fig 4.8 A classroom connected to natural elements where the tree forms part of the child's education (Tezuka-arch.com. 2016)	89
Fig 4.9 Initial Program layout on site, contain three primary programs (Author, 2016)	91
Fig 4.10 Needs of children in their cognitive, physical and emotional development (Author, 2016, adapted from Berry, 2001)	92
Fig 4.11 Central Piazza (Tarr, 2001: 35)	93
Fig 4.12 Design development perspective of kinetic play spaces (Author, 2016)	95
Fig 4.13 Sports hall size requirements (Sportscotland, 2003)	96
Fig 4.14 Schedule for reggio-inspired child development, adapted from University Child Learning and Care Centre (uwsp.edu. 2016).	100
Fig 4.15 Example of occupational therapy suite. (United Kingdom. Department of Health. 2013:33)	101
Fig 4.16 Physical nature of site according to public and private spaces, and organic and urban nature of the site (Author, 2016)	103
Fig 4.17 Program layout in context. (Author, 2016)	104
Fig 4.18 Program allocation. (Author, 2016)	105
Fig 5.1: Design development sketches. [Author, 2016]	107
Fig 5.1 Drawings showing how activities of the children give meaning to the ambiguity of the spaces (presidentsmedals.com, 2015)	109
Fig 5.2 view of classroom spaces (Arch Daily, 2013)	111
Fig 5.5 Mezzanine level floor plan (Arch Daily, 2013)	111
Fig 5.3 view of pedagogic outdoor spaces (Arch Daily, 2013)	111
Fig 5.6 The sustainable energy and water system in the building (Arch Daily, 2013)	111
Fig 5.4 Rope nests forming tree-like structures (Arch Daily, 2013)	111
Fig 5.7 Aerial view of classrooms, also alongside a river (presidentsmedals.com, 2015)	113
Fig 5.9 Drawings showing how activities of the children give meaning to the ambiguity of the spaces (presidentsmedals.com, 2015)	113
Fig 5.10 Classroom plan, showing cores, and the various child learning activities taking place (presidentsmedals.com, 2015)	113
Fig 5.8 Drawing of classrooms cores, with usable shelving systems (presidentsmedals.com, 2015)	113
Fig 5.11 Northern entrance view (Raman, 2011: 12-15)	115
Fig 5.13 Assembly court and classroom blocks (Raman, 2011: 12-15)	115



Fig 5.14 Sections showing variations in the roofs and portal frame structure (Raman, 2011: 12-15)	115
Fig 5.12 Plan of integrating parts to a whole, and central focus point (Raman, 2011: 12-15)	115
Fig 6.1: Design development sketches. [Author, 2016]	119
Fig 6.2 Initial design translation of conceptual resolution. (Author, 2016)	121
Fig 6.3 (opposite) Diagram summarising development of concept. (Author, 2016)	122
Fig 6.4 Diagram illustrating the analogue of the existing trees and how it returns the site back to human scale. (Author, March 2016)	124
Fig 6.5 What the site wants. Digital perspective on the nature of the site and what the architecture could do to change it. (Author, 2016)	125
Fig 6.6 Section through site with conceptual diagram illustrating scale differentiations of the proposed design in order to create a sense of scale balance (Author, 2016)	125
Fig 6.7 Diagram illustrating spaces of ecological potential being framed by the architecture (Author, March 2016)	126
Fig 6.8 Diagrammatic exploration of the networks the four informants on site (Author, 2016)	127
Fig 6.9 Diagram illustrating culminating environments, meandering movement through the site as well as creating spaces of refuge. (Author, 2016)	128
Fig 6.10 Progression of the exploration of how the program connects to the schools in the area (Author, 2016)	128
Fig 6.11 Plan view of final conceptual exploration. (Author, 2016)	129
Fig 6.12 Perspective of the final conceptual exploration. (Author, 2016)	129
Fig 6.13 Diagram of what elements of landscape the child can learn from , relating to site and theoretical investigation (Refer to Chapter 2) (Author, 2016)	131
Fig 6.14 Water, the tree and the child design translations. (Author, 2016)	132
Fig 7.1: Design development sketches. [Author, 2016]	135
Fig 7.2 Development of plan (Author, 2016)	138
Fig 7.3 Development of plan (Author, 2016)	139
Fig 7.4 plan development, with sports hall becoming the dominant feature on site. (Author, 2016)	140
Fig 7.5 Section development, showing relationships between tectonic and stereotomic. (Author, 2016)	140
Fig 7.7 Archetypal landscape elements relating to architectural language (Author, 2016)	141
Fig 7.6 Resultant plan according to this approach (Author, 2016)	141
Fig 7.8 Resultant Aerial view of site (Author, 2016)	142
Fig 7.9 building outlines, guiding the garden design (Author, May 2016)	143
Fig 7.10 Site plan (Author, June 2016)	144
Fig 7.11 Section bb through site (Author, June 2016)	145
Fig 7.12 West elevation (Author, June 2016)	145
Fig 7.13 Perspectives of approach from street on east side, approach from western side and sports hall respectively (Author, June 2016)	146
Fig 7.14 Site perspective aerial view (Author, June 2016)	146
Fig 7.15 Ground floor plan (Author, June 2016)	146
Fig 7.16 Development of program layout according to design translation (Author, 2016)	148
Fig 7.17 Identified gardens as the third teachers with the buildings facilitating learning (Author, August 2016)	148
Fig 7.18 Tectonic concept diagrams for each of the spaces	150
Fig 7.19 3D view of building indicating each garden and what is learnt in each and the biophilic approaches to methods of learning (Author, 2016)	153

Fig 7.20 Ground Floor Plan (Author, 2016)	154
Fig 7.21 First Floor Plan (Author, 2016)	155
Fig 7.22 Initial design sketch of vertical axis resolution (Author, 2016)	156
Fig 7.23 section development through classrooms, kinetic classrooms and atelier (Author, 2016)	157
Fig 7.24 section development through classrooms, kinetic classrooms and atelier (Author, 2016)	157
Fig 7.25 Route exploration (Author, 2016)	159
Fig 7.26 development of the classroom building from sketch phase to final design phase (Author, 2016)	160
Fig 7.27 Final development of the classrooms and the activities that take place within them (Author, 2016)	161
Fig 7.28 Zoomed in plan of classrooms and the activities that will take place in each (Author, 2016)	162
Fig 7.29 Diagram showing quiet(green) and noisy(red) spaces in the classrooms (Author, 2016)	163
Fig 7.30 Diagram showing dry(yellow) and wet(blue) spaces within and to the exterior of the classrooms (Author, 2016)	164
Fig 7.31 Diagram showing interior(blue) and yellow(exterior circulation routes and suggestive routes (Author, 2016)	165
Fig 7.33 Gross motor activities (Author, 2016)	166
Fig 7.32 Daily Arrival (Author, 2016)	166
Fig 7.34 Group activities (Author, 2016)	167
Fig 7.35 SMART time (Author, 2016)	167
Fig 7.37 Story time (Author, 2016)	168
Fig 7.36 Whole body development. (Author, 2016)	168
Fig 7.38 Home time (Author, 2016)	169
Fig 7.37 Quiet time. (Author, 2016)	169
Fig 7.39 Kinetic Classroom in plan and section , showing its connection to the outdoor play court (Author, 2016)	170
Fig 7.40 Plan of occupational therapy suits (Author, 2016)	171
Fig 7.41 security lines according to times of day (Author, 2016)	172
Fig 7.42 security types (Author, 2016)	173
Fig 7.43 Security checkpoint alternating between school children and after hours. (Author, 2016)	173
Fig 7.44 Gabion wall with berm in section (Author, 2016)	173
Fig 8.1 Technical development section. [Author, 2016]	175
Fig 8.2 Diagram of tectonic resolution of classroom (Author, September 2016)	177
Fig 8.3 Diagrammatic representations of the stereotomic and tectonic concept (Author, November2016)	179
Fig 8.6 Material palette, stereotomic (Author, 2016)	181
Fig 8.7 Material palette, tectonic (Lysacht, 2016)	183
Fig 8.8 technical explosion showing primary and secondary structure of the classrooms (Author, November 2016)	185
Fig 8.9 Detail showing how the concept influences the aesthetics of joining (Author, September 2016)	187
Fig 8.10 Section through solar stack and joining of portal frame (Author, 2016)	187
Fig 8.11 Technical Explorations (Author, 2016)	189



Fig 8.13 Diagram of proposed water system and its processes (Author, 2016)	192
Fig 8.14 Overlay of water system on building. The dark blue represents the side channel diversion and the light blue represents the rain water harvesting system (Author, 2016)	193
Fig 8.15 The water system (Author, 2016)	195
Fig 8.16 New water system showing process of rainwater collection, purification and reuse (Author, 2016)	196
Fig 8.17 Development of living skin and how it punctures the building's facade (Author, 2016)	197
Fig 8.18 ground level plants (Author, 2016)	198
Fig 8.19 higher level creepers (Author, 2016)	198
Fig 8.22 Waste management system. (Author, 2016)	200
Fig 8.23 Waste management system. (Author, 2016)	201
Fig 8.24 Base design daylighting analysis (Author, 2016)	202
Fig 8.25 Iteration 1 daylighting analysis (Author, 2016)	203
Fig 8.26 SBAT Graph and resultant score (Author, 2016)	204
Fig 9.1 View of linking pathway between schools. [Author, 2016]	207
Fig 10.1 - 10.27 (Author, 2016)	
Table 10.1 Water Budget (Author, 2016)	240
Table 10.1 Water Budget (Author, 2016)	241
Table 10.1 Water Budget (Author, 2016)	242