07 TECHNICAL INVESTIGATION

The technical investigation highlights certain elements regarding the construction of the design proposal. It is important to emphasise that the construction was simplified for various reasons such as financial feasibility and ease of construction.

The sustainability of the project was an important element and guideline throughout the design process.

The technical documentation follows the technical investigation as a separate set of drawings to be referred to.

The technical investigation discusses the various decisions that were made with regards to the technical aspects of the design. Resolutions were mainly determined by the existing structures and construction methods and by the experiential quality of the design, including elements such as material use, thermal comfort and aesthetic contrasts.

The technical resolution of the design was simplified as much as possible for various reasons.
The uncomplicated construction methods enable the local community to be employed for the construction phase of the design. The cost effectiveness of the design and construction was a stressed concern, as the limited financial resources available at the moment is one of the greatest problems at the TMC. The sustainability of the project was another important element. The concrete structures offer both aesthetic appeal and cost effectiveness. Its strength, durability and natural thermal mass result in a building that require low maintenance, offer high durability and have high operating energy efficiency.

Due to the haphazard construction of the salt and soda factory, no obvious grid system exists. The existing structures were used to guide the spatial layout of the design.

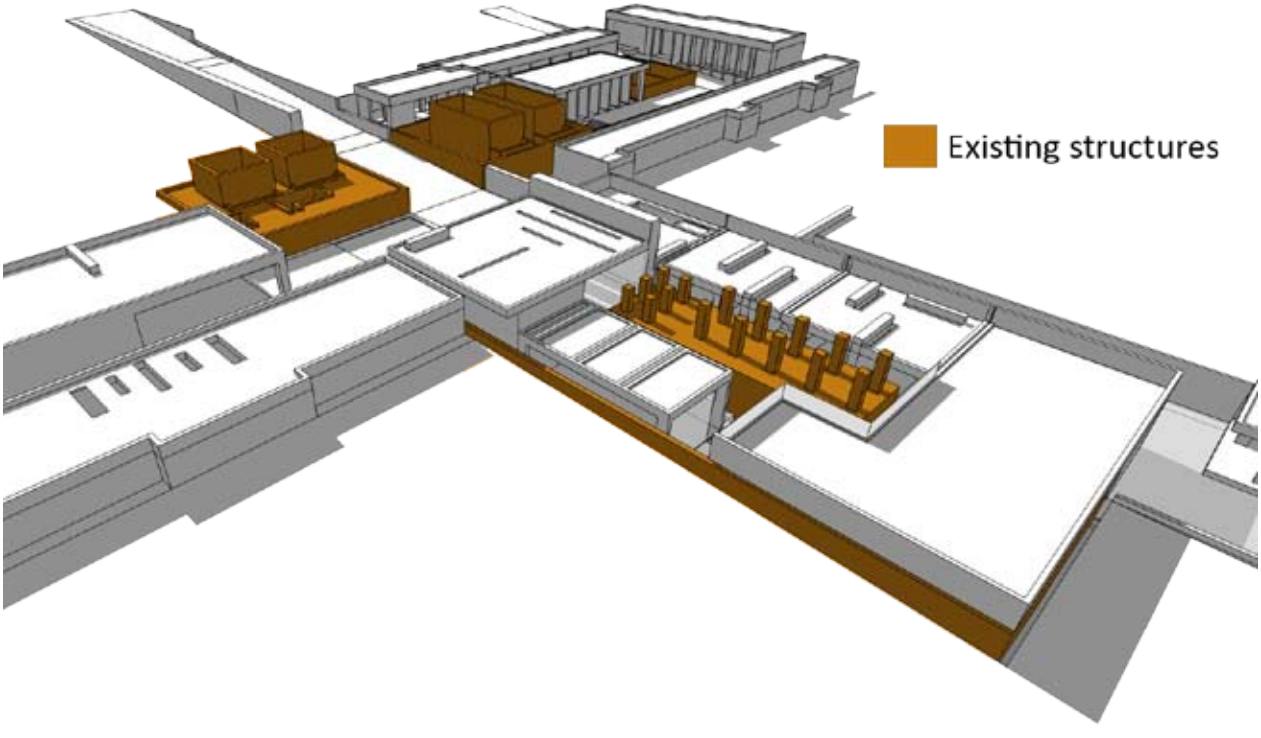


Figure 7.01 Illustration of existing structures in relation with the proposed intervention

7.1 Structure and materiality

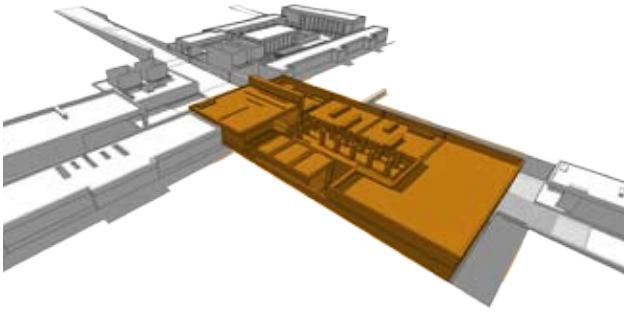
The existing reinforced concrete structures are decaying over time. The reinforcing elements are corroding due to the high salt content of the water that was used during the construction of the factory.

This fact rendered the option of incorporating reinforced rammed earth elements unfeasible as the soil around the factory would inherently have a high level of salt content as well, recreating the existing problem of corroding reinforcing elements.

The decision was made to retain the existing structures as far as possible and develop the design around these elements. In this way, the existing memory of the factory would be maintained and continued as the structures are left to decompose over time.

The primary structural system employed in the new design consists of reinforced concrete walls and reinforced concrete roofs. The decision was made to insert a new layer of construction within the existing structure by using the same construction material [reinforced concrete], due to its aesthetic association with the existing structures, cost-effectiveness and availability. The design also took advantage of the thermal mass and structural integrity of concrete as construction material.

Figure 7.02 Existing corroding reinforced concrete structures. It is suspected that these structures were used as storage tanks for the water and brine that was pumped from the crater floor. [August 2009]



In general, and where possible, a void ranging between 600mm and 1m was left between the new and existing structures, allowing the existing structures to gradually decompose over time, and simultaneously acting as a service shaft between the new and existing elements.

Water was integrated in the design as an element between the new and existing structure.

Figure 7.03 The key plan with the selected area illustrated in the plan below.

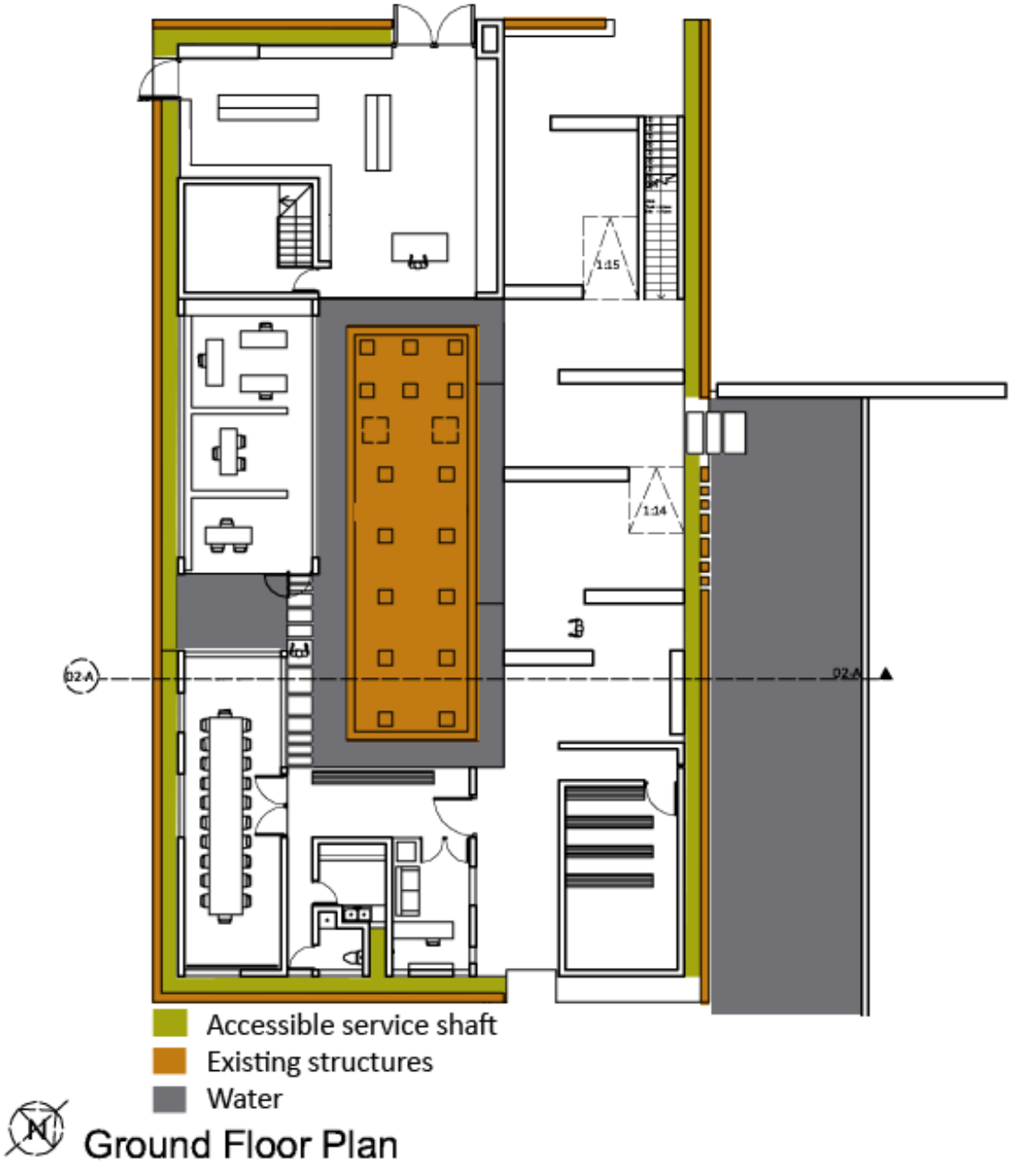


Figure 7.04 Selected plan, indicating the intervention of new structures within the existing structure.

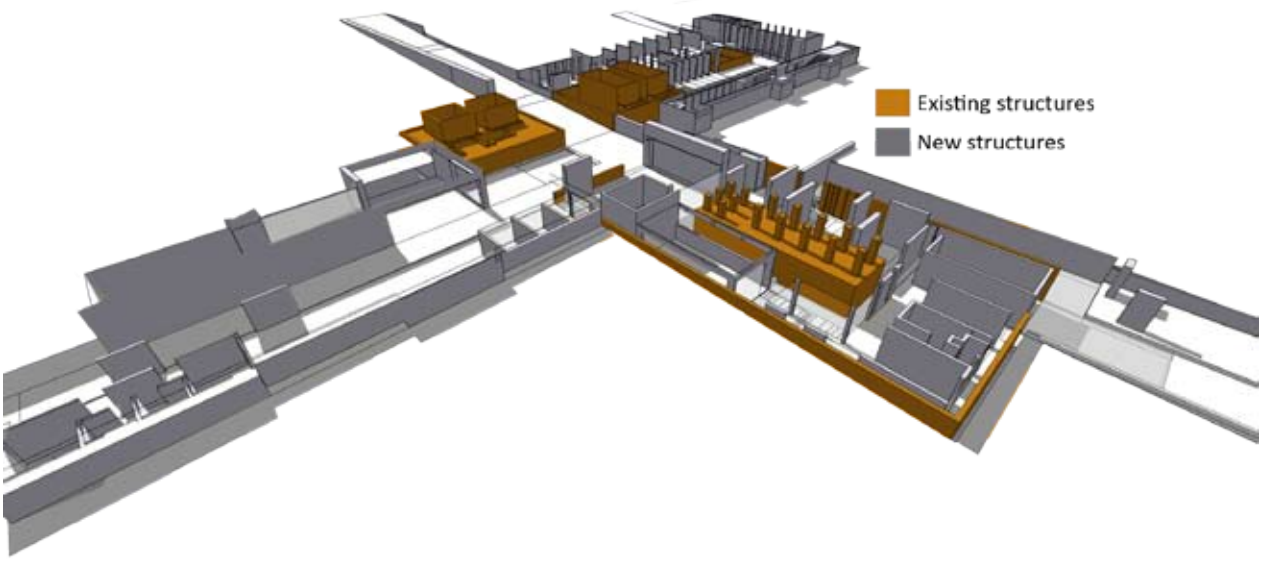


Figure 7.05 The new concrete structures in relation to the existing structures.

The existing structures range from storage tanks with a depth of approximately 3m underground, to open storage tanks rising approximately 2.1m above the natural ground level. The scale, proportion and rhythm of these structures greatly influenced the design. The majority of the new structures have floor levels that generally range from 3m below the natural ground line, to walkways that lead the visitor from these low levels up to the natural ground level.

The new structures consequently consist of reinforced concrete retaining walls defining the volumes below ground.

CALCULATIONS

Reinforced solid concrete slab

L = Typical span [2000 - 7000]

d = Typical depth [100 - 250]

L/d = Typical [22 - 32]

7000/255 = 27,45

Applied depth of 255mm over a typical span of 7000mm. [Orton, 1994:34]

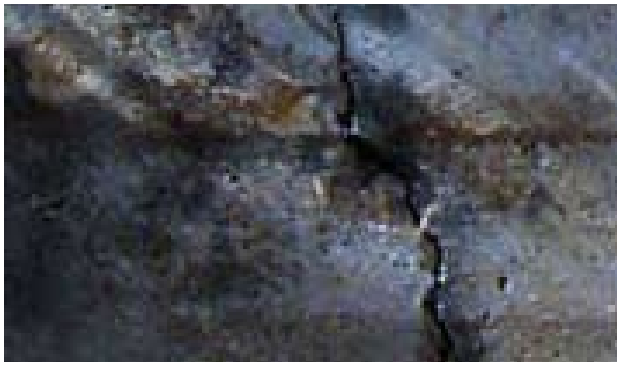


Figure 7.06 Materiality of existing concrete structures

Figure 7.07 Materiality of existing concrete structures

Figure 7.08 Texture of existing concrete structures

7.2 Roof

The green roof structure acts as another plane, planted with local veld grass to ensure minimal visual impact on the surrounding landscape, allowing the structure to blend in with the natural vegetation. The roof over the first exhibition space is accessible and planted with tufted grass. The remainder of the roofs are also planted with the local veld grass, but are inaccessible to the general public. In addition, the roof element acts as a thermal insulator, enhancing the thermal comfort of the user.

Peter Zumthor's Thermal Baths at Vals was used as inspirational precedent. In his design, all the concrete roof structures are separated by an 80mm gap which is covered with a glass panel, allowing natural light to penetrate the space while simultaneously preventing rain from entering the structure.

This concept was reinterpreted, and adapted to the construction of the design.

Figure 7.10 Thermal Baths, Vals - View of roof detail [Arte France, 2003]

Figure 7.11 Thermal Baths, Vals - View of roof detail [Arte France, 2003]

Figure 7.12 Thermal Baths, Vals - Interior view of roof detail [Arte France, 2003]

Figure 7.09 Local veld grass [August 2009]

Figure 7.13 Green roof detail of Peter Zumthor's Thermal Baths [Arte France, 2003]

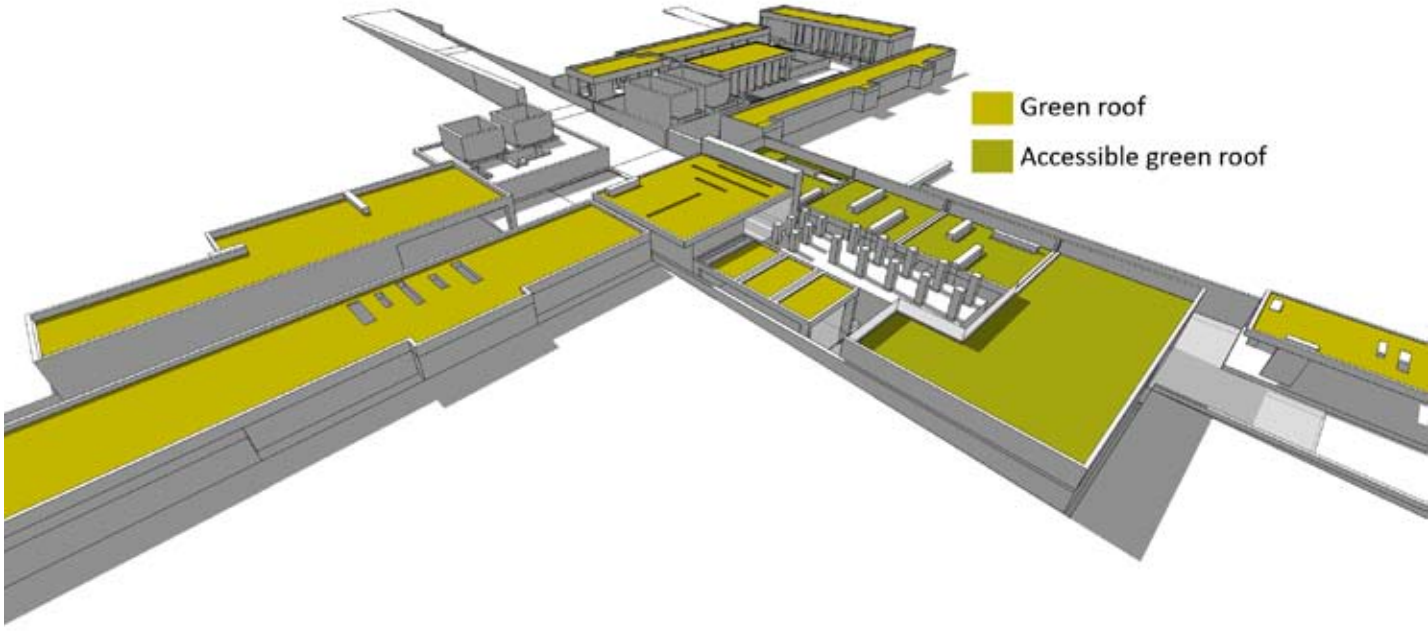


Figure 7.14 View of the design proposal indicating green roof areas.

7.3 Storm water

Green roofs have multiple advantages including the reduction of storm water runoff as opposed to conventional roof types. Furthermore, due to the semi-submerged nature of the structure, the design of storm water runoff is essential to prevent the building from becoming a retention pond. The storm water system is designed to collect, discharge and dispose the runoff water. The water is controlled by storm water channels, vegetation, catch pits, pipes and retaining walls. The approach to the storm water management consists of temporary storage and gradual release into a conveyance system.

The runoff system is partially on and below the surface, whichever is the appropriate solution in the various areas. The runoff water is discharged into the natural landscape, reducing the excessive erosion at the exit point by means of a head wall structure.

7.4 Water elements

Water is employed as a design element, reminiscent of the water flowing processes used during the operating of the factory. Water as element play a role in the aesthetics, sensory exploration and thermal environment created within the structures. The chlorinated water system is operated by a pump, circulating the water to ensure constant movement, avoiding stagnant situations that could attract insects and result in other related problems such as excessive algae. The first pump is located under the raised floor of the shop, circulating the water in the internal courtyard, while the second pump is submerged behind the retaining wall at the entrance, serving the pond next to the reception area. Both water features have overflows to ensure that the water is drained away, should an excessive amount of water be present.

7.5 Sustainability

As architect, and designer of the concrete environment, conserving the environment is of undeniable importance and an urgent obligation towards the local community as well as the valuable planet.

The *Sustainable Building Assessment Tool* [SBAT] system, developed by Jeremy Gibberd from the CSIR was used to determine the sustainability of the design. The system is divided into three different sections, consisting of social, economic and environmental sustainability.

Both the effect on the local and global environment as well as the comfort and health of the building occupants should be taken into account during the design process.

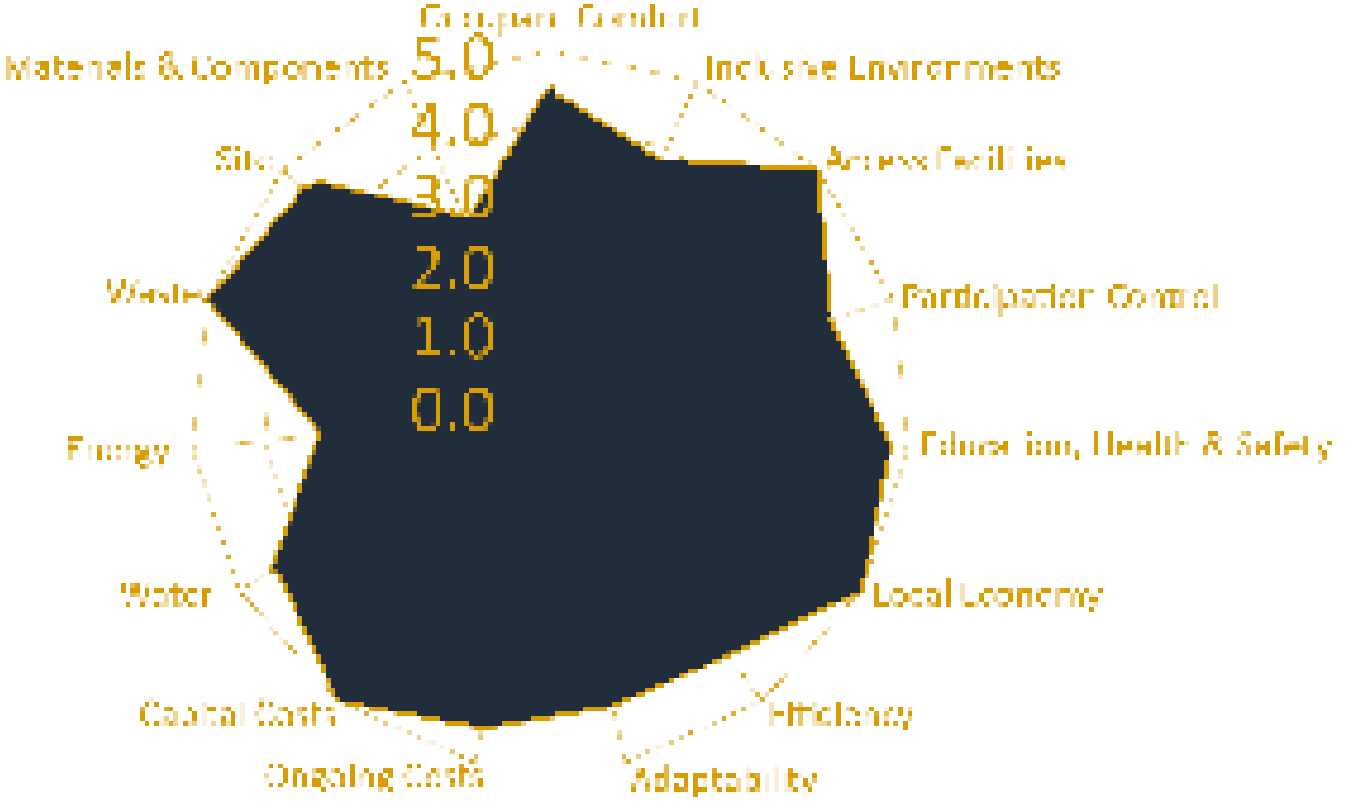


Figure 7.15 Sustainability graph indicating the different levels of sustainability of the design proposal according to the SBAT assessment tool [October 2009]

Social sustainability

The social sustainability segment of the tool presents an indication of the social performance of the building.

The strength of the social sustainability of the project lies within the occupant comfort. The general open nature of the structures enable natural light and ventilation throughout the design. Users have the ability to control their own internal environment by means of openable windows. Visual contact with the exterior environment is encouraged by means of roof lights and window openings.

Inclusive design was one of the main design concerns, ensuing structures that were purposefully designed with connecting ramps between the various levels to provide access for wheelchair users and other physically impaired users.

Due to the location of the project in the Nature Reserve, public transport is limited. It is however assumed that the proposed MCDC will be implemented in the future, improving accessibility. The SBAT tool is generally compiled for office buildings and residential units, which illustrates the proposal as weak in terms of access to public amenities. This portion of the assessment was therefore ignored as the relevance is limited due to the nature of the building typology as an interpretation centre.

The regular user would comprise of the administration personnel, management, cleaning and cooking staff who would generally come from the surrounding settlements of the Soutpan community and Soshanguve.

Workforce from the local community will be employed and trained during the construction of the centre.

As a result of the careful consideration of the above mentioned items, the assessment provided an outcome of 4.4 points out of 5 which places the social sustainability within the 'excellent' range.

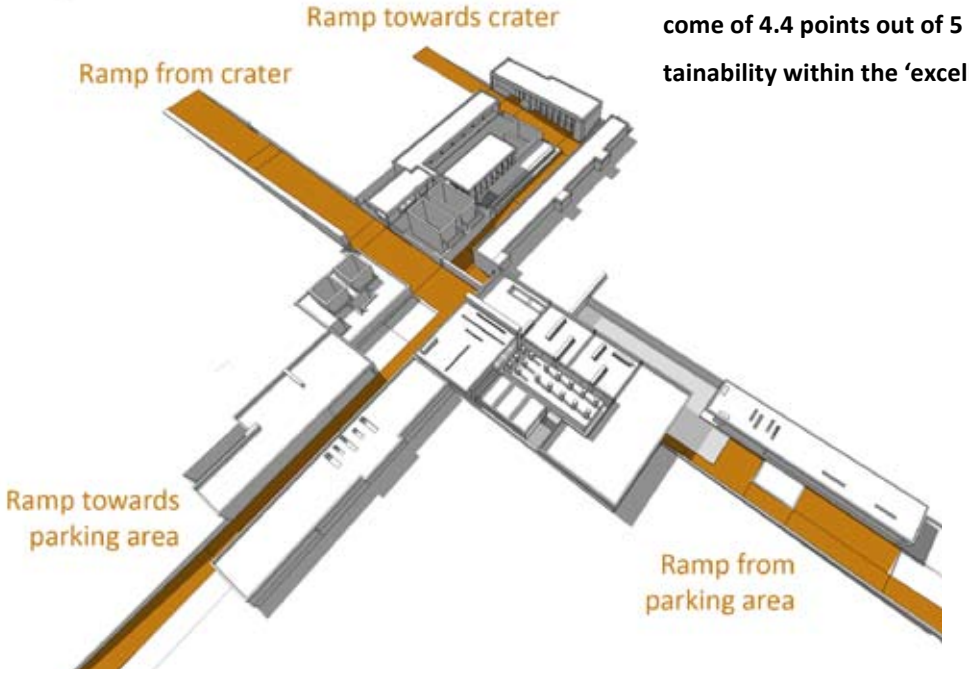


Figure 7.16 Illustration of ramps throughout the design

Economic sustainability

The economic sustainability section of the assessment provides an indication of the economic performance of the building.

The proposed project will make use of local available materials and workforce as well as well-known, uncomplicated construction techniques that enable basic training and education of the local community members during the construction phase.

The environmental sustainability assessment, provides an indication of the environmental performance of the building.

Grey water will be recycled on site and re-used where possible. Green roofs are included in the design to minimise the visual impact of the structures in the natural landscape. Local veld grass is used on the roofs, reducing the maintenance and water needed.

Environmental sustainability

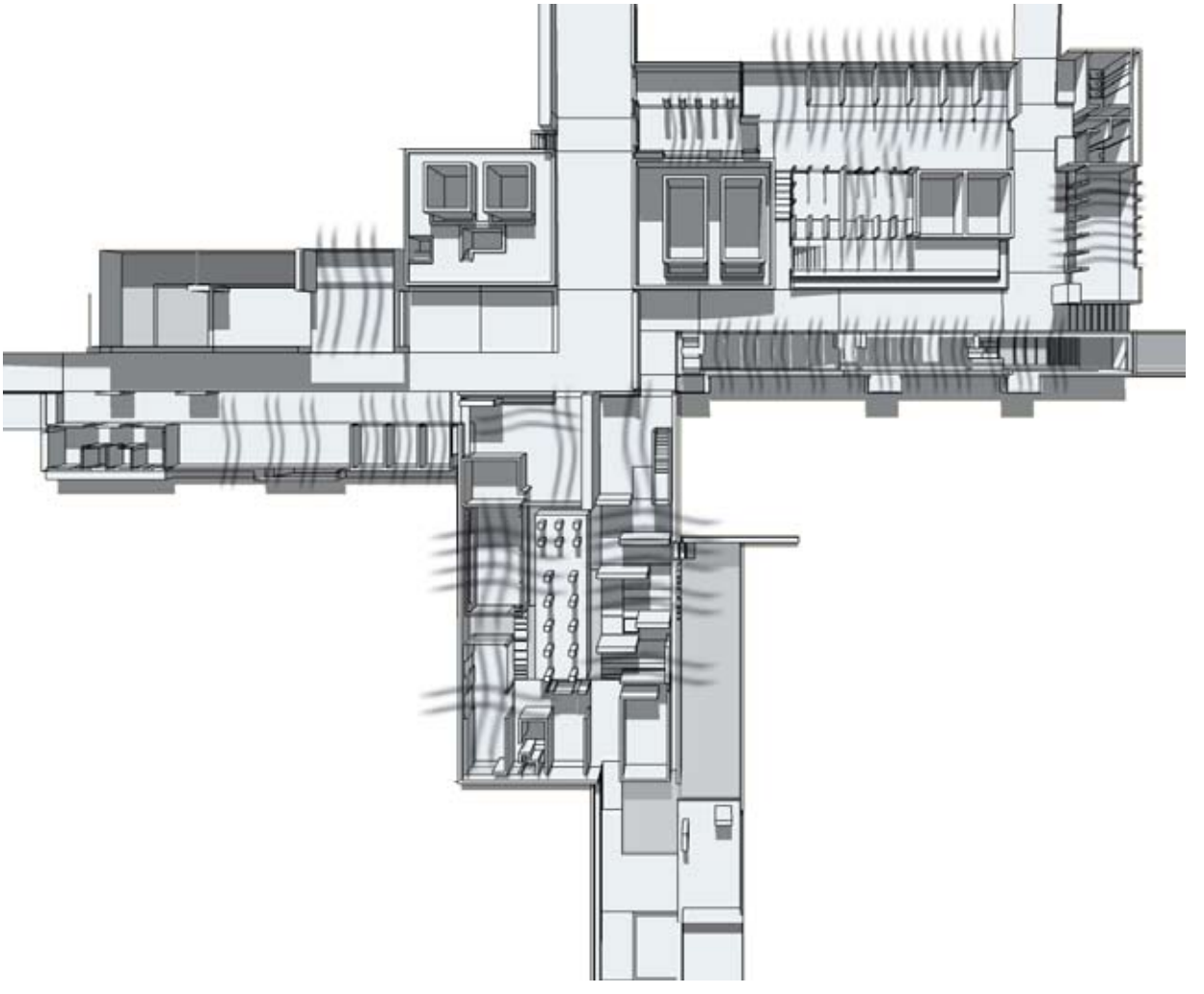


 Figure 7.17 Plan indicating natural cross ventilation throughout the structures.

Energy efficiency is increased with the use of concrete as construction material. Concrete is produced locally and offer considerable energy savings over the lifetime of the structure by means of energy efficiency and low maintenance costs. The thermal mass of the concrete structure in conjunction with the isolating properties of the soil within which the structure is submerged reduces temperature swings, the structure becomes a thermal reservoir with the ability to store large amounts of energy. A year-round energy-efficient building is produced due to the relatively stable temperature that is maintained within concrete structures, as the concrete walls and floors absorb heat during the day, and consequently radiate the warmth back into the space at night. [http://www.cnci.org.za/concrete_benefits.htm accessed 2009.10.12]

The distinct advantage of windows and openings have been exploited as far as possible. Natural light guide visitors through the structures with the exception of artificial lighting where climatic conditions may render natural light as insufficient. The pale surfaces increases the amount of available natural daylight. The external courtyards allow increased levels of natural light and ventilation to enter the semi-enclosed structures.

Adjustable elements such as blinds, openable windows, roof overhangs and ventilation respond to changing climate conditions. Natural cross ventilation is employed throughout the design and provides fresh air from outside as well as a cooling effect as the air moves through the space, replacing the hot interior air with cooler air from outside. The openable windows that extend up to the roof slab allow hot air in the upper part of the rooms to escape.

Figure 7.18 Diagrammatic illustration of a roof light as employed within the exhibition area and administration office.

Figure 7.19 Diagrammatic illustration of a light shelf as employed in the research offices.

Figure 7.20 Diagrammatic illustration of a window opening employed throughout the design.

Figure 7.21 Diagrammatic illustration of reflective blinds employed throughout the design.

The structures are orientated to take advantage of natural daylight with the appropriate window openings yet eliminating solar overheating by allowing more sunlight in during the winter and less during the summer. The pale hard concrete surfaces keep down surface temperatures as solar reflection is radiated.

The noise impact on the occupants are reduced to an absolute minimum as the location of the building in the Nature reserve is protected from excessive vehicular traffic. The nature of the occupancy of the building encourages conversation rather than contemplative silence, rendering the structure alive, reminiscent of the factory activities. The hard concrete surfaces produce a contrasting acoustic quality to the exterior landscape. Building services are reduced to an absolute minimum as passive cooling is employed throughout the design.

The concrete surfaces throughout the design render maintenance and cleaning of the building as trouble free. The majority of the spaces can be hosed clean due to the open nature of the structure.

Water saving devices such as dual flush toilets, infrared sensors fitted to taps and rainwater harvesting are proposed to be included in the building.

The sewage is recycled on site by means of a septic tank connected to a french drain. All damaged building materials and waste is recycled into the immediate surrounding community.

The design intervention is located within the area of the historic salt and soda factory, consequently reducing the impact on the environment as the site is considered as previously disturbed. The building becomes an integral part of the site. Existing vehicular routes as well as pedestrian routes are re-employed to reduce any possible disturbances of the natural landscape.

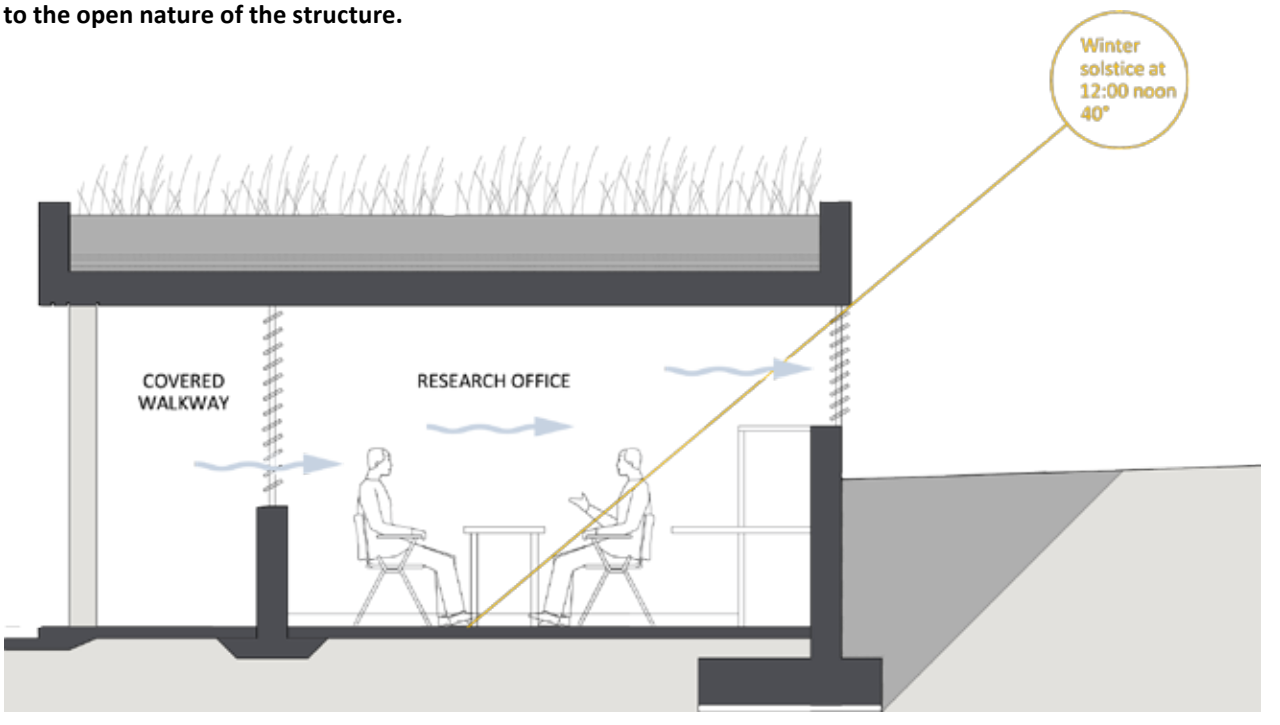


Figure 7.22 Typical section through the research office, illustrating the concept of natural ventilation and natural sunlight as employed throughout the design.

TOTAL CURRENT ESTIMATED BUILDING COST

No	Description	Unit	Area	Rate	Amount excl VAT
1	Reception area including ablutions, office and covered reception area	m²	182	R 5,275.00	R 960,050.00
2	Exhibition walkway, media room, administration offices, shop, store room, etc.	m²	611	R 6,165.00	R 3,766,815.00
3	Public ablutions, coffee shop and three smaller shops	m²	159	R 5,475.00	R 870,525.00
4	Restaurant including kitchen, change rooms, etc.	m²	219	R 6,385.00	R 1,398,315.00
5	Drill core exhibition space	m²	178	R 5,055.00	R 899,790.00
6	Lecture hall	m²	61	R 5,235.00	R 319,335.00
7	Ablutions	m²	38	R 6,485.00	R 246,430.00
8	Workshop and store	m²	69	R 4,835.00	R 333,615.00
9	Research offices and kitchenette area	m²	121	R 5,945.00	R 719,345.00
10	Library	m²	52	R 5,305.00	R 275,860.00
11	Open walkways, ponds, ramps and other areas	m²	2,578	R 1,525.00	R 3,931,450.00
12	External works (path ways, parking area, etc)	Item			R 1,753,500.00
	TOTAL CURRENT ESTIMATED BUILDING COST (EXCLUDING VAT)				**R 15,475,030.00**

VIEWPOINT
[RESERVOIR FOUNDATION]

CRATER RIM

VIEWPOINT
[MANAGER'S HOUSE FOUNDATIONS]

PATH FROM CRATER VIEWPOINT

PATH TOWARDS CRATER VIEWPOINT

1139
1138
1137
1136
1134
1133
1132

INTERPRETATION CENTRE
[SALT AND SODA FACTORY RUINS]

PATH TOWARDS PARKING AREA

PARKING AREA
[FOUNDATIONS OF WARMING PONDS]

PATH FROM PARKING AREA

N

1m 10m

MANIFESTING THE MEMORY
A MEMORIAL FOR A METEORITE
SITE PLAN

SCALE: REFER TO BAR SCALE
DATE: 2009.11.25
DRAWN: ANJA BREDELL 23337550
DRAWING NO.: 001

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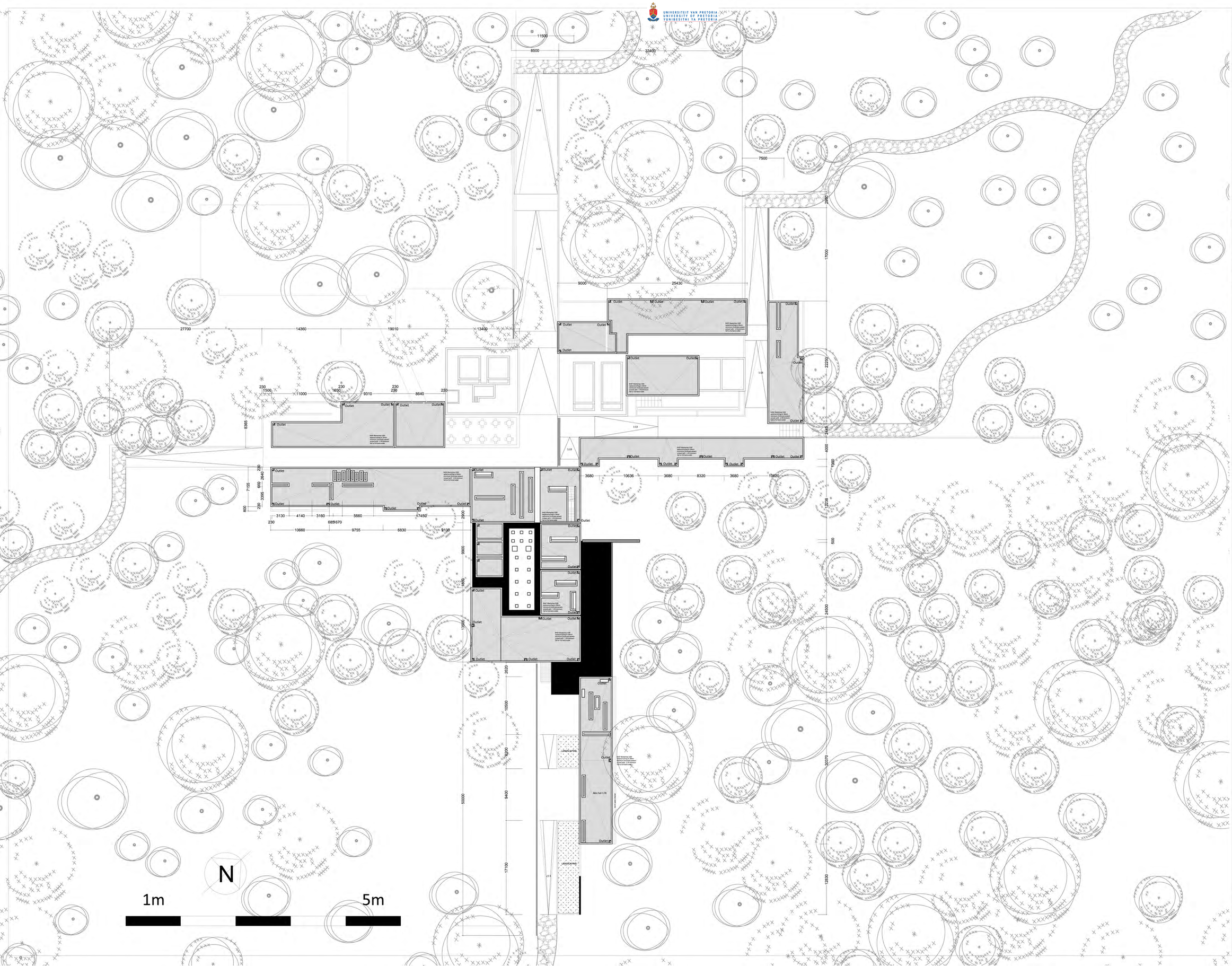

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BASF Mastertop 1330 waterproofing on 20mm minimum thickness cement screed with 1:70 minimum fall to full bore outlet

Mechanically prepare all concrete surfaces to ensure optimum adhesion. All surface repairs to be carried out using the Concresive and Emaco concrete repair ranges.
Prime the surface with one coat Mastertop Primer 2 and apply Mastertop TC 458 top coat, all as included in Mastertop 1330 deck coating system. Applied in accordance with approved BASF s[pecifications by approved applicators.

MANIFESTING THE MEMORY
A MEMORIAL FOR A METEORITE

ROOF PLAN

SCALE	DATE
REFER TO BAR SCALE	2009.11.25

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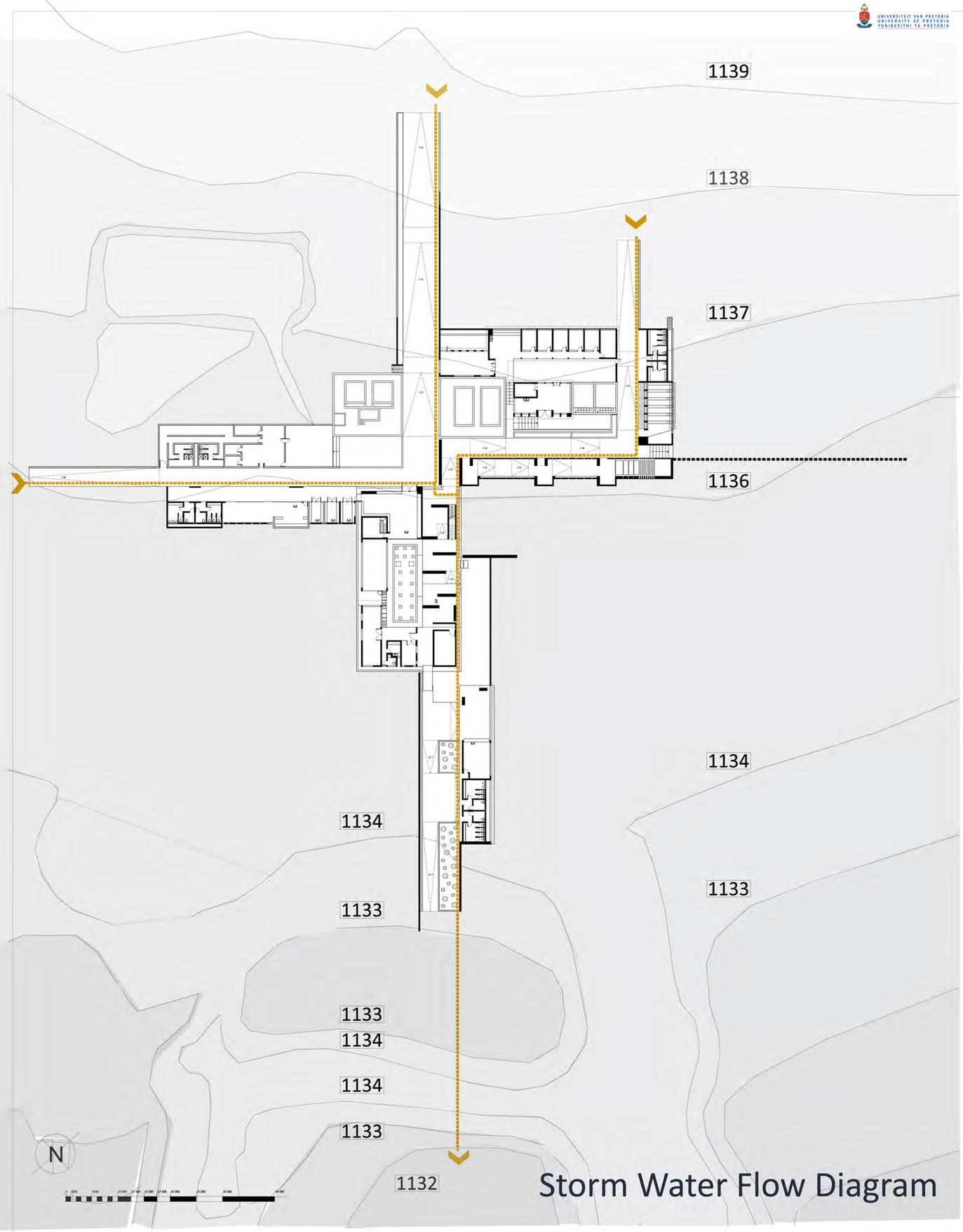
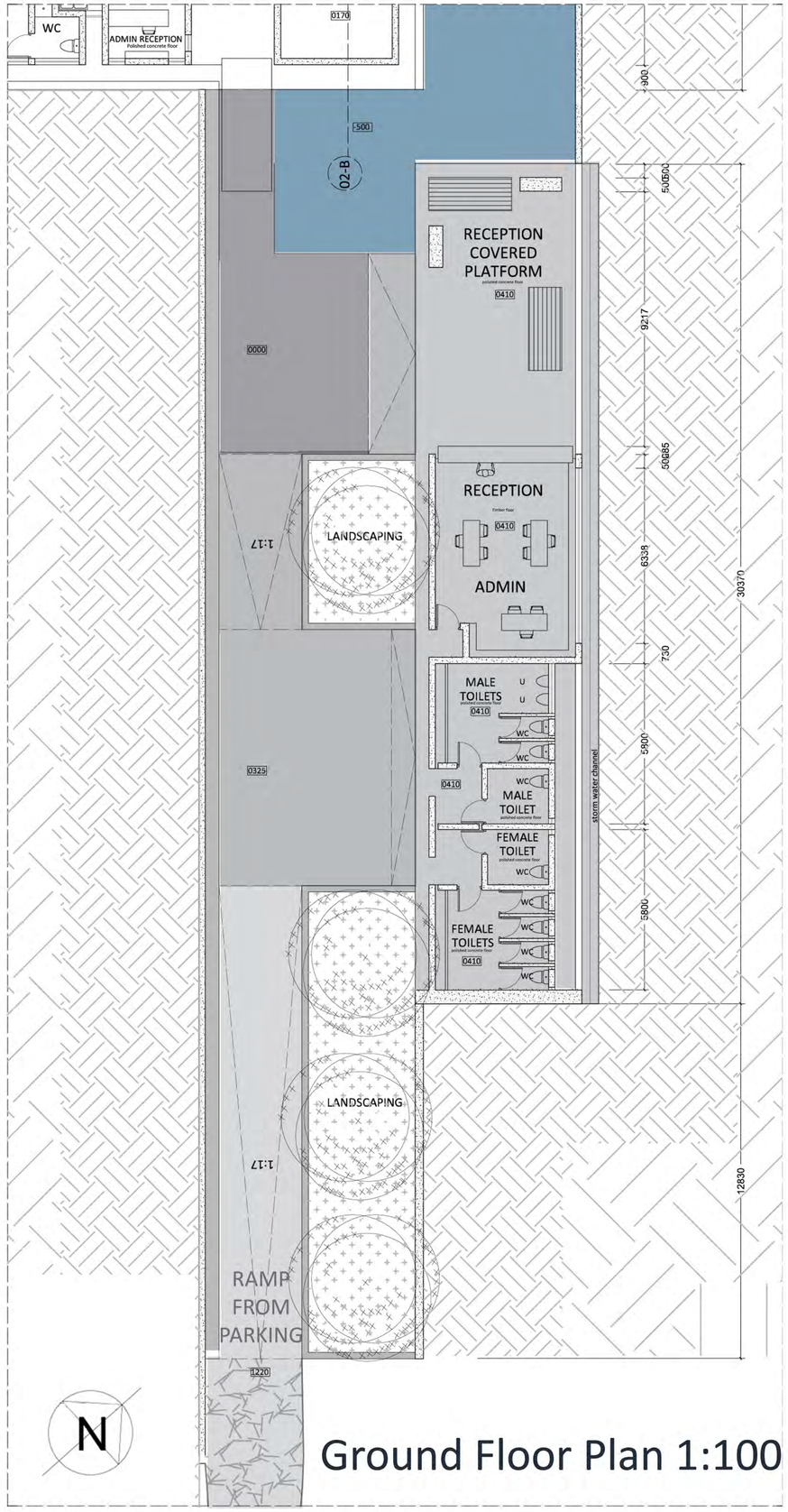


Storm Water Flow Diagram



Ground Floor Plan 1:100

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KEY PLAN

LEGEND

- LEVEL 0000
- LEVEL 0170 - 0400
- LEVEL 0400
- LEVEL 0400 - 1600
- CHLORINATED WATER
- NEW BACKFILL
  [APPROX. 1.4M DEEP ON AVERAGE]

MANIFESTING THE MEMORY
A MEMORIAL FOR A METEORITE

STORM WATER FLOW DIAGRAM
SELECTED PLAN [1]

SCALE 1:100
REFER TO BAR SCALE
DATE 2009.11.25

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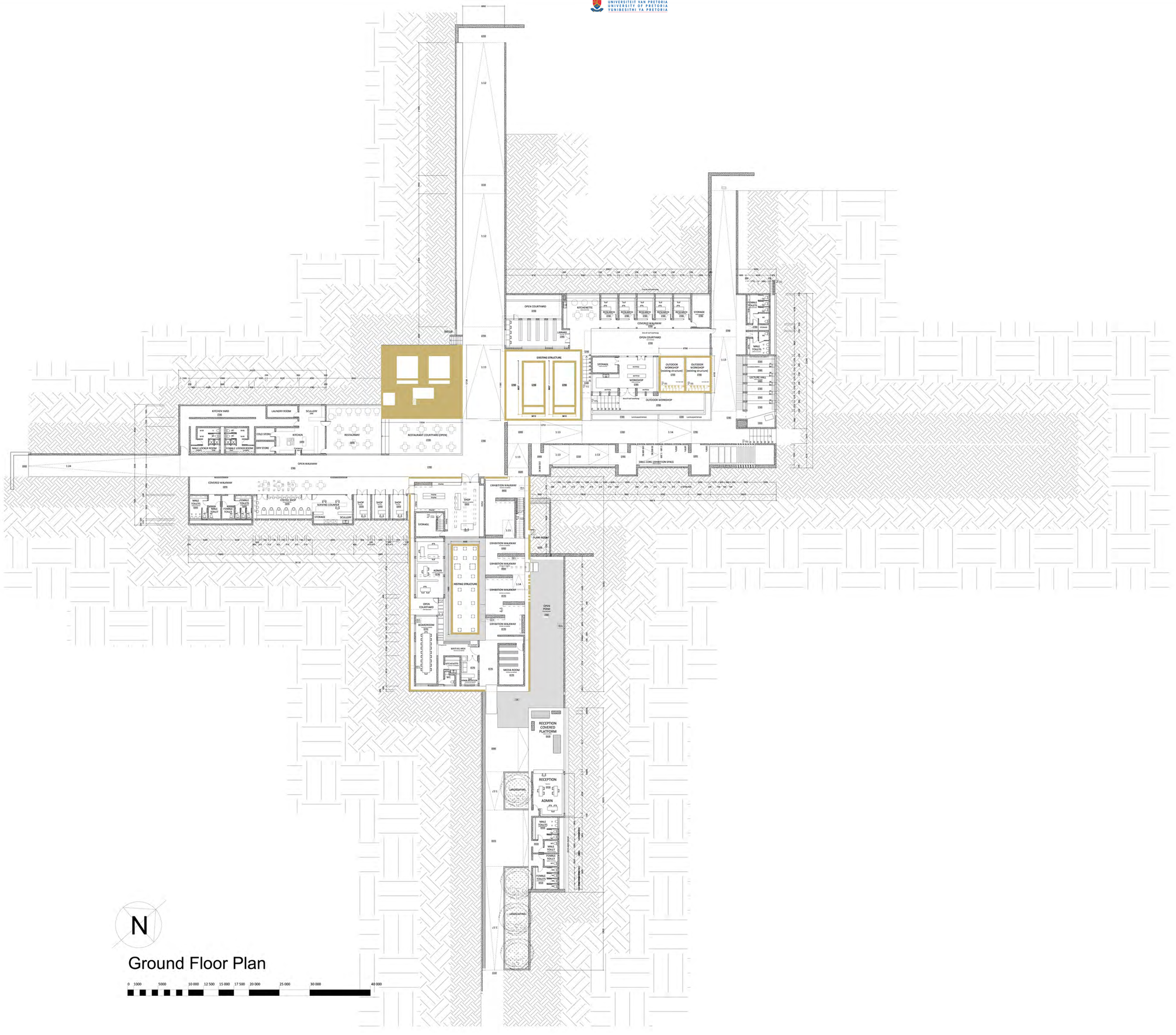

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LEGEND

EXISTING STRUCTURE

MANIFESTING THE MEMORY

A MEMORIAL FOR A METEORITE

PLAN

SCALE	DATE
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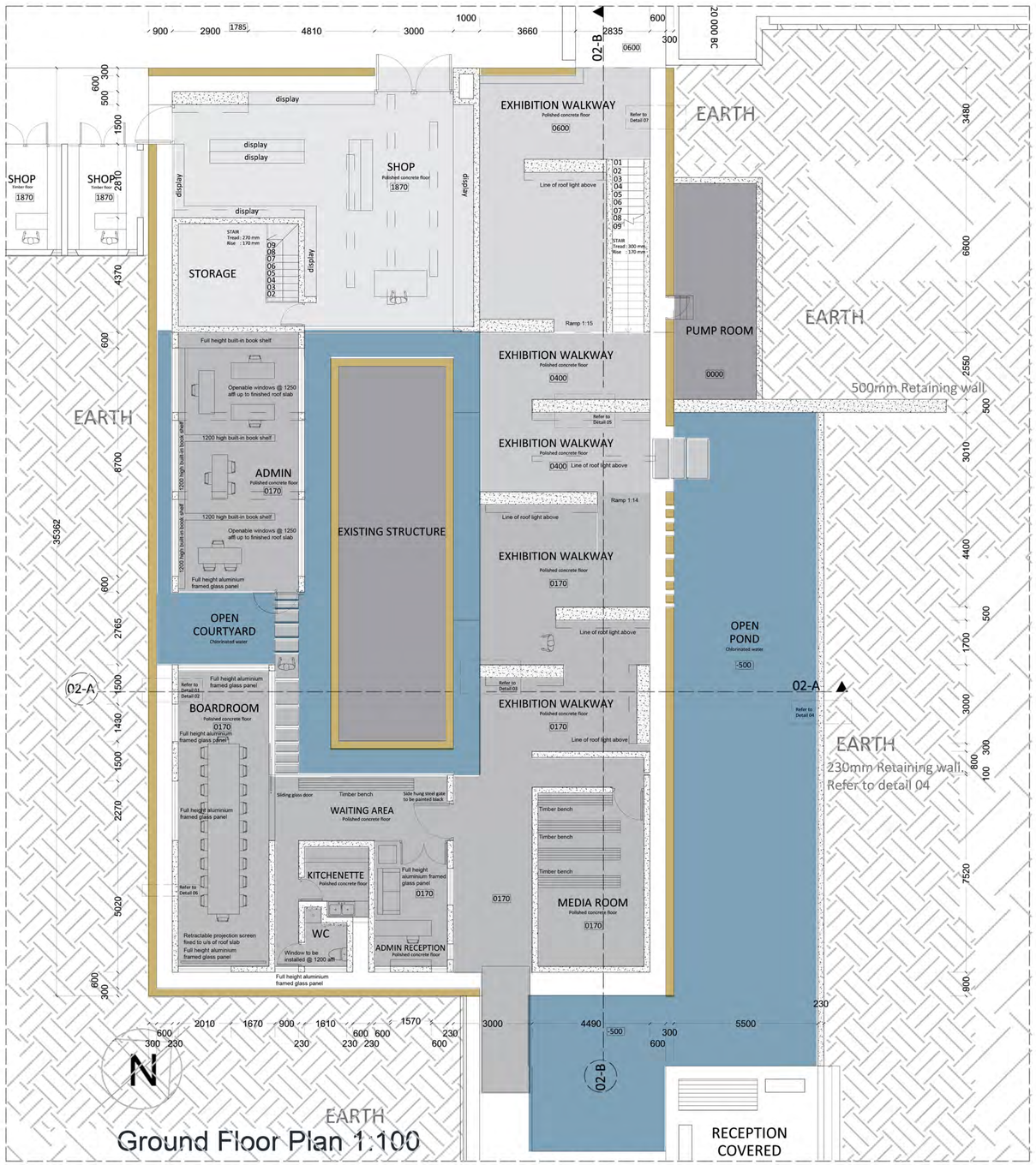

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KEY PLAN

LEGEND

- LEVEL 0000
- LEVEL 0170
- LEVEL 0400
- LEVEL 0600
- LEVEL 1870
- CHLORINATED WATER
- EXISTING STRUCTURE
- EXISTING EARTH
- BACKFILL [APPROX. 2.4M DEEP ON AVERAGE]

Notes: The selected plan illustrates the water features, with the related pumps, pipe systems, directional flow and overflow points. The sewage is directed towards a septic tank that is connected to a french drain on the site. The storm water is directed away from the structures as illustrated on the storm water diagram. The plan also illustrates the floor patterns as discussed in Chapter 06:21. Details 2, 3 and 7 illustrate the concept associated with the construction of the floor.

MANIFESTING THE MEMORY
A MEMORIAL FOR A METEORITE
SELECTED PLAN [2]
SERVICES PLAN

SCALE	DATE
1:100	2009.11.25

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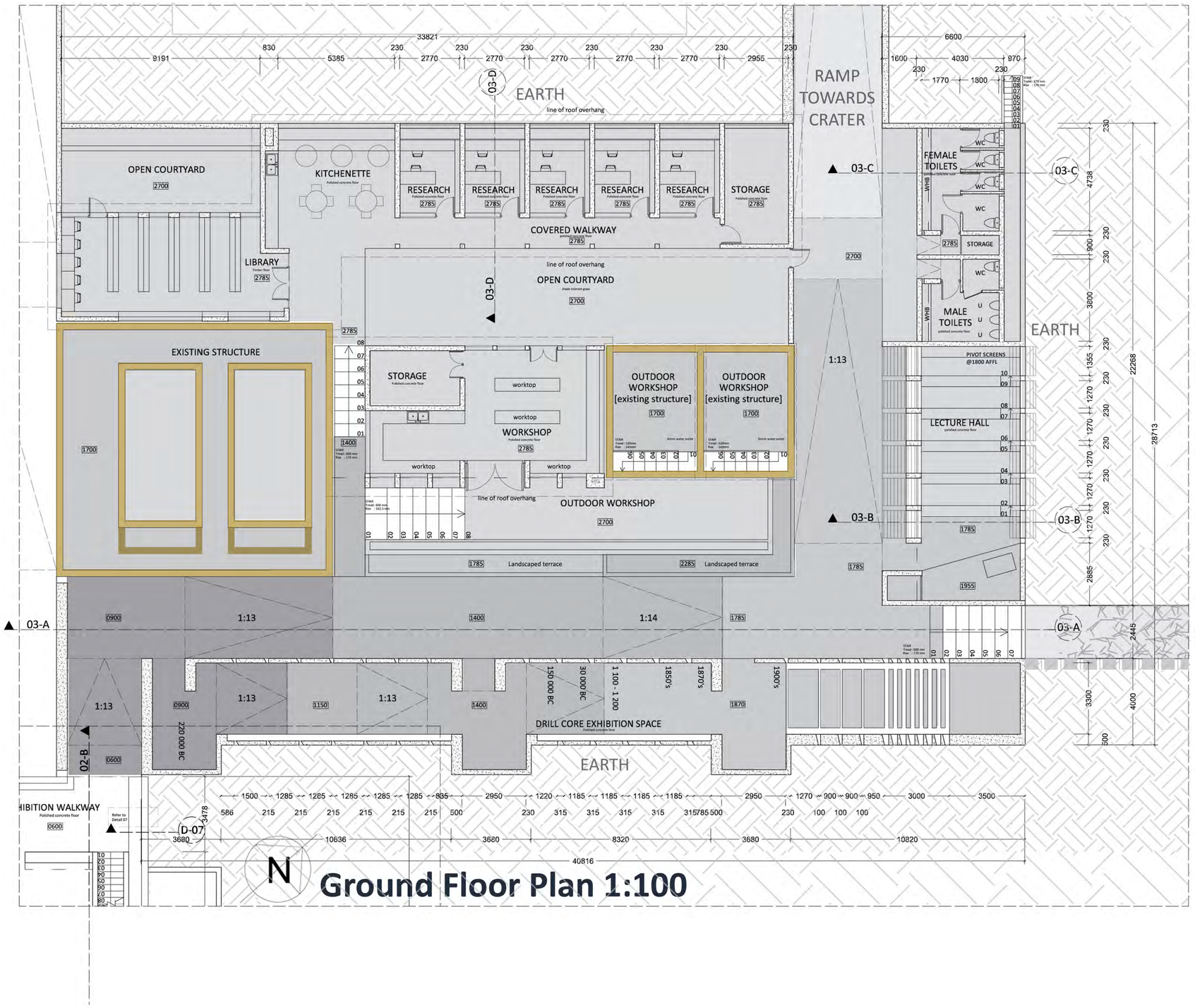

Ground Floor Plan 1:100

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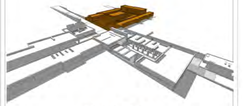

KEY PLAN

LEGEND

- LEVEL 0600 - 1150
- LEVEL 1400
- LEVEL 1700
- LEVEL 2700
- LEVEL 2700 +
- EXISTING STRUCTURE
- EXISTING BACKFILL [APPROX. 1.8M DEEP ON AVERAGE]

Note: The drill core will be exhibited as one of the main elements of the exhibition, representing the timeline of the events that took place on the site, with the appropriate exhibitions accomponying the exhibited drill core levels

MANIFESTING THE MEMORY
A MEMORIAL FOR A METEORITE
SELECTED PLAN [3]

SCALE	DATE
1:100	2009.11.25

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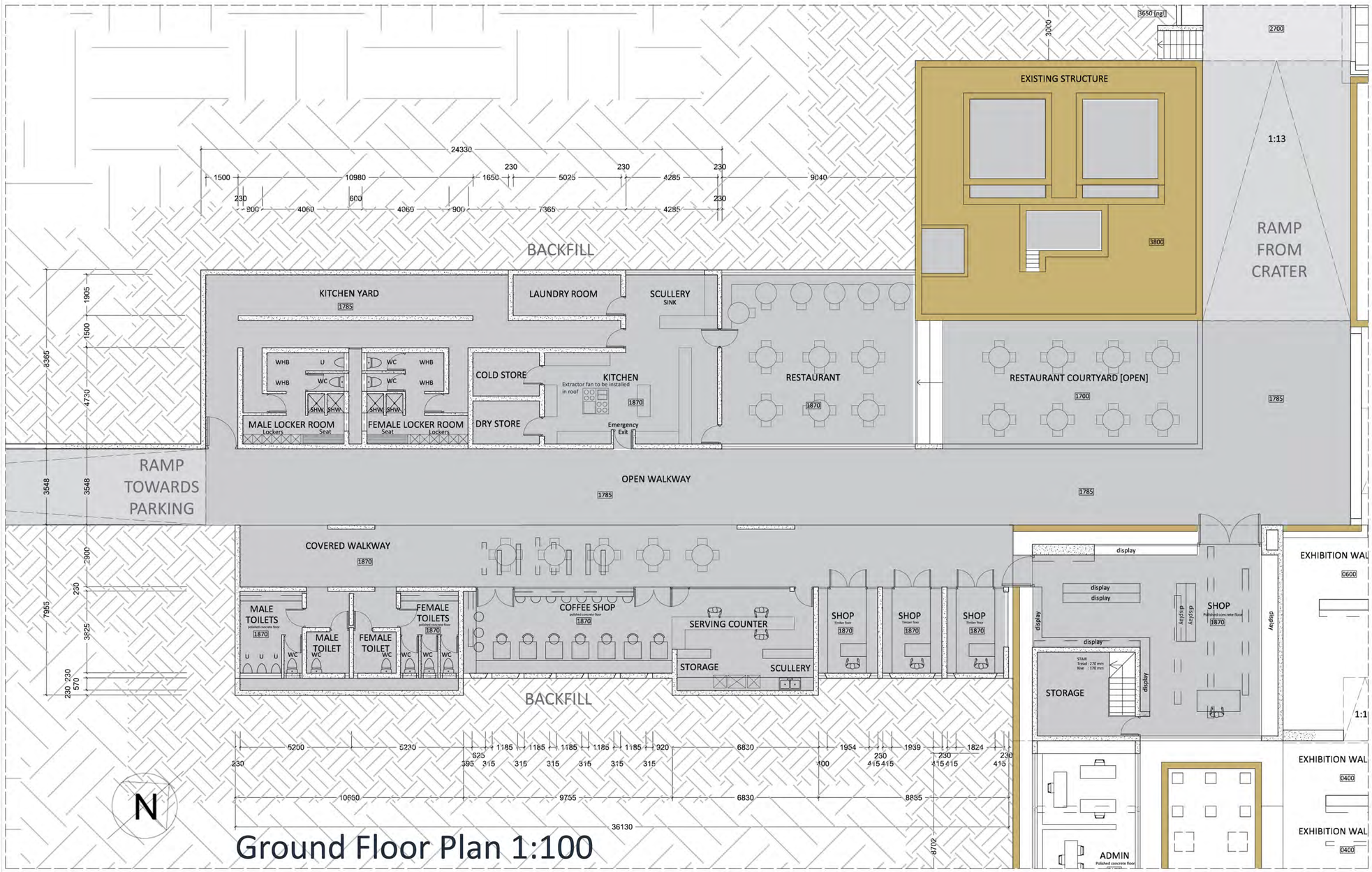

Ground Floor Plan 1:100

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KEY PLAN

LEGEND

- LEVEL 1700
- LEVEL 1700 - 2700
- LEVEL 2700 +
- EXISTING STRUCTURE
- NEW EARTH BACKFILL [APPROX. 1.6M DEEP ON AVERAGE]

MANIFESTING THE MEMORY
A MEMORIAL FOR A METEORITE
SELECTED PLAN [4]

SCALE	DATE
1:100	2009.11.25

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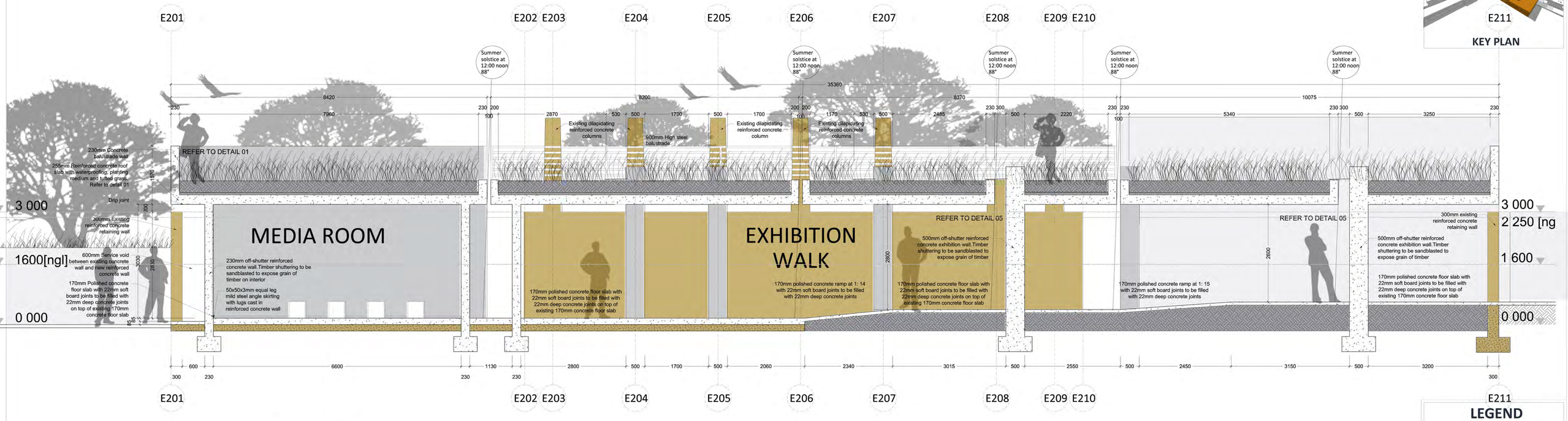
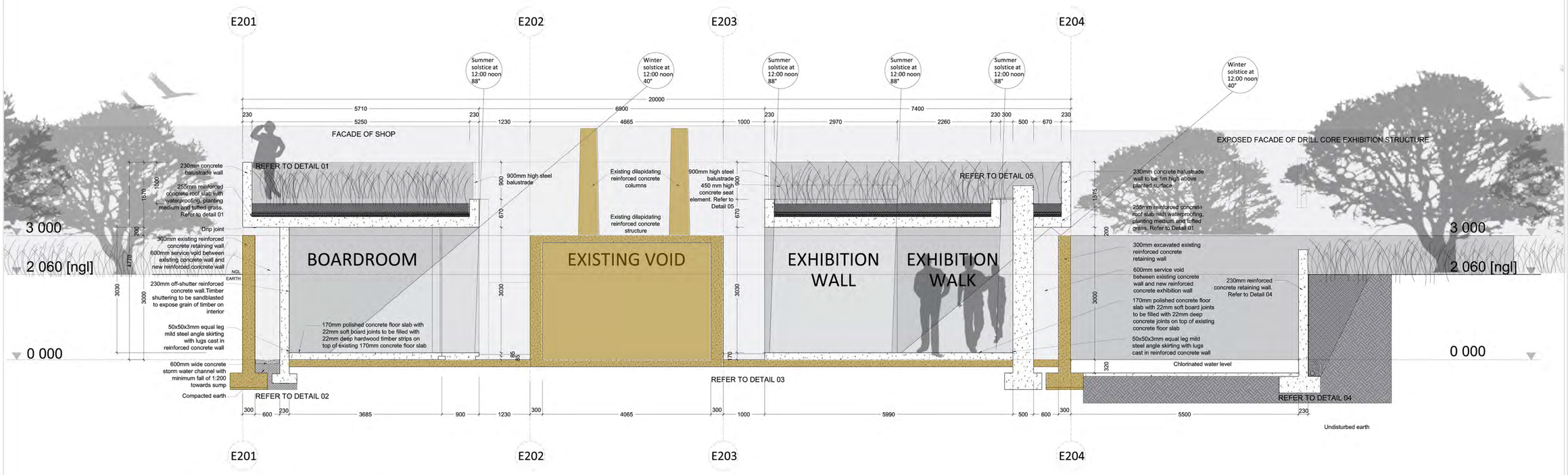


Section 02-B 1:50



Section 02-A 1:50

MANIFESTING THE MEMORY
A MEMORIAL FOR A METEORITE
SECTIONS

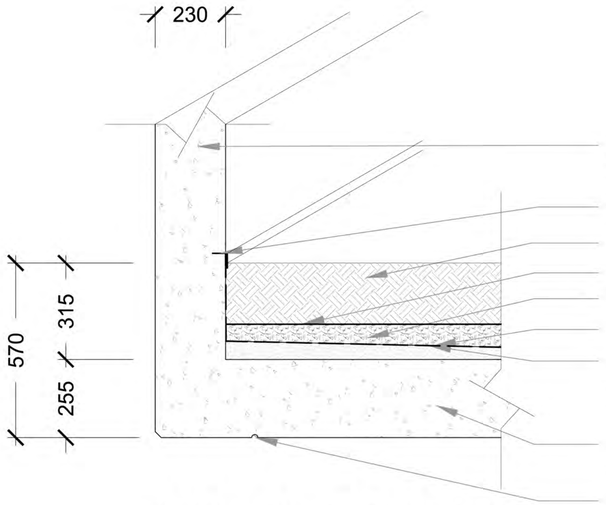
LEGEND

EXISTING STRUCTURE

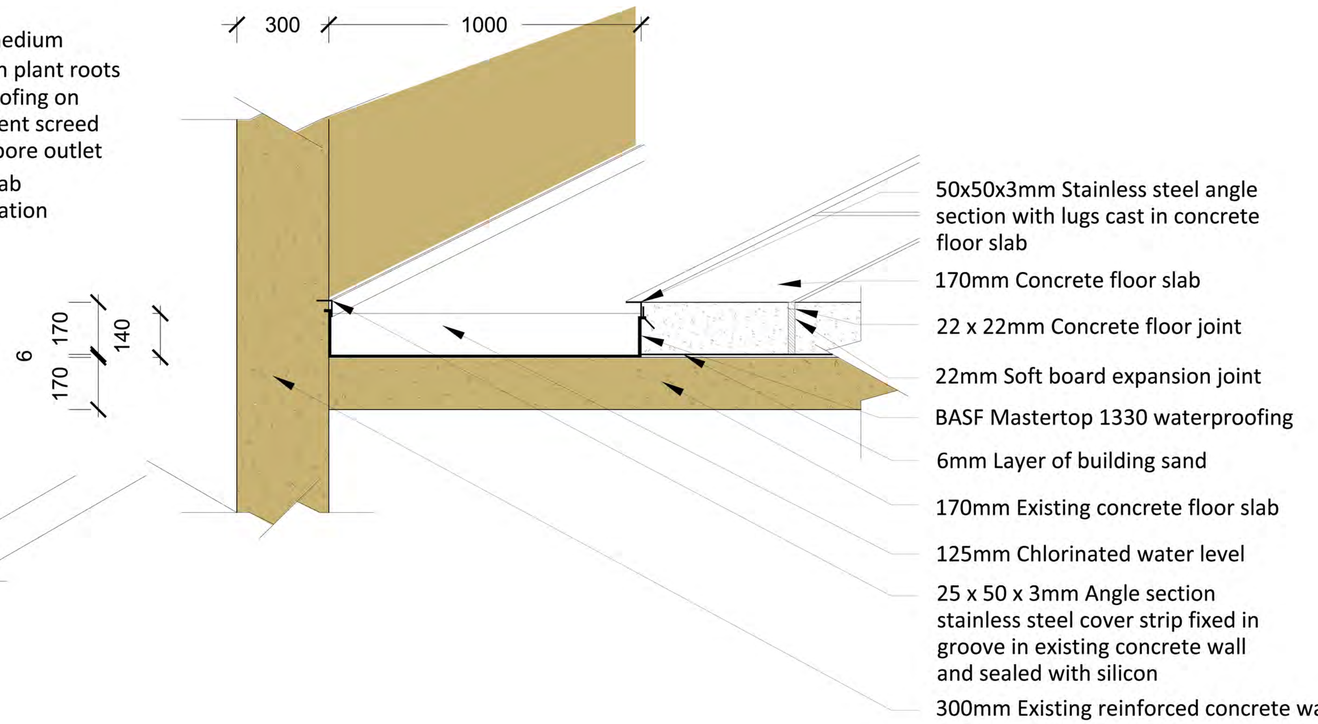
SCALE	DATE
1:50	2009.11.25

DRAWN: ANJA BREDELL 23337550

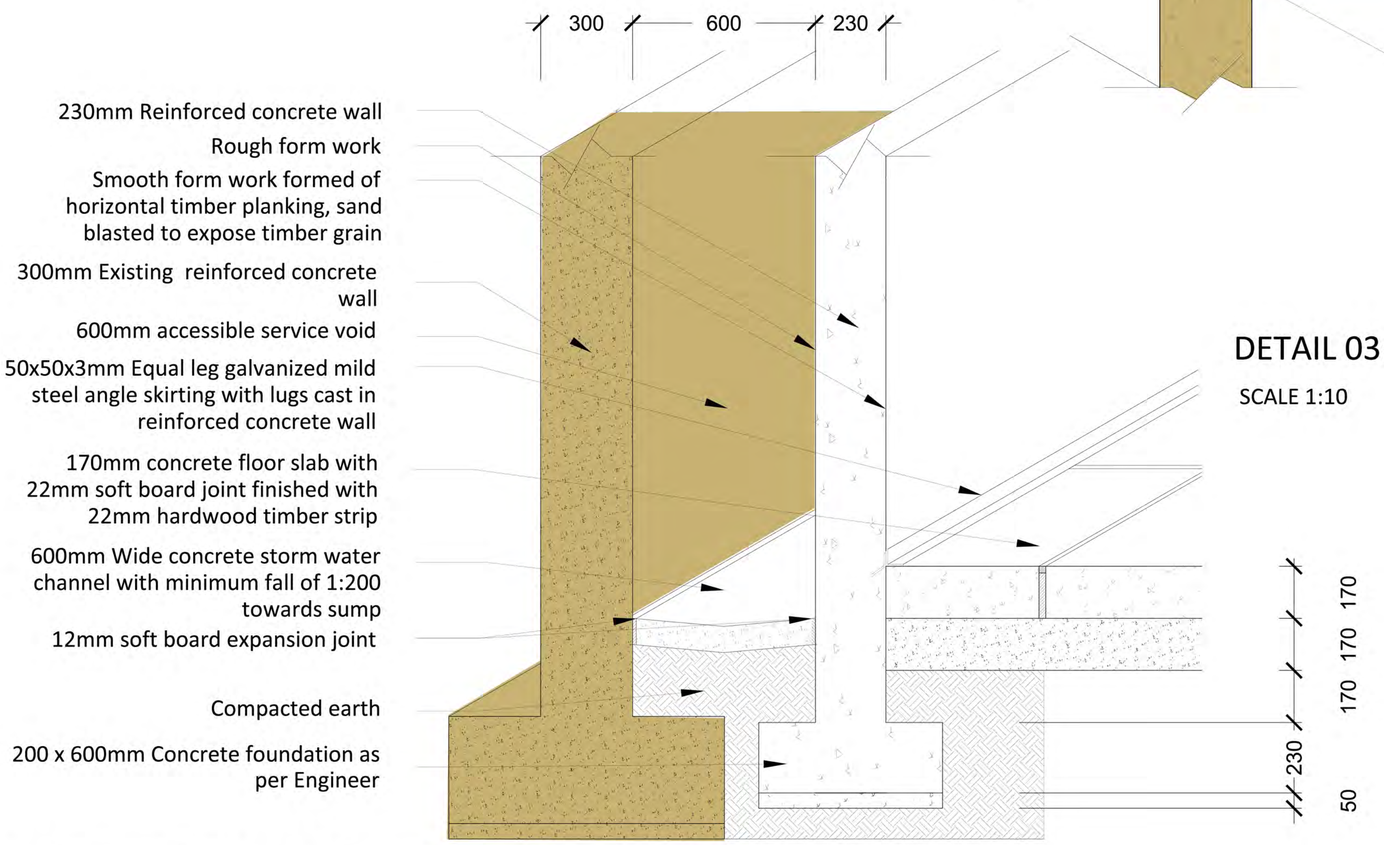
DRAWING NO.: 008



DETAIL 01: GREEN ROOF
SCALE 1:10



DETAIL 03: NEW FLOOR WITHIN EXISTING CONTEXT
SCALE 1:10



DETAIL 02: SERVICE VOID BETWEEN NEW AND EXISTING STRUCTURES
SCALE 1:10

NOTES

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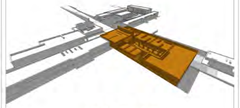


KEY PLAN

LEGEND

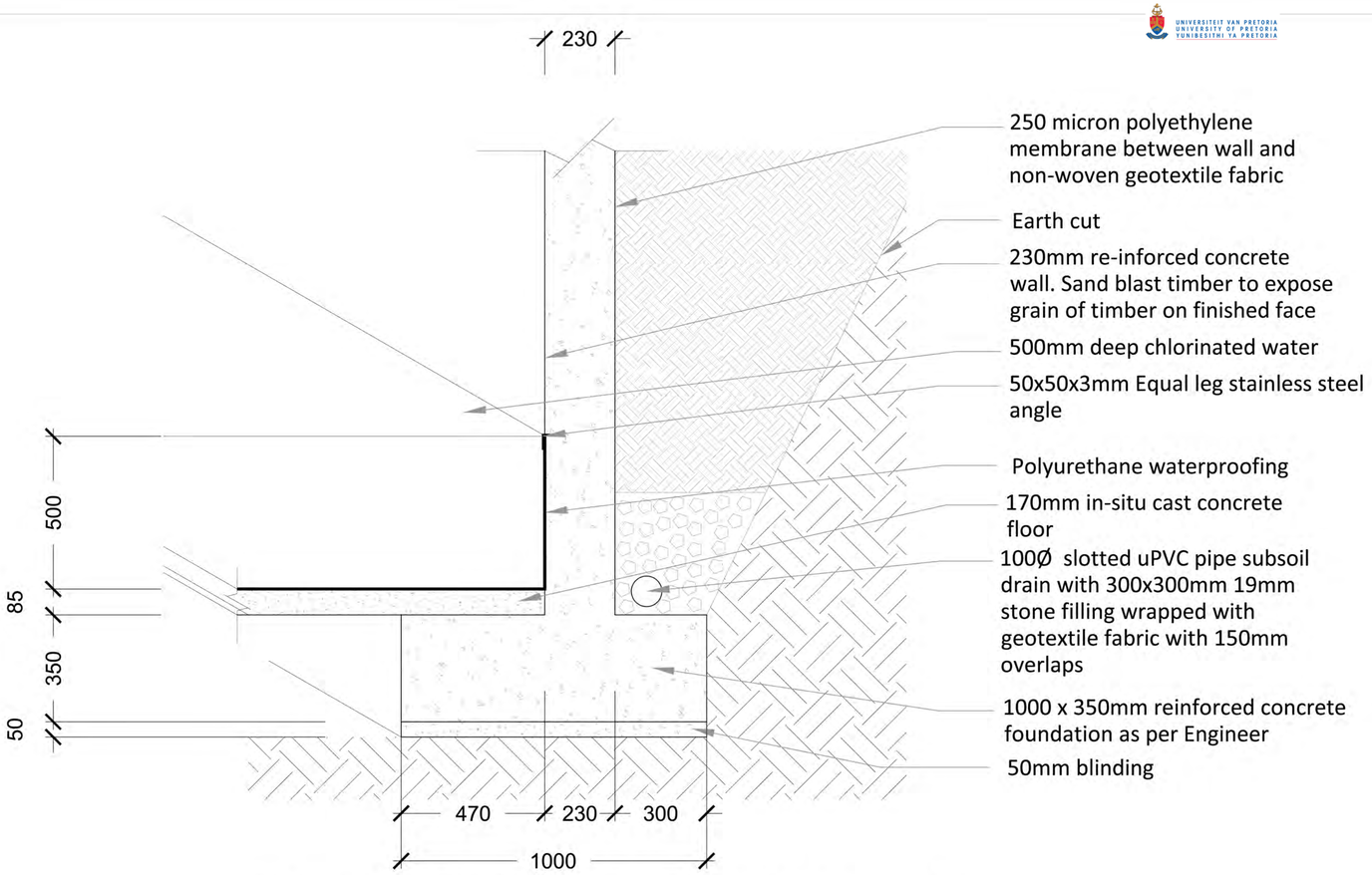
EXISTING STRUCTURE

MANIFESTING THE MEMORY
A MEMORIAL FOR A METEORITE
DETAILS

SCALE	DATE
1:10	2009.11.25

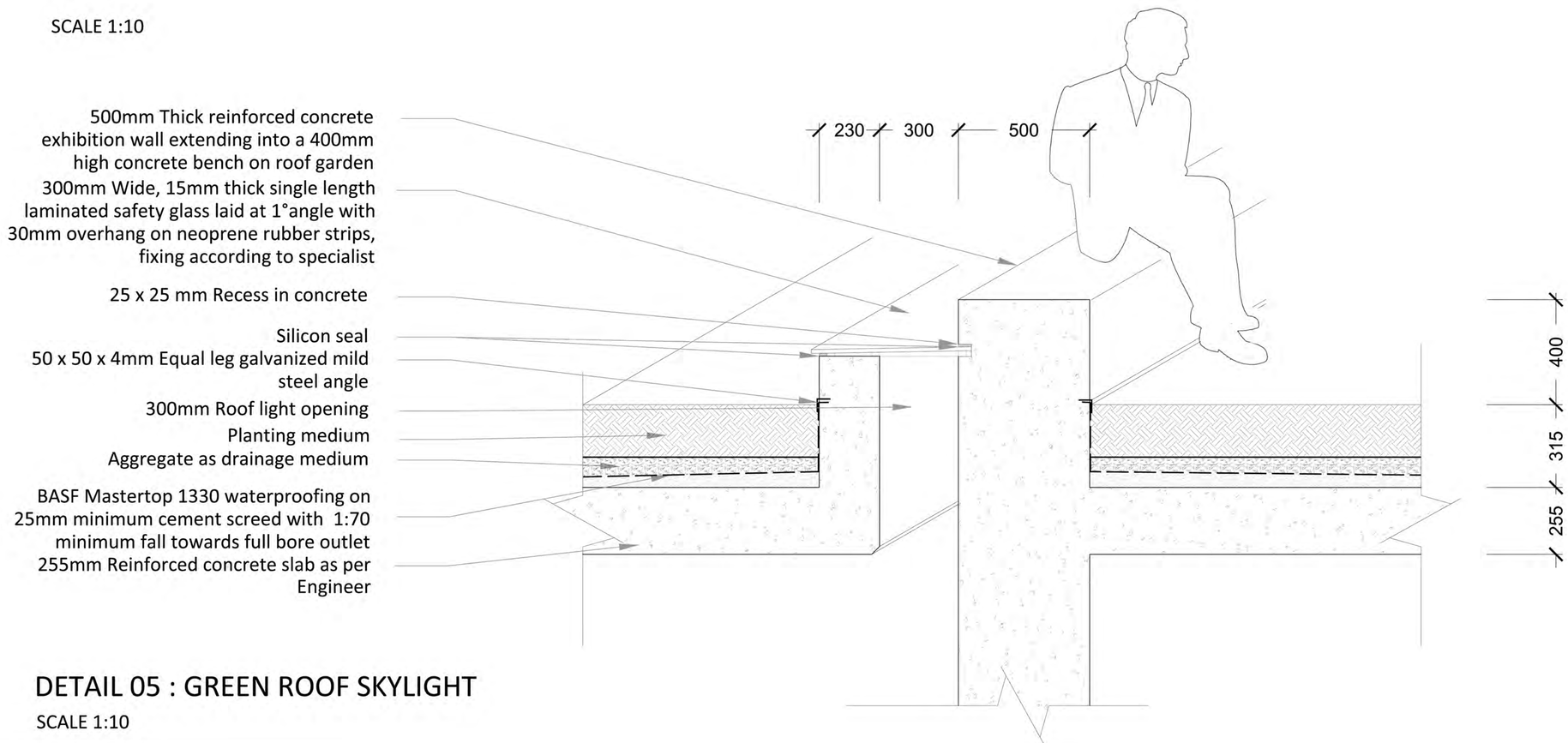
DRAWN: ANJA BREDELL 23337550

DRAWING NO.: 009



DETAIL 04 : REINFORCED CONCRETE RETAINING WALL

SCALE 1:10



DETAIL 05 : GREEN ROOF SKYLIGHT

SCALE 1:10

NOTES

KEY PLAN

MANIFESTING THE MEMORY
A MEMORIAL FOR A METEORITE
DETAILS

SCALE	DATE
1:10	2009.11.25

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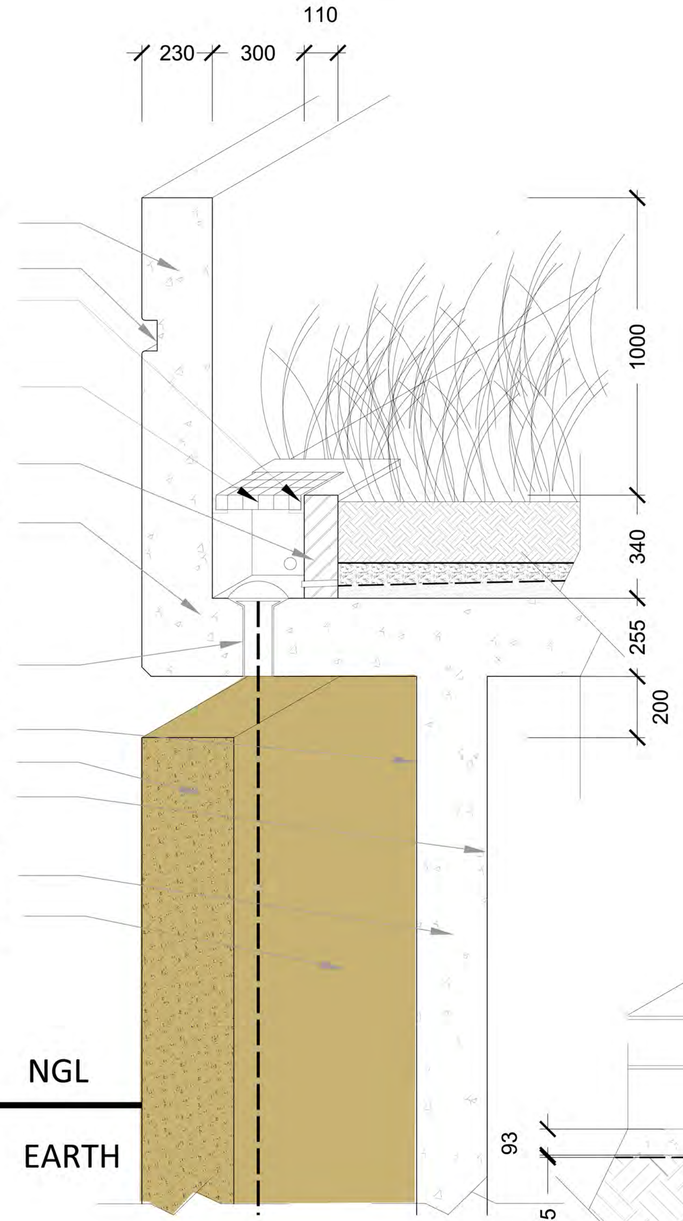
DRAWING NO.: 010



230mm Concrete balustrade wall

50x100mm Recessed shadow line

50 x 50 x 4mm Equal leg galvanized mild steel angle fixed to existing concrete wall with M10 chemical anchors

100 x 40 x 40 B60mm Galvanized mild steel Andrew Mentis gripweld grating

110mm Brick wall,finish with plaster on all exposed faces, 20mm Ø uPVc pipes at 100mm centres allround

255mm Reinforced concrete roof slab with waterproofing, planting medium and tufted grass. Refer to green roof detail 01

100 Ø Full bore outlet with chain attached to full bore cover

Rough form work

300mm Existing reinforced concrete wall

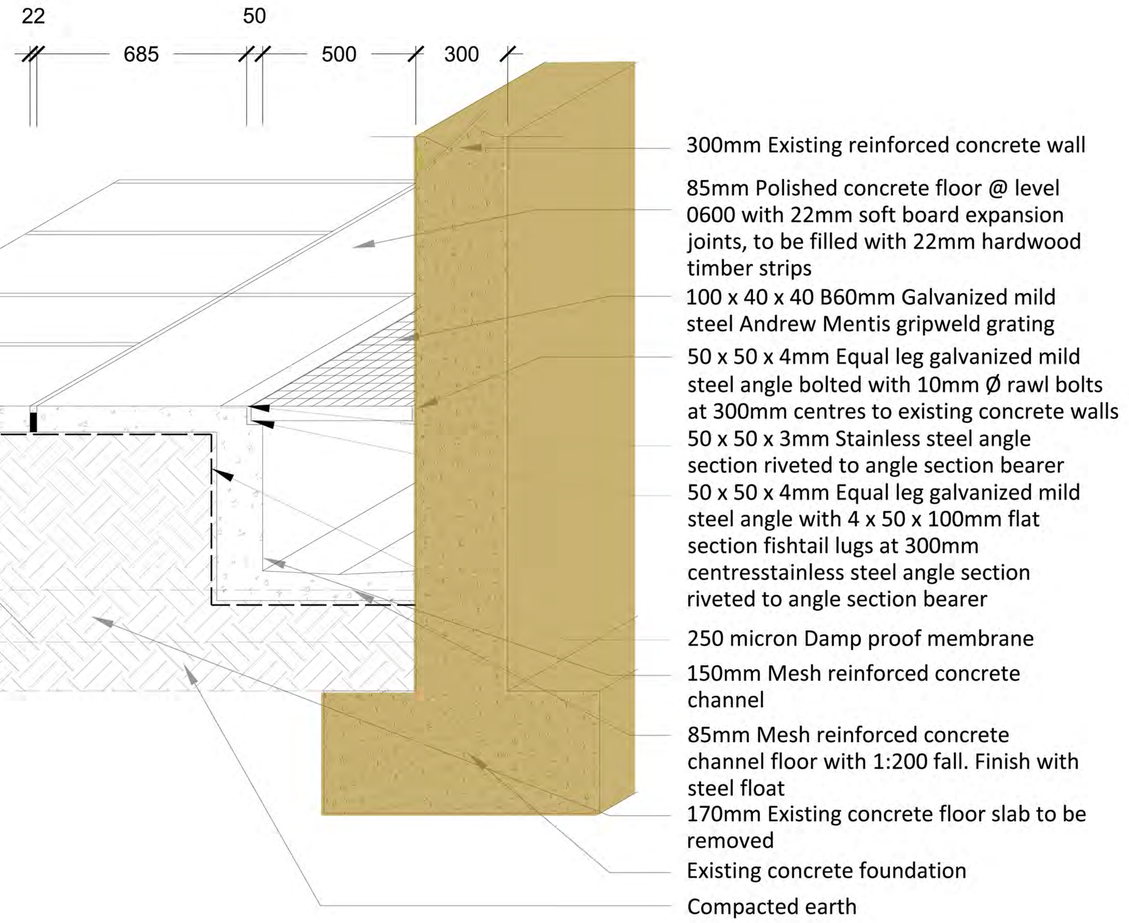
Smooth form work formed of horizontal timber planking, sandblasted to expose timber grain

230mm Reinforced concrete wall

600mm Service shaft between new and existing walls

DETAIL 06: STORM WATER OUTLET FROM GREEN ROOF

SCALE 1:10



300mm Existing reinforced concrete wall

85mm Polished concrete floor @ level 0600 with 22mm soft board expansion joints, to be filled with 22mm hardwood timber strips

100 x 40 x 40 B60mm Galvanized mild steel Andrew Mentis gripweld grating

50 x 50 x 4mm Equal leg galvanized mild steel angle bolted with 10mm Ø rawl bolts at 300mm centres to existing concrete walls

50 x 50 x 3mm Stainless steel angle section riveted to angle section bearer

50 x 50 x 4mm Equal leg galvanized mild steel angle with 4 x 50 x 100mm flat section fishtail lugs at 300mm centresstainless steel angle section riveted to angle section bearer

250 micron Damp proof membrane

150mm Mesh reinforced concrete channel

85mm Mesh reinforced concrete channel floor with 1:200 fall. Finish with steel float

170mm Existing concrete floor slab to be removed

Existing concrete foundation

Compacted earth

DETAIL 07: STORM WATER CHANNEL WITHIN EXISTING CONTEXT

SCALE 1:10

NOTES

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KEY PLAN

LEGEND

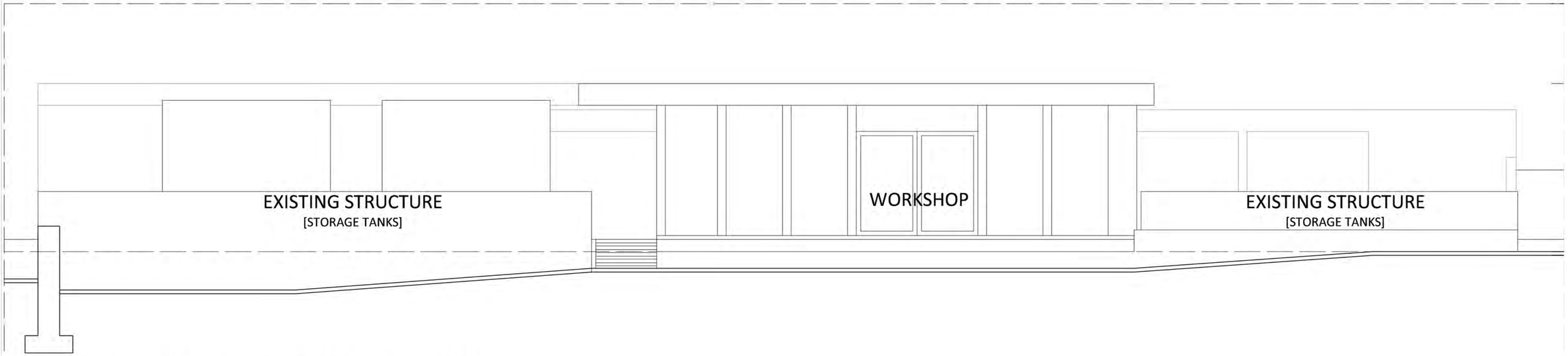
EXISTING STRUCTURE

MANIFESTING THE MEMORY
A MEMORIAL FOR A METEORITE
STORMWATER DETAILS

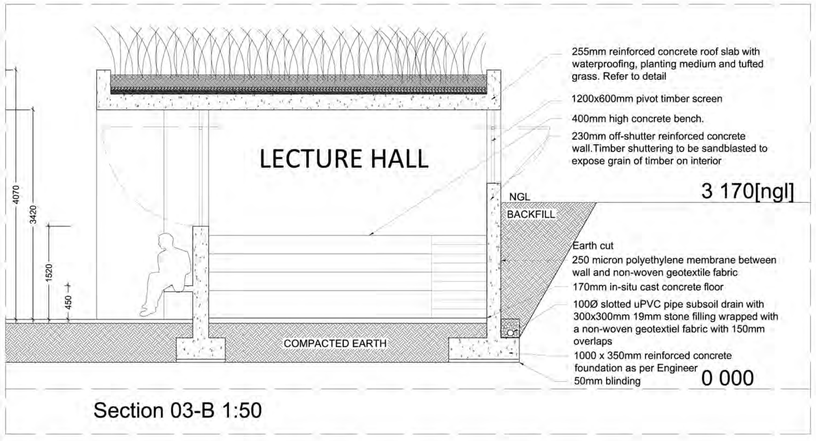
SCALE	DATE
1:10	2009.11.25

DRAWN: ANJA BREDELL 23337550

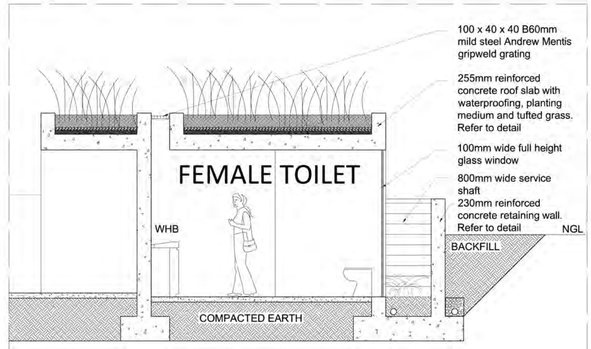
DRAWING NO.: 012



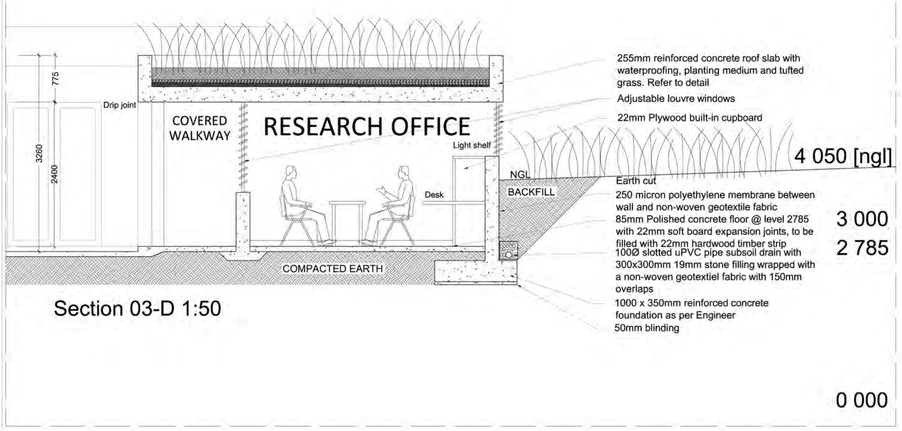
Sectional elevation 03-A 1:100



Section 03-B 1:50



Section 03-C 1:50



Section 03-D 1:50

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KEY PLAN

LEGEND

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SECTIONS

SCALE	DATE
1:50	2009.11.25

DRAWN: ANJA BREDELL 23337550

DRAWING NO.: 008