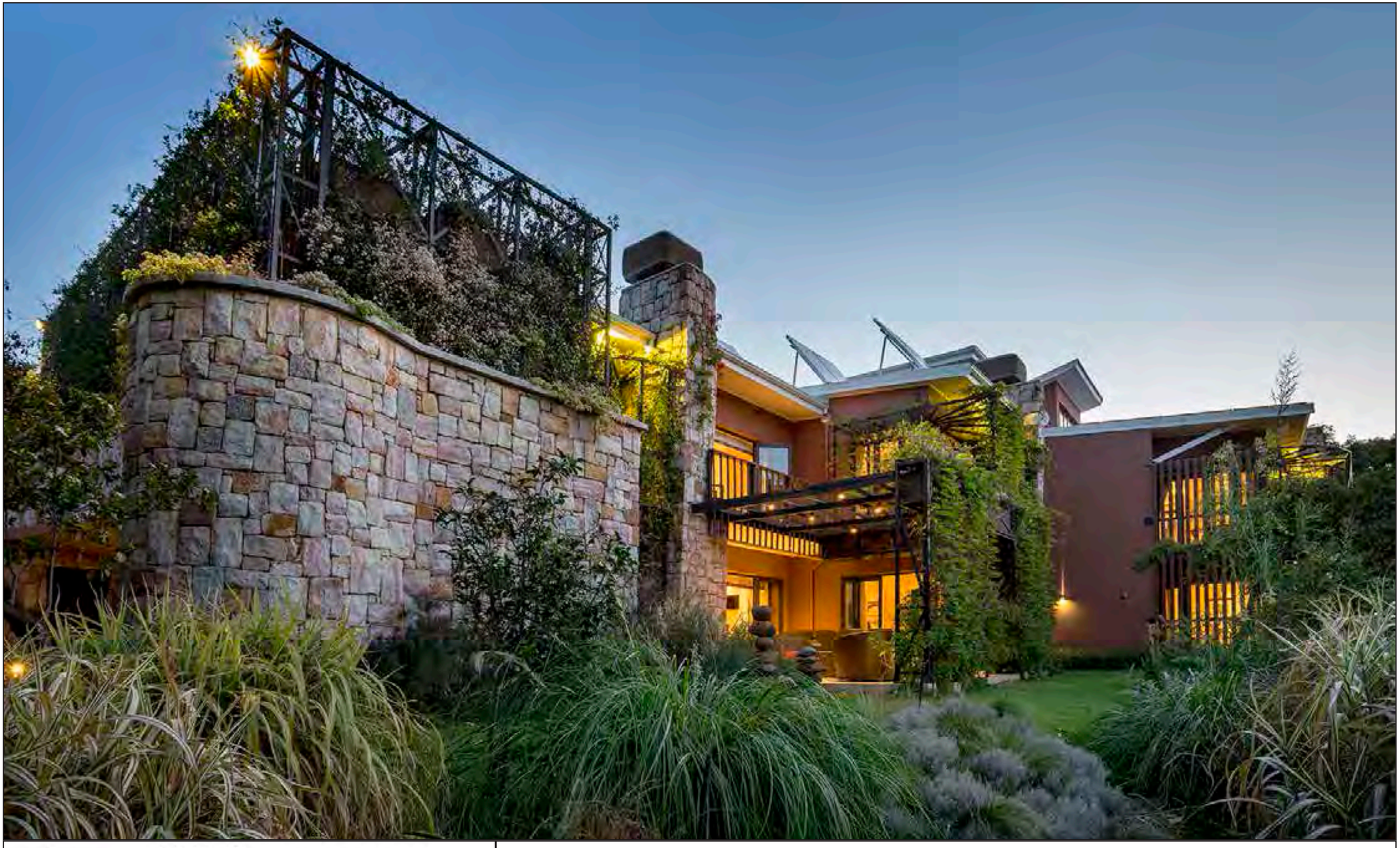

ERA ARCHITECTS

3 Garrett Road
Parktown
2193
South Africa

Tel. 011 - 482 - 1994
Fax. 086 - 298 - 5132
Cell. 082 - 451 - 8069
ken@era-architects.co.z

www.era-architects.co.za

THE SCIENCE BEHIND HOUSE JONES

Table of Contents

Figure List

IMAGE 01: SITE PLAN OFHOUSE JONES

Sustainability, Energy Conservation, Biodiversity, Use of Renewable Energy and Innovation

Sustainability: Reduction of pollution and waste

During the construction of the building several strategies were used to reduce pollution, waste and strain on the environment. These are illustrated in the graphics that follow in this section.

Reduce Construction Waste

The existing house was carefully soft-stripped, and all reusable materials were reclaimed and donated to charity. This included all electrical and sanitary fittings, windows, doors, cupboards, roof coverings and timbers. Paving blocks were also reclaimed from the existing house and incorporated into the new paving design. All remaining masonry was crushed on site and used in three ways:

1. Over-excavated foundation trenches were back filled and compacted prior to casting foundations for geotechnical reasons
2. Surface bed back filling and levelling
3. Paving subsoil back filling and levelling

This all meant no waste was carted off the site from the existing building.

Reduce Site Contamination During Construction

Environmental management clauses in the contract resulted in reduced GHG emissions and pollution of the site and surrounding area during construction:

- Soil had to be protected with a sealed lining in mixing areas from contamination during construction while using cement and other contaminating products
- Minimal storm water runoff was allowed to leave the site
- Waste generated during construction had to be minimised and sorted on site for recycling
- Substances such as paints, solvents, sealants, adhesives etc.… had to be low toxicity and low VOC, and a special sealed area was created for washing tools and equipment
- Water used on site for washing, irrigation etc.… had to be minimised through conservation and recycling

Site Preservation

All top soil under the new house footprint was removed and carefully preserved during house construction. All existing trees and vegetation were identified and carefully protected during construction. All the stored top soil and existing vegetation was then re-used in the new landscaping design. The site was subdivided which assists urban densification.

Materials

Building materials were chosen based on longevity, low maintenance, low embodied energy, high recyclability and minimal transport distances to site. All paints, solvents adhesives etc. were selected based on low toxicity and low VOC.

IMAGE 02: SOFT STRIPPING INTERIOR FIXTURES

IMAGE 03: SOFT STRIPPING STRUCTURAL MATERIAL

IMAGE 04: DONATING MATERIALS TO CHARITY

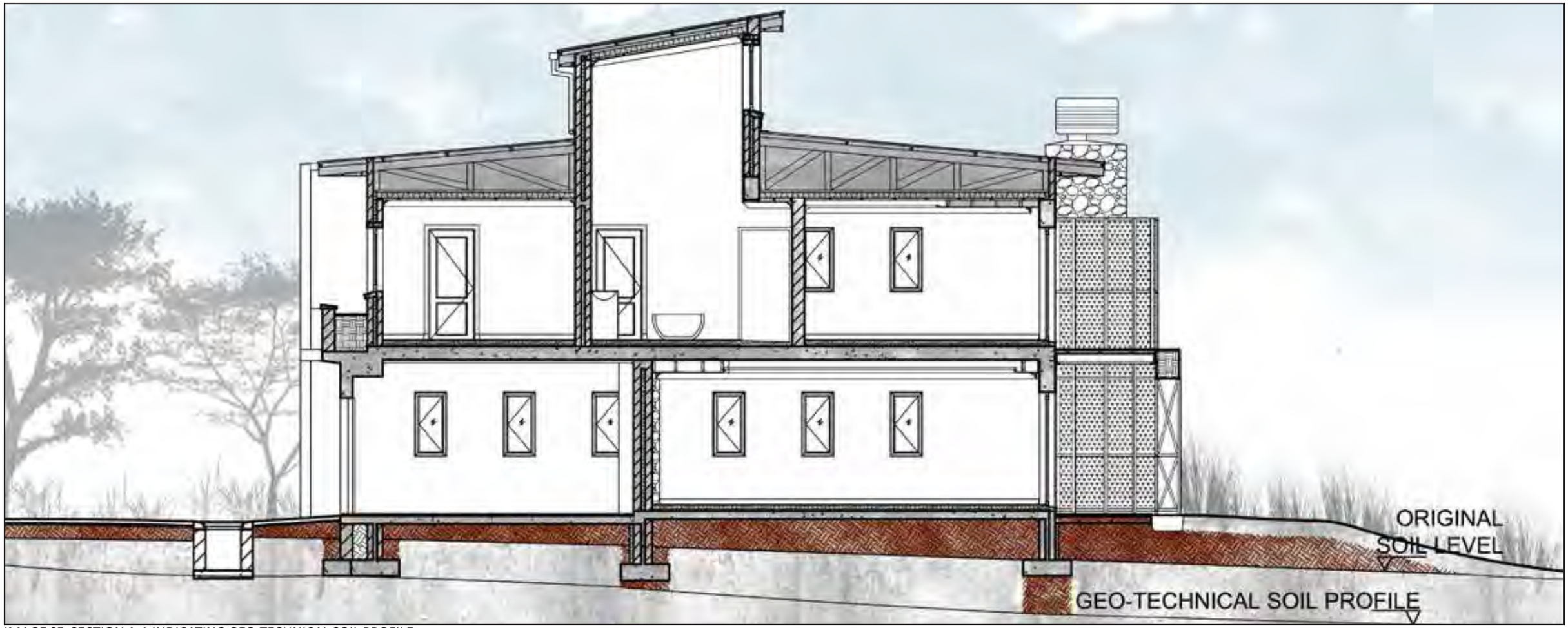

IMAGE 05: SECTION A-A INDICATING GEO-TECHNICAL SOIL PROFILE

IMAGE 06: SECTION THOUGH ENTANCE HALL

IMAGE 07: SECTION THROUGH BEDROOM, BATHROOM, MAIN KITCHEN AND MAIN STOEP

IMAGE 08: RAINWATER COLLECTION

IMAGE 09: “LILIPUT” AEROBIC DIGESTER

IMAGE 10: NATURAL WATER TREATMENT WETLAND

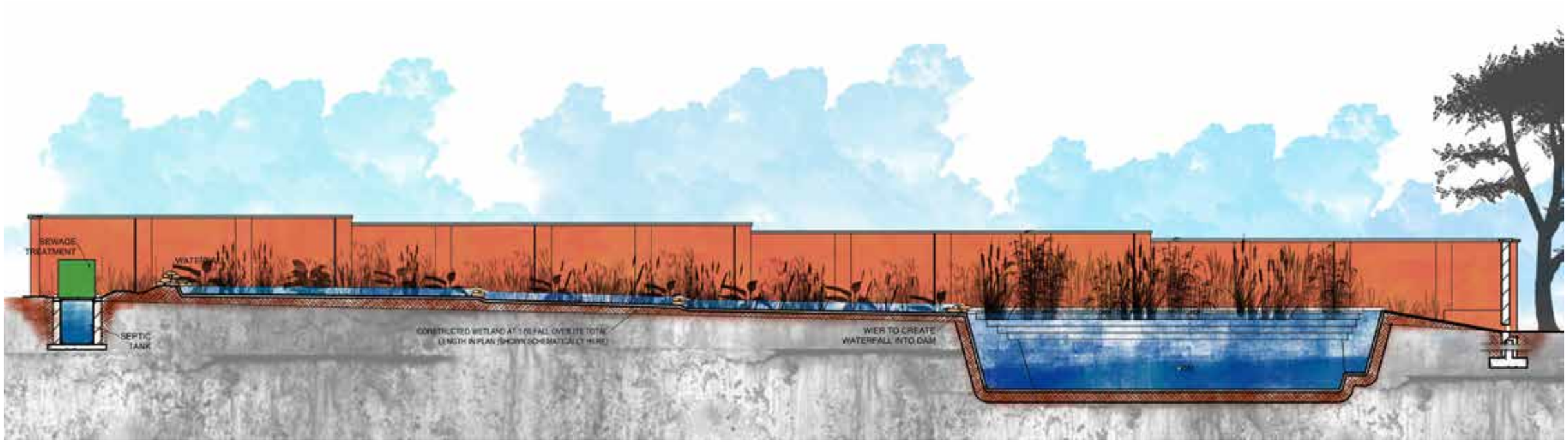

IMAGE 11: SECTION ILLUSTRATING RECYCLED WATER TREATMENT SYSTEM

Sustainability: Rainwater collection

Reduce water consumption

Rainwater harvesting is achieved in two stages:

1.Roof level rainwater is collected for non-potable use in the house

2.Paving runoff and subsoil drainage is collected directly in the storage dam and used for irrigation

Collected rainwater is stored in 40,000 litres of surface storage tanks on site. The collected rainwater is filtered and used for non-potable purposes in the house. Council water is filtered separately and delivered to 3 “potable” taps in the house.

A borehole was sunk and the water tested. The borehole is intended to be used as sparingly as possible, and only tops up the on site storage the minimum amount possible, while waiting for the rain to fill the storage systems.

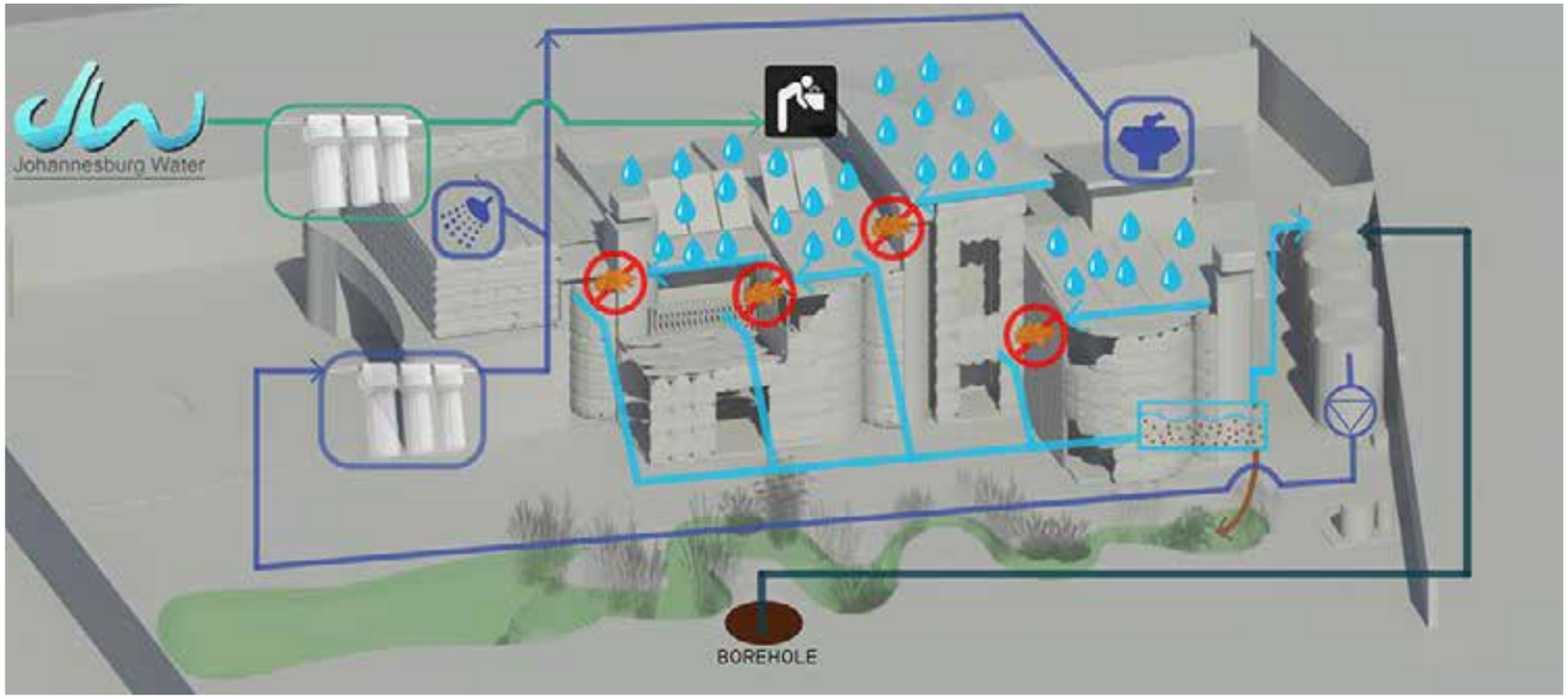

IMAGE 12: RAINWATER COLLECTION SYSTEM

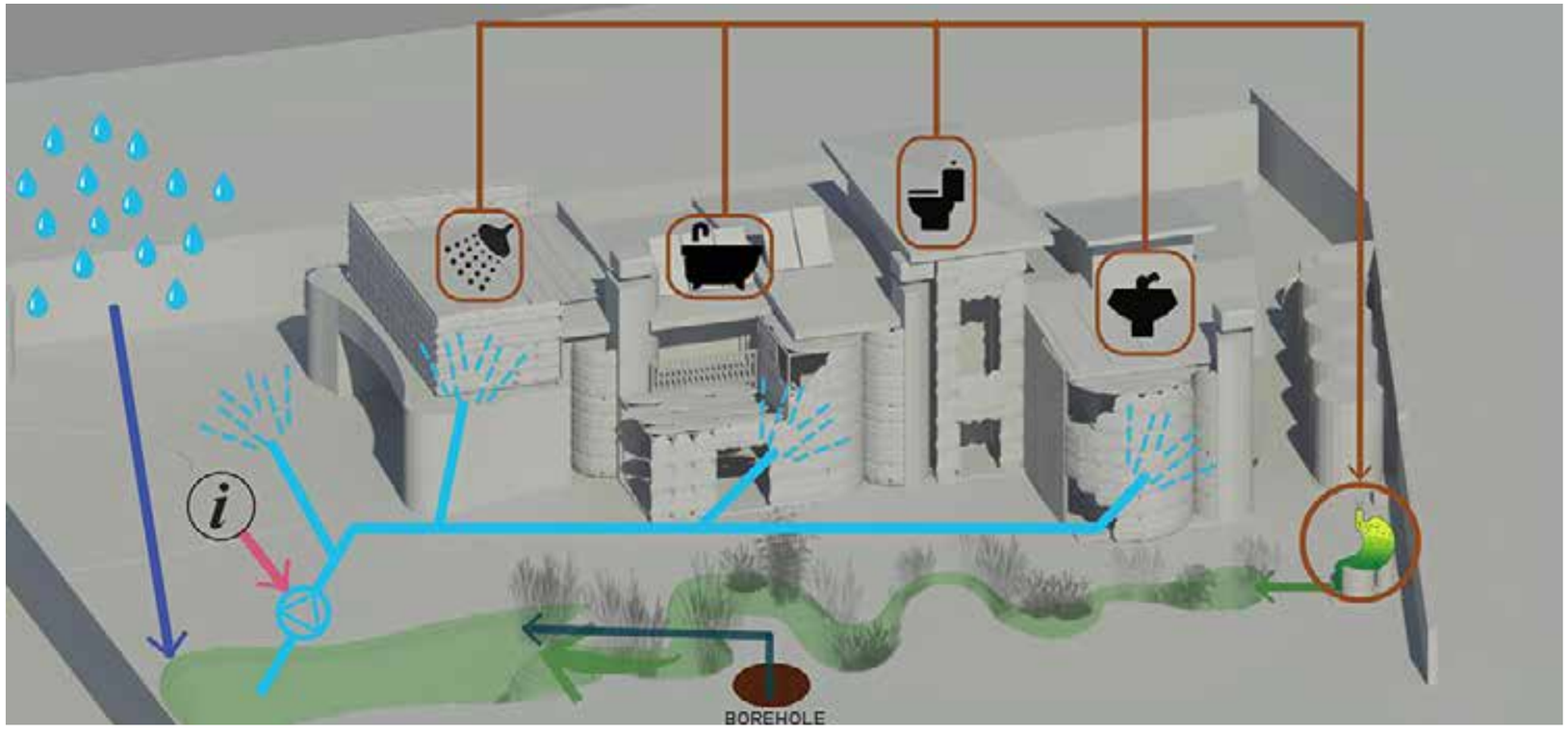

IMAGE 13: WASTEWATER TREATMENT SYSTEM

Sustainability: Wastewater Treatment System

All waste water generated in the house is treated on site in a 3 phase anaerobic tank and an aerobic digester system. Clarified water is then fed through a wetland to further polish the water before being stored in a dam and used for irrigation. Nutrients from the wastewater are used as fertigation in the irrigation system.

All the recycled water & collected ground level rainwater is collected in a 60,000 litre storage dam to be used during the dry season. The dam is designed to have its level vary from dry to wet season as the water is stored and used as required.

IMAGE 14: BACKUP GENERATOR

IMAGE 15: COMPLEX DISTRIBUTION BOARD

IMAGE 16: PHOTO VOLTAIC PANEL ARRAY

IMAGE 17: EVAPORATIVE COOLER ON STONE CHIMNEY

Energy Conservation

The building is designed to maximize natural daylighting and reduce the need for artificial lighting. All light fittings are low energy LED and all ovens and stoves use gas instead of electricity to reduce power consumption. All domestic water heating uses solar thermal energy with a heat pump as backup. During winter the house is heated by an underfloor heating system that uses solar thermal energy.

A Photovoltaic system meets the house's needs during the daytime; any excess energy is fed into the national grid. Intelligent Inverters control the power drawn from and fed into the national grid. The inverters shut off power in any event of the National feed being interrupted as a safety measure. No electrical batteries were used because of their environmental hazards in production and destruction and their limited lifespan. The house effectively uses the National grid as a battery.

An automatic start-up generator is installed to supply the house in the event of an National power outage.
A UPS provides clean, uninterrupted power to carry the various intelligence systems built into the house (that control space heating & cooling, irrigation and lighting systems) over the period between a power outage and the backup generator coming online; about 20 seconds.

The house was wired with three different circuit types:

- Non-essential services that do not operate in the event of a power outage.
- Essential services fed by the generator in the event of a power outage.
- Critical services fed by the UPS that operate without interruption in the event of a power outage.

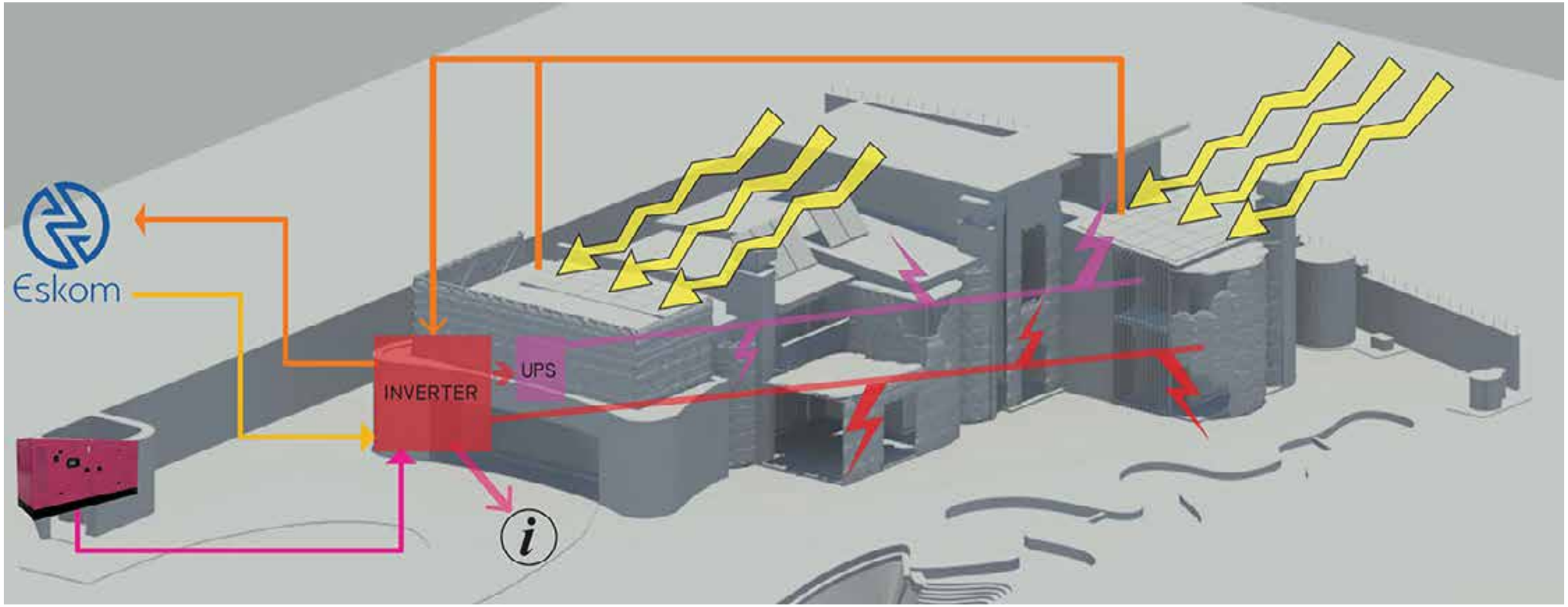

IMAGE 18: POWER MANAGEMENT

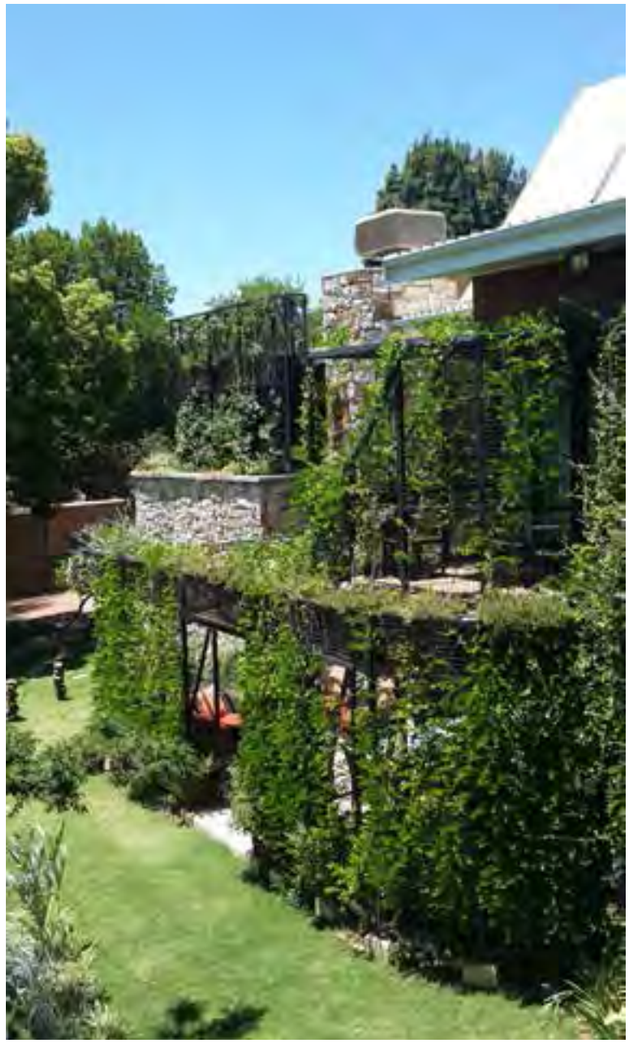

IMAGE 19: BIODIVERSITY PHOTOGRAPHIC ILLUSTRATION

Biodiversity

The landscaping was designed as a natural ecosystem. The water strategy on the site calls for wetlands and cascading rock waterfalls to oxygenate the water while it is being treated and recycled.

A circulation pump powers the oxygenation strategy, indigenous plants and fish were introduced to kick start the ecology.

Frogs and birds began discovering the natural system and colonizing it immediately.

The planting has been designed to create many areas where various animals, birds and insects can make a home. The variety of environments in terms of plant species and climatic factors make for many different characteristics of ecosystems and micro-climates where much biodiversity can flourish.

The planted screens around the house create their own individual micro-climates. These vary in quality and characteristic slightly, depending on what planted species are used. This also leads to more diversity of ecology and environment, further encouraging a variety of different species to come and make the house their home.

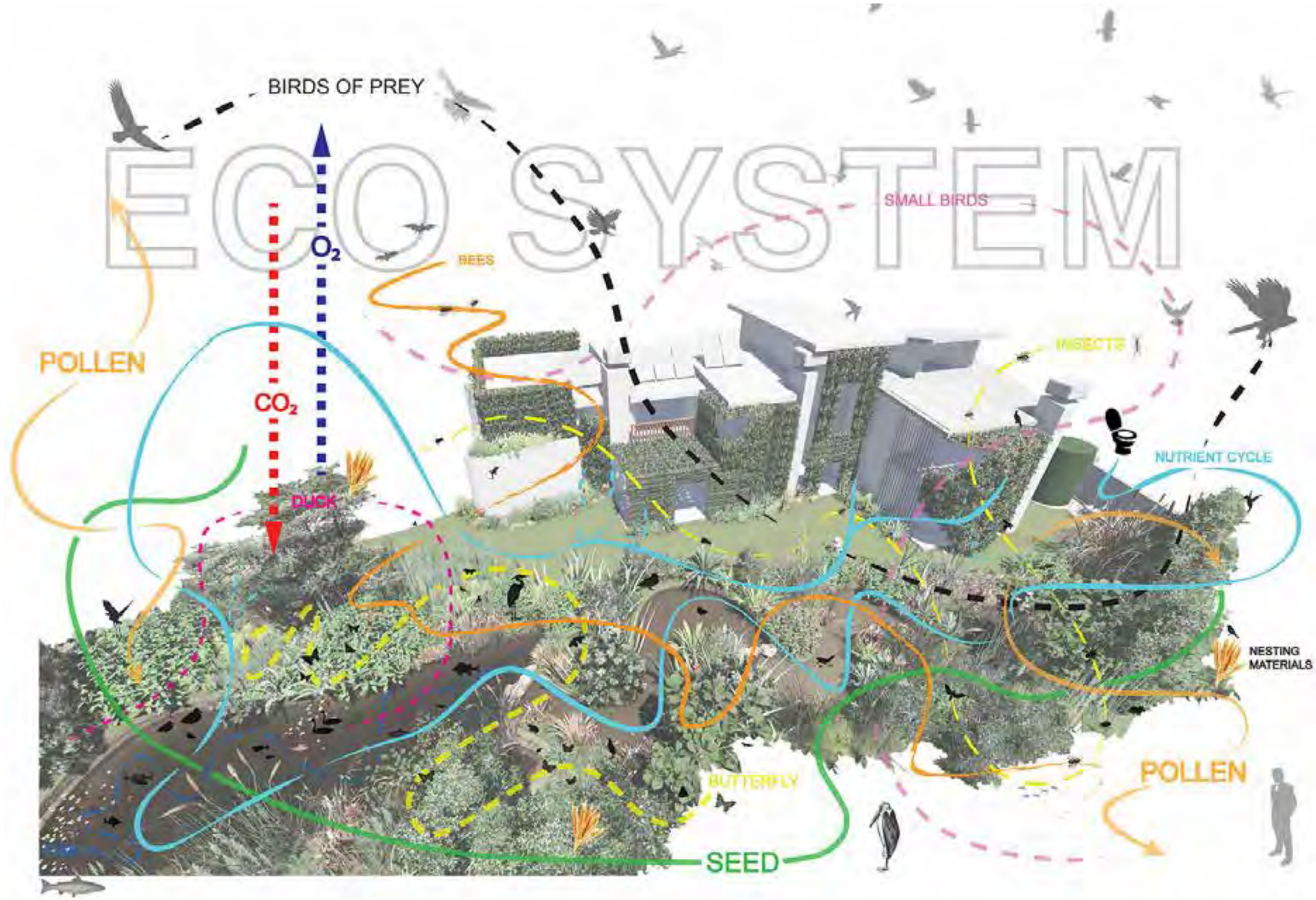

IMAGE 20: BIODIVERSITY DIAGRAMMATIC ILLUSTRATION

IMAGE 21: 1000 LITRE STORAGE TANK BATTERY AND WATER TREATMENT EQUIPMENT

IMAGE 22: SOLAR WATER HEATING PANELS

IMAGE 23: UNDERFLOOR HEATING PIPES LAYOUT

IMAGE 24: UNDERFLOOR HEATING PIPE MANIFOLD

Use of renewable energy: Space Heating System

Passive systems and low energy active components are used to achieve thermal comfort in winter:

Passive Systems:

Carefully calculated sun angles allow direct winter insolation to heat the spaces. The deciduous plants allow more insolation into the house during winter. The structure of the building is a high thermal resistance envelope which has been carefully detailed to allow minimal ex-filtration.

The Green bubbles create “warmer bubbles” during winter by protecting the spaces from cold night sky radiation.

Active Systems:

Solar thermal heated water up to 90°C is circulated through a 1000 litre storage tank that acts as a heat battery. The lower temperature water from the bottom of the tank heats underfloor heating system.

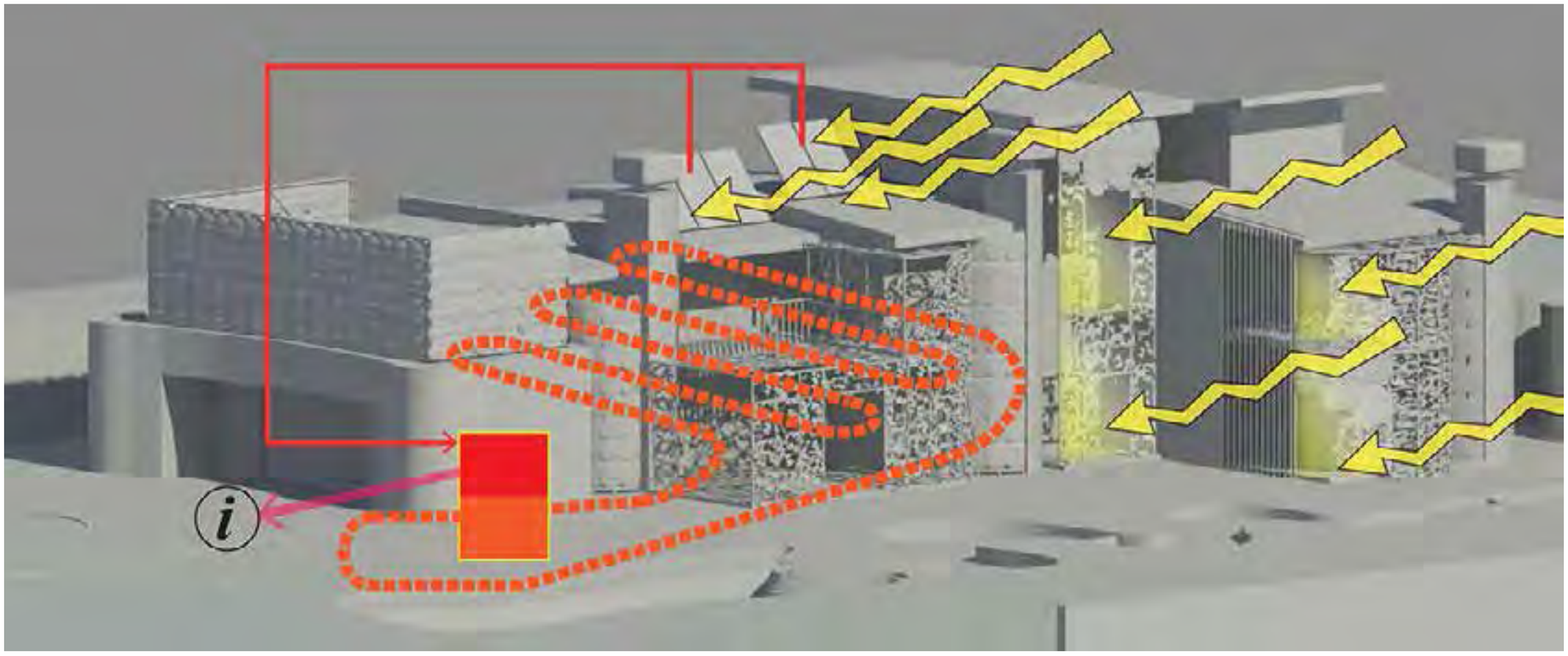

IMAGE 25: SPACE HEATING SYSTEM

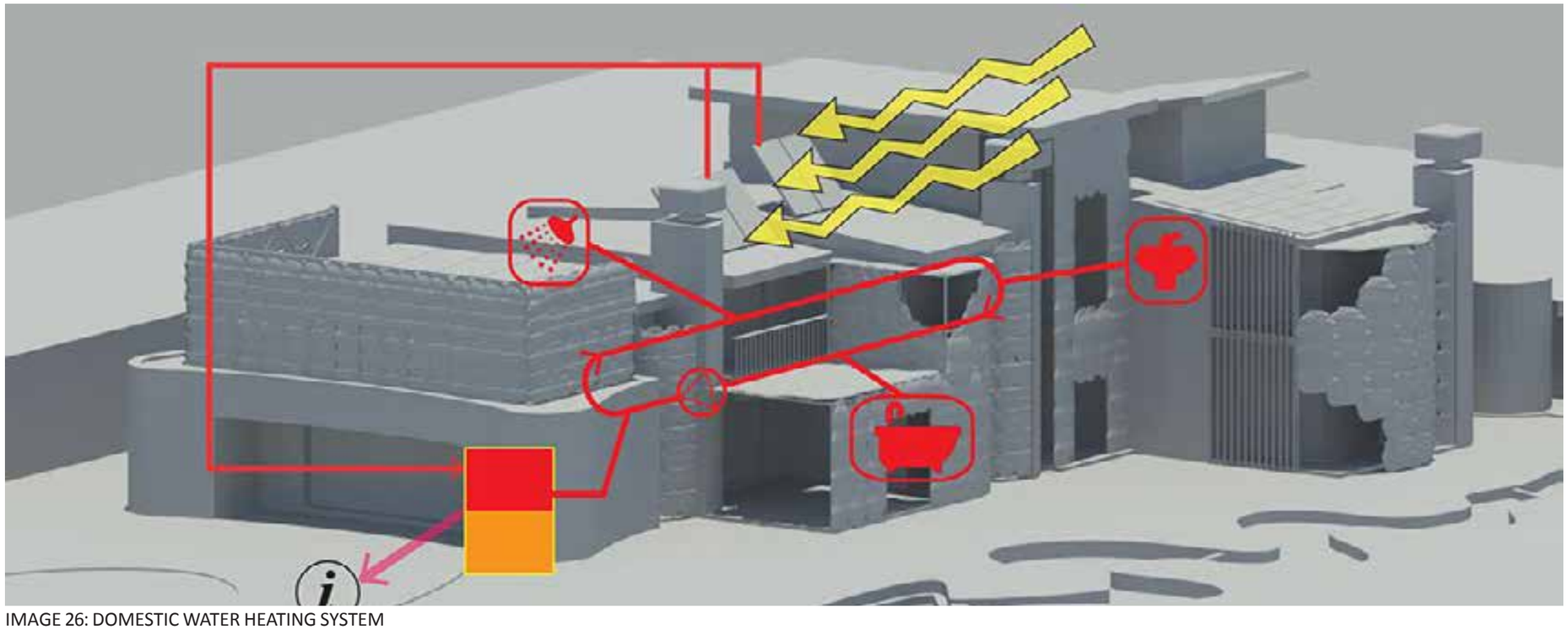

IMAGE 26: DOMESTIC WATER HEATING SYSTEM

Domestic Water Heating System

A solar powered system delivers hot water all year round:

The higher temperature water from the top of the heat storage tank heats domestic water supply.

The hot water supply runs in a well insulated ring main, circulated by a pump on a timer to keep the hot water available at any point in the house in a matter of seconds. This saves energy and water.

Innovation: Cooling System

The house is cooled by both passive and active ventilation strategies:

Passive system:
Generally the home can operate on simple cross ventilation, but on extremely hot days, evaporative coolers on top of the chimneys deliver cool air through the stone towers to the interior spaces as required.

Active System:
Sun angles were used to position planted facades that shade the internal spaces during summer.
The “green bubbles” on the northern facade of the house shade the internal spaces and temper the outside air; creating cool, comfortable spaces during summer for the house to open on to.
Adjacent to the stone chimneys are “green” planted chimneys that use atomized sprayers to evaporatively cool the surrounding air enhancing the cooling effect of the green bubbles, while irrigating the plants.

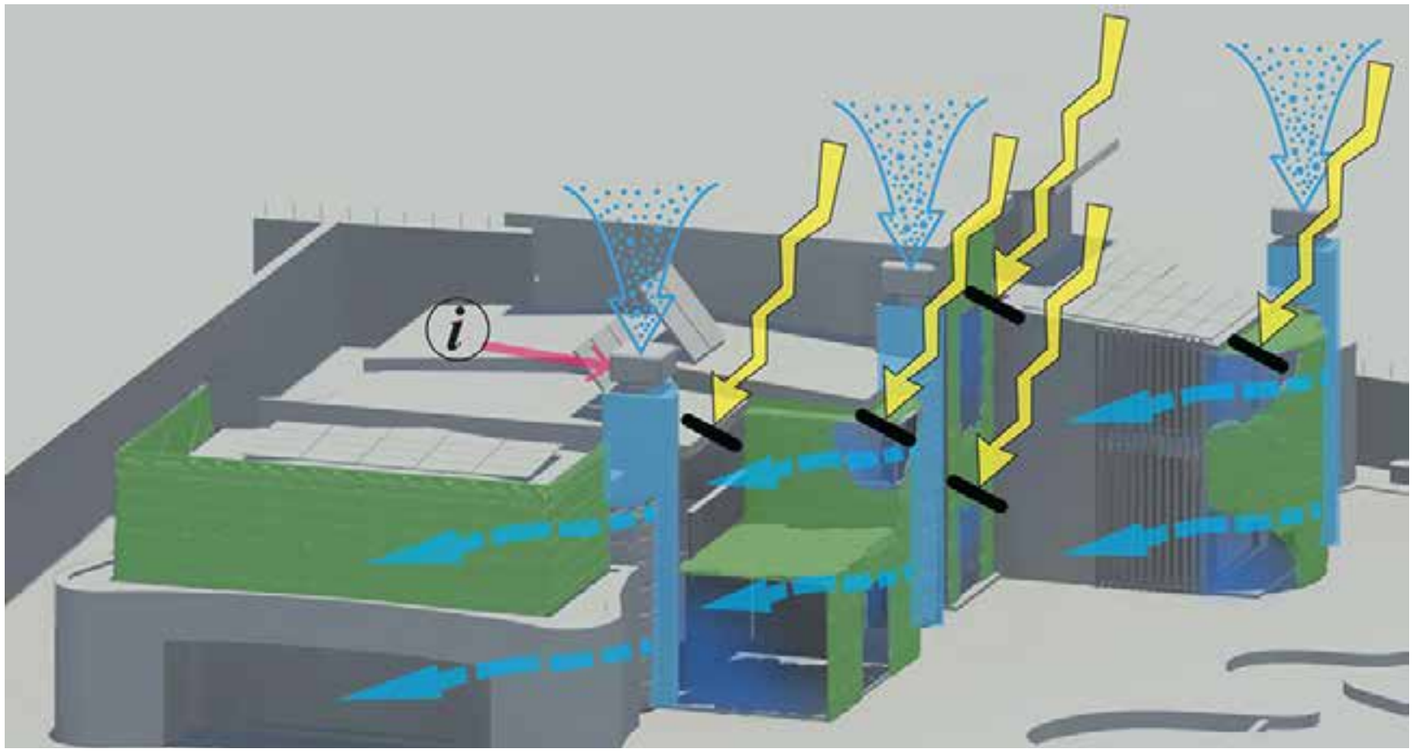

IMAGE 27: COOLING SYSTEM

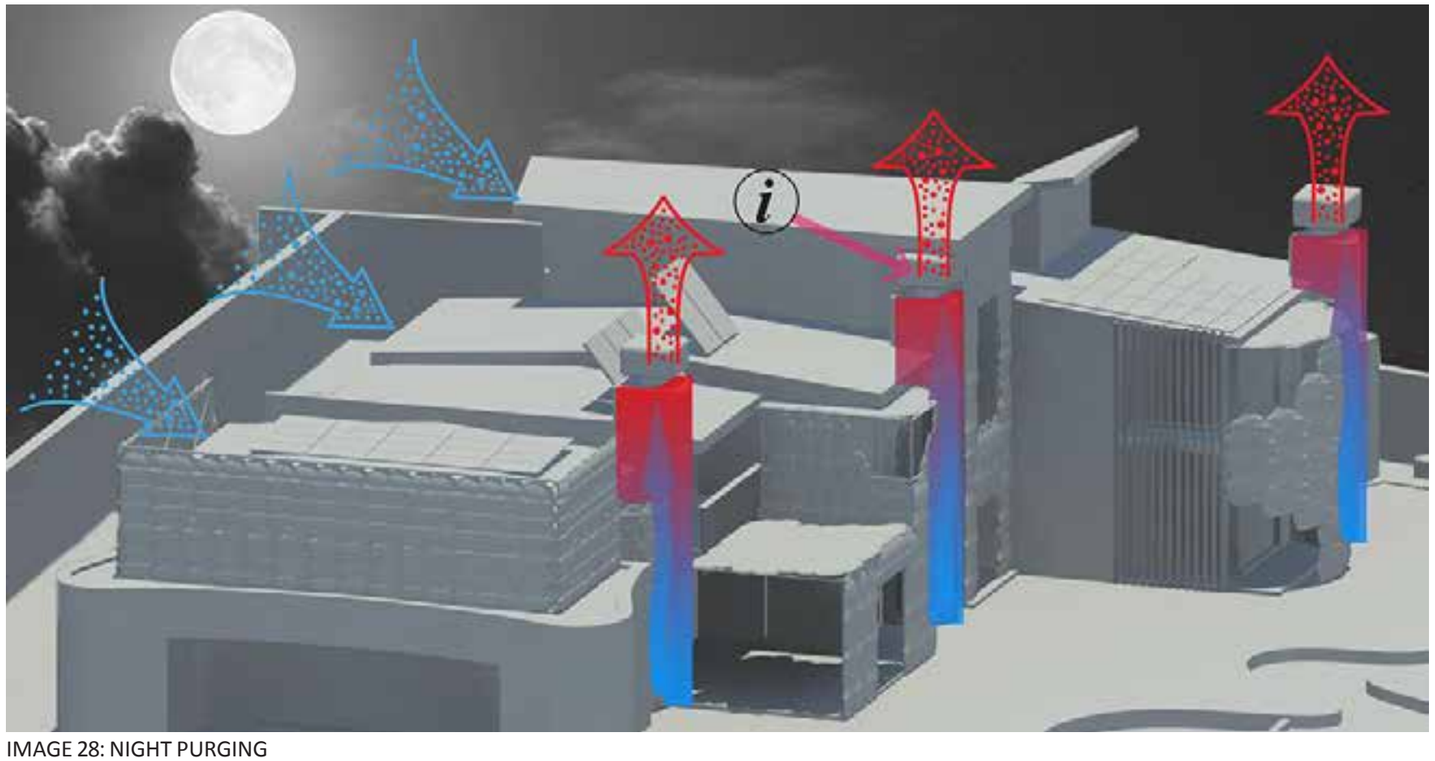

IMAGE 28: NIGHT PURGING

Innovation: Night Purging

During the night the stone ventilation chimneys invert their operation and extract warm air from the building.
Replacement cool night air is drawn through the windows on the south side of the building and cools the thermal mass of the structure preparing it to absorb the heat generated the next day.

IMAGE 29: NORTH ELEVATION

IMAGE 30: EAST ELEVATION