APPENDIX 15.13

GREEN BUILDING CODE

BY

IYER URBAN DESIGN STUDIO

HILCOVE HILLS – GREEN BUILDING CODE

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A. INTRODUCTION & OVERVIEW

The built environment is responsible for a large proportion of our national energy consumption almost all of which is currently fossil-fuel based. Eskom has decided to increase its electricity tariffs substantially to fund the construction of new coal-fired power stations needed to cope with the projected demand and historical backlog.

A large part of our electricity consumption goes towards water heating, lighting & heating/cooling in buildings generally, and the use of appliances in domestic buildings.

The South African National Standards (SANS) 204 & 10400-XA came into effect in November 2011 and constitutes the regulatory underpinnings of a move towards an energy-efficient and greener design philosophy among professionals designing, building & operating buildings in the commercial and public realm, including residential buildings. The objective of the standard is to reduce energy usage in buildings.

A1. SANS 204 AND SANS 10400-XA

SANS 204 is a voluntary standard in the early stages and represents the minimum benchmark for energy efficiency with an increasing proportion of it's content being mandated by adoption into the Building Code (SANS 10400-XA) over a period of time.

SANS 204 and SANS 10400-XA norms and standards must be incorporated in the design of buildings within the Hilcove Hills development. These documents can be downloaded from the SABS website – www.sabs.co.za. These documents are subject to a single-user license only and cannot be copied to form part of this document.

A2. THE GREEN BUILDING COUNCIL OF SOUTH AFRICA

It is generally accepted that 40% of the world's energy is consumed by buildings through direct consumption during a building's construction and operational phases, and via the embodied energy required to transport and produce building materials. The construction industry is, therefore, a major contributor to global climate change and the GBCSA has developed the Green Star SA rating tool to address green buildings in the South African context in order to –

- reduce the environmental impact of development
- establish a common language and standard of measurement for green buildings
- promote integrated, whole-building design
- raise awareness of green building benefits and
- recognize environmental leadership

There is no legislation in place to enforce the recommendations of the GBCSA but their recommendations will be adopted and utilized in the design of the Hilcove Hills development. A mixed-use planning approach has been adopted to encourage a live/work/play environment which reduces the need to long commuting to facilities.

A wide range of land uses are located within the development including residential, business park, schools, health facilities and retail (shops).

B. GREEN DESIGN PRINCIPLES

The overarching principle for the design of green buildings is one of **sustainability** which is defined in the Brundtland Report (1987) as: "ensuring sustainable management of all resources used so that we will meet the needs of the present without compromising the ability of future generations to meet their own needs"

The following inter-related principles are intrinsic to the Green Building Code –

- Local appropriateness
- Conservation of the natural environment
- Resource efficiency
- Lifecycle approach
- Zero Waste
- Use of renewable resources
- Sustainable procurement
- Local production for local use
- Human health and wellbeing

The primary goal in the design and construction of buildings should be to create environments which support healthy environments for people. Natural ventilation, using open-able windows & doors should be encouraged and access to outdoor spaces for both work and leisure should be provided.

C. DETAILED CONSIDERATIONS IN THE DESIGN OF ENERGY EFFICIENT BUILDINGS

C1. ORIENTATION

The designer/s need to consider the local site environment and the orientation of the building from the outset to optimize energy efficiency. North/South façade orientation is generally considered to be the ideal orientation in the southern hemisphere. The East and West elevations are most prone to heat gain from the early morning/late afternoon sun which is at a low angle.

If the site has a view, the designers should capitalise on this but introduce the necessary solar shading devices to exclude the summer sun whilst allowing for the heating of the building by the winter sun.

C2. NATURAL VENTILATION

Another important consideration is the positioning of openings to encourage cross ventilation. The prevailing wind patterns need to be analysed and building designs need to indicate how these winds have been harnessed to allow for natural cross ventilation through the building both in plan and in section.

Passive stack ventilation can be exploited to assist in passive ventilation by allowing cool air to enter the building at a low level through adjustable louvers and to be extracted at a high level by natural means. This can take the form of "solar chimneys", or Venturi flues, which rely on the temperature differential between the indoors and outdoors to create a pressure differential. Alternatively roof turbines can also be used offering continuous ventilation with no operating costs.

The following design considerations will help to improve natural ventilation –

- narrow plan forms are better than deep ones
- shading the exterior of the building cools the air before it enters the building
- non-reflective exterior surfaces (planting) reduces air temperature around the building

C3. DAYLIGHTING

By maximizing the use of natural lighting (daylighting), a significant reduction in artificial lighting and, therefore, primary energy consumption can be achieved. This natural lighting needs to be tempered through the use of light shelves to create indirect light to cut off heat gain in the summer months. The light shelves, or louvers, should be designed to allow for the ingress of sun for the warming of spaces in winter and reduce the need for heating.

C4. WINDOWS

The energy efficiency of the building envelope is greatly impacted by the openings in the walls. Windows and doors should not compromise the main performance requirements selected for the walls in which they are placed. The thermal performance of windows depends not only on the glazing but also on the seals on the frames. Reducing solar heat gain through glass can be achieved by using toned (tinted) glass which absorbs a greater proportion of solar heat than clear glass. Spectrally selective glazing has a low-E coating which "filters" solar radiation, allowing maximum visible light transmission while reflecting unwanted UV. Low-E glazing is, therefore, required where shading of the glass is not possible.

However, glazing which is reflective is not considered appropriate for visual reasons.

After the glazing, frames have the greatest impact on the thermal performance of glazing units. The thermal performance of a glazing unit (excluding the glass) is dependent on 2 main factors; heat gain through material properties; and loss through air leakage and ill-fitting.

Aluminium frames are conductors and the potential heat flow disadvantages can all but be eliminated through better frame design and by the use of thermal breaks. Any aluminium frame used in the design, must be authorized by the Home Owners Association.

Timber frames are good insulators but the inclusion of rubber seals on all windows and selected doors is mandatory to reduce temperature loss.

uPVC & Steel windows are not acceptable for aesthetic, durability and conductivity reasons.

C5. SUN SHADING

In general it is best to block the sun before it reaches the windows.

North-facing elevations receive higher angle sun and, therefore, require narrower overhead shading devices to cut off the high summer sun but allow low winter sun. Fixed horizontal shading devices are an option on the north elevations if the roof overhang is not adequate.

East-facing elevations require shading of the sun which is at a low level and, therefore, adjustable shading devices are recommenced. Sliding screens, louvre screens, shutters and adjustable external blinds are recommended.

South-facing elevations do not require shading.

West-facing elevations present the biggest problem with solar heat gain. Adjustable shading is the optimum solution but fixed vertical louvers preventing the ingress of low afternoon sun in summer is also acceptable.

North-East & North-West elevations require an integrated approach as they receive both high & low-level sun at various times of day.

Interior shades are not as effective as exterior shades but light- coloured, reflective, blinds can reflect heat and offer the occupants a greater degree of control and flexibility than external devices and will be considered on merit.

Pergolas and balconies can also perform a shading function. Planting can also assist in shading. Deciduous plants allow winter sun through but exclude summer sun. Large trees can effectively be planted to shade vulnerable elevations. Creeper and vines can also provide insulation to external walls.

All facades which are vulnerable to summer solar penetration are to incorporate appropriate shading devices which exclude at least 80% of summer solar radiation. For details regarding the design of shading devices please consult item 4.3.5.1 of SANS 204: 2011 – Edition 1.

C6. LIGHTING

Responsible energy use is the principle to be adopted in the design of all buildings within the Hilcove Hills development. Apart from installing the correctly specified energy-efficient equipment it is also critical that building management systems be installed that automate the system as far as possible. The use of controls such as occupancy sensors, timers, and daylight harvesting systems are mandatory in reducing building energy consumption. Artificial lighting should only be used to supplement daylighting which should be maximized.

Task lighting must be installed, as opposed to general lighting. Fluorescent lighting in commercial buildings is not permitted. Modern lighting technologies such as compact fluorescent lamps (CFL"s) and light-emitting diodes (LED's) which have a much longer operating life span than incandescent lamps must be used. Another benefit is that these technologies run at much lower temperatures which reduces the heat load that needs to be cooled. CFL lamps must be used for internal, landscape, perimeter and general lighting. Where downlights are required internally, LED technology must be used. LED's must be used in passages, kitchens, bathrooms and bedrooms in all residential buildings.

Modern electronic control gears (ECG) and controllers enable lighting to be adjusted to add flexibility. For most interior lighting a colour rendering index (CRI) of 80 or more is a requirement as this approximates the colour of daylight.

All street lights are to be a LED Source luminaires.

Further savings can be achieved by using automatic sensing of daylight levels or occupancy sensors to avoid the wasteful use of electricity. Wall switch vacancy sensors are the most cost-effective solution and are to be installed in all new residential buildings with the Hilcove Hills development. In addition, plug control devices that do not allow electronic equipment such as television sets, hi-fi equipment, microwaves,etc, to be left on in stand-by mode, must be incorporated.

C7. THERMAL MASS

Thermal mass is, essentially, a mechanism for the storage and re-radiation of heat. Thermal mass is most appropriate in climates with large diurnal temperature differentials. In such climates, such as Pietermaritzburg, thermal mass can absorb heat during the day during winter and re-radiate this heat into the interior at night. This should be considered as a source of heat in the design of buildings particularly in winter. The western elevations of buildings could be used to capture heat from the sun during the day and radiate this heat into the building at night.

C8. INSULATION

Insulation is essential in keeping the building warm in winter & cool in summer. Climatic conditions will influence the level and type of insulation and there are more specifics outlined in the SANS 204 standards. In summer 50-75% of heat enters the building through the roof and windows and 15-25% through the walls. In winter the greatest heat loss is through the roof (25-35%) and a significant amount is lost through leakage.

To determine the appropriate insulation one should assess the "R-value" of the product – the higher the R-value the higher the level of insulation.

The National Building Regulations Part XA (SANS 10400XA) sets out the minimum requirements for material R-values used in the construction of buildings and must be adhered to.

General guidelines for the installation of insulation are as follows –

- avoid gaps in all types of insulation
- install vapor barriers where required
- ventilate the roof space to allow built up heat to dissipate

C8.1 Walls

In the sub-tropical coastal region of South Africa, which includes Pietermaritzburg, the indicative CR-product (C-value x R-value) for a wall in a residential building with a surface density greater than 180 kg/m2 is 60, which translates to a 2 skin brick wall with a 50mm cavity.

C8.2 Floors

Floors account for 10-20% of winter heat loss and, therefore, the thermal characteristics of flooring can be of crucial importance in residential buildings. The choice of flooring will, therefore, need to be made with the climatic conditions of the location taken into account.

In climatic zone 5, in which Pietermaritzburg is located, there is no specific requirement for floor insulation to be installed in terms of SANS 10400 XA. However, where an in-floor heating system is installed it is imperative that insulation is used. A minimum specification for the insulation is - 25mm thick High density Expandable polystyrene layer with tongue and groove or shiplap joints laid below and along the edges of the floor slab with a minimum R-value of 1.0.

The choice of the finish to the floor surface is at the discretion of the occupant/homeowner bearing in mind the principle that the embodied energy of the material should be as low as possible.

C8.3 Roofs and ceilings

Roofs and ceilings are a very significant element in the consideration of energy efficiency in buildings. Installing roof and ceiling insulation can save up to 45% on heating and cooling of any particular building. For the sub-tropical coastal region of South Africa the minimum total R-value (m2K/W) of 2.7 must be achieved.

For typical R-values for roof and ceiling construction refer to "Energy Saving Building Solutions" published by Buildaid publishing or SANS 10400 XA.

Insulation products must be installed and used as specified by the manufacturer, subject to the provisions listed in Part T of Section 3 of SANS 10400 and tested in accordance with SANS 13812 : Part 1 (Materials for thermal insulation of buildings).

C9. SPACE HEATING & COOLING

The following forms of space heating and cooling need to be considered –

- Heating, ventilation and air conditioning (HVAC)
- Heat pumps
- Fireplaces
- Under-floor heating

C9.1 HVAC

The demand for some form of air-conditioning in South African buildings, particularly commercial buildings, is inevitable. Reducing heating and cooling loads is the first step in maximizing HVAC system energy efficiency. Better utilization of daylighting, more efficient artificial lighting systems and office equipment, better window design and adequate roof insulation can significantly reduce cooling loads, and thus the cost of the equipment.

The proposed National Building Regulations (SANS 10400 XA) stipulates the minimum requirements for HVAC systems in terms of their co-efficient of performance.(items 4.6.2 to 4.6.9). These criteria are to be used in the design of HVAC systems within the Hilcove Hills development.

All buildings using air-conditioning or mechanical ventilation are to be designed to provide an alternative means of natural ventilation in the event of an equipment or power failure.

C9.2 Heat Pumps

Heat pumps use the reverse cycle of a refrigeration system to heat air or water. Water heating costs can be reduced by 60% with a heat pump water heater as opposed to a typical resistance-element geyser and can drastically cut electricity costs. Heat- pump water heaters are easy to install, are environmentally friendly and cost significantly less than solar heating in terms of the overall system need to be considered in all new buildings.

C9.3 Fireplaces

The proposed National Building Regulations, SANS 10400 on Space Heating Part V; provides procedures in evaluating the functional regulation in regard to the design and construction of any flue pipe, chimney, hearth or fireplace.

In terms of the choice of fireplace types closed combustion wood stoves provides 85% efficiency. In Europe these units are recognized as being environmentally friendly and are, therefore, allowed. Alternatively, gas fireplaces are also acceptable.

No anthracite or coal is to be used in fireplaces as they emit CO2 which contributes to global warming.

C9.4 Under-floor heating

Contrary to the misconception that under-floor heating is not economical, the latest systems are energy efficient and cost-effective to operate compared to a two-bar heater or an oil heater and are, therefore, encouraged.

C10. ENERGY

C10.1. Solar Energy

Solar energy is available free of charge to every building and South Africa has one of the highest incidents of solar radiation globally. This energy can heat our buildings, provide hot water and generate electricity using photovoltaic (PV) panels.

There are, essentially, 2 types of solar power –

• **Conventional** – these consist of solar water heaters which are differentiated by technology – either flat plate or vacuum tube. The choice of which system to adopt needs to be investigated by the building owner but whichever system is chosen needs to be SABS approved. Alternative water heating options such as heat pumps connecting to a traditional geyser which is the most cost-effective solution (see item 9.2).

Solar water heaters can save between 20%-40% of normal electricity use and pay for themselves in 3 to 5 years. Geyser blankets and insulating all hot water pipes can make further saving and should be used.

• **Photovoltaic** (PV) panels – this technology generates DC power and converts it into AC through the use of battery packs. There is an energy loss during the conversion & the system cannot run heavy power-drawing appliances such as microwaves, coffee machines or stoves. PV systems are expensive and have a far longer payback period and, therefore, are not mandatory in residential buildings.

For office buildings a PV system is excellent to provide power to equipment such as printers, photocopiers, switchboards, electric gates and low-voltage lighting and, as such, should be seriously considered.

The plumbing installation of a solar water heater is no different from a conventional geyser and SANS 10254 "code of practice" applies. Solar water heaters are regulated by the following standards –

SANS 10106:	Solar water heaters
SANS 1307:	Domestic Solar water heaters
SANS 204:	Energy efficiency in buildings

SANS 10400: Application of the National Building Regulations XA: Energy Usage in Buildings

The design of the solar panels should be integrated with the roof design of the building and will be a strong informant of the roof orientation and pitch. The solar panels should follow the same profile as the roof pitch of the building and the colours should blend in with the roof colour so as to be as visually unobtrusive as possible. No externally mounted geysers are allowed. All geysers are to be located in the building's roof void.

C10.2. Gas

Gas is one of the simplest and most viable alternative sources of energy available today. The spectrum of gas appliances for cooking, heating water, space heating and cooling covers almost every possible household need and is recommended. Most domestic LPG installations use a number of gas cylinders. LP gas is to be used for all cooking appliances. Any gas stored outside of the dwelling needs to be suitably screened from adjacent residences and public areas.

Gas water heaters have a competitive advantage over electrical geysers but it is important to ensure that the one chosen has been tested by an accredited Testing Laboratory and is compliant in terms of SANS 1539:2005 and is rated Type B in terms of this standard for installation indoors. Mini gas water heaters can be used economically in kitchen sinks and in showers.

SANS 10087-1 2008 covers "The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial and industrial installations".

C10.3 Geothermal energy

Although geothermal heat exchange system installations have become common in other parts of the world, it is still fairly new in South Africa.

The system consists of one or more ground source heat pumps to take heat from one location to another, together with a ground heat exchanger and a distribution subsystem. Most systems use air ducting for the distribution system, and high density polystyrene pipes underground for the heat exchanger. The system extracts energy from the ground and pumps it into the building where it is concentrated by a heat pump. When the building needs cooling, the heat from the building is concentrated by the heat pumps and the system pumps it back into the ground.

The lower energy and operating costs over the life of the system can offset the added initial investment over a period of 3 – 8 years and the system can successfully operate in buildings of all sizes.

The use of such a system is recommended but not mandatory.

C11. WATER

C11.1 Rainwater

Proper management and recycling of storm-water run-off places additional water at the homeowner's disposal and reduces reliance on Municipal water all of which saves costs and water.

Rain can be collected through downpipes with leaf traps that remove large debris. The water can go either to tanks underground where it can be siphoned into pumps for further filtering, or can be stored in surface tanks. Probiotics in the tank/s and a ceramic filter, of less than 0.2 micron, eliminate bacteria, chemicals & minerals. A tank capacity of 15000 litres will last 10 days at an average use of 1500l per day without rain. This system can provide water for washing, toilet flushing and irrigation.

If a surface tank is used without the filtering and treatment, the water can only be used for toilet flushing & irrigation. PVC tanks are allowed but must be screened from adjacent properties. Corrugated steel tanks can be visible, either expressed or painted to blend in with the overall house design at the discretion of the Design Review Panel.

C12. WATER-WISE FITTINGS

All plumbing installations should be chosen with water efficiency in mind. By simply using low-flow devices (taps, showerheads, cisterns) and water efficient appliances (washing machines, dishwashers) savings of up to 50% can be achieved.

C12.1 Showers

All showers must be fitted with low-flow showerheads to reduce the amount of water used during showering. Low-flow showerheads only work efficiently with a balanced pressure geyser.

C12.2 Taps

All indoor taps must be fitted with aerators which aerate the water which reduces the flow and thus the amount of water used. Metering taps, which deliver a pre-determined, limited quantity of water, should be used in commercial buildings and on outside taps and showers to prevent taps being left on.

C12.3 Toilets & urinals

In commercial buildings flush valves must be used for all toilets. Water-free urinals must also be installed. Grey water should be used to flush toilets where possible.

In domestic buildings dual-flush toilets must be installed as they use less water in the flushing process.

D. MATERIALS

The materials chosen for construction are an important element in the makeup of the building's Green credentials. Material selection should be based on the following parameters –

- materials should have a low-embodied energy, with construction materials to be sourced locally as far as possible
- construction materials are to have a recycled content where possible (roof insulation, for example)
- solid timber should be sourced from certified sustainable forests

Many materials such as low volatile organic compound paints and sealants, low global warming refridgerants and low-E glass are now seen as standard practice.

The following guidelines apply to the choice of specific materials –

D1. CEMENT AND CONCRETE

For every ton of cement that is produced almost the same amount of CO_2 is produced. New ECO cement, produced by AfriSam has a significantly lower carbon footprint than the worldwide average for cement, primarily through the substitution of clinker with mineral components. Lafarge has also developed a full range of extended, environmentally friendly cements in South Africa.

Concrete, of which the largest component is cement, has one of the lowest energy consumptions compared to other building materials for the same application and is considered to be one of the greener building materials.

For these reasons the use of "Eco" cement and concrete should be seriously considered in large commercial developments within the Hilcove Hills development.

D2. CLAY BRICKS

Durability is a key criterion of a truly sustainable green building material. Whilst a product might have a high embodied energy (the amount of energy used in it's production), it may also have a higher lifecycle. Maintenance costs are also a factor.

A clay brick house affords the lowest life cycle cost compared to either a light steel frame structure or a timber structure and, therefore, this form of construction is recommended for residential buildings. Clay bricks should be used on the external skin of all domestic buildings with the inner skin possibly comprising concrete blocks if costs are a factor.

D3. RAMMED EARTH CONSTRUCTION

Rammed earth construction can be used in parts of domestic buildings if there is surplus material on site after earthworks have been undertaken. It is imperative that any rammed earth walls are designed with input from a Structural Engineer. The method consists of a wet, or damp, mixture of earth (soil), sand, clay and gravel with cement or lime added. The mixture is poured into a shutter and rammed down in layers.

The advantage of rammed earth construction in residential buildings is that –

- it is a method using green building materials resulting in a building with a very low carbon footprint
- rammed earth walls offer high levels of thermal mass and humidity control which reduces heating and cooling costs
- buildings can be constructed quickly and relatively inexpensively if there are locally available resources
- only basic skills are required and it can contribute to local job creation

A Structural Engineer is needed to ensure that the correct compressive strength is achieved as per the NHBRC's minimum requirements.

D4. ASPHALT ROADS

Road construction costs can be reduced by using recycled asphalt. Warm-mix asphalt (WMA) technology can reduce the carbon footprint of the asphalt production process by reducing the mixing and placing temperature of the asphalt. In so doing less energy is used and fewer emissions generated. In addition recycled building rubble can be specified for the layer works on new roads.

D5. PERMEABLE PAVING

Permeable paving allows storm-water to sink through the surface layer into a porous base. The depth of the structural layers depends on the expected traffic loading and on the strength of the underlying soil.

Permeable paving has major advantages over traditional paving, or asphalt roads as –

- it relieves pressure on existing storm-water infrastructure, rivers and dams by allowing water to seep back into the ground thus replenishing the groundwater table
- storm-water can be harvested and stored underground for future use as a grey water source for landscape irrigation.
- there are economical benefits - traditional storm-water drainage systems can be reduced or omitted entirely

- roads can be built level and will remain dry.
- heavy metals, and other pollutants, are removed from the rainwater as it filters through the gravel mix and the geo-synthetic membrane before it is stored in the sub-base

It is compulsory to use permeable paving for driveways within the Hilcove Hills development.

D6. TIMBER

Wood has a smaller carbon footprint than other materials used to construct windows and doors making it an ideal green option. It takes 4 times the amount of energy to make an equivalent uPVC window, 6 times the amount of energy to make an equivalent aluminium window and 11 times the amount of energy to make an equivalent steel window.

Wood also has a 50 year life cycle and can also be recycled which is an added benefit.

Wood should be chosen with reference to the Forest Stewardship Council (FSC) list of well-managed forests that have met the FSC's high social and environmental standards. FSC approved forests are forests which are specifically managed to ensure that timber harvested is replaced with newly planted material to ensure the continuity of the source material.

Ordinary local treated SA pine and FSC-certified hardwoods such as Jarrah and Tasmanian Oak which are grown specifically for harvesting are recommended options.

Sustainable alternatives for flooring, decks and other applications such as – cork, "Resysta", "X-board, bamboo and coir could be considered.

E. FINISHES

E1. CARPETS

Only carpets which do not use Volatile Organic Compounds (VOC) may be specified. These are widely used in South Africa at present.

E2. PAINT & VARNISH

The carbon footprint of paint can be reduced using water-based products where the Volatile Organic Compounds have been reduced. All paints used must also have reduced levels of glycol and solvents as well as being lead free. Plant-based oils or water-based sealants must be used to treat timber. However, If varnish is used it must have a VOC rating of less than 75g/l.

F. WASTE MANAGEMENT

During the construction phase of the project the property owners are to ensure that all waste generated on site is disposed of at an appropriate and registered landfill site. All recyclable materials – glass, tins, paper and plastics – must be taken to appropriate recycling centres.

G. LANDSCAPING

G1. SITE CLEARANCE & CONSTRUCTION

Topsoil is the most important component of soil as it is the portion which is rich in organic materials and seed stock. In order to limit the loss of topsoil during construction, every construction site should have a soil erosion control plan in place.

Topsoil loss occurs when plants have been removed in order to build and soil is washed away by rain or blown away by wind. Erosion control measures including temporary planting, mulching or earth dykes should be implemented during the building's construction phase. Alternatively if the site requires excavating or grading the topsoil should be removed, stockpiled & saved for later use.

Heavy earth moving equipment and other vehicles are primary causes of soil compaction on a construction site. If soil becomes too compacted water is unable to penetrate the surface causing faster run-off during rains causing erosion. In order to prevent soil compaction wooden planks or mulching should be placed in areas which vehicles use.

G2. WATER-WISE LANDSCAPING

Indigenous plant material will be used in the public areas of the development to reduce water consumption. Large areas of lawn that require continual watering must be avoided. *Cynodon Dactylon* or indigenous Buffalo grass must be used where grass is required but natural grassland species are recommended as an alternative to manicured lawns.

Water saving irrigation systems such as bubblers and drip irrigation should be used to reduce evaporation by focusing water where it is needed. Irrigation timers should be used to ensure that watering only occurs in the early evening.

A list of permissible plant types to be used on individual sites will be included in the Architectural Design Code for Hilcove Hills.
A Landscape Architect will prepare a landscaping plan for all public areas with input from the Civil Engineers to determine the positions of retention ponds on individual sites.

H. REFERENCE DOCUMENTS

H1. PUBLICATIONS

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" Energy Saving Building Solutions"	- Buildaid Publishing.
" Green Cement"	- Urban Green File. April 2011.
" Solar water-heater Shoot-out"	- Urban Green File. Feb 2010.
" Flood reduction made easy"	- Urban Green File. Dec 2007.
" Rammed Earth – Ancient yet Modern"	- Earthworks Oct/Nov 2011.
" A Reversal of supply"	- Earthworks Oct/Nov 2011.
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" Drive on it – again!"	- SUSTAIN 2009.
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" Iconic. Empowering. Sustainable"	- Earthworks. Apr/May 2011.
" 9 green principles@ the Energy Works"	- Urban Green File. Feb 2009.
" The source beneath..."	- Earthworks. 3/2011.
" More than its parts"	- Earthworks. 3/2001.
" Wasted resource recovery"	- Urban Green File. Dec 2010.

H2. STANDARDS

SANS 204	- available from the South African Bureau of Standards
SANS 10400-XA	- available from the South African Bureau of Standards
Institute of Zero Waste in Africa(IZWA)	- zerowaste@iafrica.com

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