

# **Sustainable Development Criteria for Built Environment Projects in South Africa (CSIR)**

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## **1 Introduction**

South Africa faces a range of social, economic and environmental challenges. HIV/AIDS has resulted in life expectancy dropping from 52 years in 1997 to 43 years in 2007 (Harrison 2009). Unemployment is estimated to be 23.5% and about 6.7 million people in South Africa are functionally illiterate (Presidency 2009, DoE 2009). Climate change is likely to make this situation worse and will lead to increasing water stress, reduced food security and loss of species and ecosystems (DEAT 2009).

Sustainable development, which aims to achieve social and economic improvement while reducing, or avoiding, negative environmental impacts can be used to address these challenges. However sustainable development is difficult to achieve. It requires a holistic and integrated approach and the development sector and in particular, the construction industry, tends to operate in a highly fragmented way. The application of sustainable development is also not well understood and has not been adequately translated into practical actions that can be implemented.

This paper is based on work undertaken for the Gauteng Department of Agriculture and

Rural Development (GDARD) developing a set of sustainable development criteria for built environment projects requiring environmental impact assessments. (Gibberd 2010). Some aspects therefore refer specifically to Gauteng-based policy, although the general principals of the work are applicable to other areas of South Africa. The paper provides a definition of sustainable development and shows how this can be translated into objectives and criteria which can be used to guide the development of more sustainable built environment projects.

## **2 The environmental context**

Increasing carbon emissions from human activities and a reduction in the ability of the natural environment to absorb carbon dioxide is leading to an accumulation of greenhouse gases in the upper atmosphere. These gases trap more heat in the upper atmosphere leading to global warming. As a result, temperatures are predicted to increase by 2 - 6°C OC by the end of the century (IPCC, 2007). Estimates carried out for the City of Joburg indicate that temperatures in the next 50 years may increase between 2 and 3.5°C (Hewitson, Engelbrecht, Tadross, Jack, 2005).

Within Africa, South Africa produces the highest CO<sub>2</sub> emissions and has one of the highest CO<sub>2</sub> emissions per GDP in the world.

In 2002, carbon emissions per capita in South Africa were 8.4tonnes/capita - higher than Western European averages of 7.9 tonnes/capita (SEA 2006).

Global warming is likely to impact Africa particularly negatively. The National Climate Change Response Policy developed by the Department of Environment and Tourism outlines the following impacts (DEAT 2009a):

- Agricultural production and food security in many African countries are likely to be severely compromised by climate change and variability. Projected yields in some countries may be reduced by as much as 50% in some countries by 2020 and as much as 100% by 2100. Small scale farmers will be most severely affected.
- Existing water stresses will be aggravated. About 25% of Africa's population (about 200million people) currently experience high water stress. This is projected to increase to between 75-250 million by 2020 and 350-600 million by 2050.
- Changes in ecosystems are already being detected and the proportion of arid and semi-arid lands in Africa is likely to increase by 5-8% by 2080. It is projected that between 25 and 40% of mammal species in national parks in sub-Saharan Africa will become endangered.
- Projected sea-level rises will have implications for human health and the physical vulnerability of coastal cities. The cost of adaptation to sea level rise could amount to 5-10% of

gross domestic product.

- Human health will be negatively affected by climate change and vulnerability and incidences of Malaria, Dengue fever, Meningitis and Cholera may increase.

### **3 The contribution of the built environment**

Construction and the built environment make a substantial contribution to global warming and play a significant role in most economies. Environmental, social and economic impacts attributed to the built environment at a global scale are outlined below.

- Consumes 40% of energy use,
- Consumes 17% of fresh water use,
- Consumes 25% of wood harvested,
- Consumes 40% of material use
- Employs 10% of the world's work force
- Construction is the largest employer of micro-firms (less than 10 people)
- Buildings are typically located on the most productive land (Estimated to be 250 million hectares world wide, mostly on primary agricultural land)

In South Africa the built environment is directly responsible, through electricity consumption, for over 23% of South Africa's carbon emissions (see table below). Vehicle-based infrastructure and transport planning has resulted in transport contributing to 16% of South Africa's CO<sub>2</sub> emissions and an additional 18mt CO<sub>2</sub> per year, or about 4% of South Africa's CO<sub>2</sub> emissions, come from the manufacture of building materials (CIDB 2009).

Sector	CO <sub>2</sub> Emissions
Commercial	10%
Residential	13%
Transport	16%
Industry	40%
Mining	11%
Other	10%
Total	100%

Figure 1: South African carbon emissions per sector

#### 4 Defining sustainability

Recent work by the World Wildlife Fund contributes substantially to defining sustainable development by providing quantified minimum criteria for sustainability. In the 2006 Living

Planet Report, sustainability is defined as achieving an Ecological Footprint (EF) of less than 1.8 global hectares per person and an Human Development Index (HDI) value of above 0.8 (WWF 2006). This is shown by the shaded rectangle in the graph below.

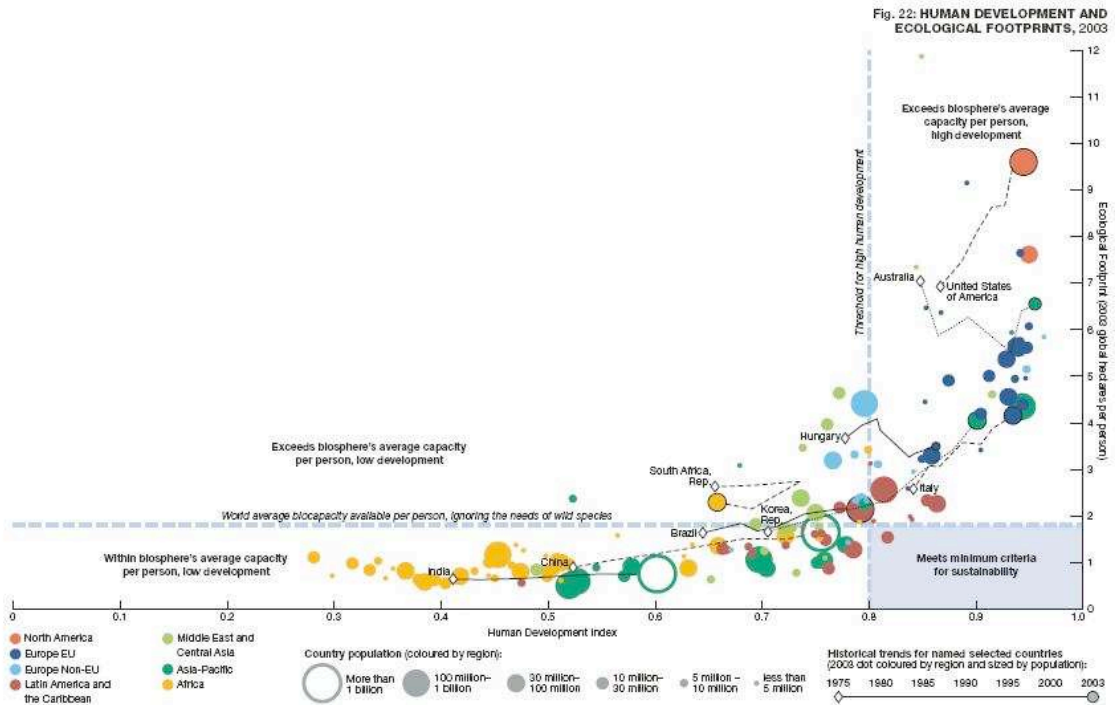


Figure 1. Human Development and Ecological Footprint (WWF 2006)

## Ecological Footprint

An Ecological Footprint is an estimate of the amount of biologically productive land and sea required to provide the resources a human population consumes and absorb the corresponding waste. These estimates are based on consumption of resources and production of waste and emissions in the following areas:

- Food, measured in type and amount of food consumed
- Shelter, measured in size, utilization and energy consumption
- Mobility, measured in type of transport used and distances traveled
- Goods, measured in type and quantity consumed
- Services, measured in type and quantity consumed

The area of biologically productive land and sea for each of these areas is calculated in global hectares (gha) and then added together to provide an overall ecological footprint. This measure is particularly useful as it enables the impact of infrastructure and lifestyles to be measured in relation to the earth's carrying capacity of 1.8 global hectares (gha) per person.

## The Human Development Index

The Human Development Index was developed as an alternative to economic progress indicators and aimed to provide a broader measure that defined human development as a process of enlarging people's choices and enhancing human capabilities (United Nations Development Programme 2007). The measure is based on:

- A long healthy life, measured by life expectancy at birth
- Knowledge, measured by the adult literacy rate and combined primary, secondary, and tertiary gross enrolment ratio
- A decent standard of living, as measure by the GDP per capita in purchasing power parity (PPP) in terms of US dollars

### South African EF and HDI figures

The figures below show that South Africa has an ecological footprint of 2.1, above the maximum required of 1.8 gha and a human development index measure of 0.66, below the minimum of 0.8 required for sustainability.

Measure	South Africa	Sustainability Target
Ecological Footprint (gha)	2.1	1.8
Human Development Index	0.658	0.8

For South Africa to move towards sustainability there must therefore be an improvement in both the Ecological Footprint and Human Development Index performance.

## 5 The legislative and policy context

South Africa has legislation and policy that aims to protect the environment and support sustainable development. Examples include the South African Constitution and the National Environmental Management Act (NEMA) which are discussed briefly below.

### South African Constitution

The South African Constitution contains a Bill of Rights that enshrines the rights of all people in South African and affirms the democratic values of human dignity, equality and freedom. The Bill has sections covering equality, human dignity, privacy, freedom of religion belief and opinion, environment, property, housing, healthcare, food, water and social security, children, education, language and culture. Through a section on equality, the Bill requires that all people have full and equal enjoyment of these rights and freedoms:

Everyone is equal before the law and has the right to equal protection and benefit of the law.

Equality includes the full and equal enjoyment of all rights and freedoms. To promote the achievement of equality, legislative and other measures designed to protect or advance persons, or categories of persons, disadvantaged by unfair discrimination may be taken.

Environmental rights in the Bill of Rights include the right to an environment that supports health and well being. It also requires legislation to be developed to ensure that the environment

is protected and that development that does occur is both sustainable, and justifiable:

### 24. Environment

*Everyone has the right*

- a. *to an environment that is not harmful to their health or well-being; and*
- b. *to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that*
  - i. *prevent pollution and ecological degradation;*
  - ii. *promote conservation; and*
  - iii. *secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development*

Sustainable development and the protection of the environment is therefore a constitutional obligation, and government and society must ensure that this is fulfilled through 'reasonable legislative and other measures'.

Section 24 also refers to a requirement to 'secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development'. Within the context of the Bill of Rights, justifiable economic and social development can be interpreted to define development that promotes the achievement of other rights in the Constitution such as the equality, housing, healthcare, food, water and education. Within this paper this interpretation is used to suggest that development that helps to fulfill

<sup>1</sup>[http://www.footprintnetwork.org/en/index.php/GFN/page/world\\_footprint/](http://www.footprintnetwork.org/en/index.php/GFN/page/world_footprint/)

<sup>2</sup>Human Development Report 2006, United Nations Development Programme

<sup>3</sup>Section 9 of the South African Constitution

constitutional obligations should be prioritized over development that does not.

## The National Environmental and Management Act

The National Environment and Management Act include a set of principles that specifically address sustainable development and environmental management (DEAT1998):

*(2) Environmental management must place people and their needs at the forefront of its concern, and serve their physical, psychological, developmental, cultural and social interests equitably.*

*(3) Development must be socially, environmentally and economically sustainable.*

(4) (a) Sustainable development requires the consideration of all relevant factors including the following:

- (i) That the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied;
- (ii) that pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimised and remedied;
- (iii) that the disturbance of landscapes and sites that constitute the nation's cultural heritage is avoided, or where it cannot be altogether avoided, is minimised and remedied;

- (iv) that waste is avoided, or where it cannot be altogether avoided, minimised and re-used or recycled where possible and otherwise disposed of in a responsible manner;
- (v) that the use and exploitation of non-renewable natural resources is responsible and equitable, and takes into account the consequences of the depletion of the resource;
- (vi) that the development, use and exploitation of renewable resources and the ecosystems of which they are part do not exceed the level beyond which their integrity is jeopardised;
- (vii) that a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions; and
- (viii) that negative impacts on the environment and on people's environmental rights be anticipated and prevented, and where they cannot be altogether prevented, are minimised and remedied.

This Act makes it very clear that there is a requirement for projects to be 'socially, environmentally and economically sustainable'. However it does not provide much further detail on what this entails. This makes it both difficult to interpret, and to enforce.

The sustainable development criteria listed later in this paper are an attempt to describe this requirement in the form of a set of criteria that can be used by both government and the private sector to guide the integration of

sustainable development into built environment projects.

## 6 Carbon emission mitigation strategies

South Africa is a signatory to both the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. In order to address UNFCCC commitments the Long Term Mitigation Scenarios (LTMS) process was initiated in 2006 and completed in 2008. This formulated strategies to ensure that South Africa would reduce carbon emissions. Many of the mitigation strategies identified have implications for the built environment and a number of these are outlined below (DEAT 2009b):

- Limits on less efficient vehicles
- Passenger modal shift
- Solar water heater subsidy
- Commercial efficiency
- Residential efficiency
- Renewables with learning
- Waste management
- Land use: afforestation
- Escalating CO<sub>2</sub> tax

Following the LTMS process, key policy approaches were agreed on by the South African cabinet. These strengthen current energy efficiency and demand-side management initiatives such as environmental fiscal reform and carbon taxation. These will penalize energy inefficient technology and provide for additional tax allowances of up to 15% for energy efficient equipment.

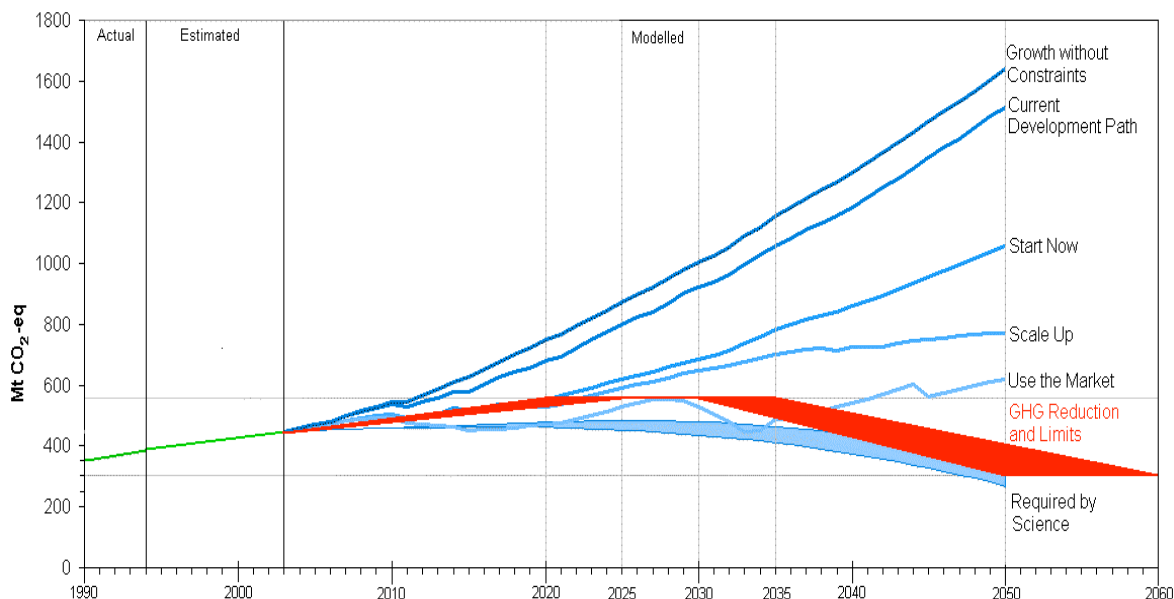


Figure 2. Strategic options to get from 'Growth without Constraints' to 'Required by Science' (DEAT 2007).

The LTMS showed that although significant emission reductions can be gained through technology-based actions, these are not sufficient for the scale of change required to achieve the 'Required by Science' trajectory shown in the graph above.

Adaptations in social behavior were therefore also explored and the LTMS proposes a number of people and building orientated measures that achieve low-cost, large scale mitigation impacts (DEAT 2009c). These include:

- Social adaptation and changes in human habitation, urban planning and the built environmental
- Changes in the distance between work, home and other life functions
- Modal shifts to public transport and moves away from individual car owners towards the operation of shared vehicles
- Changes in food production and consumption and the localization of these activities.

The LTMS is valuable because it provides direction for the future development of the built environment. By presenting the scale of the problem, it communicates the necessity for immediate change and the requirement for a paradigm shift in the way we design and manage the built environment. It also demonstrates that technological interventions are not sufficient.

## 7 Built environment sustainable development objectives and criteria

The environmental context, legislation and scenario modelling indicate that it is essential that the built environment support sustainable development. Supporting sustainable development in the built environment will require measures that can be easily understood, and implemented.

This section of the paper proposes a set of sustainable development objectives for the built environment. These objectives aim to ensure that the built environment supports sustainable development as defined earlier in the paper. Linked to each of these objectives are criteria which list key measures which, if implemented, will support the achievement of the overarching sustainable development objective.

## 8 Land Use and Integrated Development

**Objective:** Development should be integrated with existing and planned infrastructure and land uses to ensure efficient systems and balanced use of land.

### Criteria

- **Spatial Development Frameworks:** Proposed development can demonstrate it is aligned with Spatial Development Frameworks.
- **Environmental Management Frameworks:** Proposed development can demonstrate that it is aligned with



- relevant Environmental Management Frameworks.
- **City Development Strategies:** Proposed development demonstrates it aligns with relevant city development strategies.
- **Urban development boundary:** Proposed development can demonstrate that it is within the urban development boundary.
- **Existing and planned infrastructure:** Proposed development can demonstrate it will be integrated into and use existing or planned infrastructure such as roads, storm water and sewage systems and water and energy supplies. Studies have been carried out to demonstrate there is adequate capacity in these systems and proof that the Local Authority accepts these findings.
- **Public transport networks:** Proposed development demonstrates access to the site can be easily achieved through existing or proposed public transport systems (see also TR, Transport and Routes).
- **Complementary social and economic land uses:** Development demonstrates that it will complement local land uses.
- **Building density:** Development demonstrates that it will exceed the minimum building density requirements of relevant local policy and planning schemes.
- **Open space:** The nature and type of open space provision in the development is aligned with local planning, policy and bylaws. Development includes the following minimum open space provision.

Type of development	Open space provision
Subsidy housing	20% of site area
Other Residential	20% of site area
Business	20% of site area
Industrial	20% of site area
Where open space provision is specified by local municipalities these can be aligned with in preference to the above requirements.	

## 9 Biodiversity

**Objective:** Development should be located where damage to natural environments and ecosystems is minimised. It should ensure that existing natural environments are preserved and take opportunities to strengthen this.

### Criteria

- **Sensitive areas:** Proposed development demonstrates that it does not include any areas that could be defined as sensitive. If the development does include areas that may be defined as sensitive, the project demonstrates full compliance with all requirements of the

GDACE Requirements for Biodiversity Assessments (GDACE 2008).

- **Development on ridges:** Proposed development demonstrates that no development will occur on ridges. If the proposed development does occur on a ridge, the development will indicate classification of affected ridge and demonstrate that conditions in Departmental Policy Development Guidelines for Ridges will be achieved (GDACE 2001).
- **Greenfield sites:** Proposed development can demonstrate that the site that will be used is not a green field site and does not provide valuable ecosystem services. The site proposed has been previously built on or is already extensively disturbed. Where part of a proposed site is in a green field condition the proposed development retains and protects this within the proposed development.
- **Site clearing:** Design and contract documentation indicating the following considerations:
  - **Site clearing:** Large-scale clearing of the site is avoided and the area disturbed by development is minimized.
  - **Mature trees and natural features:** Mature trees and natural features such as large rocks or outcrops are retained (see also MC Materials and Construction for protection measures). Exceptions to this are trees which are invasive

species and trees which are incompatible with the relevant town planning scheme.

- **Existing vegetation:** Where existing indigenous vegetation is to be cleared and is of an appropriate quality, plants should be rescued and replanted, or propagated and replaced.
- **Locally indigenous planting:** Planting scheme including locally indigenous plants proposed for the development. This demonstrates how local biodiversity and the creation of habitats will be supported.

## 10 Agriculture and Landscaping

**Objective:** Development should not lead to a loss of agricultural land. Appropriate agriculture and landscaping should be integrated in developments to improve the provision of local fresh food and ecosystem services.

- **Retention of agricultural land:** Development should avoid sites with high agricultural potential and ensure that this land is retained for farming. The proposed development does not encroach on land identified by The Gauteng Agricultural Potential Atlas (GAPA) as land with high agricultural potential. Exceptions to this include land within the Urban Edge that has high development potential such as land located in a development node. Development nodes are defined in local Spatial Development Frameworks (SDFs).

- **Environmental impacts of agriculture:** Management plan that ensures that negative environmental impacts of agriculture are minimized. This may include plans to manage and monitor agricultural inputs, such as fertilizer, herbicides and pesticides, in order to minimize negative environmental impacts. The use of organic and labour intensive farming methods.
- **Degraded or contaminated sites:** The proposed development is located on a degraded or contaminated site. Proposed remediation and improvement processes are outlined.
- **Planting:** The proposed development demonstrates how planting will be effectively integrated into the site. Planting will be determined by local circumstances, however the following guideline provision is proposed.

Type of development	Planting provision
Subsidy housing	Minimum of 1 indigenous or fruit tree per unit
Other Residential	Minimum of 1 indigenous or fruit tree per unit
Business	Minimum of 1 indigenous or fruit tree per 200m <sup>2</sup> of gross floor area
Industrial	Minimum of 1 indigenous or fruit tree per 300m <sup>2</sup> of gross floor area
Other planting instead of trees also meet this criteria if they are deemed to be equivalent alternatives. Equivalent alternatives to the provision to 1 tree are: 5 m <sup>2</sup> (area) of indigenous grasses, shrubs, or other plants or 5m <sup>2</sup> of food gardens.	

- **Green roofs:** Proposed development demonstrates that the vegetation lost through development, or a substantial portion of this (over 40%) will be replaced in the form of green roofs.
- **Hard external surfaces:** Large areas (over 500m<sup>2</sup>) of impermeable external hard surfaces are avoided. This does not apply to strips of hard external surfaces (less than 15m in width) such as those used for roads and paths.
- **Environmental impacts of landscaping:** Management plan that ensures that negative environmental impacts of landscape maintenance are minimized. This may include plans to use landscaping that has minimal irrigation requirements, and to manage and monitor landscape inputs such as fertilizer, herbicides and pesticides in order to minimize negative environmental impacts. It may also include the use of organic and labour intensive methods.

## 11 Water, Sewage and Storm Water Runoff

**Objective:** Development should minimise the consumption of municipal potable water and the disposal of sewage into municipal systems. Increased storm water runoff and water pollution should also be avoided.

### Criteria

- **Water efficient fittings:** Efficient water fittings should be used in new

development to avoid wasting potable water.

- Shower heads have a maximum flow rate of 10L/minute
- Wash-handbasins taps have a maximum flow rate of 6L/minute
- Toilets are not water based or are dual flush and do not exceed 3L (1/2 flush) and 6L

(full flush)

- Waterless urinals are used or these have a maximum flush of 2L/flush.
- **Rainwater harvesting:** Development demonstrates how it will use rainwater harvesting to reduce mains potable water consumption and include the following minimum provision. Where possible this capacity should be increased.

Type of development	Minimum rainwater harvesting capacity
Subsidy housing	40L/m <sup>2</sup> of gross floor area
Other Residential	40L/m <sup>2</sup> of gross floor area
Business	20L/m <sup>2</sup> of gross floor area
Industrial	10L/m <sup>2</sup> of gross floor area
The above capacity can be provided individually (per building) or collectively in larger storage facilities such as large underground tanks.	

- **Grey water:** Eighty per cent of wash hand basins and showers are linked to grey water systems.
- **Sewage:** Water efficient fittings (see above) are installed to reduce production of sewage. Where there is adequate space the proposed development uses ecological local sewage treatment plants that ensure that sewage can be treated locally and provides useful outputs such as fertilizer. Plan to show how treated effluent will not cause negative environmental impacts. This criterion can be deemed 'not applicable' if confirmation from the local authority has been provided stating that it will not accept onsite ecological sewage treatment plants.
- **Storm water runoff management:** Sustainable urban

drainage systems (SUDS) including swales, filter strips, retention ponds, infiltration trenches, green roofs and permeable paving are used to avoid polluting storm water runoff and control storm water runoff from site. Calculations and or modeling to show how SUDS will function to reduce peak flows, ensure onsite retention and avoid water pollution. This should include data such as climatic information, infiltration potential of surfaces, capacity of rainwater harvesting systems as well quantitative performance of SUDS components such as attenuation ponds and swales. requirements are specified. Exotic plants with high water requirements are avoided.

- **Low water requirement planting:** Locally indigenous plants with low

water requirements are specified. Exotic plants with high water requirements are avoided.

- **Irrigation water:** Efficient irrigation system linked to controls which ensure irrigation does not occur when it is not needed and irrigation occurs when evaporation losses are lowest. As far as possible, water for irrigation is sourced from grey water or rainwater harvesting systems. This criterion does not apply to agricultural irrigation.

## 12 Materials and Construction

**Objective:** Development should minimise the negative environmental impacts of construction and the consumption of resources. Positive social and economic impacts of construction and resource use should be maximised.

### Criteria

- **Sourcing of building materials:** Procurement policy requiring twenty per cent of materials (such as bricks, sand and cement) by weight used in construction to be sourced within 400km from site.
- **Sourcing of components and equipment:** Procurement policy requiring twenty per cent of equipment and components (such as electrical, mechanical and wet services materials and equipment and components such as doors and windows) by value to be sourced from within 400km of site.
- **Local jobs:** Procurement

policy that requires eighty per cent of construction workers to be sourced within 50km of site.

- **Labour intensive construction:** Design and construction strategies support the use of labour intensive approaches. Targets in terms of person years of construction work created per million rand construction spent should be provided showing how these compare favourably with best practice benchmarks. Best practice benchmarks can be obtained from organisations such as the Development Bank of South Africa and the Department of Public Works (Expanded Public Works Programme). Compliance with the Construction Industry Development Board (CIDB)'s labour intensive construction guides including 'Labour-based methods and technologies for employment intensive construction works' and 'Implementing labour intensive road works' (CIDB 2005, CIDB 2007).
- **SMME support:** Procurement policy supports the use of small and medium enterprises based within 50km of site. Compliance with the CIDB's guide for small and medium enterprises and contracting '3 R's basic guide for SMMEs' (CIDB 2003).
- **HIV / AIDs:** Construction planning and contract documentation for the development comply with the 'Specification for HIV/AIDs awareness' (CIDB 2003a).

- **Material selection:** Design specifications and contract documents reflect the following material selection considerations.
  - **Embodied energy:** Preference is given to materials that have consumed the least amount of energy in their sourcing, manufacturing and transportation.
  - **Reused materials:** Reused materials such as materials from the demolition of buildings, including crushed aggregate is used in new construction.
  - **Recycled content:** Preference is given to materials that have recycled content over those that do not.
  - **Renewable sources:** Checks and accreditation is in place to ensure that materials specified, such as timber, are from renewable sources. For instance, timber with Forest Stewardship Council (FSC) certification comes from forests where trees are replanted.
  - **Grown materials:** Where possible, renewable grown materials such as timber, thatch, wool and cork are used in construction.
  - **Insulation:** Insulation that contains refrigerants or uses refrigerants in its manufacturing process is avoided.
- **PVC:** The use of PVC based materials and components is avoided or minimised.
- **Construction waste:** A requirement for at least thirty per cent of all construction waste to be recycled or reused is included in contractual documentation.
- **Soil retention:** Construction and contract documentation indicating the following considerations:
  - **Movement of earth:** Large-scale cut and fill operation and movement of earth is avoided.
  - **Soil erosion:** Soil erosion and sediment control plan for construction works which indicate measures such as mulching, seeding, vegetative filter strips, gabions and retention ponds to prevent soil erosion.
  - **Retention of topsoil:** Where top soil is removed this is reused on site and not transported elsewhere.
- **Protection of vegetation and natural features:** Construction and contract documentation provide for protection measures such as buffers, fencing and signage around trees, vegetation and natural features being retained on site.

### 13 Energy, Mechanical and Electrical Systems

**Objective:** Development should minimise the use of non-renewable energy and maximise use of renewable energy sources.

#### Criteria

- **Urban heat island:** Roof and external hard surfaces have absorptance value of less than 0.5. For further information see 'SANS 204, Energy Efficiency in Buildings' standard' (SABS 2009).
- **Urban heat island:** Large areas of car parking or hard external surfaces (over 500m<sup>2</sup>) should be avoided. If these cannot be avoided, a minimum of 20% of the area should be shaded, preferably by trees.
- **Site layout:** Site layouts and modeling demonstrate that buildings have good access to fresh air, views and daylight. A minimum of 4m of clear external space (vegetation and open fencing can be located in this area but not solid walls or other buildings) immediately in front of windows in useable spaces should be provided. This does not apply to rooms not occupied on a continuous basis such as storerooms and toilets.
- **Orientation:** The long section of buildings should be orientated to +/- 15 degrees North and the extent of the façade facing north should be maximized while the length of façade facing east and west should be minimised.
- **Built form:** Building plan depths should not exceed 15m, unless buildings have substantial atria or their particular function ie a cinema, requires this.
- **Glazing:** Solar shading and glazing designed to comply with 'SANS 204 Energy Efficiency in Buildings' standard (SABS 2009).
- **Thermal insulation:** Insulation values of all elements of the building envelope (roof, wall and floors) meet 'SANS 204 Energy Efficiency in Buildings' standard (SABS 2009).
- **Natural ventilation:** Opening area in building envelope (such as opening windows) equivalent to a minimum of 5% of useable area.
- **Daylight:** Daylight modeling showing that eighty per cent of useable area within buildings has a 2% or higher daylight factor. A deemed to satisfy condition for this can be achieved where eight per cent of the useable area can be shown to be within 2h of an external window, where h is the height of the head of the external window.
- **Passive environmental control:** Proposed buildings demonstrate use of passive environmental control strategies to reduce energy consumption.
- **Water heating:** Water heating is achieved through solar water heaters or other energy efficient means of heating water provided.
- **Electrical lighting:** Internal electrical lighting power densities in the development comply with 'SANS 204, Energy Efficiency

in Buildings' standard

- **Electrical lighting:** Lighting controls such as motion sensors, timers and daylight switching are used to ensure lighting is only on when needed.
- **Swimming and ornamental pools:** Avoidance of swimming or ornamental pools, unless these have no energy demands or these are met from renewable energy sources.
- **Energy consumption and peak demand:** Proposed development confirms that it will comply with 'SANS 204 Standard on Energy Efficiency in Buildings' standard and achieve energy consumption and peak demand targets.
- **Renewable energy:** New development demonstrates that 10% of its energy requirements will be met from onsite renewable sources. Where possible this capacity should be increased.

## 14 Waste and Pollution

Objective: New developments should minimise the amount of waste diverted to land fill. Pollution should also be avoided.

### Criteria

- **Recycling provision:** Provision for waste recycling made in the new development including recycling space of sufficient size and appropriately located for ease of use by occupants and recyclers.
- **Organic waste:** Where possible, development proposals demonstrate

how organic waste produced on site, is recycled on site.

- **Recycling plans:** Recycling plan which sets out waste minimization, reuse and recycling targets and describes strategies and systems that will be used to achieve these including local recycling partners.
- **External lighting:** Low level lighting and light fittings with hoods are used to avoid light pollution. In addition controls such as timers and movement sensors are used to ensure lighting is only on when needed.

## 15 Local Economic Development

**Objective:** Development should support diverse productive local economies that create work and sustainable enterprises.

### Criteria

- **Small enterprise development:** The proposed development demonstrates that it will support existing or new small or micro enterprises
- **Job creation:** The proposed development demonstrates that it will support a labour intensive approach and shows how employment created will be in line with local best practice.

## 16 Transport and Routes

Objective: Development should reduce the reliance on cars and ensure that energy efficient, environmentally friendly forms of transport are encouraged.



**Criteria**

- **Public transport:** Development demonstrates that people who work or live in the development are located within 1,200 m of scheduled public transport (bus or train). Where public transport is not available, a green transport plan is developed which demonstrates how car usage will be avoided and energy efficient transportation used. This could include agreements with local minibus or bus operators and provide details on how other criteria in this section would be achieved.
- **Walking:** Provision of dedicated accessible pedestrian paths on the site linking buildings to each other and to public transport nodes on public highways.
- **Cycling and walking routes:** Cycle routes along dedicated cycle paths and clearly demarcated cycle lanes are provided for at least the equivalent length of vehicular roads provided within the estate. Cyclist and pedestrians are given priority at all crossing points and junctions and measures such as signage and traffic calming features are incorporated into roads to ensure that drivers acknowledge this. Compliance with ‘Cycle Friendly Environment Guidelines’ (Gauge 2009).
- **Cycling facilities:** Work environments: Secure cycling parking is provided for at least 3% of the building occupants. Residential environments: At least one secure parking point per unit is provided.
- **Local facilities:** Access to following local facilities is provided.

Type of development	Local facilities
Subsidy housing	Access to the following facilities within 750m can be demonstrated: bank (or bank ATM), crèches, food retail and leisure and recreation facilities
Other Residential	
Business	Access to the following facilities within 400m can be demonstrated: bank (or bank ATM), crèches, food retail or café/restaurants
Industrial	

- **Working facilities:** Access to following local facilities is provided.

Type of development	Working facilities
Subsidy housing	Access to a business centre / facility with video / tele-conferencing / internet, meeting rooms and printing facilities within 1,200m of every residential unit.
Other Residential	
Business	Access to broadband/video/teleconferencing within 400m of any office work environment accommodating more than 5 people.
Industrial	

## 17 Health and Well Being

**Objective:** Development should support the health and well being of people on site and in neighbouring communities.

### Criteria

- Daylight:** Eighty per cent of all useable space within buildings should achieve a 2.0% daylight factor. This can be demonstrated through daylight modelling. Alternatively, an acceptable deemed to satisfy condition is to demonstrate that eighty per cent of the useable area is within 2.5H of an external window, where H is the height of the head of the window.
- Ventilation:** All buildings in the estate have ventilation openings (such as an opening window) of at least 5% of the associated useable floor.
- Views:** Eighty per cent of all useable area within buildings is within 6m of an external window and has a direct line of sight to this. An unobstructed space of 4m is provided externally in front of windows (vegetation and open fencing can be included but not solid walls and other buildings) to ensure that the view of the external space is adequate.
- Indoor air quality:** The specification of materials for buildings in the development should avoid these materials and finishes.
- VOCs:** Some carpets, adhesives and paints have volatile organic compounds (VOCs) which are off-gassed, negatively affecting air quality. Products with no or low VOCs are specified.
- Formaldehyde:** Formaldehyde similarly can be off-gassed from composite boards and timber products, negatively affecting indoor air quality. Products with no or low formaldehyde are specified.
- Exercise and recreation facilities:** Access to following local facilities is provided.

Type of development	Exercise and recreation facilities
Subsidy housing	Access to the following facilities within 1000m from residential environment can be demonstrated: park / gym / walking or running trails.
Other Residential	
Business	Access to the following facilities within 400m from work environments can be demonstrated: park / gym / walking or running trails.
Industrial	Not applicable

## 18 Education and Ongoing Learning

### Criteria

**Objective:** Development should support education and ongoing learning of people on site and in neighbouring communities.

- Facilities for education and ongoing learning: Access to following local facilities is provided.

Type of development	Exercise and recreation facilities
Subsidy housing	Facility for education and ongoing learning that can accommodate 5% of the residents will be made available in week day evenings and during week ends. A facility of this nature should be available within 1,000m of every residence.
Other Residential	
Business	Facility for education and ongoing learning that can accommodate 5% of the workers will be made available. A facility of this nature should be available within 400m of every workstation
Industrial	

- Primary schools:** Primary school facilities are located within 1,500m of all family dwellings along a safe walking route.
- Secondary schools:** Secondary school facilities are located within 2,250m of all family dwellings along a safe walking route.
- Site operation worker training:** Proposed development demonstrates that human resource policy will include a requirement for site operation workers to access accredited education for a minimum equivalent

of 5% of working hours.

- Construction worker training:** Construction contract document indicates a requirement for construction workers to access accredited education for a minimum equivalent of 5% of working hours.

## 19 Housing

**Objective:** Development should support Inclusionary Housing and ensure that people who work on site do not have to travel long distances to access affordable housing.

## Criteria

- **Affordable housing:**  
The development demonstrates everyone working on the site that needs affordable housing is able to access this within 10km of the site.
- **Inclusionary housing:** Inclusionary housing is integrated in the development in line with the Inclusionary Housing Policy and local compulsory prescriptions.

## 20 Social Cohesion and Inclusion

**Objective:** Development should support social cohesion and benefit the full diversity of the population.

## Criteria

- **Sporting and recreation facilities:**  
Affordable access to sporting and recreation facilities in the development is provided for local communities as well as for people within the development.
- **Health and education facilities:**  
Affordable access to health and education facilities in the development is provided for local communities as well as for people within the development.
- **Children and youth facilities:**  
Affordable access to children and youth facilities in development is provided for local communities as well as for people within the development.

- **Natural, cultural and historical landscapes:** Access is provided to the local community as well as for people within the development to natural, cultural and historical landscapes located within the development.
- **Inclusive and accessible facilities:**  
The new development demonstrates that facilities will be inclusive and able to accommodate the full diversity of the population.
- **Information about the development:**  
Inclusive participatory processes are planned that respond to local communities and take into account issues such as language, income, education and disability.

## 21 Management and Monitoring

**Objective:** Sustainable development targets that reflect the South African context should be set for the development. Management and monitoring should be carried out to ensure that these are achieved.

## Criteria

- **Development conditions:** Developer should make the Record of Decision (ROD) and other development conditions readily available to the local community through a website or other means. Information and reporting on compliance should also be made available through the same means.
- **Environmental Management Plan (EMP):** Environmental Management Plan for the development

covering both construction and operational phases. Environmental Management Plan includes sustainable development criteria from this guide and show how these will be achieved.

- **Environmental Control Officer (ECO):** An Environmental Control Office is appointed for the development. The ECO reports on the achievement of ROD development requirements, the EMP and sustainable development targets to management (and possibly to relevant stakeholders such as the future homeowners, the local community and local and provincial authorities). Reports are developed on a monthly basis during construction phases and on a two monthly basis during operation of the development.
- **Operational performance:** Building user guides are developed for occupants of buildings to ensure that systems designed to support sustainability are maintained and operated optimally.
- **Operational performance:** Facilities management manuals and monitoring requirements to ensure that systems designed to support sustainability are maintained and operated optimally. As minimum, energy, water and waste performance against targets should be reported on.
- **Independent certification:** Commitment by developer that independent environmental rating or certification such as a 'Greenstar' rating or 'Fair Trade in Tourism'

certification will be achieved.

## 22 Using the sustainable development criteria for built environment projects

The sustainable development criteria for built environment projects can be used in a range of different ways. Their key use however is as a framework that can be used by developers to design projects and then to show how these projects have addressed sustainable development.

As part of an iterative development process the criteria can be used to evaluate different options and strategies in order to rapidly identify the most sustainable solutions. Once a project has been developed, data tables and documentation, as outlined below, can be used to demonstrate how sustainable development has been addressed. This documentation helps to ensure that there can be effective evaluation of proposals and constructive interaction on key issues with key stakeholders before implementation occurs.

Land use categories*	Existing site	Proposed development	Difference (units)	Difference (%)
Subsidy and affordable housing (m <sup>2</sup> )				
Other residential (m <sup>2</sup> )				
Business (m <sup>2</sup> )				
Industrial (m <sup>2</sup> )				
Education, community or institutional purposes (m <sup>2</sup> )				
Resorts (m <sup>2</sup> )				
Mining (m <sup>2</sup> )				
Transport (m <sup>2</sup> )				
Service infrastructure (m <sup>2</sup> )				
Open space (m <sup>2</sup> )				
Private open space (m <sup>2</sup> )				
Agriculture (m <sup>2</sup> )				
Total site area (m <sup>2</sup> )				
<b>Land use indicators</b>				
Percentage of the site used for residential purposes (%)				
Percentage of the site used for education, community or institutional purposes (%)				
Percentage of the site that is open space (%)				
Percentage of site used for agriculture (%)				

Table 1. Data table for Land Use and Integrated Development.

LU	Land Use and Integrated Development	Documentation
	Data table	Completed data table, discussion of positive and negative differences (%)
LU1	Spatial Development Frameworks	Extract of SDF, statement of compliance
LU2	Environmental Management Framework	Extract of EMF, statement of compliance
LU3	City Development Strategies	Extract of Strategy, statement of compliance
LU4	Urban Development Boundary	Extract of SDF with Urban Development Boundary, indication of site location relative to boundary

LU5	Existing and planned infrastructure	Studies indicating that there is adequate capacity in local roads, storm water, sewage, power and water supply for development. Confirmation from Local Authority
LU6	Public transport networks	Map indicating public transportation relative to site with distances. Documentation on public transportation including timetables and costs.
LU7	Complementary social and economic land uses	Needs study carried out of adjacent areas, indication of how development will address needs identified.
LU8	Building density	Extract of building density requirements of LA / good practice. Calculations indicating that this will be achieved / surpassed.
LU9	Open space	Site plan and calculations indicating compliance

Table 2. Documentation for Land Use and Integrated Development Criteria.

## 23 Conclusion

The social, economic and environmental context of South African suggests that implementing sustainable development is increasingly important. However, opportunities within built environment projects to adopt a sustainable development approach often appear to be missed. This may be the result of planning and design approaches that do not take sustainability into account. It may also be easier to follow conventional routes rather than take on processes that appear to be both complex (by addressing a range

of different objectives simultaneously) and contentious (by addressing social, economic and environmental issues).

This paper aims to demonstrate that a relatively simple framework can be developed to help ensure that sustainable development is integrated into built environment projects. It argues that a holistic and integrated approach, in which social, economic and environmental objectives are addressed simultaneously, encourages the development of innovative and effective solutions that support sustainable development within a South African context.

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