Hartbeespoortdam Butterfly Conservancy

Design and Development Guidelines - Baseline

PART 2

Figure 001: Parides iphidamas by Ryan Pettey

Introduction

The following Design and Development Guideline is compiled using the *Sustainable Building Assessment Tool* [1] and development guidelines extracted from the *U.S Department of the interior & National Park Services*.[2]

DESIGN AND DEVELOPMENT GUIDELINES

Site design is a process of intervention involving the location of circulation, structures, and utilities, and making natural and cultural values available to visitors. The process encompasses many steps from planning to construction, including initial inventory, assessment, alternative analysis, detailed design, and construction procedures and services.

SUSTAINABLE SITE DESIGN

Sustainable site design requires holistic, ecologically based strategies to create projects that do not alter or impair but instead help repair and restore existing site systems. Site systems such as plant and animal communities, soils, and hydrology must be respected as patterns and processes of the living world.

GENERAL SITE DESIGN CONSIDERATIONS

The following considerations apply to sustainable site design:

- Plan landscape development according to the surrounding context
  - Site context including all natural features - form main generator
- Do not sacrifice ecological integrity or economic viability in a sustainable development; both are equally important factors in the development process.
- Understand the site as an integrated ecosystem with changes occurring over time in dynamic balance; the impacts of development must be confined within these natural changes.
- Allow simplicity of functions to prevail, while respecting basic human needs of comfort and safety.
  - Passive environmental system of climate control
  - Building elements which promote storage of natural energies and are colour and texture rich.
- Minimize areas of vegetation disturbance, earth grading, and water channel alternation.
  - The building layout should conform to natural land features and promote conservation of existing indigenous vegetation.
- Locate structures to take maximum advantage of passive energy technologies to provide for human comfort.
- Provide space for processing all wastes created on site (collection/recycling facilities, digesters, etc.) so that no hazardous or destructive wastes will be released into the environment.
- Determine environmentally safe means of onsite energy production and storage.
- Allow the natural ecosystem to be self-maintaining to the greatest extent possible.
- Develop facilities to integrate selected maintenance functions such as energy conservation, waste reduction, recycling, and resource conservation into the visitor experience.
- Incorporate indigenous materials and crafts into structures, indigenous plants into landscaping, and local customs into programs and operations.

SPECIFIC SITE DESIGN CONSIDERATIONS

Density

Concentration versus dispersal. Natural landscape values may be easier to maintain if facilities are carefully dispersed thus encouraging a better understanding and experience of the site. Conversely, concentration of structure leaves more undisturbed natural areas.

Climate

Climate should be considered when locating facilities so that human comfort can be maximized while protecting the facility from climatic forces such as storms and other extremes.

Vegetation

It is important to retain as much existing indigenous vegetation as possible to secure the integrity of the site. Natural vegetation is an essential aspect of the visitor experience and should be preserved. The site should maintain large habitat areas and avoid habitat fragmentation and canopy loss.

Views

Views are critical and reinforce a visitor experience. Site location should maximize views of natural features and minimize views of visitor and support facilities.

Figure 001: Parides iphidamas by Ryan Pettey

1. Gilbert, 2003 | **2.** U.S Department of the interior & National Parks Service, 1994

Separation of Support Facilities from Public Areas
Safety, visual quality and noise are all factors that need to be considered when designing service facilities. These areas need to be separated from public use and circulation areas. In certain circumstances, energy systems, and waste recycling areas can be a positive part of the visitor experience.

SOCIAL ISSUES

OCCUPANT COMFORT

Occupant comfort for the butterfly conservancy requires that the design respond to two different users - the butterfly and *Homo sapien.*

This thesis focuses on creating liveable spaces which are sustainable and incorporate available technology without making the development uneconomical.

Lighting
Internal spaces that are naturally lit are more cost effective and generally provide a better quality of light. Glare and excessive contrasts should be avoided so as to create better visual comfort for the user.

The brief requires that the concept be representative of the butterfly and its life cycle. Thus I envisage that the structure will be light and encompass a quantity of glass and steel which will ensure that the recommended day lighting requirements are met.

DAYLIGHT REQUIREMENTS		
Dwellings:	Bed/bathrooms	50 lux
	Kitchens	100 lux
	Reading/ sewing	150-200 lux
Offices:	Computer, writing, reading	200 lux
	Drawing	300 lux
Education facilities:	Class/ lecture rooms	70 lux
	Laboratories	150 lux
Industry	setting/ assembly/ fitting	1000 lux
	Lathe work	500 lux
	General fittings/ assembly	100 lux

2.01: DAYLIGHT REQUIREMENTS

Night Lighting
The nighttime sky can be dramatic. Light intrusion and over-lighting glare can obscure what little night sight is available to humans. Care is required to limit night lighting to the minimum necessary for safety. Low voltage lighting with photovoltaic collectors will be considered as an energy-efficient alternative. Light fixtures will remain close to the ground, avoiding glare from eye level fixtures.

Ventilation
Ventilation must be provided naturally. Passive ventilation, natural convection and existing wind patterns must be utilized to facilitate air changes. "Infiltration may provide sufficient fresh air in buildings that are not airtight".[3]

If additional mechanical ventilation is needed, mechanical systems may be used as long as a renewable energy source is used which still remains economic to the project.

The air quality in and around the Hartbeespoortdam area is excellent due to the rural context in which it is found. With continued development, the air quality may start to deteriorate, a main contributor being an increase in traffic.

Noise
Butterflies for Africa, situated in the industrial area of Pietermaritzburg, measured noise levels of 79dB within the butterfly conservancy. (These levels dropped within the confines of the structure). This is not a pleasant background hum but quite a disturbing noise. The butterflies are not affected by this noise, although it is not pleasant for visitors to the conservancy.

Noise impacts which are safe for the human ear fall between 0 and 85 dB. The dB levels for the butterfly conservancy should not exceed 55 dB. Levels higher then this are disturbing and hamper communication. Areas within the development, zoned for audio visual use are recommended to have a sound level of not more than 20 dB. [5]

The average ambient noise level in and around the Damdoryn node, during the day is 53dB.[6] The main generator of noise being the R27. As development and traffic levels increase so to will the noise levels in and around the area. The need to respond to this increase is obviously necessary.
Soft landscaping, sound absorbent, reflective and insulating materials can all be used to reduce the effects of noise. Taking into account that the context is rural, noise plays a minor role compared to other factors.

Figure 001: Parides iphidamas by Ryan Pettey

3. Holm, 1996:15 | **4.** SABS, 199x | **5.** Measured with a Nokia 5100 cell phone

NOISE IMPACT			
0-8 dB	Hearing Threshold		
8-25	Exceptionally Quiet		Sound Studio
25-55	Normal Communication	25-40 dB	Residential
		40-50	Offices
		50-55	Fine Engineering
55-85	Disturbing		Light Industry
85>	Hearing Damage		Heavy Industry

2.02: NOISE THRESHOLDS

Views

Views from and towards the development are very important. An overarching concept is the coalition of in and out, thus views to the outside are important.

The Hartbeespoortdam area is naturally beautiful and attracts many people. The rapid growth and development in the area is due to its pristine beauty, safety and its supposed easy access to Johannesburg and Pretoria. This is all good and well, but as more and more developments are erected, so the main reasons for people originally investing in the area diminishes. A major physical contributor to this is the fact that many of the developments are erected on sites that were bulldozed, flattened and without a thorough site analysis; structures erected. Major view sheds that give the area its characteristic appeal, are being transformed into rolling hills of Tuscan developments. This is a good enough reason to carefully consider the views from different approaches, distances and angles.

CLIMATE

There are three different climates which form the bases on which the biomes are to be established - Tropical climate, Highveld climate and Mediterranean climate. The passive regulation of climate within these areas is important but if this is not possible mechanical systems will be used to regulate the climates.

Tropical Climate (COSTAL BUSHVELD-GRASSLAND BIOME)

Rainfall is heavy in all months. The total annual rainfall is often more than 1000 mm. There are seasonal differences in monthly rainfall but temperatures remain constant around 27°C. Humidity is between 77% and 88%. The summers are warm and very humid.

- **Average temperature: 25°C max average/ 17°C min average**
- **Annual Precipitation: 1009 mm.**
- **Latitude Range: 29°S**
- **Global Position: Eastern region of South *Africa.***

Highveld Climate (MIXED BUSHVELD BIOME)

A seasonal change occurs between wet tropical air masses and dry tropical air masses. As a result, there is a very wet season and a very dry season. It gets a little cooler during this dry season but will become very hot just before the wet season.

- **Temperature Range: 25°C max average/ 12°C min average**
- **Annual Precipitation: 681mm.**
- **Latitude Range: 25° S**
- **Global Range: Hartbeespoort region of South Africa**

Mediterranean Climate (MOUNTAIN FYNBOS BIOME)

This is a wet-winter, dry-summer climate. Extremely dry summers are caused by the sinking air of the subtropical highs and may last for up to five months.
Plants have adapted to the extreme difference in rainfall and temperature between winter and summer seasons. Fires occur frequently in Mediterranean climate zones.

- **Temperature Range: 22°C max average/ 11°C min average**
- **Annual Precipitation: 515 mm**
- **Latitude Range: 33°S**
- **Global Position: Cape Town region of South Africa**

INCLUSIVE ENVIRONMENTS

The need to design buildings to accommodate all sectors of the population is very important in today's society. Thus in the design of the conservancy and all public spaces, every effort will be made to cater for the special needs of physically challenged people, children and the elderly.

ACCESS TO FACILITY

Site Access

Site access refers not only to the physical access to the development but also the en route experience. The en route experience could include transitions between origin and destination, or it could provide an interpretive and/or educational experience. Other considerations for enhancing the experience of accessing the development include:

- Provide anticipation and drama by framing views or directing attention to landscape

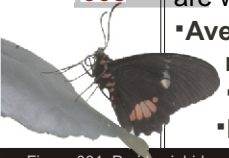


Figure 001: Parides iphidamas by Ryan Pettey

features along the access route.

▪Provide a sense of arrival at the destination.

Site access can be achieved by means of pedestrian and vehicle based transport. These transportation means impose limitations on users based on the capabilities of the traveller or the capacity of the particular transportation mode. Transportation means that are the least polluting, quiet, and least intrusive in the natural environment is the most appropriate for the development.

Road Design and Construction.

Access corridors should be provided for multiple purposes - e.g., visitors, maintenance, security, emergency vehicles, and underground services. Unpaved surfaces (parking) are appropriate but they require more maintenance (can also be used as retention zones) and allow limited percolation of precipitation. Impermeable paved surfaces are needed for roads with higher load and traffic requirements (main entrance). Road colour should blend with predominant landscape tones.

Internal Site Access.

Access within the development is to be typically pedestrian. Vehicles should be restricted to the edges of the development. Paths should be laid out to avoid sensitive resources. In areas that are particularly environmentally sensitive, elevated walkways can be used which will limit indiscriminate pedestrian access to fragile vegetation.

Public Transport

Public transport in and around the area is not sufficient, however once at the Damdoryn node the need for transport diminishes.

The area is already on many itineraries and forms part of the main route to Sun City, making it an ideal stop for tourist busses.

PARTICIPATION AND CONTROL

Environmental Control

As previously stated the philosophy on which the design will evolve is based on a thorough understanding of what the site is and what it offers. The design will respond to this, which in turn will produce a building that relies on a passive system of environmental management. This will ensure that the user participates in decision-making about his/her environmental well-being.

User Adaptation

A successful, sustainable building relies on the adaption and manipulation of the internal spaces - furniture and fittings - so as to insure a prolonged life cycle. The Conservancy, as well as the other functions, will be designed so that manipulation of internal spaces is possible.

EDUCATION, HEALTH AND SAFETY

Education

Great emphasis is put on education in today's society. Schools are being built and the educational system is constantly being reviewed. As a hands on education facility, the conservancy will be focussed on the educational upliftment of the immediate community. Arts and crafts will also be taught by local artist.

The extent to which the educational net could be cast is endless. People from all walks of life, all areas of South Africa and all seven continents visit this area. A successful conservancy could positively impact on nature conservation and education world wide.

Smoking

Obviously smoking within the constraints of the structures will not be allowed, but adequate exterior areas will be available.

Visitor Safety and Security

The design of a tourism development involves a closer, more integrated relationship of visitors with nature. Visitor awareness of their natural surroundings is the best safety insurance - a passive means - but present circumstances demand a higher awareness of safety.

Some important design considerations are as follows:

▪Visitors must have a sense of personal safety and security to be attracted to recreation area.

▪The facility must have reasonable provisions to protect visitors.

▪The design should consider safety from climate extremes; visitors may be unaware of natural hazards, including intense sun and heavy rainfall.

▪The use of artificial lighting should be limited to retain natural ambient light levels - ground mounted light fixtures will be used to limit spill over light impacts while providing a basic sense of security.

▪Appropriate atmosphere and security can be enhanced by controlled access to the facilities - incorporate natural barriers into the design to minimize need for security fencing or barriers.

Figure 001: Parides iphidamas by Ryan Pettey

ECONOMIC ISSUES

LOCAL ECONOMY

To reduce embodied energies and uplift local communities, local contractors, building materials and manufactured components will be locally sourced.

EFFICIENCY OF USE

Occupancy

Achieving an occupancy of about 40 hours a week would prove to be sustainable, compared to other traditional offices, schools and businesses. The development will operate during the week, as well as over weekends, thus increasing the use time considerably compared to other operational buildings.

ADAPTABILITY AND FLEXIBILITY

Space use

The adaptable use of spaces will increase the operational income as well as the life expectancy of the building. Using spaces for more then one purpose will be important in achieving a design that represent a holistic sustainability. The repetition of spaces must be avoided as well as the creation of areas that are not often accessed - dead zones. Flow patterns will become important in this instance.

CAPITAL AND ONGOING COSTS

We live in an era where the focus on sustainability and the sustainability of materials is important. Materials for the development will be a combination of materials which are very resistant to the environmental elements, and those which are not. The materials which weather well and are resistant to environmental impacts will be used for components of the design which are crucial to the stability of the structure and the aesthetics of the design. Emphasis will also be placed on materials which promote passive climatic control.

Materials which constantly need replacing and maintenance will be used to promote the building as a dynamic system which grows and adapts to its changing environment and use.

Careful consideration with respect to material choice is important. Capital costs of materials which need to be replaced during the life time of the building must be weighed up against ongoing costs before materials are specified.

ENVIRONMENTAL ISSUES

SITE-ADAPTIVE DESIGN CONSIDERATIONS

With a sustainable approach, more ecological knowledge is at the core of the design. Instead of human functional needs driving the site design, site components respond to the indigenous spatial character, climate, topography, soils, and vegetation as well as compatibility with the existing cultural context. All facilities should conform to constraints of existing landforms and tree locations, and the character of the existing landscape will be largely maintained. Natural buffers and openings for privacy are used rather than artificially produced through planting and clearing.

NATURAL CHARACTERISTICS.

The greatest challenge in achieving sustainable site design is to realize that much can be learned from nature. When nature is incorporated into designs, spaces can be more comfortable, interesting, and efficient. It is important to understand natural systems and the way they interrelate in order to work within these constraints with the least amount of environmental impact.

WATER

Rainwater

The collection of rainwater will be integral to the design. Run-off from roofs and paved areas will be collected and stored for use in the nursery, conservancy and water closets. Water collected off roofs could also be consumed if the first rain of the season is diverted from the holding tanks. This is according to Professor D Holm who explained his philosophy of water use and consumption during an open day at his autonomous house in Hartbeespoort.[7]

Wastewater or excess runoff water from developed areas should be channelled and discharged in ways that allow for groundwater recharge.

Water use

The site has six functional bore holes which provide the present nursery with sufficient water. This together with the collection of rainwater ensures that there is ample water supply to provide for the conservancies needs.

Apart from the mere use of water in its liquid state, it will also be used for evaporative cooling, which will cool the building during hot dry summer days. The conservation of water is very important.

Figure 001: Parides iphidamas by Ryan Pettey

7. Holm, 2002

Indigenous plant species and water saving appliances will be used to promote water conservation.

Grey water
Grey water could be used in the nursery as an additional source of water

Storm Drainage
Drainage is typically handled by vegetation canopies, ground cover, plants and soil absorption. The main reason for storm drainage control is to: regulate runoff water, provide protection from soil erosion and avoid directing water into unmanageable volumes. Captured runoff could be directed into depressions to help recharge groundwater supply.

ENERGY
Wind
The major advantage of wind in recreational development is its cooling aspect. Outdoor gathering places and structures will be orientated to take advantage of this cooling wind movement, or natural “air conditioning.”

Sun
Provision should be made for shade devices to aid human comfort and safety in activity areas (e.g. pathways and patios). The most economical and practical way is to use natural vegetation, slope aspects, or introduced shade structures. The need for natural lighting in indoor spaces and the use of solar energy are important considerations that will save energy and showcase environmental responsive solutions.

Heating and cooling
The design of a light structure will accommodate the requirements as set out in the brief. As a result of the large areas of glazing making up the structure there will be heat loss in winter and at night but this will also be the greatest source of solar heat gain. To oppose the negative affects of the glazing thermal mass will be used to achieve a thermally comfortable building. Correct overhangs, orientation and the use of vegetation, louvres and evaporative cooling will also be integral to the design. Solar passive design allows for the optimum design of the building envelope.

Renewable Energy
Wind turbines are not feasible as wind in the area on average is below 13km/h [8].

The use of photovoltaic systems and solar water heaters will definitely be integrated into the design as the average number of sunny days per an annum vary between more than 50% sunshine for 85% of the year and less than 50% sunshine for 15% of the year.[9] Thus the possibilities of using the sun for energy that can be used by the building and its users are endless .

RECYCLING AND REUSE
Organic waste
All organic waste will be recycled and reused in the nursery.

Operational Wastes
Recycling will be encouraged from design inception throughout the development’s life cycle. Areas within the development will be designed to highlight recycling opportunities.

SITE
Topography
Topography can potentially provide vertical separation and more privacy for individual structures. Changes in topography can also enhance and vary the way a visitor experiences the site by changing intimacy or familiarity.

Geology and Soils
Designing with geologic features can enhance the sense of place and bring the visitor in direct contact with the resources available and the uniqueness of the place. Soil disturbances should be kept to a minimum to avoid erosion of fragile top soils and growth of exotic plants should be discouraged. If limited soil disturbance has to take place, erosion control must be practised.

Vegetation
Existing vegetation should be maintained to encourage biodiversity and to protect the nutrients held in the biomass of indigenous vegetation. Indigenous planting should be incorporated in all new developments on a 2:1 ratio of plants removed. Vegetation can enhance privacy, be used to create "natural rooms," and be a primary source of shade. Plants also contribute to the visual integrity or inclusion of a new development into the natural setting.

Figure 001: Parides iphidamas by Ryan Pettey

8. s.n. 2001 | **9.** Carruthers, 1990:51

Wildlife

Encouraging wildlife to remain close to human activity centres enhances the visitors experience. This can be achieved by maintaining as much original habitat as possible. The conservancy and butterfly garden will also depend on indigenous and feeder plants to create the correct habitat for the sustained existence of the butterflies.

Visual Character

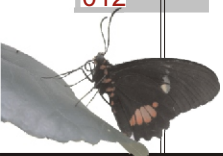
Natural vistas should be used wherever possible in design. Creating onsite visual intrusions (road cuts, utilities, etc.) should be avoided. Views of offsite intrusions should be carefully controlled. A natural look can be maintained by using natural building materials, hiding structures within the vegetation, and working with the topography.

CONSTRUCTION LIMITS AND LANDSCAPE.

Where disturbance occurs, the site should be restored as soon as possible. All topsoil from construction area should be collected for use in site restoration.

INDIGENOUS LANDSCAPE PRESERVATION/ RESTORATION

Preservation of the natural landscape is of great importance during construction because it is much less expensive and more ecologically sound than subsequent restoration. Preservation entails carefully defining the construction zone. Restoration of indigenous planting patterns should be used when site disturbances are unavoidable. All indigenous plants that might be disturbed by the construction process should be stored in the nursery temporarily and be replanted after construction.



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