5

AN AGGREGATED SUSTAINABILITY INDEX FOR THE CAPE METROPOLITAN AREA

Karen Shippey
B.Sc, B.Sc (Hons)

MSc Dissertation

Supervisor: Prof. Richard Fuggle

Department of Environmental & Geographical Science

University of Cape Town

December 2001

ABSTRACT

This dissertation adapts the International Union for the Conservation of Nature and Natural Resources (IUCN) 'Barometer of Sustainability' for use in the Cape Metropolitan Area. It examines both the concept of sustainability and the search for indices to measure progress towards sustainability. Selection of the Barometer of Sustainability is justified and the procedures used to adapt and test the model for meaningful use in the Cape Metropolitan Area are fully described.

The research indicates that the model is compatible with the type of data available in the city's State of the Environment Report and that it does generate an understandable, aggregated sustainability index. It also indicates that the Barometer of Sustainability is a highly adaptive tool which can be used to focus attention on the interrelationships between multiple issues and explore values being applied to environmental topics.

TABLE OF CONTENTS

LIST OF BOXES

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

ANZECC	Australian and New Zealand Environmental Conservation Council
CIA	Central Intelligence Agency
CMA	Cape Metropolitan Area
CMC	Cape Metropolitan Council
CPNP	Cape Peninsula National Park
CSD	Committee on Sustainable Development
DF/S/R	Driving Force-State-Response
EEU	Environmental Evaluation Unit
EF	Ecological Footprint
ESI	Environmental Sustainability Index
GDP	Gross Domestic Product
GPI	Genuine Progress Indicator
HDI	Human Development Index
IDRC	Canadian International Development Research Centre
IISD	International Institute for Sustainable Development
IUCN	International Union for the Conservation of Nature and Natural Resources
MCDA	Multi-Criteria Decision Analysis
NGO	Non-governmental Organisation
NRTEE	National Round Table on the Environment and the Economy (Canada)
OCED	Organisation for Economic Co-operation and Development
SAM	System Assessment Method
SNA	System of National Accounts
SOE	State of the Environment Report
UNESCO	United Nations Education, Scientific and Cultural Organisation
UN CSD	United Nations Commission on Sustainable Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
VISA	Visual Interactive Sensitivity Analysis
WCED	World Commission on Environment and Development
WRI	World Resources Institute
WWF	World Wildlife Fund
WSU	Washington State University

Note to reader: An update of the methodology for calculating the Barometer of Sustainability was published in 2001 after this dissertation was completed. All calculations were undertaken using the1997 and 1999 IUCN publications.

ACKNOWLEDGEMENTS

I would like to extend my deepest gratitude to the volunteers who made time in their busy schedules to participate in the research workshops.

I would also like to acknowledge the staff of the Environmental Management Department of the City of Cape Town Administration (formerly Cape Metropolitan Council) for their participation, advice and interest. A special word of thanks to Mr Craig Haskins and Mr Keith Wiseman for their encouragement and co-operation.

I extend my deepest gratitude to my supervisor and mentor, Prof Richard Fuggle. The guidance, support and patience exhibited throughout my numerous consultations is a tribute to you as an individual and to your position in an academic institution. You are an inspiration.

To my workshop assistant, Mr Matthew Gush, thank you for helping me through very long hours and thanks for going beyond the call of duty to record the results. To Ms Lynette Kruger, Dr Theo Shippey and Mr Neil Carr for their comments on an early draft of the thesis and assistance with proof-reading.

On a more personal note, I would like to thank my parents for their never-ending love, support and encouragement. To my husband, Neil, my love and thanks for all your support, encouragement and understanding throughout this project. And finally, I would like to acknowledge the love and guidance of the Lord God and thank Him for giving me the ability and opportunity to undertake this project.

CHAPTER 1
INTRODUCTION

> *"...discover and tell the truth about the successes and failures of the present and the potentials and the obstacles in the future. And above all...[have] the courage to admit and bear the pain of the present world, while keeping a steady eye on a vision of a better future..."(Meadows, Meadows and Randers,1992).*

Over time, as humans have come to understand the mechanisms which control our planet, there has been a realisation that the continued existence of life requires balance between the systems which cleanse and support and those which consume and produce wastes. Scientific investigation during the latter years of the past century has focused our attention on the intricacies of the system within which we are seeking that balance.

Newtonian science requires that we isolate each element of the system and understand it, but the environment is more than a sum of its parts — there are interactions and feedback loops between elements. Systems need to be viewed holistically if they are to be understood. This is a dilemma of modern science. How can a complex system be understood sufficiently to know what is required to ensure balance or sustainability within the system?

This dissertation seeks to aid the understanding of a complex system in order to enable proactive attempts to be made to alter the system to reach its optimum, sustainable level. The system under examination is the metropolitan area of the City of Cape Town, South Africa. A tool called the Barometer of Sustainability will be used to assess the information gathered by local authorities as well as to develop an aggregated sustainability index for the Cape Metropolitan Area.

1.1 Background

The concept of environmental sustainability has a long history and can be traced in ancient writings such as those of Plato 111AD (Thomas, 1956) where he laments the poor farming practices causing excessive erosion. There are hundreds of essays over the centuries concerned with retaining the quality of arable land and the provision of food for a growing population. The concept of sustainability, however, became more focused in the 20th Century when writings such as William Vogt's "Road to Survival" (1949) and Fairfield Osborn's "Limits of the Earth" (1953) examined the growing awareness of the existence of environmental constraints to human growth and development.

In the early 1960's a book was published by Rachel Carson (1962) entitled "Silent Spring", which is acknowledged by many as the work which launched modern environmentalism. Carson's book reported on research on toxicology, ecology and epidemology and suggested that agricultural pesticides were building to catastrophic levels. This was followed by more scientific reports establishing that human interaction with the environment was reaching levels where ecosystem support mechanisms would be permanently damaged. Institutions such as the Club of Rome, United Nations Education, Scientific and Cultural Organisation (UNESCO) and Friends of the Earth promoted environmental issues as a global concern during the 1960's and enlarged environmental concerns beyond nature conservation to include consideration of human quality of life and human-ecosystem interactions as well.

In the early 1970's the reports of increasing pollution and uncontrolled population growth began to focus the environmental debate on the need to find a balance in which humans can live in harmony with the planet which supports them (Meadows et al, 1972, Ward and Dubos, 1972). During the mid-1970's the Bariloche Foundation published its research report "Limits to Poverty" (1974) which extended the debate to include the different development needs of the northern hemisphere and the southern hemisphere, and the poverty established in Third World economies. The limits to economic growth and limitations in the use of resources were simultaneously beginning to be investigated by economists such as Schumacher (1974); Solow (1974) and Daly (1977). These differing perspectives reinforced the call for political mobilisation on environmental issues.

In 1980, the International Union for the Conservation of Nature and Natural Resources (IUCN), United Nations Environment Programme (UNEP) and World Wildlife Fund (WWF) published "The World Conservation Strategy". This document introduced the term **sustainable development** which it defined as *"...maintenance of essential ecological processes and life support systems, the preservation of genetic diversity, and the sustainable utilisation of species and ecosystems"*.

This term was later popularised by a report commissioned by the World Commission on Environment and Development (WCED) under the leadership of Norwegian Prime Minister, Gro H. Bruntland. The report was entitled "Our Common Future" (WCED,

1987) and was prepared as a strategy for achieving global sustainability. The definition for **sustainable development** given in this report was: "*development which meets the needs of the present without compromising the ability of future generations to meet their own needs*" (WCED, 1987, p.8).

Lélé (1991) identified the distinct shift in philosophy between these two reports as being an attempt to ensure that societal change in addition to traditional development objectives be included in the objective or constraint of "ecological sustainability" (Lélé, 1991, p.610 quoted in WSU, 1998).

In October 1986, Prime Minister Bruntland is quoted as saying :

> *"There are many dimensions of sustainability. First, it requires elimination of poverty and deprivation. Second, it requires the conservation and enhancement of the resources base which alone can ensure that the elimination of poverty is permanent. Third, it requires a broadening of the concept of development so that it covers not only economic growth, but also social and cultural development. Fourth, and most importantly, it requires unification of economies and ecology in decision-making at all levels" (Bruntland 1986 quoted in Murcott, 1997).*

The third Earth Summit in Rio de Janerio, 1992, was significant in that it called together the world's governments to discuss what action is required to ensure humankind's long-term survival on the planet. However, the ideology of **sustainable development** as presented at the Earth Summit was criticised as being too development-centered, and imposing a western concept of development on the rest of the world (Latouche, 1993). It was also criticised for being based on human-centered concerns, thus neglecting other species.

Definitions of the term **sustainable development** have proliferated since the Bruntland Report (WCED 1987) and Pezzey (1989) has, for example, developed a ten page list of definitions used during the late 1980's and Murcott (1997) extends this list to include definitions used during the early 1990's. Since the 1990's there has been a growing debate surrounding terminology. In 1991, the IUCN, UNEP and WWF published "Caring for the Earth: A strategy for Sustainable Living" which challenges the WCED definition of **sustainable development** and suggests an alternative, namely: "*Improving the quality of human life while living within the carrying capacity of supporting ecosystems" (IUCN et al.,* 1991, p10). It also adopts the term **sustainability** and uses phrases such as "sustainable living" and "sustainable society".

Prescott-Allen (IUCN,1999) suggests that most definitions of sustainable development and sustainability include three basic goals:

- A desirable human condition
- A durable ecosystem condition
- Equity

A challenge arises when attempting to establish criteria against which initiatives towards sustainability can be measured. What conditions are desirable for society? Prescott-Allen (IUCN,1999) argues that while there may be general consensus regarding issues such as health, basic shelter and education, the inclusion of issues such as spiritual, cultural and psychological needs are far from agreed. He questions whether it is possible to develop a set of criteria which measure these issues across a wide range of geographic scales. Measuring durability of the ecosystem raises similar concerns such as issues of scale and a lack of understanding of the complex relationships between species, habitat, natural flux and evolution, and their interaction with human activities.

Despite our limited knowledge regarding both the exact state of our planet, and a possible ideal, "sustainable" state, an attempt to measure the current situation must necessarily be based on current best knowledge. Specialised complex technologies allow the measurement of quality, quantity and throughput of life-supporting processes, human activities and human interactions. However, the cumulative effects of these processes, actions and interactions need to be understood in order to determine whether progress is being made towards a durable, desirable and equitable state.

The academic literature dealing with indicators of sustainability and determination of the state of the environment, proliferated during the 1990's. A literature review is undertaken in the second chapter of this dissertation. This literature review details some of the tools developed to provide a holistic measurement by aggregating available information to produce sustainability indices.

Sustainability implies that natural and social systems operate in relative harmony. This means that measurement of the interacting aspects is required to obtain an understanding of the "state of the environment". This, however, produces a vast amount of information, which is often highly scientific and numerical in nature. Because of its nature and volume, such measurements are inaccessible to laymen and decision-makers (Oelofse *et al.,* 1998). The efforts of many researchers have therefore turned to attempting to synthesise such information and provide an aggregated index that could be reported and understood easily. (World Bank

1993, 1995, 1996a, OCED 1993 , UNDP 1996, Wackernagel and Rees 1996, IUCN 1997a). It is on the development of an appropriate aggregated index that this dissertation concentrates.

This dissertation comprises a review of the indicators utilised in the Cape Metropolitan Area for the 1998 State of the Environment Report together with a proposed method for calculating an appropriate aggregated sustainability index.

1.2. Motivation and Objectives

Cape Town is home to approximately three million people (CMC, 1999). It is also the main city in the Cape Floristic Kingdom, which boasts high endemism in flora and fauna (Huntley, 1989). The metropolitan authority spends an estimated R250 000 per annum (C. Haskins Pers. Comm., February 2001) on reporting on the state of the environment (SOE) in order to "*...facilitate setting environmental management priorities and policy options...*"(CMC,1999, p.2).

In 1999, the Cape Metropolitan Council (CMC) published its first State of the Environment (SOE) report for Year One, 1998, in an attempt to determine the state of the environment for the Cape Metropolitan Area (CMA). Refer to **Figure 1.1**. This was a 233-page document, which reports on 14 themes: air quality, water, soils, biota, urbanisation, infrastructure, transportation, energy, waste, economy, environmental health, education, safety and security and environmental governance.

Measurements in the document, sometimes even within a theme, are occasionally conflicting, leaving the reader with no clear sense of how sound the overall state of the environment is, and whether or not the city is achieving sustainability (EEU, 1998).

A critical issue in a developing country, such as South Africa, is that the decision-makers are required to prioritise issues in the face of limited resources. Environmental issues need to be clearly and understandably reported so that they are seen in a broad context — a critical link to the wellbeing of the region. If SOE reporting fails to communicate the inter-linkages and state of the environment effectively, efforts to improve the situation are unlikely to receive the necessary resources. If the public and politicians had been provided with a synthesised version of the results, there may be greater understanding into the seriousness of the environmental problems which the CMA faces.

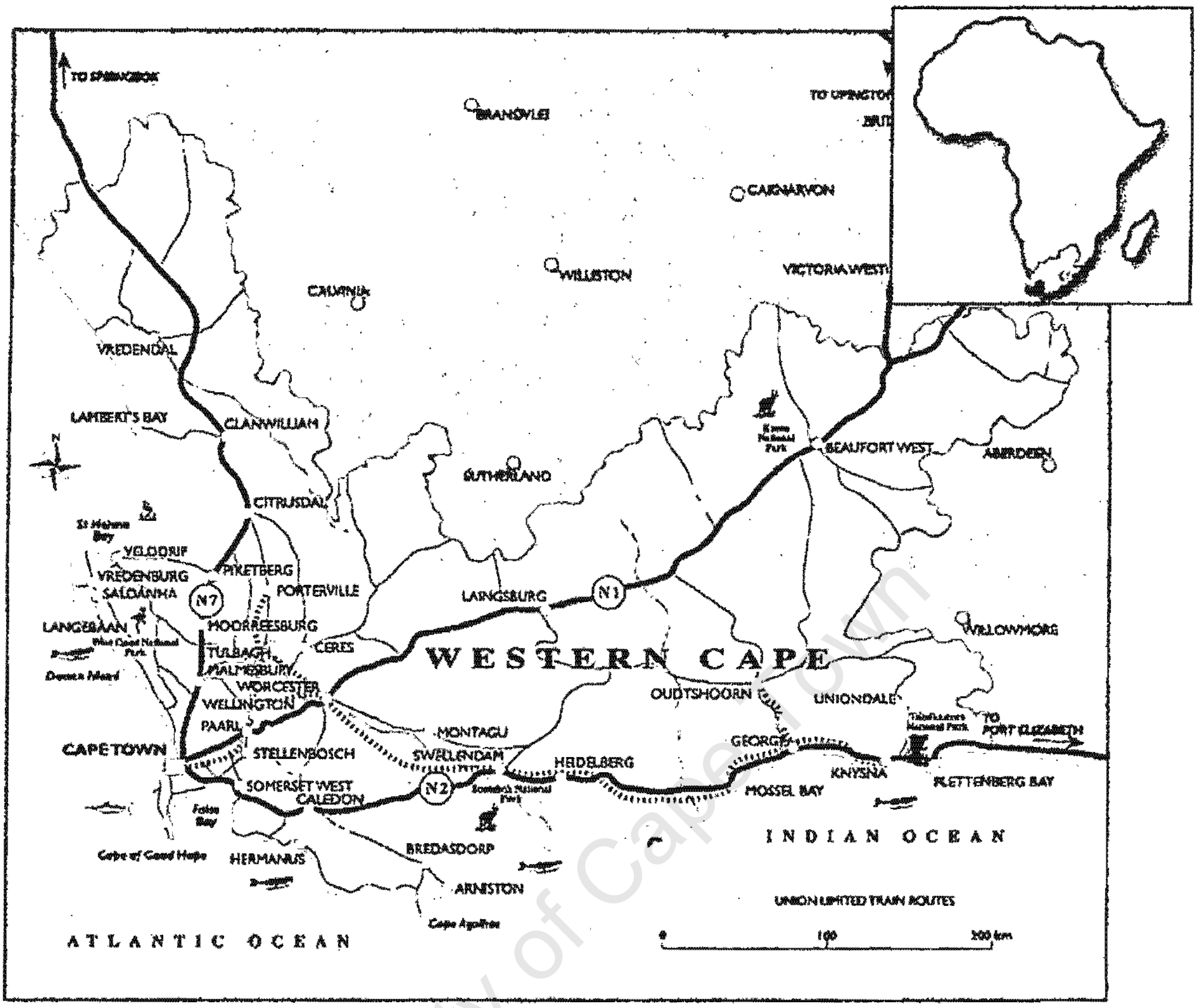


Figure 1.1: Map of the Western Cape showing the location of Cape Town. Source: Nelson's Guides, 2001 (Inset: Africa showing the location of South Africa in yellow and the Western Cape as a red dot. Source: CMC,1999)

It is the apparent lack of an "overall picture" which provided the inspiration for this research. This thesis aims at investigating a tool which provides a clear index of the region's SOE. An index which is easily understood and calculated, and is compatible with the type of data already being collected within the CMA. After an assessment of available aggregation techniques, the details of which can be found in the Literature Review (Chapter 2), — a tool called the Barometer of Sustainability (IUCN, 1997a) was selected as an index for Cape Town.

"The Barometer is a tool for measuring and communicating a society's wellbeing and progress towards sustainability. It provides a systematic way of organising and combining indicators so that users draw conclusions about the conditions of people and the ecosystem and the effects

of people-ecosystem interactions" (Prescott-Allen in Moldan and Billharz,1997, p.133). It presents visually the conclusions drawn by the users. The Barometer of Sustainability is shown in **Figure 1.2.**

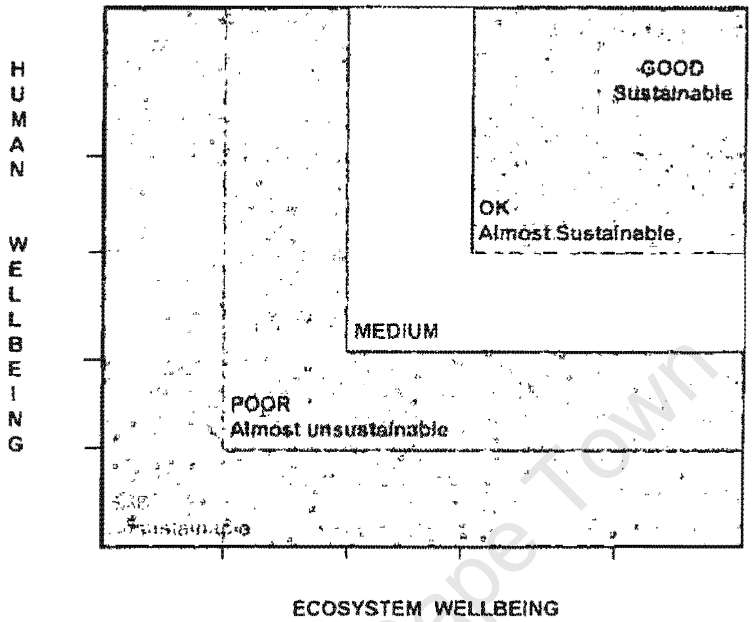


Figure 1.2: Barometer of Sustainability (Source: IUCN, 1997a)

This selection was made for several reasons:

1. The tool is highly adaptable and can be tested with almost any selection of SOE indicators — this ensured that the CMA data could be utilised with little adaptation.

2. It provided an opportunity for the resulting sustainability index to reflect local values and priorities.

3. Value judgements are explicit and the tool requires calculations which are mathematically uncomplicated thereby broadening the range of people who are able to critically review the aggregation process.

4. The index results are displayed graphically, which is easier for people to comprehend (Moore and Dwyer, 1994).

The objectives of this thesis are therefore:

- To determine whether it is feasible to use the data already being collected in the Cape Metropolitan Area to produce a valuable measure of sustainability, and, to identify whether any critical monitoring elements are missing.

- To determine whether the "Barometer of Sustainability" can be used as an analytical tool to provide a holistic picture of the results gathered for a State of the Environment report, so as to assist in an understanding of environmental (ecosystem & human) issues in the Cape Metropolitan Area.

1.3 Scope of the Study

The scope of this thesis is described below:

- Undertake a literature review of sustainability indicators and current aggregated sustainability measurement techniques;

- Describe the Barometer of Sustainability as a tool for measuring progress toward sustainability;

- Undertake three workshops with representatives of three different sectors of society, namely; university staff and students, government officials and environmental non-governmental organisations. Utilise the 1998 CMA SOE to calculate the Barometer of Sustainability for the CMA with each of these groups;

- Check the sensitivity of the Barometer of Sustainability by introducing the 1999 CMA SOE indicator data into the workshop results;

- Use the results of the workshops and commentary by participants to critique the Barometer of Sustainability;

- Review the indicators collected for the 1998 CMA SOE using the Barometer of Sustainability as a framework for review;

- Comment on CMA sustainability measures with a view to providing guidance for future research and metropolitan environmental management.

1.4 Study Area

Cape Town is a major port city of the Western Cape, South Africa **(Figure 1.1).** The Cape Metropolitan Area is 2 153,7km^2 in extent (Gaffney, 1999) and is home to an approximated three million people (CMC,1999). It is broken down into six sub-units which, until December 2000, were individual municipalities which fell within the jurisdiction of the metropolitan authority, the Cape Metropolitan Council **(Figure 1.3).** The metropolitan area became one unified metropolitan authority, the City of Cape Town Administration, after the local elections held in December 2000.

1.4.1 Settlement

The Cape Metropolitan Area is surrounded by mountains. The Peninsula Mountain Chain forms a rocky spine along the peninsula south of the central business district (CBD), the Tygerberg Hills and the Hottentots Holland Mountains are to the east. There is a plain of flat land between these mountain ranges which extends between the Atlantic and Indian oceans which is commonly known as the Cape Flats. It is along the coastal margin, fringing the peninsula and across the Cape Flats, that urban development has occurred. The CMA is representative of many apartheid cities in that there is a noticeable inequality in the provision of services between residential settlements based on race and income. The polarised and fragmented nature of settlement has not changed in the post-apartheid years (Watson, 2000). The previously, white and coloured areas are more formalised, and have greater access to services and transport routes than the majority of black settlements.

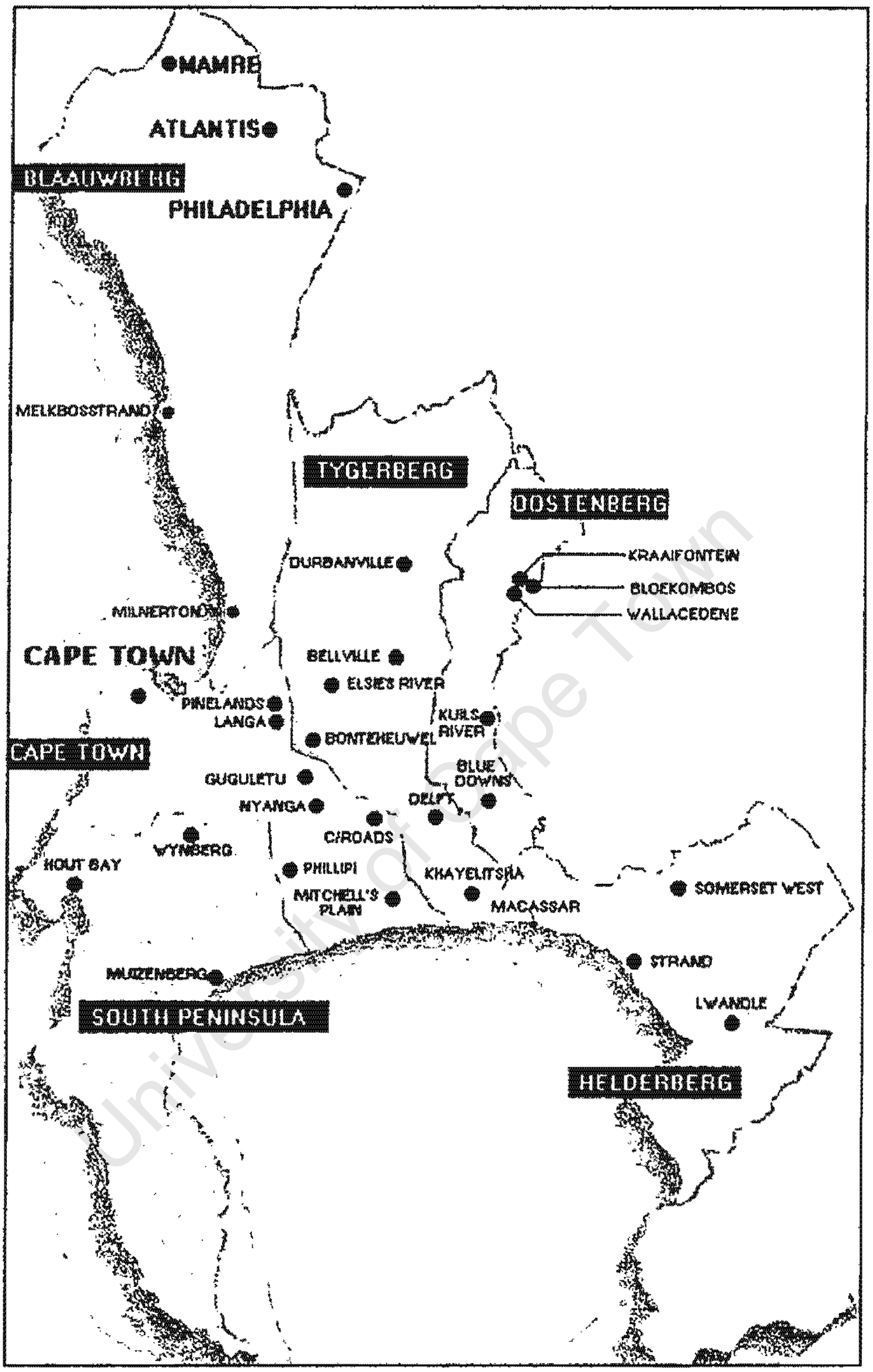


Figure 1.3: Map of the Cape Metropolitan Area - Former Municipal Units (Source: CMA, 2001)

1.4.2 Natural Environment

Geologically, three major rock types have created the topography of the area. Malmesbury Shale, Cape Granite and Table Mountain Sandstone. The erosion of these rocks has resulted in the relatively sandy, shallow and nutrient-poor soils found in the Peninsula (CPNP, 2000). The plant species which evolved have had to adapt to these harsh conditions, resulting in the many endemic species. The CMA falls within the botanical area of the Cape Floristic Kingdom which supports an impressive 4914 endemic species of flora and fauna (Huntley,1989). Most of the mountainous areas are conservation areas, the most noticeable of which is the Cape Peninsula National Park, which incorporates the Peninsula Mountain Chain. This park is surrounded by urban settlement.

The coastal environment of the CMA lies at the junction of two major Southern African marine provinces, namely: the cool Namaqua Province on the west coast and the warmer Agulhas Province on the east coast, this results in the marine biology of the area being extremely diverse (CPNP,2000). Many of the species found here are endemic to Southern African waters.

1.5 Structure of this Report

This chapter has given a brief statement of the research problem and an indication of methodology as an introduction to the thesis. The next section, **Chapter 2,** discusses current literature on the topic of sustainability indicators. **Chapter 3** provides a background for the selection of the tool investigated in this thesis, namely, the Barometer of Sustainability. Further, it investigates the techniques and philosophy applied to the Barometer of Sustainability.

Chapter 4 covers the specific methodologies of the techniques used in this research including the limitations of the research. **Chapter 5** presents the results of the research undertaken. Data from the workshop series is presented, and the Barometer of Sustainability for Cape Town is calculated. **Chapter 6** is a detailed analysis of data and a discussion of the findings. It also includes discussion on opportunities for the utilisation of these results. **Chapter 7** details the conclusions drawn from the research and provides recommendations for future research. Finally, the **Bibliography** provides a detailed list of all references used.

CHAPTER 2

LITERATURE REVIEW PART 1:

Sustainability and Sustainability Indicators - Tools for Measuring Progress

> *"Every human society exhibits a tension between a desire to exploit and an obligation to protect. Some turn to the gods to help them, some to more natural orders, others to science, technology and managerial ingenuity. " (Tim O'Riodan, 1990 in Elliot 1994).*

Throughout history mankind's attitude toward the ecosystem, which supports human activity and life, has been ambivalent. The services and functions of the ecosystem are often taken for granted, or seen as the enemy when natural disasters cause death or loss of property. Although there have been cultures which may have espoused co-operation and co-dependence with nature (Smith,1887), the dominant view was that nature must be dominated and overcome by the ingenuity of man (Goudie,1990). There appeared to be no limitation to the resources and services nature could provide, as long as man had a way to access them.

The industrial revolution heralded the era of fossil fuel usage, changing demographics and saw mankind altering the environment more completely, over larger expanses, more quickly than ever. During the latter part of the 20th Century there was a growing awareness that as a species, we have the capacity — and according to trends, the tendency — to destroy our own life support system (See Bates, 1962, Carson, 1962, Ward and Dubos, 1972, Meadows *et al* .1972, Meadows *et al.*,1992). This realisation has prompted research and critical thought aimed at overcoming this tendency to allow our technology and lifestyle to destroy ourselves.

In view of deteriorating global environmental conditions, it was a logical development that the concept of ***sustainability*** be developed and become widely accepted as a goal of human society. Sustainability requires that humankind uses resources responsibly while considering the requirements of future generations (Murcott, 1997). Measuring whether a change in policy or action has the desired effect, is therefore critical in determining progress towards sustainability.

2.1 Definitions of Sustainable Development and Sustainability

The Chambers Twenty-first Century Dictionary (1996) defines "sustain" as "to maintain; support the life of; to keep going; prolong." The concept of sustainability therefore implies that an individual, community or species, must be viable, in order to maintain or support continued life. Bossel (1999) argues that for our global ecosystem this implies a series of complex, adaptive systems, embedded in other complex systems which depend on each other, to sustain or maintain life. Maintenance of a complex ecosystem requires these systems to have robustness and the ability to adapt to stresses. Without this adaptability, the system may be devastated by a change in the *status quo*, and would therefore not be sustainable.

This ability to adapt and evolve must be maintained if systems are to remain viable i.e. cope with their changing surroundings. Thus sustainability does not imply a static state; rather it implies the ability to remain viable under varying conditions.

The phrase "sustainable development" was first introduced by the International Union for the Conservation of Nature and Natural Resources (IUCN), in its World Conservation Strategy (1980). This document stated that, "*...for development to be sustainable it must take account of social and ecological factors, as well as economic ones; of the living and non-living resource base; and of the long term as well as the short term advantages and disadvantages of alternative actions*" (IUCN *et al.*,1980, p. 23).

The World Conservation Strategy (IUCN *et al.*, 1980) focused on ecological sustainability but it recognised that the future of ecological systems, was closely linked to the social and economic activities of man. This interrelationship was highlighted in the Bruntland Report entitled "Our Common Future" (WCED, 1987), where the emphasis was on human development. Human development and intergenerational equity were seen as an integral part of ensuring global sustainability (Baker *et al.*, 1997).

The definition of sustainable development, found in the Bruntland report, has become popularised and is quoted here together with the caveats added in the original text.

> *"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:*

- *the concept of 'needs,' in particular the essential needs of the world's poor, to which overriding priority should be given; and*

- *the idea of limitations imposed by the state of technology and social organisation on the environment's ability to meet present and future needs.*

Thus the goals of economic and social development must be defined in terms of sustainability in all countries - developed or developing, market-oriented or centrally planned. Interpretations will vary, but must share certain general features and must flow from a consensus on the basic concept of sustainable development and on a broad strategic framework for achieving it" (WCED, 1987, p. 43).

Since the Bruntland Report, there have been many adaptations of this definition. Pezzey (1989), Pearce *et al.* (1989) and Murcott (1997) provide extensive lists of definitions used. Satterthwaite (1999) notes that the main difference in definitions is not so much what is covered but the extent of the emphasis given to the three aspects highlighted in the Bruntland definition, namely, meeting human needs; sustaining or keeping intact natural resources and ecosystems, and ensuring that human activities or values can be 'sustained'. O'Riordan *et al* (2000) notes that there is a growing tendency to make use of the more general term "sustainability" rather than "sustainable development" as the terminology is fraught with contention and the concept has become less of an objective and more of a pathway or transition.

2.2 The Need to Measure Our Progress

Sustainability is a complex concept but it is vital for our continued existence. Measuring our progress towards this goal is critical. Deciding how and what to measure helps decision-makers and the public define sustainability and develop objectives and targets. Measurements help prioritise issues in the face of changing circumstances. It assists decision-makers to link past and present activities to future goals and targets — indicators are a key tool in this process. Indicators provide a structure for evaluating performance and making comparisons over time, thereby ensuring that appropriate actions and policies are being implemented.

Indicators should:

- Measure change as a means of assessing progress towards achieving targets or goals of sustainable development (UNEP, 1994).
- Alert one to a problem before it gets too bad (Hart, 1997).
- Assist decision-makers to recognise what needs to be done to correct the problem (Hart, 1997).

2.3 Definition of Indicators

The term "indicator" comes from the Latin verb *indicare*, which means "to disclose or point out, to announce or make publicly known, or to estimate or put a price on" (Adriaanse, 1993 quoted in EEU,1998; Hammond *et al.*, 1995 quoted in Hardi *et al.*, 1997). Each one of us utilises indicators in our daily life as a way to accumulate information that informs our decisions. For example, we may watch the temperature, the cloud cover and wind speed to determine whether or not to go sailing or we may decide that we don't need to do our shopping at lunchtime as the shops are too crowded. These decisions are based on the information we have accumulated using our senses and interpreting this information using our experience of the world. Indicators measure simple aspects of complex events and systems, thereby allowing us to make informed decisions without necessarily knowing all the information nor understanding the system completely.

The selection and use of indicators is important, as factors measured must be representative of that system. If they are not, the information may be skewed and may misrepresent the status of the system. Knowledge of systems which interact to form the world as we know it, is filled with uncertainty so we have developed models to attempt to understand how the components of our world operate. These models are often highly simplified and incomplete. Indicators are partial reflections of reality based on imperfect and uncertain models (Meadows D. in Satterthwaite 1999).

Indicators can fall into various categories as outlined by Hardi *et al.* (1997, p8).
An indicator can be:

- a **variable** (e.g. the total amount of organically farmed products).
- a **function of variables** (e.g. a ratio, such as recycled vs. total amount of solid waste).
- a **quantitative variable** (e.g. energy use in kilowatt hours/year, gross domestic product/capita). These are the most widespread.

- a **qualitative variable** (e.g. safe–unsafe neighbourhood, participatory–non-participatory decision making), this type of indicator is important when measuring non-quantifiable issues such as cultural values.
- a **ranking variable** (e.g. acceptable or unacceptable training programme, lowest or highest mortality rate)

The majority of indicators measure the condition of specific aspects of the environment. Although they give us valuable information, they would not be considered "sustainability indicators" in and of themselves, as they only measure one aspect. Measuring progress towards sustainability is complex and requires integrated or interlinked sets of indicators or an aggregation of indicators (Hardi *et al.*, 1997).

2.4 Indicators and Indices of Sustainable Development

Indicators measure one facet of the environment whereas an index is the measurement of several facets which are then calculated together and reported as one overarching measurement. An example is the Gross Domestic Product (GDP). Sustainable development is multifaceted and therefore requires multiple measurements to represent it.

Bossel (1999) proposes a number of requirements for indicators of sustainable development. Indicators or indices of sustainable development should:

- guide policies and decisions at all levels of society.
- be holistic and measure the interactions at an intra- and intersystem level.
- be comprehensive and compact, with the smallest set of reliable indicators possible.
- identify indicators in a participatory manner to represent the visions and values of the community or region for which they are developed.
- be clearly defined, reproducible, unambiguous, understandable and practical.
- assist in the deduction of the viability and sustainability of current developments, and be able to compare alternative development paths.

The principles which should be used to measure sustainability have been summarised in what are known as the Bellagio principles. These principles are highlighted in Box 2.1.

BOX 2.1: BELLAGIO PRINCIPLES

Guidelines for Practical Assessment of Progress Toward Sustainable Development

(from Hardi, P. and T. Zdan, 1997. p.2-4, Assessing Sustainable Development: Principles in Practice. Winnipeg: IISD)

"1. GUIDING VISION AND GOALS

Assessment of progress toward sustainable development should:

- *be guided by a clear vision of sustainable development and goals that define that vision.*

2. HOLISTIC PERSPECTIVE

Assessment of progress toward sustainable development should:

- *include review of the whole system as well as its parts;*
- *consider the well-being of social, ecological and economic subsystems, their state as well as the direction and rate of change of the state of their component parts, and the interaction between parts;*
- *consider both positive and negative consequences of human activity in a way that reflects the costs and benefits for human and ecological systems, both in monetary and non-monetary terms.*

3. ESSENTIAL ELEMENTS

Assessment of progress toward sustainable development should:

- *consider equity and disparity within the current population and between present and future generations, dealing with such concerns as resource use, over consumption and poverty, human rights, and access to services, as appropriate;*
- *consider the ecological conditions on which life depends;*
- *consider economic development and other non-market activities that contribute to human and social well-being."*

4. ADEQUATE SCOPE

Assessment of progress toward sustainable development should:

- *adopt a time horizon long enough to capture both human and ecosystem time scales, thus responding to current short-term decision-making needs as well as those of future generations;*
- *define the space of study large enough to include not only local but also long distance impacts on people and ecosystems;*
- *build on historic and current conditions to anticipate future conditions: where we want to go, where we could go.*

5. PRACTICAL FOCUS

Assessment of progress toward sustainable development should be based on:

- *an explicit set of categories or an organising framework that links vision and goals to indicators and assessment criteria;*
- *a limited number of key issues for analysis; a limited number of indicators or indicator combinations to provide a clearer signal of progress;*

Continued on next page…

Box 2.1 continued…

- *standardising measurement wherever possible to permit comparison;*
- *comparing indicator values to targets, reference values, ranges, thresholds or direction of trends, as appropriate.*

6. OPENNESS

Assessment of progress toward sustainable development should:

- *make the methods and data that are used accessible to all;*
- *make explicit all judgments, assumptions and uncertainties in data and interpretations.*

7. EFFECTIVE COMMUNICATION

Assessment of progress toward sustainable development should:

- *be designed to address the needs of the audience and set of users;*
- *draw from indicators and other tools that are stimulating and serve to engage decision-makers;*
- *aim, from the outset, for simplicity in structure and use of clear and plain language.*

8. BROAD PARTICIPATION

Assessment of progress toward sustainable development should:

- *obtain broad representation of key grassroots, professional, technical and social groups, including youth, women and indigenous people to ensure recognition of diverse and changing values;*
- *ensure the participation of decision-makers to secure a firm link to adopted policies and resulting action.*

9. ONGOING ASSESSMENT

Assessment of progress toward sustainable development should:

- *develop a capacity for repeated measurement to determine trends;*
- *be iterative, adaptive and responsive to change and uncertainty because systems are complex and change frequently;*
- *adjust goals, frameworks and indicators as new insights are gained;*
- *promote development of collective learning and feedback to decision-making.*

10. INSTITUTIONAL CAPACITY

Continuity of assessing progress toward sustainable development should be assured by:

- *clearly assigning responsibility and providing ongoing support in the decision-making process;*
- *providing institutional capacity for data collection, maintenance and documentation;*
- *supporting development of local assessment capacity."* (Hardi, P. and T. Zdan, 1997, pp. 2-4).

Hardi and Zdan (1997) detail how the Bellagio Principles can guide the selection, interpretation and communication of indicators. These principles should be applied holistically to the measurement of sustainability whether referring to a set of indicators or an overarching index.

An index is a specific type of indicator which represents highly condensed information obtained by aggregating data or a set of interlinked indicators (Hardi *et al.*, 1997). Too much information can confuse the user by presenting conflicting trends thus it is sometimes beneficial to be able to determine a small number of indices which are able to present a comprehensive picture of the state of a multidimensional system being measured. A well-known example of such an index is the Gross Domestic Product (GDP) which measures the total value of production in a country. Another example is the Human Development Index (HDI), which contains indicators representing three equally weighted dimensions of human development: longevity (life expectancy at birth), knowledge (adult literacy and mean years of schooling) and income (purchasing power parity in dollars per capita and income above the poverty line) (UNDP, 1996).

In most cases the indicators being aggregated to form an index are not of equal significance. Some types of measurements may be more important than others. Weighting is often used to ensure that indicators which are more accurate, or for which a change in the measurement has a significant impact on the total system, are correctly reflected in the aggregated measurement.

There are, however, limitations inherent in utilising indicators which must be noted. For example, Hardi *et al.* (1997) recognise that there is a loss of analytical power as evaluation is based on less detailed information. Further, the complexity of the real system may be lost or not fully reflected thereby giving a misleading result (Meadows, 1998). It is possible that the indicators and indices may be used to evaluate something they do not actually reflect. Examples are: using the GDP to measure overall wealth while it actually only measures economic output (Hardi *et al.*,1997, p10), or the use of birth rates to reflect availability of family planning programmes when they may in fact only reflect the freedom of women to use such programmes (Meadows, 1998, p4).

Hardi *et al.* (1997) categorise the methodological and procedural limitations of aggregated indices as falling into four catagories.

(i) **Aggregation of data:** How can variables, expressed in different units of measurement, different time series and different spatial units, be aggregated?

(ii) **Weighting of issues:** Aggregation in this context cannot simply be viewed as the mathematical average of combined data but a weighted average of individual data. Weighting, however, requires value judgements to determine which data is more or less important than other data. Weighting therefore needs to be properly justified.

(iii) **Creation of composite indices**: Creating measurement techniques for simple characterisation of policies and activities, using as few indicators as possible, is an operational problem. Composite indices are necessary because of the integrative perspective of sustainable development. The problem of these indices is that the combination of data is frequently arbitrary.

(iv) **Procedural issues**: It is essential to ensure the reliability of data and to ensure the appropriate dissemination of data as well as having a large enough budget to cover the costs of measurement and data processing.

Despite these limitations Hardi *et al.* (1997) conclude that aggregation and composite indices can provide valid judgements about sustainable development policy performance. In order to develop an approach as to how indicators should be used and how they should be aggregated, it is necessary to develop a model or framework which provides the basis for the measurements you undertake.

2.5 Models and Frameworks of Sustainable Development

The world is comprised of a complex series of relationships and component systems which are necessary for the viability and functioning of the total system. A "systems view" attempts to produce an understandable representation of how particular elements of a system interact with each other. This requires contemplation, aggregation and condensation of information regarding what we have observed in relation to that element or the interaction between elements — the result of this effort is some kind of a model — a mental model, a verbal description, or a more formal mathematical or computer model (Bossel,1999).

The terms, “framework”, “model” and “system” have been used to refer to such a conceptual structure that helps select and organise the issues that will define how the world operates, and in turn, what indicators can be used to measure it. These frameworks, however, can not truly capture the complexity of the real world, and are therefore a simplified model which best explains our current understanding of how things operate. The fact that the model is not a complete reflection of the real world means that models are challenged and have to be adjusted constantly to accommodate different interests and values.

There are currently five dominant models influencing measurement of progress toward sustainable development and these will be briefly discussed in the next section. The models may be categorised (Hardi *et al.*,1997) as:

- Economics-based models,
- Multiple capital models.
- Theme-based models,
- Stress-response-based models, and;
- Linked human and ecosystem models,

2.5.1 Economics-Based Models

Contemporary thinking is dominated by the capitalist economic system as the overarching control of resource flows. Economics-based models have developed over time and this development will be briefly discussed below. A classic approach from economic theory is to view the world as a flow of goods and services. Economists such as Thomas Malthus (1766-1834) and David Ricardo (1772-1823) introduced the concept that there was a limit to possible economic growth as environmental goods (e.g. high quality agricultural land) provided diminishing returns as their scarcity increased (Pearce & Turner,1990). This ‘environmental limits thinking’ provided the basis for the economics–based environmental models. Goods or services which were not paid for in the production process are called externalities. Externalities were traditionally not included in the accounts and hence issues such as pollution were not included in economic measurements. As awareness of environmental issues intensified in the 1960's and 1970's this view of economics was challenged and the inclusion of environmental and social externalities and the efficient use of natural resources was introduced into models (Pearce & Turner,1990).

Several examples of economics-based models can be found in indicator literature such as the Genuine Progress Indicator (GPI) in Cobb *et al.* in 1995 (Cobb, 2000) **(Refer to section 2.6.1).** This model also provides the underpinnings for the calculation of the Ecological

Footprint in Wackernagel and Rees, 1996 **(see section 2.6.2)** and the efforts to amend the System of National Accounts in World Bank,1993 **(see section 2.6.3).**

2.5.2 Multiple Capital Models

Economists view the world as being comprised of different types of resources or capital. The types of capital can be defined as (Rees,1999 in Satterthwaite,1999):

- Human-made capital (all produced assets generally measured in financial and economic accounts e.g. fixed assets, infrastructure)
- Natural capital (stock of environmental assets e.g. soil, water, forests, atmosphere)
- Human capital (knowledge, skills, education)
- Social capital (social infrastructure)

The Bruntland Report (WCED, 1987) definition of **sustainable development** implies the provision of economic, environmental, human and social capital for future generations which is at least equivalent to what the current generation has access to. The multiple capital models, however, examine the substitutability between types of capital, as there is no indication what combination of capitals should be left for the next generation. An application **(see Section 6.2.4)** of this model is the four capitals approach of the World Bank (World Bank, 1995, 1996a).

2.5.3 Multi-Component or Theme Models

Common systemic perspectives which have been adopted to describe the environment include the multi-component model, the most common of which is the Three-component Model **(Figure 2.1).** The three components include social, economic and environmental components. There are many variations regarding which elements are included in each. Hardi *et al.* (1997) for example comment that: the social element may address some or all of the social, cultural, community, health and equity concerns. The environmental field may be restricted to narrowly defined ecosystem or bio-physical concerns, or more generally be related to ecology, natural resources and environmental development. The economic element addresses traditional economic issues such as wealth generation.

This three-component model was adopted by Carew-Reid *et al.* (1994) as the three spheres of sustainable development. A slightly different model was introduced by Hammond *et al.* (1995) for the World Resources Institute (WRI) approach for measuring policy performance

(Figure 2.2). These frameworks have a similar approach as they place "the environment" — referring specifically to the bio-physical realm — in one unit and the other aspects of human interactions in other units. Although these cognitive models indicate interaction between units, they assume nevertheless some degree of separation between people/society and the ecosystem.

Theme-based models are frequently used by community-based sustainable development initiatives (Hardi *et al.*,1997). These models often simply compile a suite of indicators which reflect the concerns of the community regarding a particular theme/issue. Some of the indicators which reflect this approach include the Oregon Benchmark Initiatives (Oregon State Progress Board, 1992 in Hardi *et al.*,1997) and Sustainable Seattle (AtKisson, 1999 in Satterthwaite, 1999) **see Section 2.6.5**. and the Environmental Sustainability Index, (Samuel-Johnston, 2001**) see Section 2.6.6**.

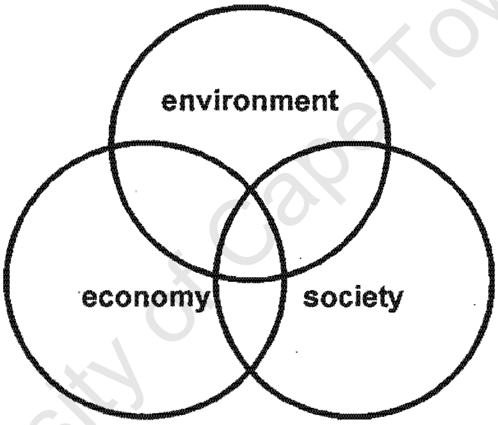


Figure 2.1: Three spheres of sustainable development (Source: Carew-Reid *et al.*, 1994)

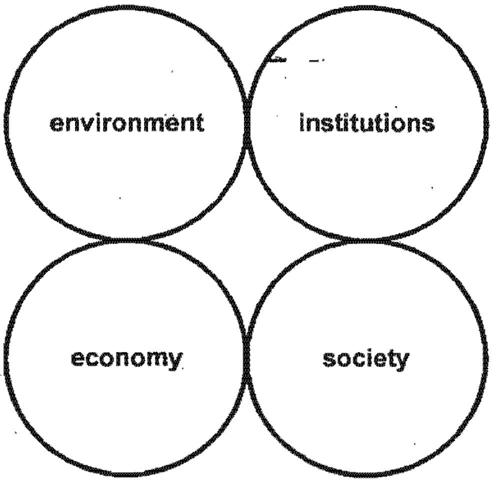


Figure 2.2: Four Spheres — UN CSD Policy Performance Measure (Source: IUCN,1999)

2.5.4 *Stress–Response Models*

The Stress-Response model (also referred to as the "condition-pressure-response model" or the "pressure-state-response model" or the "driving force-state- response model") organises information into three broad categories:

- information about the *condition* (or *state*) of the environment;
- information about human activities (*stress, driving forces or pressure*) which affect the environment;
- information about human efforts (*response*) to address environmental problems. (ANZECC, 2000).

Early applications of Stress–Response Models were adopted in, for example, the disaster management field (see Janis, 1954 in Hardi *et al.* 1997) and focused on stress imposed by the environment on people. In 1979, Rapport and Friend, used this approach to analyse environmental statistics. It was this early work which laid the foundation of the OECD's pressure-state-response model (OECD, 1993) and more recently the United Nations Commission on Sustainable Development (UN CSD,1996) version, **see Section 2.6.7**. This model is driven by the recognition that stress imposed by human activity spans physical, chemical and biological attributes. It assumes that with adequate responses, the "stress" induced impacts can be mitigated and /or prevented.

2.5.5 *Linked Human/Ecosystem Wellbeing Models*

This model was developed to apply system ideas simultaneously to the goal of maintaining or improving human and ecosystem wellbeing. Initially proposed in Canada's National Round Table on the Environment and the Economy (NRTEE,1993) it was further developed by Hodge (1995). Four types of indicator were identified as critical to developing a measure of wellbeing, (Hardi & Barg,1997, pp.64-65) namely:

- *ecosystem* (indicators facilitating an assessment of ecosystem wellbeing);
- *interactions* (indicators facilitating an assessment of the flow of benefits and stresses generated at the interface between people and the enveloping ecosystem);
- *people* (indicators facilitating an assessment of human wellbeing); and
- *synthesis* (indicators facilitating an assessment of emergent system properties and providing an integrated perspective for current and anticipatory analysis).

The Barometer of Sustainability **(Section 2.6.8)** is an adaptation of the linked human/ ecosystem model and will be examined briefly in this chapter and in detail in Chapter 3.

The usefulness of these models lies in their ability to assist in the selection of indicators and to highlight indicators which do not reflect current priorities but may emerge in the future. Hardi *et al.* (1997) comment that an effective framework serves as a template to be revisited from time to time as a test of current priorities. The models described above result from different focuses on one or other aspect of the same issue. In real world applications, different aspects of these models are often combined to produce a richer base model for indicator selection. This review serves to highlight the dominant models for Sustainable Development indicator selection against which to select an approach for the Cape Metropolitan Area SOE.

2.6 The Search for Sustainability Indices

The 1992 Earth Summit Agenda 21 is considered to be the action plan for governments attempting to address sustainability issues. Section 40.4 of Agenda 21 states that indicators of sustainable development need to be developed to provide solid bases for decision-making at all levels and to contribute to a self-regulating sustainability of integrated environment and development systems. This section describes some measurement tools which are currently available for various levels of sustainable development measurement ranging from national to regional and to local levels. Different tools have been adopted by different sectors and nations, however, there has yet to be consensus on a single approach which addresses sectoral and regional concerns.

2.6.1 Genuine Progress Indicator

The shortcomings of gross domestic product (GDP) to measure welfare or wellbeing has been the incentive for the development of a tool known as the Genuine Progress Indicator (GPI). The GPI was developed by Cobb *et al.* in 1995 to ensure that social wellbeing was included into the measurement of wealth as measured by GDP calculations.

> *"The problem with the GDP is that it does not make any distinction between economic transactions that add to wellbeing and those that diminish it, and it ignores contributions which do not have market transactions, such as those of families, communities and the natural environment. As a result, the GDP often masks the breakdown of social structures and natural habitat and, in many cases, it portrays this breakdown as an economic gain"* (Hardi *et al.*, 1997, p38).

For example, money which is spent on private security and lawyers because of crime is a sign of loss of wellbeing in a community rather than an addition to it. Likewise environmental cleanup operations resulting from polluting industries are included in the GDP when it should be subtracted from the GDP to show a statement of net benefit rather than simply a statement of expenditure (Hardi,1997,p39). The GPI uses 20 aspects of economic life which the GDP ignores (**Refer to Table 2.1**). Then it integrates these factors into a composite measure so that the benefits of economic activity may be weighed against the costs of such activity.

The GPI adds the value of products and services consumed then subtracts three categories of expense related to that consumption, namely:

- defensive expenditure
- social costs
- depreciation of environmental assets and natural resources

Table 2.1: Components of the Genuine Progress Indicator

Item	**Adjustment in GDP**
Personal consumption	positive
Income distribution	(adjusts consumption)
Value of household work and parenting	positive
Value of volunteer work	positive
Services of consumer durables	positive
Services of government capital	positive
Cost of crime	negative
Cost of family breakdown	negative
Loss of leisure time	negative
Cost of underemployment	negative
Cost of consumer durables	negative
Cost of commuting	negative
Cost of household pollution abatement	negative
Cost of automobile accidents	negative
Cost of water pollution	negative
Cost of air pollution	negative
Cost of noise pollution	negative
Loss of wetlands	negative
Loss of farmland	negative
Depletion of non-renewable energy resources	negative
Other long-term environmental damage	negative
Cost of ozone depletion	negative
Loss of old growth forests	negative
Net capital investment	positive/or negative
Net foreign lending or borrowing	positive/or negative

Source: Cobb *et al.* (1995).

An advantage of the tool is that it provides for economic contributions for aspects which were previously ignored by the calculation of the GDP. It also weighs the economic activity against the real costs of such activities. Further market and non-market activities are dealt with within a single framework which gives a long-term perspective (Hardi & Barg, 1997).

Hardi and Barg (1997) argue that a limitation of this tool is that the value of non-market products and services is difficult to measure and the assignment of negative and positive values to contributing factors as shown above in Table 2.1 is value laden.

2.6.2 The Ecological Footprint Model

The Ecological Footprint (EF) Model (Wackernagel and Rees, 1996) is a tool which calculates the productive land area required to sustain resource consumption and waste assimilation requirements for a defined entity (person, city, nation, human population or economy), in a single aggregate index. Wackernagel and Rees (1996) calculate the EF of Vancouver (through its water, energy and waste disposal demands) to be 14 times the geographic area of the city.

This model postulates a "fair earthshare" (total productive land area divided by world population) of 1.5ha apiece — a number which obviously decreases as the world population grows. The EF is therefore a function of the population and the per capita material consumption. The model assumes that all types of energy, material consumption and waste discharge require the productive or absorptive capacity of a finite area of land and water, and calculation of the model requires the incorporation of relevant income, prevailing values, socio-cultural factors and technology for the area of study (Hardi *et al.*, 1997).

An advantage of the EF is that it is a powerful and easy to understand tool. It is also strongly linked to issues of equity. Another advantage is the use of land as the numerator rather than a money or energy measure. It associates the measurement with a commodity which is fixed and universally recognised.

Hardi and Barg (1997) note that the calculation scheme needs to be more dynamic to be able to more accurately predict future footprints. The simplification of the calculation methodology can result in over-optimistic estimates which Wackernagel and Rees (1996) warn of. Another limitation is that it only considers the effect of economic decisions with respect to resource use on the environment.

2.6.3 Greening the System of National Accounts

Economic measures such as the GDP measure economic wealth but ignore the environmental, social and institutional wealth of a system and therefore are an incomplete measure of welfare. Internationally there has been an effort to integrate economic accounting and environmental accounting. Bartelmus (1999) outlines the approach of integrated accounting as the following:

a) *Segregation and elaboration of all environmental-related flows and stocks of traditional accounts* — the purpose of this is to present environmental protection expenditures separately i.e. money spent to compensate for the negative impacts of economic growth.

b) *Linkage of physical asset accounts with monetary accounts and balance sheets* — physical asset accounts covering the total stock reserves of natural assets and the changes therein. These have also become known as material/energy flow accounts.

c) *Assessment of environmental costs and benefits* — Costing and use of natural resources, noting the changes in environmental quality.

d) *Accounting for the maintenance of tangible wealth* — the concept of capital is extended to include natural as well as human-made capital. The concept of capital formation is therefore broadened as concepts of scarcity and non-renewability of capital are included.

e) *Elaboration and measurement of indicators of environmentally adjusted product and income* — costs of depletion of natural resources and change in environmental quality are accounted for in a modified domestic product.
(Bartelmus 1999, in Moldan and Billharz,1999)

Environmental components are thus added to traditional accounting methods. The greatest challenge of this approach, however, remains in the valuation of environmental aspects.

Hardi and Barg (1997) note that an advantage of this tool is that the environmental data is related to individual economic sectors. This can provide insights for resource managers and provides an empirical base for developing other sustainability indicators. The addition of satellite accounts is acceptable to economic decision –makers and as such this method has the capacity to integrate indicators that reflect the depletion of natural capital into economic decisions.

A limitation of the tool is that the changes to the system of National Accounts does not focus on integration, rather each sub-system uses its own set of indicators. Also the relationship between economic and environmental issues is mostly focused on biophysical aspects and resource utilisation. This focus means that the human and social aspects tend not to be well covered. Most importantly the tool remains controversial and there has been little progress in incorporating this system at national level (Hardi & Barg,1997).

2.6.4 The World Bank's Measure of the Wealth of Nations

The World Bank began experimenting with monitoring progress towards sustainable development in the mid-1990's (World Bank, 1995,1996a). The World Bank attempted to measure the wealth of nations by measuring the natural capital (resources) relative to produced assets (human-made capital) and human resources (social and human capital) (See section 2.5.2).

The "Measure of the Wealth of Nations" compared the different types of capitals through indicators from the study of integrated economic and environmental accounting. Natural capitals are measured through agricultural cropland, pastural land, timber, non-timber forests, protected areas and non-renewable materials.

Human-made capital is measured from fixed capital formation (including machinery and transport equipment), buildings, construction and urban land. Social capital is measured as relationships and institutions of society (social integration, social mobility, crime, political freedom) as well as growth, equity and poverty alleviation. Human capital is measured through average levels of education and health (life expectancy).

Indicators are selected to represent these categories as a monetised value. Trends are then measured by "genuine savings" as a percentage of adjusted GNP. Where the adjustment includes depletion of natural resources, damage caused by pollution is indicated as minuses, and spending on education as a plus.

A benefit of the tool is that it is easily understood as the concept of capital is extended to natural, human and social fields. The methodology is based on balance sheet calculations for national accounts and has clear policy relevance which makes it acceptable to a wide audience. It also expresses indicators in comparable units which makes aggregation easy (Hardi & Barg,1997).

A distinct limitation is that the calculations are highly advanced and difficult to understand and the presentation of the information is not transparent, as indicators are not presented in a matrix or other format. The tool focuses entirely on monetised values and therefore only those elements which can be expressed in money terms can be adequately addressed. Hardi and Barg (1997) comment that measurements in the field of social capital are not well testedwhich limit the applicability of the tool as a sustainability measure.

2.6.5 Sustainable Seattle

Sustainable Seattle was initiated in 1991 as a community-based initiative to question the environmental, social and economic problems facing Seattle's long-term wellbeing (AtKisson, 1996 in Satterthwaite, 1999). The multi-stakeholder initiative organised a task team which developed a set of draft indicators which were then taken to a wider audience in the form of a civic panel. The civic panel reviewed the draft indicators and narrowed the list and categorised the indicators into issues. The task team was then instructed to undertake a technical review of the indicators and further narrow the indicator list based on the availability of data and accessibility of the information to the general public. The indicators were then distributed to the public.

Sustainable Seattle created a list of 40 indicators which were distributed to the public in the categories of environment, population and resources, economy, youth and education and health and community. This project utilised local resources and knowledge to determine indicators relevant to local users and was widely accepted due to the participatory nature of the approach (AtKisson, 1996).

An advantage of this tool is that the indicators are identified in a multi-stakeholder process. The structure is designed to be open for regular modification and updates. The categories and indicators utilised reflect community priorities thereby recognising the importance of value judgements in measuring sustainability. The indicators are designed to be useful, educational and accessible to the public.

A limitation of the tool is that some of the indicators cannot be presented in a time series so comparisons over time are difficult. Hardi and Barg (1997) comment that the limitations of the process are that it does not emphasis target setting and that the value judgements used to select indicators are not made explicit.

2.6.6 Environmental Sustainability Index

The Environmental Sustainability Index (ESI) was an initiative of the Global Leaders for Tomorrow Environment Task Force, of the World Economic Forum (Samuel-Johnston, 2001). The progress toward sustainability is scored based on 22 core indicators each of which combines a total of 67 underlying variables. It focuses on five areas:

- Environmental systems: air, water and soil,
- Stress on environmental systems: pollution and exploitation
- Human vulnerability in the form of loss of food, shelter and exposure to disease.
- Social and institutional capacity: ability to deal with flux
- Global stewardship: ability and willingness to co-operate in collective efforts to preserve ~~persevere~~ global resources e.g. biodiversity conventions.

The ESI is calculated by taking the average of the 22 indicators across and into the five focus areas. These are then converted to a standard normal percentile for each of the five focus areas given above (Samuel-Johnston, 2001). The ESI for South Africa is shown below in **Figure 2.5.**

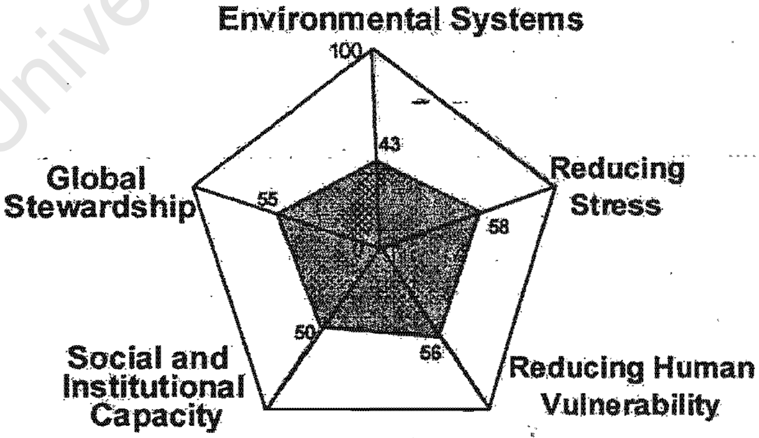


Figure 2.3: 2001 Environmental Sustainability Index for South Africa

(Source: Samuel-Johnston, 2001, Annex 5 Country Profiles)

An advantage of the tool is that it focuses on a selection of variables which are already widely collected ensuring comparability between regions. The five focus areas form a stable basis for sustainability by integrating human, social and ecosystem functions. The graphical output display is reasonably intuitive and quickly communicates the state of the system.

The calculations are however are highly advanced and difficult to understand which is a limitation and the tool requires information on a minimum of 67 variables many of which were not available for even the ESI 2001 study.

2.6.7 UN CSD Indicators

The United Nations Department for Policy Co-ordination and Sustainable Development adopted a work programme in 1995 which included a list of over 130 indicators which are grouped according to Agenda 21 chapters, in four main sectors, namely, social, economic, environmental, and institutional indicators. Wherever possible, indicators were developed to measure each component specified in Agenda 21 (Luxem and Bryld 1997 in Moldan and Billharz, 1997).

The model assumes a causal relationship between human activities and changes in the state of the environment. It therefore assumes that with adequate response (policy change) the impacts can be mitigated. The "driving force" therefore is human activity, the "state" shows the condition or status of the environment (natural and social). Response indicators reflect policy options and other responses to change in the "state" (UN CSD, 1996). Examples of the indicators used are given in **Table 2.2**.

The initial list of indicators was seen as a working list which was expected to be developed and updated over time. The UN Department of Policy Co-ordination and Sustainable Development developed methodology for the application of each of the indicators to assist countries in utilising this tool.

Table 2.2: The CSD Framework of Indicators of Sustainable Development

Category	Chapters of Agenda 21	Driving Force Indicators	State Indicators	Response Indicators
Social	Chp 3, 5 -7, 36	e.g. Population growth rate	Population density	GDP Spent on education
Economic	Chp 2,4,33,34	e.g. Capital goods imports	Share of environmentally sound capital goods imports	Technical co-operation grants
Environmental	Chp 9-20, 22	e.g. Annual withdrawals of ground and surface water	Groundwater reserves	Waste-water treatment coverage
Institutional	Chp 8, 23-32, 35, 37- 40,	e.g. -	Potential Scientists and engineers per million population	Expenditure on R&D as a percentage of GDP

Source: Adapted from Moldan & Billharz,1997 Box 2L Bryld.

The use of Agenda 21 categories is practical since it acts as a checklist to ensure that measurement covers a wide range of elements. The methodology sheets, which assist with implementation, are a benefit. The tool provides some flexibility as the full list provided in the methodology sheets can be seen as a "menu" from which countries can select appropriate indicators. A limitation however is that no method of selecting from the available menu is provided.

Another limitation of the tool is the large set of approximately 140 indicators, many of which are not geared toward decision-making. Also there has been no attempt at aggregation measures. Hardi and Barg (1997) comment that the DF/S/R approach oversimplifies interlinkages and relationships amongst issues. It ~~is~~ often ambiguous whether an indicator represents a driving force or a state e.g. unemployment . There are often multiple pressures for most states and multiple states for most pressures. e.g. fish populations are not only affected by fishing but also by pollution, weather, global warming, competition and nutrient availability. The tool lacks a holistic perspective and does not provide a measure of progress.

2.6.8 The Barometer of Sustainability

Prescott-Allen (1995) developed the tool "The Barometer of Sustainability" which assesses a region's progress toward sustainability through the systematic integration of economic, biophysical and social health indicators. It presents the outcome visually, providing an immediate picture of the human and ecosystem wellbeing. The calculation of the Barometer of Sustainability requires people to state explicitly their assumptions about human and ecosystem wellbeing so that calculated sustainability ratings can be scored against desired levels. The Barometer of Sustainability is a combination of ecosystem and human wellbeing, each measured individually by their respective indices (Hardi *et al.*, 1997, p. 51). **Chapter 3** details the Barometer of Sustainability process.

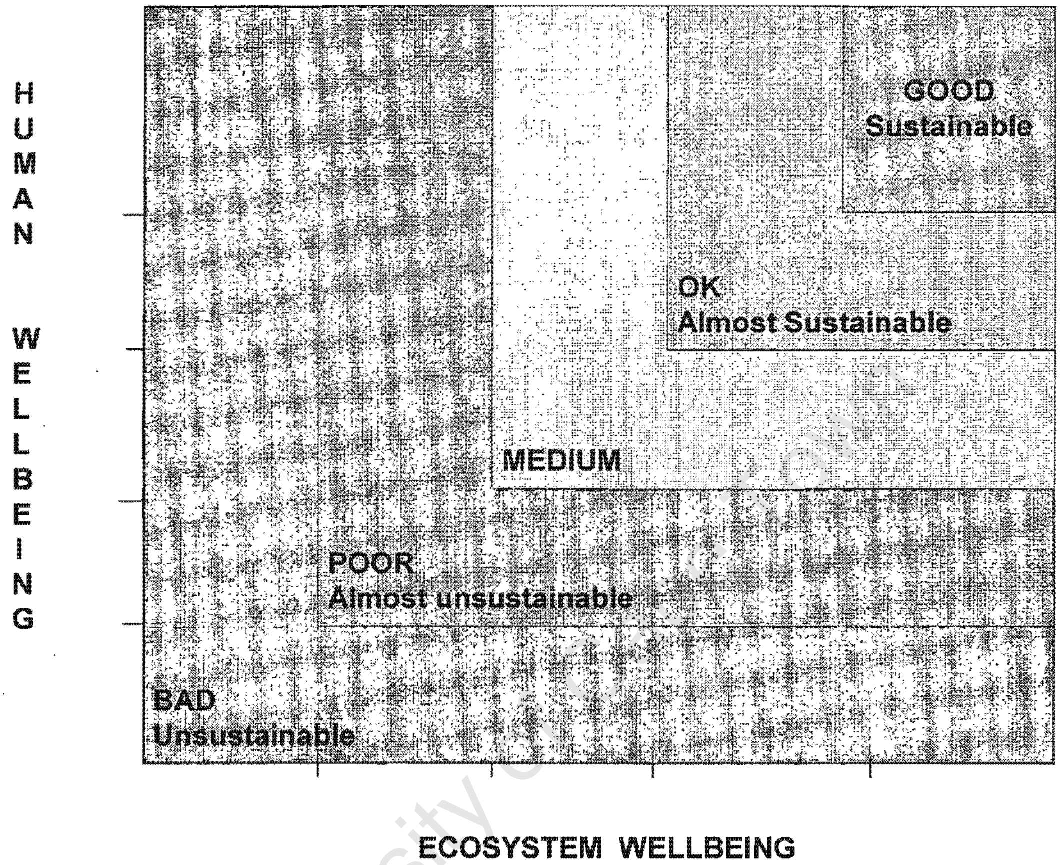


Figure 2.4 : Barometer of Sustainability (Source: Prescott-Allen in Moldan and Billharz, 1997)

The index of ecosystem wellbeing measures trends as a function of land, water, air, biodiversity and resource use indicators. The index of human wellbeing is a function of the wellness of individuals: health, education, unemployment, poverty, earnings and crime on the one hand, and business and human actions on the other (Prescott-Allen 1997 in Moldan & Billharz,1997).

An advantage of this tool is that it captures the holistic character of sustainable development through the integration of the ecosystem and the human system. The graphic format for presentation is easily understood and communicable and opportunities exist for comparative analysis. Another advantage is that the indices are combined therefore information is not lost i.e. an improvement in one factor does not mask a decline in the other. The Barometer also requires explicit statement of values used to set goals. It uses an integrated percentage scale for performance measurement, which is easy to use for calculations and easily understood. However, the scale is arbitrarily selected, and uncertainty in calculations is high.

Hardi and Barg (1997) comment that is a limitation that the weighting of indicators is left to the discretion of the researcher and/or public. Also the calculations can be made only if numerical target values or standards are available or can be created and therefore indicators, which cannot provide numerical targets, are excluded.

2.7 Selection of an Appropriate Tool for this Case Study

The literature and framework review given in this chapter provides a background for the selection of the Barometer of Sustainability as an appropriate tool for use in the further consideration of the Cape Metropolitan Area State of the Environment Indicators.

Table 2.3 summarises the advantages and disadvantages of the models examined in this chapter.

Table 2.3: Table of Advanta

Index	Advantages	
Genuine Progress Indicator	• GPI estimates economic cor • The GPI weighs economic a • The GPI provides values for • GPI provides a long-term pe	e. rs is value laden.
Ecological Footprint	• The Ecological Footprint is p • The use of land is the numer	dict future footprints. resource use on the environment. istic estimates.
Greening of the System of National Accounts	• Environmental data related t • Addition of satellite accounts • Method has the capacity to i • Provides an empirical base f	ntegration. Each sub-system uses its own set of indicators. issues- mostly biophysical aspects and resource utilisation. nal level and it remains controversial.
The World Bank's Measure of the Wealth of Nations	• The concept of capital exper focused western culture. • Methodology is based on ba • It expresses indicators in co	d. ose elements which can be expressed in money terms. a matrix or other format.
Sustainable Seattle	• Indicators are identified in a • The structure is designed to • Categories and indicators re • Indicators are designed to b	comparisons over time are difficult.
Environmental Sustainability Index	• Selection of variables which • Five focus areas -good indic • The graphical output displa	
UN CSD Indicators	• The use of agenda 21 categ range of elements. • Methodology sheets assist w • The full list can be seen as a	d as there is no attempt at aggregation cting from the available menu. ps amongst issues. It is often ambiguous whether an indicator ates for most pressures. e.g. fish populations are not only affected by and nutrient availability.
Barometer of Sustainability	• It captures the holistic chara human system. • Indices are combined theref the other. • Opportunities exist for prese • It requires explicit statement • It uses an integrated percen	nd/or public. ards are available or can be created. n is great.

(Adapted from Hardi

In order to justify this selection of a particular model, however, it is necessary to review the objectives set for this study and the criteria established earlier for good sustainability indicators. Bossel's 1999 criteria (refer to **Section 2.4**) and the Bellagio Principles **(Box 2.1)** provide the guidelines for such indicators models. These guidelines have been used to rate the models on the following categories in **Table 2.4:**

Holistic Perspective:
Does the model have a clear vision of sustainability?
Does the assessment consider the wellbeing of the whole system as well as its parts?

Adequate Scope:
Does it include consideration of equity, human and social wellbeing as well as ecosystem carrying capacity?
Does the model have a long enough time horizon?

Openness:
How accessible are methods and data used?
How explicit are judgements, assumptions and uncertainties?

Effective Communication:
How well does the model address the needs of the users?
Does the model use a simple structure and plain language?
Is broad participation a key elements of the model?

Institutional Capacity:
Is there capacity for repeated use of the tool?
Is the data required by this tool already being collected?

The ratings given by the number of are stars indicated for each model.

☆☆☆☆ Excellent

☆☆☆ Good

☆☆ Fair

☆ Poor

Table 2.4: Comparative ratings for models

Index	Holistic Perspective	Adequate Scope	Openness	Effective Communication	Institutional Capacity
Genuine Progress Indicator	☆☆	☆☆☆	☆	☆☆	☆
Ecological Footprint	☆☆☆	☆	☆☆	☆☆☆	☆
Greening of the System of National Accounts	☆	☆	☆	☆	☆
Measure of the Wealth of Nations	☆	☆	☆	☆	☆
Sustainable Seattle	☆☆	☆	☆☆☆☆	☆☆☆☆	☆☆
Environmental Sustainability Index	☆☆☆	☆☆	☆☆	☆☆☆	☆☆
UN CSD Indicators	☆☆☆☆	☆☆	☆☆☆	☆☆	☆☆
Barometer of Sustainability	☆☆☆☆	☆☆	☆☆☆☆	☆☆☆☆	☆☆☆

The objective of this study is to determine whether it is feasible to use the data already being collected in the Cape Metropolitan Area. This requires a tool which is flexible enough to utilise the base indicators data collected for the Year One (1998) State of the Environment Report. The tool is also required to be able to assist in identifying any critical missing monitoring elements. And, finally, to produce a meaningful measure of progress toward sustainability which can be easily understood and communicated to others.

Based on the aggregation tools reviewed, the Barometer of Sustainability is the only tool which allows the SOE data to be utilised without significant manipulation. It also produces a graphic output which is easily communicated as a measure of sustainability.

The next chapter focuses on the Barometer of Sustainability. It details the development of the tool by the IUCN and the supporting framework and assumptions of the Barometer.

CHAPTER 3

LITERATURE REVIEW PART II:

Barometer of Sustainability

> *"The main use of the Barometer is to combine indicators — enabling users to draw broad conclusions from an array of often confusing and contradictory signals. As such it can be employed in a variety of assessment methods. An additional use is as a communication tool, helping people to consider people and the ecosystem together" (IUCN, 1997a, p1).*

A Tools and Training Series entitled: "An Approach to Assessing Progress toward Sustainability" was released in 1997 as a result of a joint project between the International Union for Conservation of Nature and Natural Resources (IUCN) and the Canadian International Development Research Centre (IDRC). The series contained eight volumes illustrating various tools which could be applied for measuring progress toward sustainability. One of the approaches developed was a tool to display indicators graphically which was termed the **Barometer of Sustainability.**

> *"The Barometer of Sustainability is a tool for measuring and communicating a society's wellbeing and progress toward sustainability. It provides a systematic way of organising and combining indicators so that users can draw conclusions about the conditions of people and the ecosystem and the effects of people-ecosystem interactions. It presents conclusions visually, providing anyone — from a villager to head of state — with an immediate picture of human and ecosystem wellbeing" (IUCN, 1997a, p1).*

The underlying approach of "Assessing Progress towards Sustainability" was to create tools which could be adapted to local circumstances at different regional scales, and which are "people-focused". The principles are:

- Recognition of the "wholeness" of the environment, including people and the ecosystem.
- Recognition that appropriate indicators should be selected with thorough understanding of the dynamics of the system.
- Realisation that opportunities should be created for groups to reflect and learn as institutions.

The system was tested successfully at a local level in Zimbabwe, India and Columbia during 1997-1998 and has been successfully applied to 185 countries at a national level in the book "Wellbeing of Nations" being published in 2001.

3.1 Framework and Assumptions

The Barometer relies on a particular theoretical framework of the environment. To understand this framework, it is useful to consider common approaches which provide the framework for models discussed in **Section 2.5**. The Barometer of Sustainability falls under the category of Linked Human/Ecosystem Wellbeing Models.

The author, Robert Prescott-Allen (IUCN,1999) argues that multi-component models such as the three and four component frameworks as discussed in **Section 2.5** allow for a system of double or even triple counting of human issues. In the three-component model (**see section 2.5.3** and **Figure 2.1**), for example, a change in the human condition (economy and society spheres) may be counted twice as important as a change in the environmental conditions (environment) because it reflects in twice as many spheres. The Bruntland Report (WCED,1987) definition of sustainability implies a balance of emphasis between human and environmental systems. With this as a basic assumption IUCN have developed a framework which is described as the "Egg of Sustainability" (**Figure 3.1**).

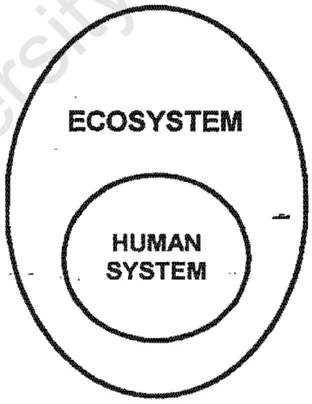


Figure 3.1: Egg of Sustainability (adapted from IUCN, 1999 p5)

In the metaphor of an egg, people depend on the ecosystem much as the yolk of an egg is surrounded and supported by the white. In turn, the white of the egg will not be healthy if the yolk is rotten. "*Just as an egg can only be good if both yolk and white are good, so a society can be well and sustainable only if both people and the ecosystem are well" (IUCN,1999, p5).*

This "dual element" approach conceptualised in the "egg of sustainability" implies a sense of interdependence and allows progress in human development and ecosystem conservation to be compared. Prescott-Allen (IUCN,1999) argues that a society is more likely to be sustainable if human wellbeing is high and ecosystem stress is low.

With the Barometer of Sustainability it is possible to determine the wellbeing of the human system and the level of stress on the environment. It is therefore possible to comment on the progress toward "sustainability" without having to determine the precise conditions which would be sustainable for any particular situation. The measure being proposed is a simple measure of human wellbeing per unit of ecosystem stress (IUCN,1999).

As mentioned earlier, the Barometer creators, the IUCN, strongly encourage the inclusion of decision-makers and the local community, in establishing the indicators to be used; the performance criteria; the weighting of the indicators during the aggregation; and in the calculation of the Barometer. In this way, one is able to include the aspirations and objectives of a community into the Barometer. This is desirable as it is their wellbeing and progress toward sustainability which is being measured. For the purposes of this study, the group used to determine the Barometer will be referred to as the reference group.

3.2 Hierarchy of Information

The Barometer of Sustainability is an index which is aggregated from a hierarchy of indicators which account for the different levels of information collected. The "egg of sustainability" can be considered the top level (a system), and each of the elements a subsystem, the two subsystems are human wellbeing and ecosystem wellbeing.

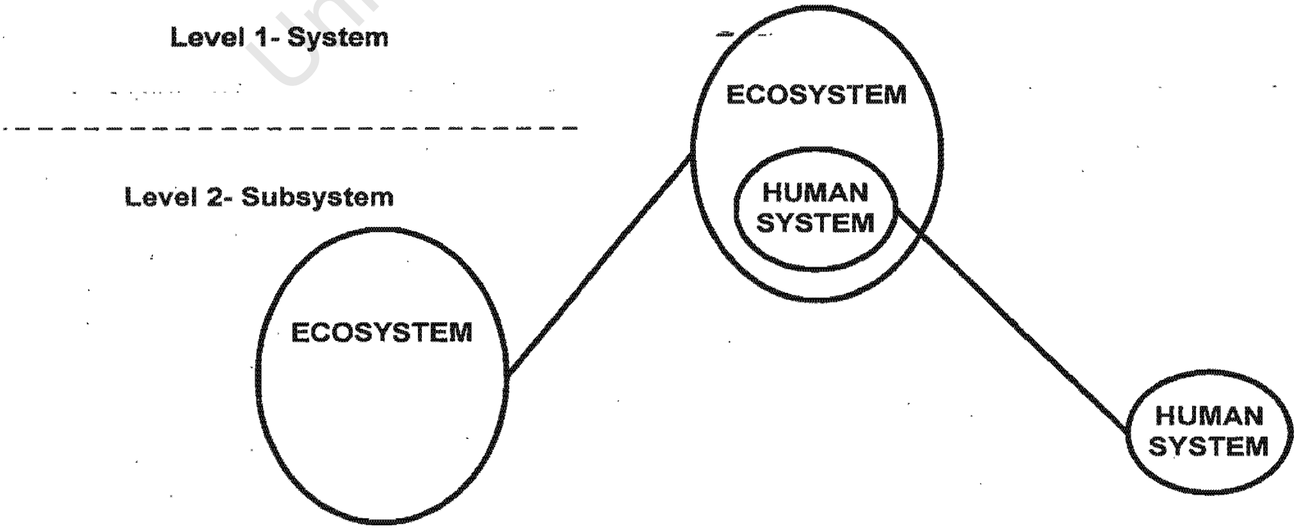


Figure 3.2: System and Subsystem Levels of the Barometer Hierarchy

This clearly specifies the two elements of concern when measuring sustainability. Each subsystem can be regarded as an aggregation of several other factors which are called dimensions. A structure was adopted by the IUCN for the Wellbeing of Nations Report (IUCN,1999), termed the System Assessment Method (SAM) which contains five human dimensions and five ecosystem dimensions. This common framework allows assessments to remain flexible and to be adapted to local conditions at an issue level while remaining comparable with other assessments and ensuring that a wide range of sustainability concerns are included. The SAM is recommended by the IUCN to ensure that Barometer results are comparable across projects, but this group of dimensions does not have to be used. **Figure 3.3** shows the common framework dimensions for the ecosystem subsystem and **Figure 3.4** shows the common framework for the human subsystem.

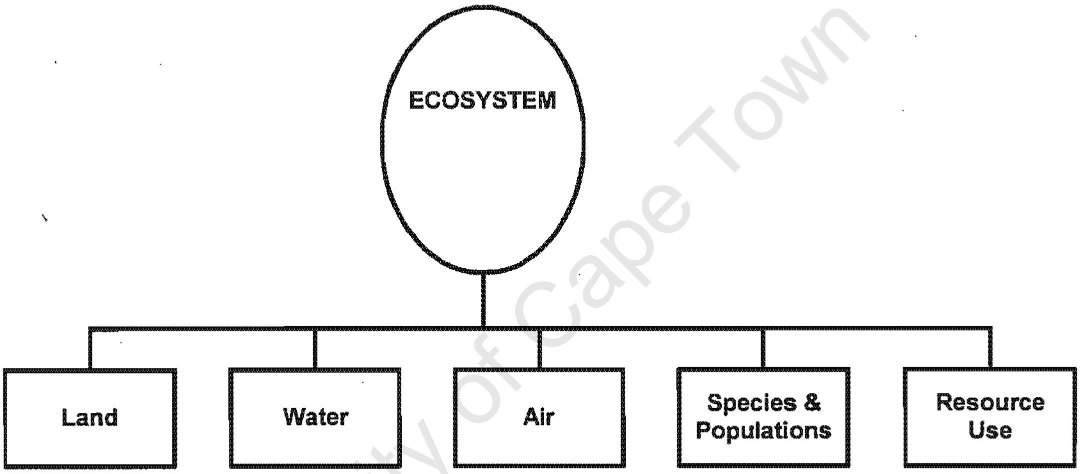


Figure 3.3: System Assessment Method - Common Framework for the Ecosystem Dimension Level of the Barometer of Sustainability Hierarchy (adapted from IUCN,1999)

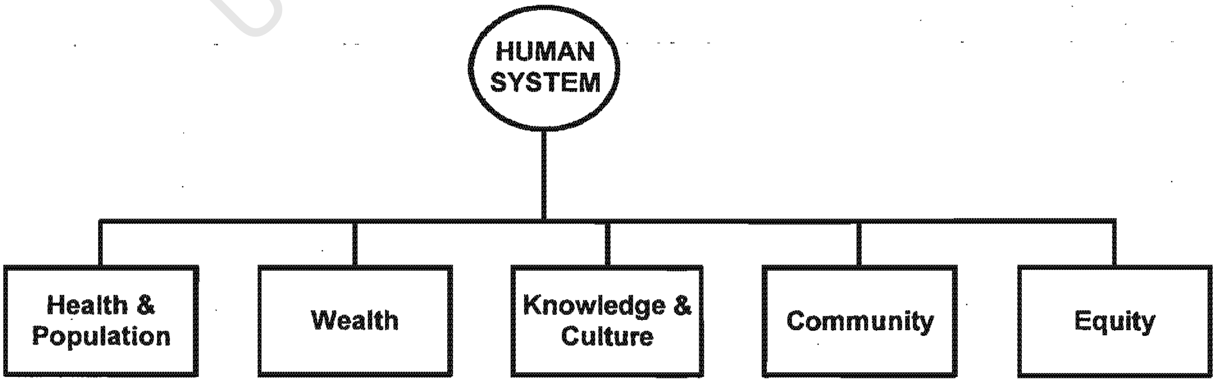


Figure 3.4: System Assessment Method - Common Framework for the Human System Dimension Level of the Barometer of Sustainability Hierarchy (adapted from IUCN,1999)

Each dimension in turn can be unpacked into a series of issues. Each of the issues may, in turn, be unpacked into sub-issues and so on. **Box 3.1** contains the definitions provided by the IUCN for each of the dimensions. **Figure 3.5** is an example of how the Barometer might be aggregated from the lowest level of information to the most aggregated system level by a reference group. Each piece of information is an indicator — no matter which level of the framework it falls into.

BOX 3.1

IUCN System Assessment Method Dimension Definitions (IUCN, 1999, p7)

LAND

The diversity and quality of land ecosystems, including their modification, conversion and degradation.

AIR

Local air quality and the global atmosphere.

WATER

The diversity and quality of inland water and marine ecosystems: modification by dams, embankments, pollution and water withdrawal.

RESOURCE USE

Energy and materials, waste generation and disposal, recycling, resource sectors such as agriculture, fisheries, timber, mining and hunting.

SPECIES & POPULATIONS

Status of wild species and wild and domesticated crops, diversity and quality habitats.

WEALTH

The economy, income, material goods, infrastructure, basic needs for food, water, clothing and shelter.

HEALTH & POPULATION

Physical and mental health, disease, mortality, fertility, population growth.

EQUITY

Distribution of benefits and burdens between males and females and among households, ethnic groups and other social divisions.

COMMUNITY

Rights and freedoms, governance, institutions, peace, crime, civil order.

KNOWLEDGE & CULTURE

Education, state of knowledge about people and the ecosystem, communication, systems of belief and expression.

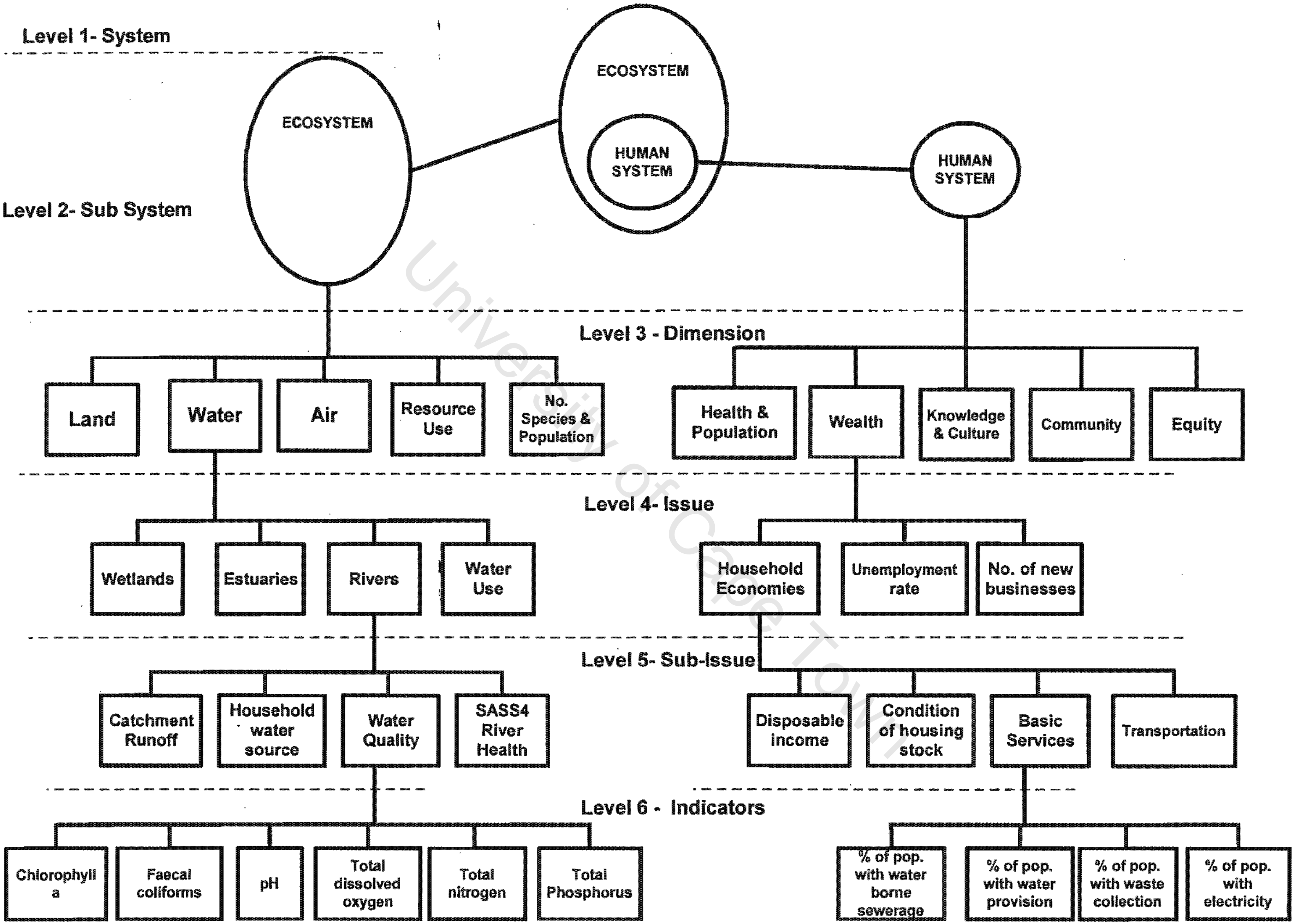


Figure 3.5: Example of the Hierarchical structure of the Barometer of Sustainability

3.3 Weighting of the Indicators

Once the reference group has established a hierarchy for the indicators, each indicator must be weighted. An example is given in **Figure 3.6** of how indicators can be positioned in branches below the dimension level.[1] Weighting places relative importance on those indicators which the reference group feels are more important or more accurate. Three kinds of weighting can be used:

- **Averaging** – if indicators are considered equally important, they are added together and the average is taken;
- **Full Weighting** – if some are regarded as more important than others, they are weighted accordingly relative to their importance before being calculated, and;
- **Veto** – if one indicator is judged to be critical, it can receive a veto function, overriding the other indicators.

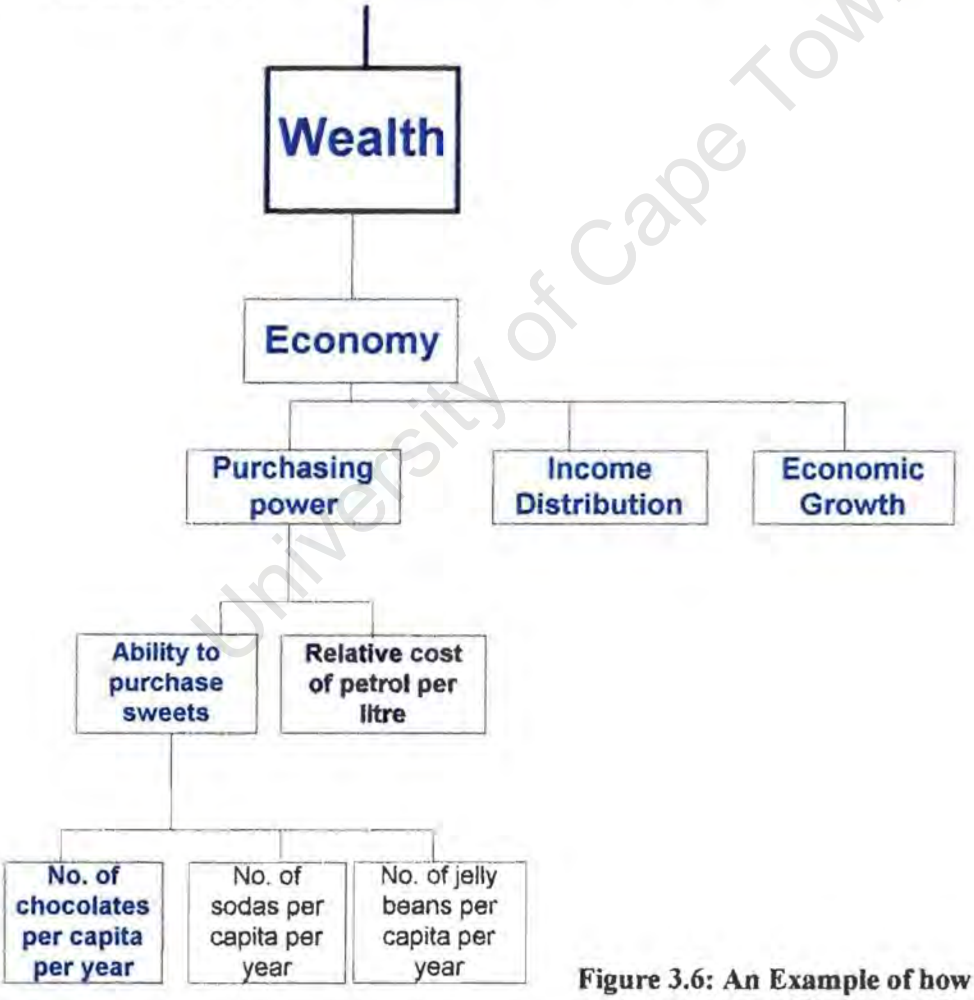


Figure 3.6: An Example of how Indicators can be positioned into a Hierarchy Under Dimensions

---

[1] *NOTE: The example used in the Figures 3.6—3.10 is the example used during the actual explanatory session with participants to describe the Barometer of Sustainability. It contains fictitious indicators and structure so as not to introduce bias when working with the actual data. The blue colour allows the path of one indicator to be followed throughout the process.*

The weighting is conducted for each level of each dimension. On any particular level the weightings can add up to no more than 1 or 100%. It is not necessary for the weightings to add up to 1 if the indicators are not fully representative of that aspect. **Figure 3.7** illustrates how weightings need to be assigned to each indicator on each level of the hierarchy.

This is achieved by requiring the group to agree on the relative importance of each indicator on a level. Assigning a percentage value to each indicator indicates the relative importance. These percentages must add up to not more than 100% for each level of each dimension.

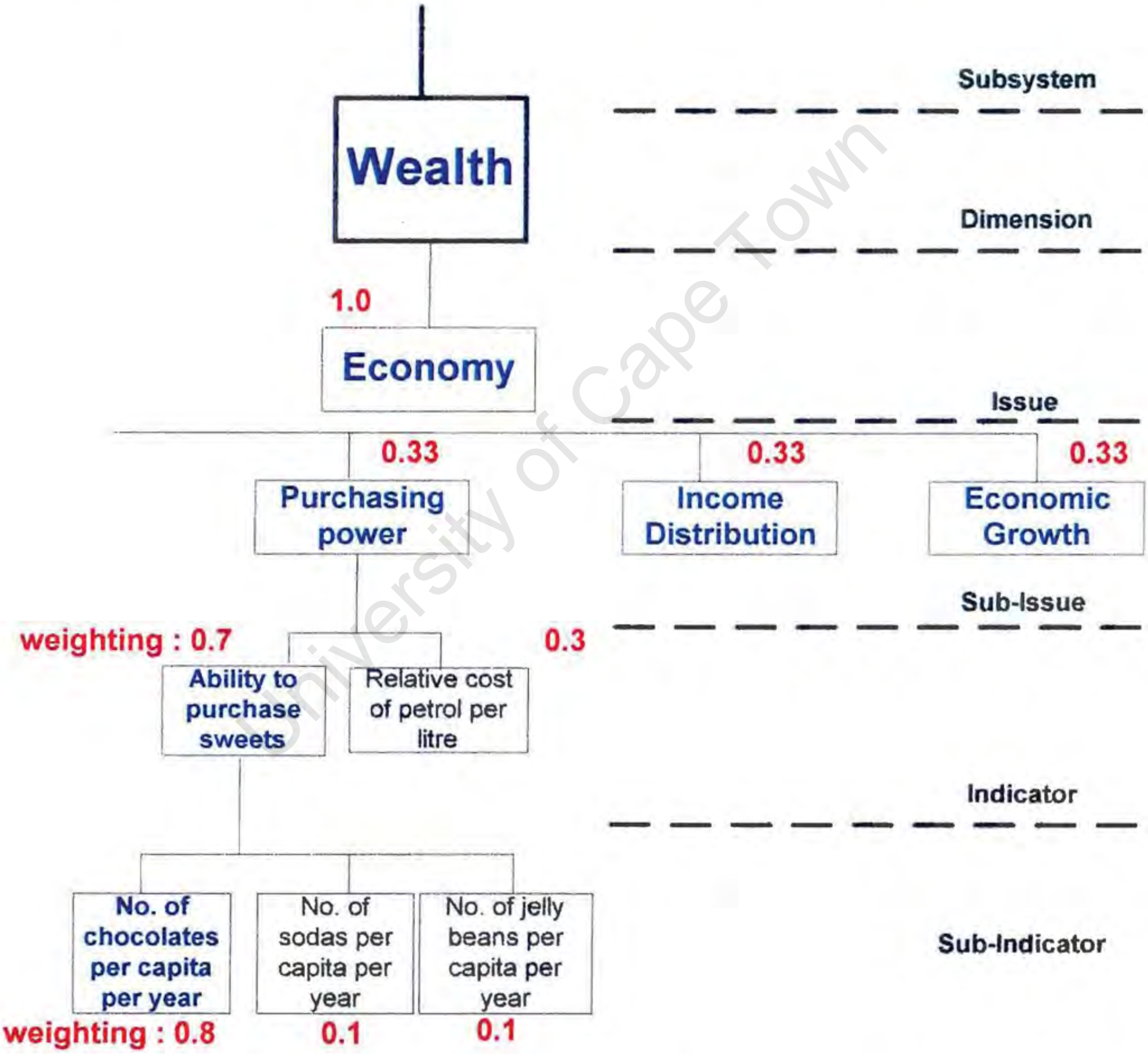


Figure 3.7: Assigning Weightings to Each Indicator at Each Level of the Hierarchy. (The figure above shows just one branch of the hierarchy. Note that the weightings on each level add to 1).

The only stipulation given by the IUCN (1999) is that, if the System Assessment Method is being followed, the ten dimensions must be equally weighted. It is argued that this is because all of these aspects are equally necessary in order to say something meaningful about sustainability.

3.4 Setting the Scale

Assessing the state of the environment and progress toward sustainability requires a wide range of indicators. Each indicator represents the state of the particular issue that it is measuring. Different indicators measure a range of things in different units. For example, in water samples, pH conditions are measured on a pH scale but total dissolved oxygen content is measured in mm/l. Combining them directly is impossible. A **common measurement unit** is therefore required for the indicators to be combined. The two alternatives frequently used, are:

- a monetary scale and;
- a performance scale .

(IUCN,1997a)

A monetary scale can be used effectively for items which are traded and therefore have a market price. Many human and ecosystem indicators, however, have no market price. It is extremely difficult to assign a fiscal value to, for example, the existence of a species. To date the economic models attempting to deal with this issue have not been able to produce monetary values which are commonly accepted for non-market goods and services provided by human and natural resources, furthermore, they are often highly technical. This type of scale therefore is inappropriate for an index which encourages community participation in its development (Meadows, 1998).

The second alternative is the performance scale. This type of scale is regularly used in the field of Multiple Criteria Decision Analysis (MDCA) and is also found in international indicator projects such as Sustainable Seattle (AtKisson, 1996). A performance scale allows the researcher, decision-makers or public to determine what measurement of a particular indicator is acceptable or unacceptable. This sort of performance scale can be linked to goals and objectives for particular indicators as set by the community or by decision-makers. The IUCN (1997a) suggests that, for the Barometer of Sustainability, it is best if a group representing the community develops the performance scale.

In the Barometer, the performance criteria need to be set for each indicator so that the units in which the indicator was originally measured, can be converted to a performance rating on a Barometer point scale. The indicator measurements are then equivalent and can be mathematically manipulated.

It is important to note that the Barometer of Sustainability can only combine indicators to which one can assign a performance value. An example of an indicator which can be assigned a performance value, is unemployment. It is possible for people to determine desirable as well as unacceptable levels of unemployment. Indicators which are neutral or are of unknown significance are excluded. For example, purely descriptive indicators, such as wind direction or temperature are important for understanding the context and surrounding environment but are not valuable as performance indicators as it would be impossible for people to assign a desirable and unacceptable level of either of these factors. These types of indicators are therefore considered to be neutral indicators.

Indicators which are of unknown significance are also difficult to place on a performance scale. For example, percentage of population in urban areas. "*There may be an optimum ratio of rural to urban populations, or a society may decide that there is. But until a desirable ratio is discovered, or agreed on, the indicator cannot be used*" (IUCN, 1997a, p6).

Recognising that there are no performance criteria for particular indicators, or that certain types of information are not being measured, may assist in focusing our efforts in researching sustainability. Due to the fact that certain types of indicators may be unusable or missing from the data set, the Barometer may not adequately cover certain important issues. The participants and recipients of the final index must therefore be made aware of what has been omitted.

For those indicators which qualify for performance setting, the scale is set by defining the best and worst values for the indicator. Performance of other countries or towns can be included if the information is available. In this way the indicators are measured and the performance scale is broken into five categories or sectors, which are: "Bad", "Poor", "Medium", "OK" and "Good". In order to ensure simplicity this is reflected on a scale of 0-100. Refer to **Table 3.1**. This particular scale has been arbitrarily chosen by the IUCN but it does provide a familiar range within which people may work. End points need not always encompass the full range of the data. A value lower than the worse result on the scale would be given a zero value while performance better than the best would be given a score of 100.

TABLE 3.1: Scaling of Indicators

Sector	Barometer Points	Indicator Measurement
Good	81-100	The range of values which would be considered 'good' or 'sustainable' by the community
OK	61-80	The range of indicator results which would be considered 'ok' or 'mostly sustainable' by the community
Medium	41-60	The range of indicator results which would be considered 'medium' by the community
Poor	21-40	The range of indicator results which would be considered 'poor' or 'mostly unsustainable' by the community
Bad	1-20	The range of indicator results which would be considered 'bad' or 'unsustainable' by the community

3.5 Calculating Barometer Points

As explained earlier the Barometer has a 0-100 scale which is divided into sectors of 20 points each. The user must define the indicator measurement range for each of the sectors. The scale needs to be set for each indicator. This involves defining the best and the worst values for that indicator. An approach suggested, is to select the end points as the best and worst that encompass the range of performance that has been experienced in the recent past and can be experienced in the foreseeable future. The worst performance is given a zero score and the best receives a score of 100.

> *"Converting indicators to the Barometer scale maintains a process of more clearly defining what we mean by human wellbeing and ecosystem wellbeing. It obliges people to state explicitly their assumptions about the significance of the indicator for human or ecosystem wellbeing, and the levels of achievement that would be ideal, desirable, acceptable, unacceptable, or disastrous"* (IUCN, 1997a, p10).

The basic scaling operation occurs in the following manner. Using life expectancy as an example, a reference group would be asked what life expectancy would fall into each of the performance categories. The reference group would establish an indicator scale (See **Table 3.2**), which is used to determine the performance of the indicator's actual measurement.

Table 3.2: Example of Life Expectancy as an Indicator

Sector	Points on scale	Indicators result (yrs)
Good	81-100	76-85
OK	61-80	66-75
Medium	41-60	56-65
Poor	21-40	46-55
Bad	1-20	26-45

If the actual life expectancy measured was **63,** a simple calculation is carried out to convert actual measurement on the indicator scale into barometer points. The equation is as follows:

[(actual - min) ÷ (max - min)] x sector points + max points of previous sector

(Adapted from IUCN 1997a)

NOTE: Scores are rounded to the nearest whole number and "*...when calculating scores within sectors, the maximum is the maximum of the sector concerned but the minimum is the maximum of the sector below it. This is because the minimum always corresponds to the zero position at the base of the scale*"(IUCN, 1997a, p24).

In this case the calculation would be :

63 (actual) - 55 (minimum) = 8
65 (maximum) - 55 (minimum) =10
8 ÷10= 0.8 x 20 (points in sector)+ 40 (points from previous sector) = 56

So an indicator value of 63 years measures 56 Barometer points and falls within the "Medium" performance sector.

There are times when the indicator scale will be in reverse and higher values will be "bad" and lower values will be "good", such as for pollution measurements. If the above calculation is used the result will be a fraction and hence the calculation changes slightly as follows:

[1- (actual - min) ÷ (max - min)] x sector points + max points of previous sector

(Adapted from IUCN 1997a)

Table 3.3: Example of Illegally Dumped Garbage

Sector	Points on scale	Indicator result (tonnes)
Good	81-100	0 - 10
OK	61-80	10.1- 20
Medium	41-60	20.1- 40
Poor	21-40	41- 70
Bad	1-20	71-200

Actual reading 45

Calculation:

45(actual) - 40(minimum) = 5

70 (maximum) - 40 (minimum)=30

5÷30= 0.167

1-0.167= 0.833 x 20(points in sector)+ 20 (points from previous sector) = 36.6 ≈ 37

So an indicator value of 45 tonnes measures 37 Barometer points and falls within the "Poor" performance sector.

The Barometer of Sustainability allows complete flexibility in setting the scales for determining performance. It allows the reference group to specify:

- the end points only, meaning that the values are equally distributed between these points—this would be known as an **uncontrolled scale**.
- only one or two sectors, and the others are equally distributed, this is a **partially controlled** scale.
- determine each of the sectors individually, which is called a **fully controlled** scale.

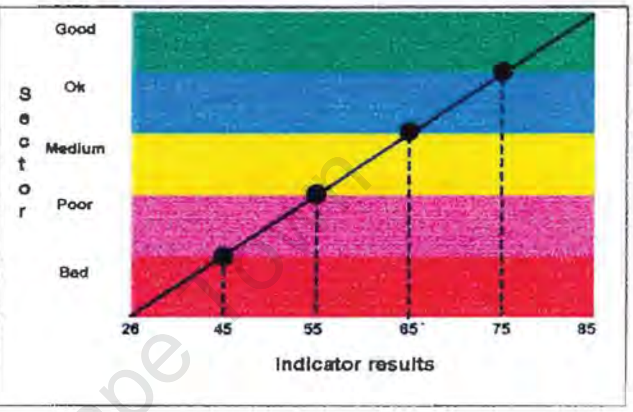
These options are allowed to ensure that there is complete flexibility in the performance evaluation of the indicators, so that the resulting scale reflects the reference groups' preferences as accurately as possible.

3.5.1 Uncontrolled Scale:

Only the two end points are defined and the intervals between them are equal. Thus each sector is 20 points apart on the scale (Refer to **Table 3.4**).

Table 3.4: Example Uncontrolled Scale
Indicator- Life Expectancy

Sector	Points on scale	Indicator result (yrs)
Good	81-100	76-85
OK	61-80	66-75
Medium	41-60	56-65
Poor	21-40	46-55
Bad	1-20	26-45

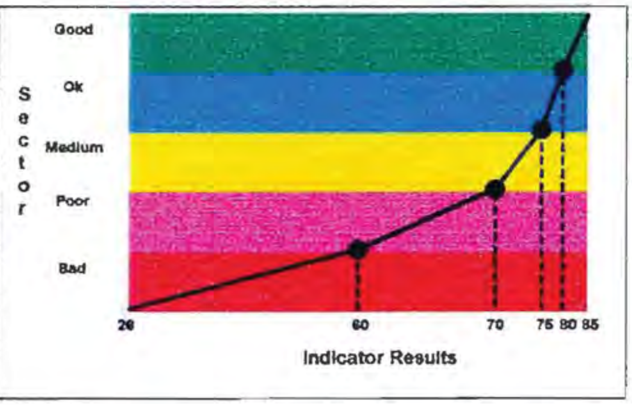


3.5.2 Partial or Fully Controlled/ Defined Scale:

If a scale is partially controlled, only one or two sectors have been specified, and the others are equally distributed. If a scale is fully controlled then each of the sectors has been individually determined (Refer to **Table 3.5**). Partial or fully controlled scales may include narrower or wider ranges of performance than the other sectors — a small increase in performance may show a big movement on the scale due to its importance or weighting.

Table 3.5: Example Controlled Scale
Indicator- Life Expectancy

Sector	Points on scale	Indicator result (yrs)
Good	81-100	80-85
OK	61-80	75-79
Medium	41-60	70-74
Poor	21-40	60-70
Bad	1-20	26-59



In the above example the references and value judgements of those setting the scale influence the position of the indicator and the shape of the curve. This is advantageous as one establishes the type of scale which is most appropriate considering the nature of the data under assessment. Calculation of indicator points uses the same basic equation no matter which type of scale is used.

Table 3.6: Example of Calculating Position on a Controlled Scale

Indicator - Life expectancy

Indicator reading: 63 years

Sector	Points on scale	Indicators result (yrs)
Good	96-100	76-85
OK	91-95	66-75
Medium	81-90	56-65
Poor	51-80	46-55
Bad	0-50	26-45

Calculation

63 (actual)-55 (minimum)=8

65 (max)-55 (min)=10

8/10=0.8

0.8 x 10= 8

8 + 80= **88**

Once hierarchy position, weighting and performance scales have been determined for each indicator it is possible to start calculating the Barometer result for the ecosystem and human system wellbeing.

3.6 Calculating the Barometer Hierarchy

The hierarchy developed for the Barometer of Sustainability is used to record the weightings and performance scale (in the form of Barometer points) assigned to each indicator. The weight and point value is written below each indicator. The hierarchy shown in **Figure 3.8** demonstrates the process detailed below. Starting at the bottom of each dimension's hierarchy, one calculates the final value for each indicator by multiplying its point value by its weighting. The final values of each indicator on that level of the hierarchy are then added together to calculate the point value of the parent indicator from which they branched. This is done for each level in turn until Barometer points have been calculated for each of the dimensions.

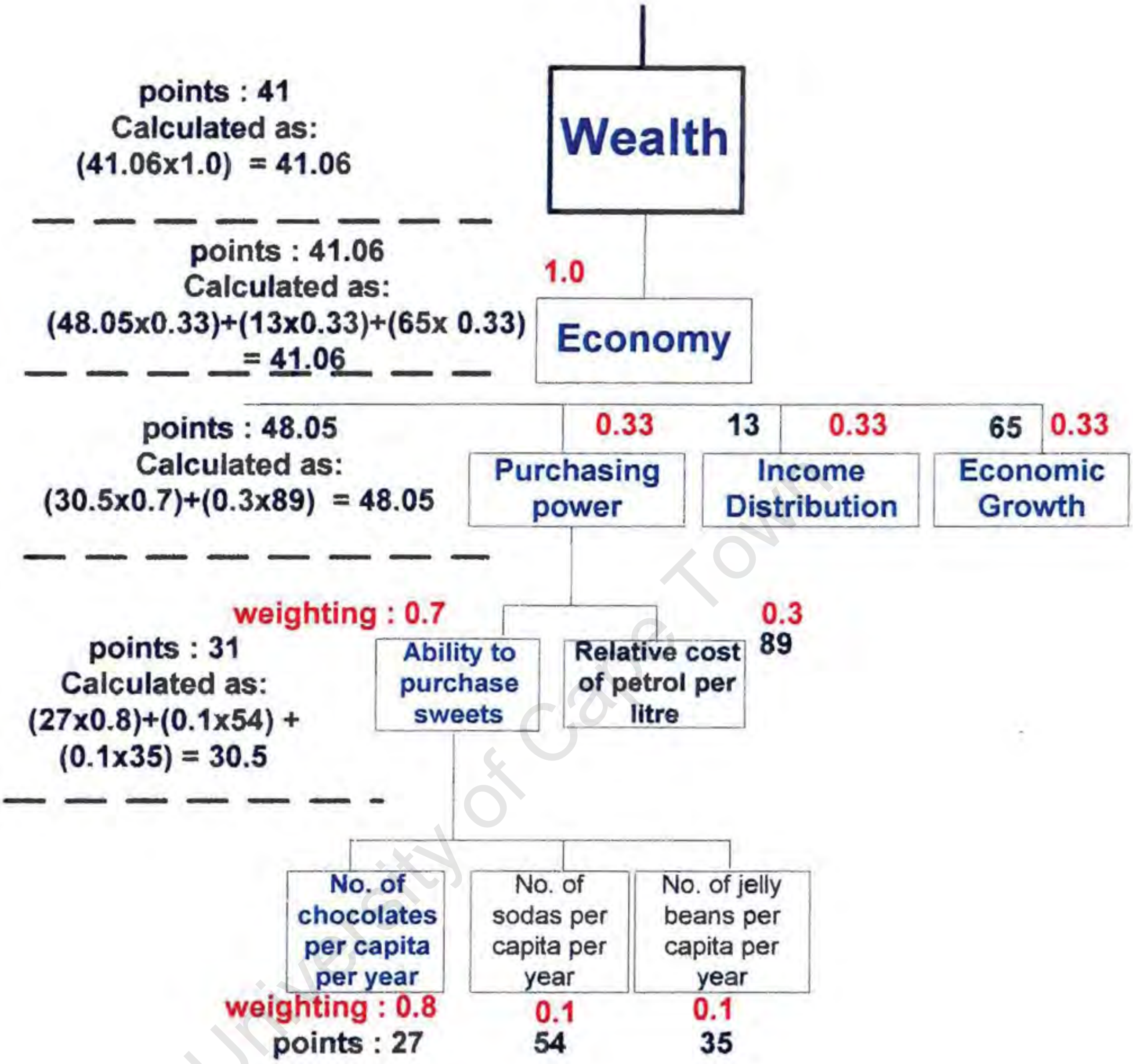


Figure 3.8: The Calculation Process to Determine the Measure of Ecosystem and Human System Wellbeing.

The dimension values within a particular subsystem are multiplied by their equal weighting of 0.2 to determine the Barometer point value of the human system and ecosystem respectively. These values are considered to be a measure of human system and ecosystem wellbeing (IUCN, 1997a).

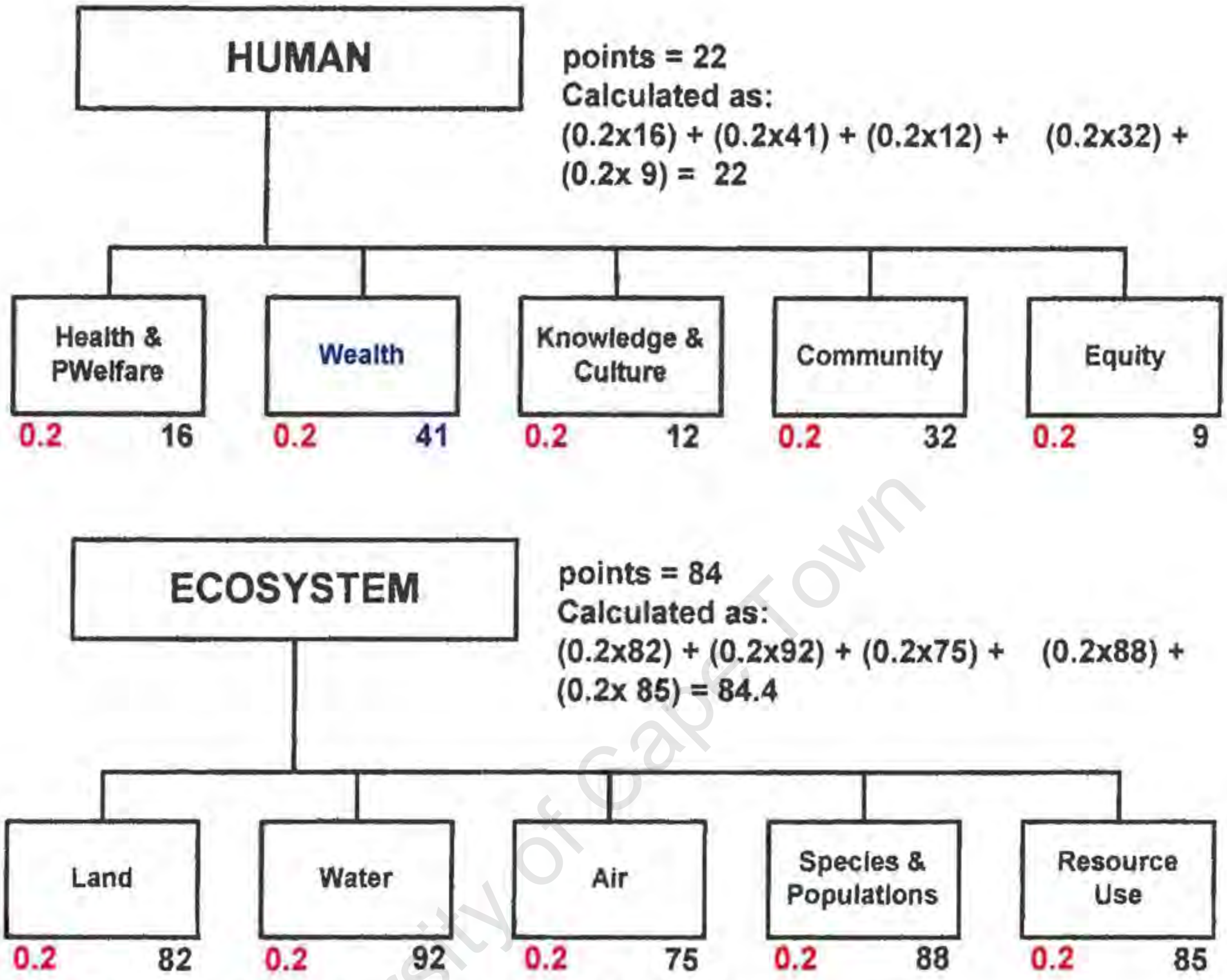


Figure 3.9: Calculation of Barometer Points for Each of the Dimensions

Assuming the calculation of barometer points has occurred for each of the dimensions you will have a series of results for each dimension as shown above. These values are used to calculate the Ecosystem and Human Wellbeing values.

3.7 Graphical Output

The final product of the Barometer of Sustainability is a graphical representation of the aggregated information. The Barometer is represented as two axes, one for human wellbeing represented on the y-axis and the other for ecosystem wellbeing on the x-axis. Continuing the example represented in the **Figures 3.6, 3.7, 3.8 and 3.9** the results of this example are plotted on the standard representation of the Barometer of Sustainability as shown in **Figure 3.10**.

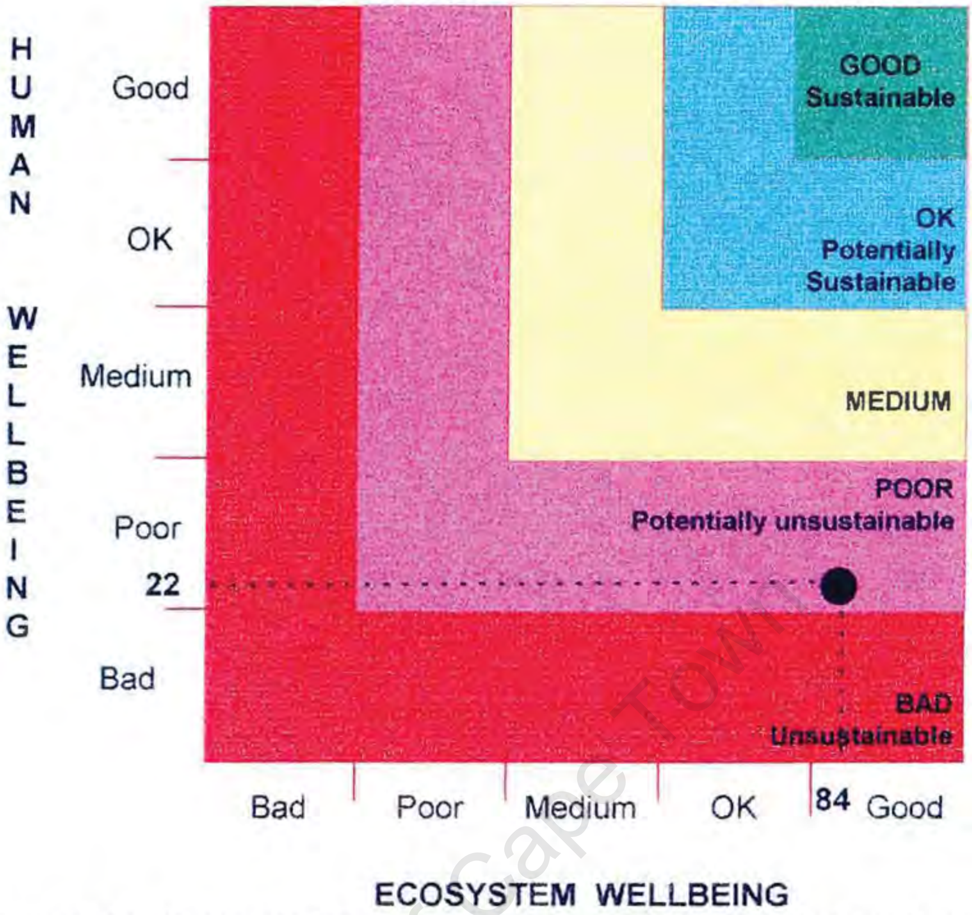


***Figure 3.10**: **The Barometer of Sustainability Graphical Result** (adapted from IUCN, 1997a)*

3.8 Conclusions

The Barometer of Sustainability is useful because it is a graphical summary of the state of the environment. The value judgements and assumptions are explicit, which allows a complex set of value systems to be incorporated through co-operation and negotiation between different stakeholders. The Barometer does not therefore replace an analysis of the key issues but can be used to communicate and highlight key issues. "*Together, the results and the analysis will enable politicians, officials and the public to draw conclusions about conditions of people and the ecosystem, the main interactions between people and the ecosystem and priorities for action*" (IUCN, 1997a, p29).

The Barometer will be used in this dissertation to examine sustainability within the Cape Metropolitan Area using the data obtained from the State of the Environment Report 1998 indicators. This data will be used to develop a Barometer of Sustainability for the CMA. It will also be used to assess the effect which alternative values and judgements of stakeholders in the CMA could have on the results produced by the Barometer process. **Chapter 4** details the methodology adopted for this thesis and considers the limitations of the research.

CHAPTER 4
METHODOLOGY

"...curious that it is scientific specialisation which eventually leads us to realise the interconnected nature of life" (Ward and Dubos, 1972).

This chapter details the techniques used to obtain data for the CMA Barometer of Sustainability. The sampling methods and procedures are explained together with a detailed description of the analysis techniques applied. The results of these activities and procedures are documented in Chapter 5.

4.1 Summary of Steps Required to Calculate a Barometer of Sustainability

The IUCN generated technique to develop a Barometer of Sustainability is summarised below:

STEP I: Select community /reference group.

STEP II: Define system, goals and identify issues.

STEP III: Develop the hierarchy and identify indicators to be measured.

STEP IV: Select performance criteria.

STEP V: Measure selected indicators.

STEP VI: Weight indicators.

STEP VII: Choose combining procedure.

STEP VIII: Plot each indicator's actual measurement onto its own performance scale to determine a reading between 1-100.

STEP IX: Record the weighting and Barometer points for each indicator under its position in the hierarchy.

STEP X: Multiply the weighting and barometer point value for each indicator to obtain the final value.

STEP XI: Add all indicator final values up the hierarchy to the subsystem level to obtain the index of ecosystem wellbeing and human wellbeing respectively.

STEP XII Plot the Barometer point value of ecosystem wellbeing and human wellbeing .

The process, which was adopted for this study, differs from the original IUCN process in that the indicators had been selected and measured by the SOE report. The Barometer is therefore being retroactively applied to this pre-selected set of indicators. The potential limitations of this adapted approach are discussed in section 4.10. The steps followed in this study are as follows:

STEP 1: Select a reference group to develop Barometer of Sustainability — this group will determine the hierarchy, weightings and performance scale required for the index (Refer to section 3.1).

STEP 2: Utilise the SOE selected indicators (Refer to sections 3.1 and 3.4).

STEP 3: Structure the indicators to form a hierarchy (system, subsystem, dimension, issues, sub-issue). (Refer to section 3.2).

STEP 4: Determine weightings for all indicators within a level for all branches of the hierarchy (Refer to section 3.3).

STEP 5: Develop a performance scale for each indicator at the most basic level (Refer to section 3.4).

STEP 6: Plot each indicator's actual measurement onto its own performance scale to determine a reading between 1-100 (Refer to section 3.5).

STEP 7: Record the weighting and Barometer points for each indicator under its position in the hierarchy (Refer to section 3.6).

STEP 8: Multiply the weighting and barometer point value for each indicator to obtain the final value (Refer to section 3.6).

STEP 9: Add all indicator final values up the hierarchy to the subsystem level to obtain the index of ecosystem wellbeing and human wellbeing respectively (Refer to section 3.6).

STEP 10 Plot the Barometer point value of ecosystem wellbeing and human wellbeing on the standard Barometer output graph and draw lines through the points perpendicular to the axes. The point of intersection of the lines drawn represents the overall assessment of the study area's progress toward sustainability (Refer to section 3.7).

4.2 Selection of Reference Group (STEP 1)

It has been shown by many researchers, such as Watson (1931), Shaw (1932), Thorndike (1938) and Laughlin (1980), that when undertaking complex tasks, groups operate better than individuals. Solutions of a higher quality are possible due to the interaction of the group members, resulting in ideas and insights which no one member of the group would have produced alone (Johnson and Johnson, 1997).

It is both this group phenomenon and the principle of inclusion which are important to the Barometer of Sustainability. The Barometer of Sustainability requires, by design, several community representatives to determine regional criteria for what is sustainable or acceptable to them. Prescott-Allen (1995) states that it is in the process of contemplating the issues of sustainability that much of the Barometer's value lies, rather than simply its graphical outcome.

The CMA is a very diverse region and a truly representative group would be very large, if it were to represent all interests. Cape Town has a population of over 3 million and this includes four different race groups with distinct cultural and religious influences. The legacy of apartheid in South Africa has caused people to be protective of their social and cultural identity and to become politicized therefore participative processes require that the a very large number of people be included to reflect the social dynamics present in the metropole. Stech & Ratliffe (1979) argue that the larger a group the more difficult it becomes to assess complex issues, as the group dynamics become more complex and the quality of the solution can deteriorate. They suggest that an ideal group size is five to eight people. It was deemed, therefore, that for the purposes of this study it is sufficient to have a series of reference groups of between five and eight persons representing different sectors of the community. These groups would be used to determine a CMA Barometer of Sustainability using the 1998 SOE indicators.

The three reference groups were used, representing the following sectors:

- University Staff and Students
- Local Government Officials
- Non-Governmental Organisations

These particular reference groups were chosen for the following reasons:

- It was important to select groups which were familiar with and knowledgable about environmental issues, terminology and interlinkages. This precluded the need for the author to undertake any form of education to prepare individuals for participation.
- The project had no external funding hence it was necessary to identify groups who would be sufficiently interested in the outcome to volunteer at least 8 hours of their time to the study.
- The sectors chosen are highly organised structures and could be easily contacted.
- The selected sectors were expected to have distinct opinions about the state of the environment which would allow for the examination of the Barometer's sensitivity to the value judgements being introduced.

All participants volunteered to be involved in the workshops. A list of participants and their affiliation is given in **Appendix 1**.

4.3 Selection of Indicators (STEP 2)

The Cape Metropolitan Council 1998 State of the Environment Report (SOE) was used as the data source. This report was used because the objective of this study is to assess the suitability of the indicators used in this document to achieve the CMC's stated sustainability goals. Each indicator in the text was extracted together with its actual indicator measurement and relevant information regarding the timeframe or guidelines used. These were listed in the approximate order in which they were found in the SOE (CMC, 1999). The indicators were given a numerical identification code in order to be able to identify them quickly when building the hierarchy. A table of indicators and their identification codes is given in **Appendix 2.**

4.3.1 Provision of Additional Contextual Information for Indicators

The Barometer requires the group to make value judgements about the indicator results hence it was necessary to provide them with sufficient information to place the indicator and the measurement in a national and global context. For this reason, information contained in the indicator lists produced from the 1998 SOE was annotated before being given to the reference groups. The indicators were listed numerically and given a descriptive name as well as the 1998 SOE result/measurement. Where possible, a description of the indicator was added to the list detailing the nature of the substance/issue being measured. Additional regional or global information useful for assisting the group in establishing a scale was also provided where available. The two main sources of information used to provide the global context information for the indicators, were:

i) The United Nations Development Programme Human Development Report 1999 (UNDP, 1999)

In the UNDP Human Development Report, various indicators are used to calculate a Human Development Index (HDI). Countries are classified as having high, medium or low HDI. South Africa is considered to have a medium HDI. In general, countries which have a high HDI are first world countries, and those with a low HDI are third world countries. The supplementary information derived from this report was the average measurement for high HDI countries, the average measurement for medium HDI countries, and the lowest reading in the medium HDI countries. An example of an indicator with additional information taken from the HDI Human Development Report is given below.

EXAMPLE

No.	Indicator	SOE result	Information
54	Dependency ratio	**52**	The dependency ratio is defined as the ratio of people under 15 and over 64 to the working-age population, aged 15-64 (UNDP, 1991). **SA Result: 64.4** **High HDI Ave Result: 49.6** *(1st world countries)* **Med HDI Ave Result: 46.6** **Medium HDI Worst Result: 86.3**

ii) United Nations Centre for Human Settlements (UNCHS) Habitat : Urban Indicators Programme Update 1998 (UNCHS, 1998)

The United Nations Centre for Human Settlements (UNCHS), also known as "Habitat", promotes sustainable urban development through policy advice, capacity-building, knowledge creation and the strengthening of partnerships between governments and civil society. A database of urban indicators from more than 80 cities across the world has been established by UNCHS. Supplementary information was generated from the mean and median of the data provided for the 80 cities. The arithmetic highest and lowest values for a particular indicator across all cities were also provided. An example of an indicator with additional information taken from the Habitat Urban Indicators Report is given below.

EXAMPLE

No.	Indicator	SOE result	Supplementary Information
29	Volume of waste in the landfill	0.34t/yr per capita	Tons of waste per capita per annum Habitat II Mean = 0.43 Habitat II Median = 0.29 Habitat II Lowest = 0.01 Habitat II Highest = 8.0

Due to the complex nature of the information provided in the SOE report and the fact that the Barometer of Sustainability was unfamiliar to the reference groups, it was decided that a "pre-workshop" information meeting should be held to describe the tool and the indicator matrix which would be utilised during the workshop. The indicators and supplemental global-context information described above, was presented at a pre-workshop meeting as a Background Information Document (**Appendix 2**). This document provided the reference group with all the information necessary to calculate a Barometer for the CMA. The original SOE document was not provided but official summary documents were available to participants in hard copy and on the CMC website prior to the Barometer workshop.

4.4 Determination of the Barometer Hierarchy (STEP 3)

The workshop venues were chosen to ensure that participants had sufficient space and light to spend long periods of time in the room without discomfort. Refreshments were made available and the participants encouraged to move freely about the room and eat or drink whenever they wished. The room was arranged with a table and chairs in the middle. Ten A1 sheets of paper were stuck to the wall with the ten dimension names written at the top (one per page). The indicators had been printed on separate individual adhesive squares of paper so that they could be pasted onto the dimension sheets.

A sample completed Barometer hierarchy was given to each of the participants. The facilitator explained to Group 1 that this was a suggested structure which the group could modify until it fitted their understanding of the environment. The suggested hierarchical structure was not used for Group 2 and 3 as Group 1 reported that it did not feel that it was useful and did not save time as was its intention.

4.4.1 Determining Indicator Dimensions

Each of the group members was given a matrix which listed the indicators and the ten dimensions to which they could be assigned, as well as a category for indicators which they felt should be excluded from the structure. The definitions for the dimensions are given in **Box 3.1**. An example of the matrix completed by the participants is given below.

EXAMPLE

		X	Land	Air	Water	Resource	Species	Wealth	Health	Equity	Community	Knowledge
No.	Indicator											
1	Commuter trip length	✓										
2	Property appreciation							✓				
3	CMA Population								✓			
4	Ecological Classes-River				✓							

X = exclude this indicator

✓ *filled in by participant- each indicator is assigned to one of the dimensions or excluded*

It was emphasised that exclusion of an indicator did not necessarily mean that the information it conveyed was not valuable, only that it was unscalable using the Barometer of Sustainability's criteria for scaling indicators (**Section 3.4**). The group was required to assign each indicator to a dimension without discussion. Questions of clarity were allowed, to ensure that participants were confident that they understood each individual indicator. Group 1 undertook this exercise during the workshop, whereas Groups 2 and 3 were issued matrices at the pre-workshop meeting and asked to complete and return them before the workshop session.

Once the individual dimension assignment matrices were completed, the group was asked to agree on a level of consensus at which it would accept the dimension assignment without further discussion. The matrices represented the individual participants' opinions as to where (under which dimension) a particular indicator should be placed in the Barometer structure. The facilitator suggested that if 75% of the participants' matrices placed a particular indicator into a particular dimension, this should be accepted. That indicator would then be moved onto the A1 dimension sheet on the wall. The group was allowed to decide whether it accepted this consensus ruling or whether additional arguments for placing the indicator in a different dimension would be heard even if the consensus limit was reached. Occasionally, despite the majority of participants assigning an indicator to a particular dimension, some specialist insight was raised by a member of the group and used to convince the others that the majority view was incorrect. This was permitted.

4.4.2 Finalising Indicator Hierarchical Structure

The averages of the matrix results were read out and if there was consensus based on the matrix results there was no further discussion. However, if there was no clear majority, the group was encouraged to discuss the indicator to determine where it should be placed. If an indicator was to be excluded from the hierarchy, it was removed from the dimension pages. Once all the indicators were assigned to the accepted dimension, the indicators were arranged into hierarchies by group consensus.

4.5 Determining Weighting for Indicators Within Structure (STEP 4)

The weighting of each indicator was then undertaken by the entire group (**Section 3.3**), the facilitator prompting discussion by posing the question: "how important are the indicators on this level relative to each other?" The facilitator prompted with questions to promote discussion until there was consensus regarding the weighting to be assigned.

For the purposes of this study, it was decided that the weighting on each level should add up to 1 or 100% (refer to section 3.3). This was done to force the reference group to make value judgements about the pre-selected indicator set rather than allowing them to defer judgement to include non-existent indicators.

The distinction between combining procedures, namely averaging, veto and full weighting (refer to section 3.3), was not made, in the study or with the reference groups during their workshops. They are simply different nomenclature for a process of assigning importance to the available indicators on a level. The participants were instructed to weight the indicators and were not told of the names of these possible combining procedures. This was done to simplify the process. All three combining procedures were however utilised by the participants under the terminology "weighting of indicators".

4.6 Determining Scales for Indicators (STEP 5)

Overhead projector transparency sheets with the "good to bad" Barometer categories and the associated 20 point increments were used. The group was required to develop a scale based on the information in the Background Information Document — namely indicator measurement, the additional information, global context — and their own value judgements. The specific indicator result was thereby converted to Barometer points which represented its performance as determined by the reference group. The calculation used for this conversion is detailed in **section 3.4** in **Chapter 3** and a worked example is illustrated below. The scales determined by the groups are provided in **Appendix 3**.

It should be noted that although the Barometer methodology provides for "controlled" and "uncontrolled" point scales, it was decided that it would be easier for participants in this research if all the scales were provided as uncontrolled scales. The Barometer sectors are therefore represented by 20 points each. The indicator scales however were controlled completely by the participants and therefore the freedom of scaling allowed by the IUCN was retained. An example of the scaling is given below.

EXAMPLE:

Indicator no: ***13***

Indicator name: ***Car ownership - vehicles per 1000*** (SOE result= 170)

Sector	Points	Indicator Scale
Good	81-100	***<100***
OK	61-80	***101-120***
Medium	41-60	***121-140***
Poor	21-40	***141-160***
Bad	1-20	***160-200***

4.7 Calculating the Barometer of Sustainability (STEPS 6- 10)

The details of the structure of the Barometer, the relative weightings and the scales assigned to each indicator were recorded during the workshop by a research assistant on a spreadsheet (Microsoft Excel). The spreadsheet included the formulae which calculate the Barometer point values (**Section 3.3**) which were then multiplied by the assigned weightings.

The resultant value was then written onto the wall sheets under each indicator. The values were added together up the hierarchy and a value was calculated for each of the dimensions in this manner. The dimensions were added together with equal weightings to determine the axis value. The value for the wellbeing of human systems and ecosystem wellbeing was finally used as co-ordinates to plot the State of the Environment as a single point on the Barometer's graphical output. The calculation spreadsheets and scalings from the three groups are included as **Appendix 3**.

It was determined from comments in the first two workshops that the reference groups had difficulty assessing the final Barometer hierarchies due to the amount of information on them. In the Group 3 workshop, coloured stickers relating to the colours used for the Barometer sectors were used to aid visual interpretation and quick identification of low-scoring indicators. This adaptation worked very well and aided immediate visual analysis of the hierarchies. This technique has been also been used for the hierarchy reporting in **Chapter 5**.

The calculation of the Barometer was originally planned to be undertaken during the workshops. However, due to time constraints, was actually completed after the workshop and emailed to the participants. The participants were sent their graphical Barometer display and asked to comment on the following questions:

- Does the outcome of the Barometer of Sustainability reflect your sense of the CMA state of the environment?
- Comment on the process we used to develop this index.

Notes and observations from the workshop sessions are included as **Appendix 4** and the participants comments are included as **Appendix 6.**

4.8 Method of Data Analysis

4.8.1 Comparison of workshop results

The results from the three groups were plotted on a Barometer of Sustainability graph to compare the graphical relationship between the results.

- A comparison was undertaken to determine which indicators were excluded and to what degree there was agreement between the groups as to which indicators should be excluded. The results of this comparison were graphed using a bar graph.
- A comparison was undertaken to determine which dimension indicators were assigned to the different groups and to what degree there was agreement between the groups. The results of this comparison were graphed using a bar graph.

The analysis of the results is included as **Appendix 5**.

4.8.2 Group Responses to the Workshops

The responses to the emailed Barometer graphical output and questions detailed in section 4.7 were compiled and are detailed in **Appendix 6** and discussed in Chapter 6.

4.9 Testing Index on 1999 Data

The sensitivity of the hierarchies to a change in the indicator measurements was examined. An attempt was made to model the hierarchies obtained from the workshops by using a computer programme, V.I.S.A. (Visual Thinking International Limited, 2000) which uses a Multiple Criteria Decision Analysis approach. This attempt was largely unsuccessful as there appear to be too many variables operating in the Barometer of Sustainability process. The sensitivity of the Barometer to change in indicator measurement was therefore tested by introducing the 1999 SOE data (CMC,2000) into the 1998 hierarchies which had been established by each of the groups. Due to the fact that some of the indicators used were changed between 1998 and 1999 only those which are common to both years can be incorporated into the index. The 1999 hierarchies have been included in **Chapter 5** and the list of 1999 indicators is included in **Appendix 7**.

4.10 Limitations of the Study

The Barometer of Sustainability process was created to work from first principles to create a framework and then develop appropriate indicators to measure it. In this study it was adapted to utilise a set of pre-selected indicators and this introduced challenges to the study. The hierarchy had to be built with the SOE indicators that had not been developed with the Barometer hierarchy in mind. The SOE indicators poorly represented some of the dimensions. It is believed that the utilisation of the adapted Barometer methodology was appropriate as it enabled the participants to highlight the type of information which is lacking in the SOE. The aim of the study was firstly, to test the SOE indicators in a sustainability framework. Secondly, to test the ability of the Barometer of Sustainability to be adapted to a situation where indicators were already in existence. It would have been inappropriate to attempt to recreate the SOE for this dissertation.

The IUCN Barometer of Sustainability process encourages the broad community to agree on a framework and objectives and creating the hierarchy of indicators prior to scaling the indicators. This means that the Barometer's from multiple reference groups can be directly compared. The reference groups in this study were dealt with individually allowing them to develop their own hierarchies which created difficulties when comparing the Barometer results. This was done to observe how different the results would be between reference groups. And therefore to be able to comment on the required scale of participation for a non-experimental attempt to develop a widely acceptable Barometer of Sustainability for Cape Town.

Another process issue was the order of the steps. In the IUCN original process the weighting is undertaken after the performance criteria has been set for each indicator. In this study the weighting was undertaken as part of finalising the hierarchy structure. This was to ensure that the participants had an understanding of the hierarchy and its implications for the indicators prior to scaling individual indicators.

It is important to note that this study does not present a Barometer representative of Cape Town society, as it included small groups from distinct sectors of the community. Further, the sectors were selected on the likelihood that they would be reasonably well-informed about environmental issues and concepts. This was done to decrease the amount of time needed to prepare individuals for participation in developing the index. Secondly, it was these sectors which were most likely to be interested in the outcome of such a project and would be willing to volunteer for the workshops. Efforts were made to ensure that individuals within these sectors would be able to participate. This included provision of transportation, childcare facilities and the re-scheduling of the workshops to appropriate times and the limiting of the duration. Despite these efforts, it should be noted that this study does not reflect the values of the urban poor. Any attempt to implement the Barometer at a Metropolitan level would require significant efforts to educate and include a much broader reference group.

The timing of this study limited the focus of the workshops to the first SOE produced, as the Year Two report was only released mid-way through this research. It is acknowledged that

(Year Two) 1999 report has addressed some of the concerns highlighted in the workshops regarding 1998 data. This means that some of the observations and recommendations are not based on the latest SOE indicators and reporting structure.

Limitations to the repeatability of the research occurred partially due to the research design. In selecting a volunteer reference group it was necessary to accommodate the specific needs of the groups which resulted in the workshops being run slightly differently. The following changes were made:

The workshops spanned different time periods: -

Group 1 – (8 hour workshop) one all day session 08:00- 17:00
Group 2 - (6 hour workshop) 11:00-17:00
Group 3 -(9 hour workshop) two consecutive evenings 18:30-23:00

The most significant result of this was that Group 2 split into two groups of four people to scale the indicators - one group scaled the environmental indicators and the other group scaled the human indicators. In both groups 1 and 3, the indicators were scaled by all members of the group.

In all three cases the groups had insufficient time available to finalise the Barometer development and to discuss the process and result as a group. This is not believed to have compromised the quality of the Barometer structure but may have jeopardised a clear sense of closure for the participants. An attempt was made to rectify this by using a version of the Delphi Technique (Dalkey, 1972), sending email copies of correspondence to all participants and asking them to comment. It is felt, however, that more insightful discussion would have been held if the group had been able to undertake this immediately after completing the workshop.

The next chapter, **Chapter 5**, details the results obtained from the three workshops as well as the test case using the 1999 SOE data.

CHAPTER 5
RESULTS

"The road we are laying out for the world is paved with good intentions, but do we know where it leads?" (Carl O'Sauer in Thomas, 1956).

This chapter details the outcome of the three workshops. The overall results of the CMA Barometer of Sustainability for the three reference groups are given for the 1998 SOE. These hierarchies were also used to calculate the 1999 Barometer of Sustainability. The 1998 and 1999 results are reported collectively and then each group is reported individually. A discussion of the dynamics, criticisms and recommendations of each group is detailed in Chapter 6.

5.1 Overall Results

The results of the 1998 CMA Barometer of Sustainability calculation undertaken in three workshops held in December 2000 and January 2001 are shown in **Figure 5.1** and are tabulated below in **Table 5.1**. The groups are identified as follows:

Group 1: University Staff and Students
Group 2: Local Government Officials
Group 3: Non-Governmental Organisations

Table 5.1: Table of 1998 Results Calculated from the Workshops

	Group 1	*Group 2*	*Group 3*	*Average*
Air	50	70	35	**52**
Land	27	49	34	**37**
Resource Use	53	63	47	**54**
Species	40	58	32	**43**
Water	40	20	19	**26**
Ecosystem Result	**42**	**52**	**33**	**42**
Health	13	27	12	**17**
Equity	36	38	45	**40**
Community	14	24	13	**17**
Knowledge	40	65	39	**48**
Wealth	47	41	46	**45**
Human System Result	**30**	**39**	**31**	**33**

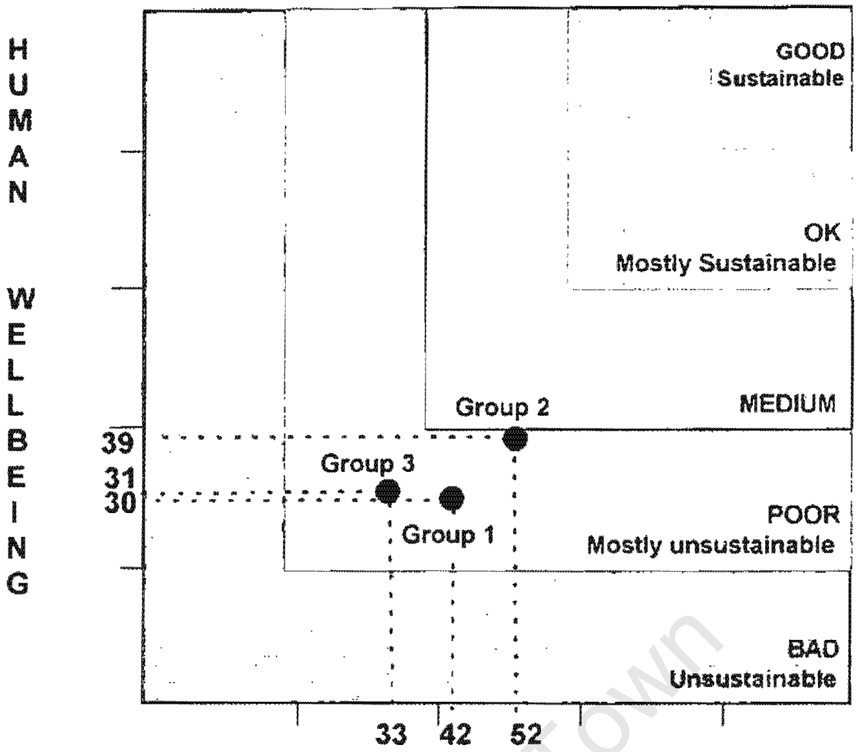


Figure 5.1(Above): The Barometer of Sustainability graphical output showing the relative points calculated by the three reference groups for the 1998 State of the Environment Report.

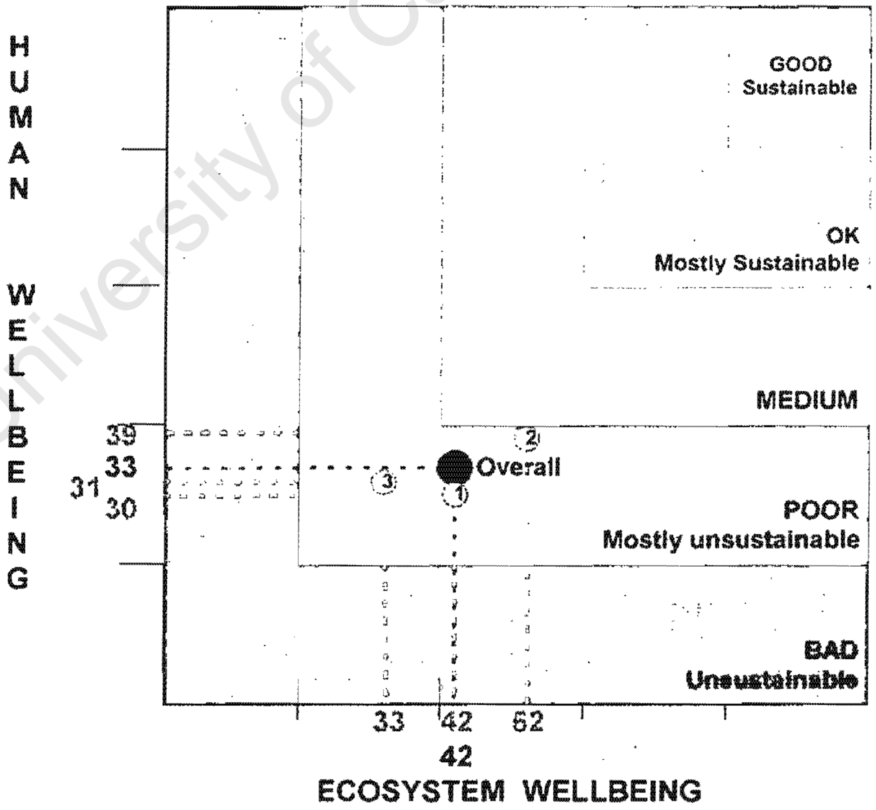


Figure 5.2: The Overall Barometer of Sustainability graphical output showing the average of the points calculated by the three reference groups for the 1998 State of the Environment Report.

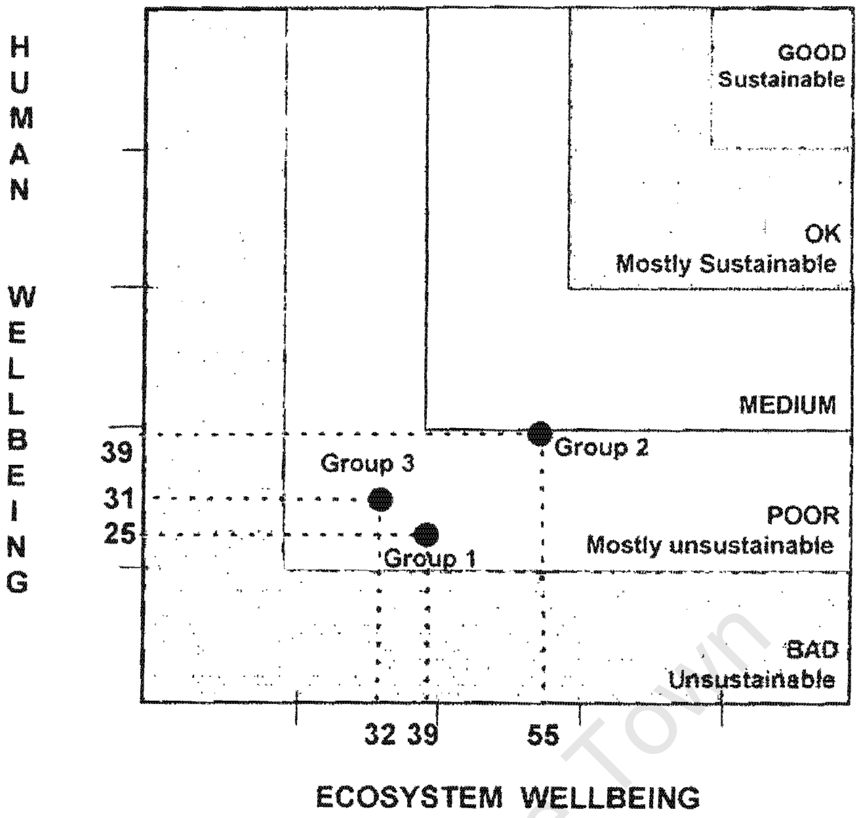


Figure 5.3: The Barometer of Sustainability graphical output showing the relative points calculated by the three reference groups for the 1999 State of the Environment Report.

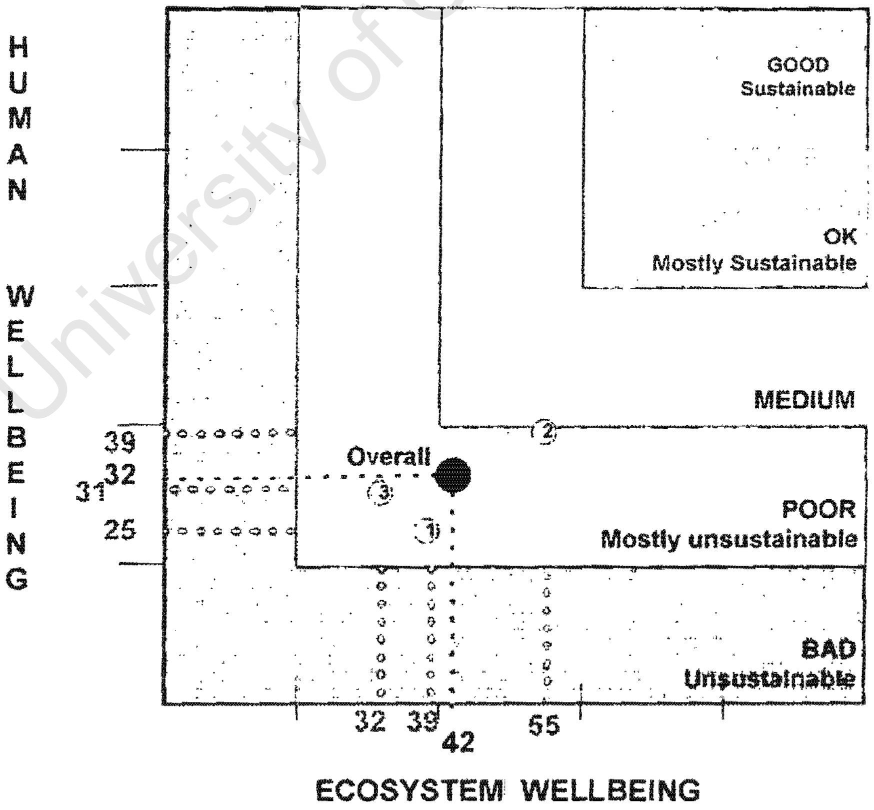


Figure 5.4: The Overall Barometer of Sustainability graphical output showing the average of the points calculated by the three reference groups for the 1999 State of the Environment Report.

5.2 *Differences in Hierarchy Structure between Reference Groups*

There was 84% agreement between the groups as to which subsystem (human or ecosystem) particular indicators should be assigned to. A table indicating the assignments is given in **Appendix 5**. There was more discrepancy regarding which dimension the indicators fell into than which sub-system (ecosystem or human) they represented. For the 100 indicators, there was 40% full agreement, where all three reference groups assigned the indicators to the same dimension. There was 50% partial agreement, where at least two groups placed the indicators in the same dimension. The distribution patterns can be seen in **Figure 5.5**, which shows the relative number of indicators assigned to each dimension.

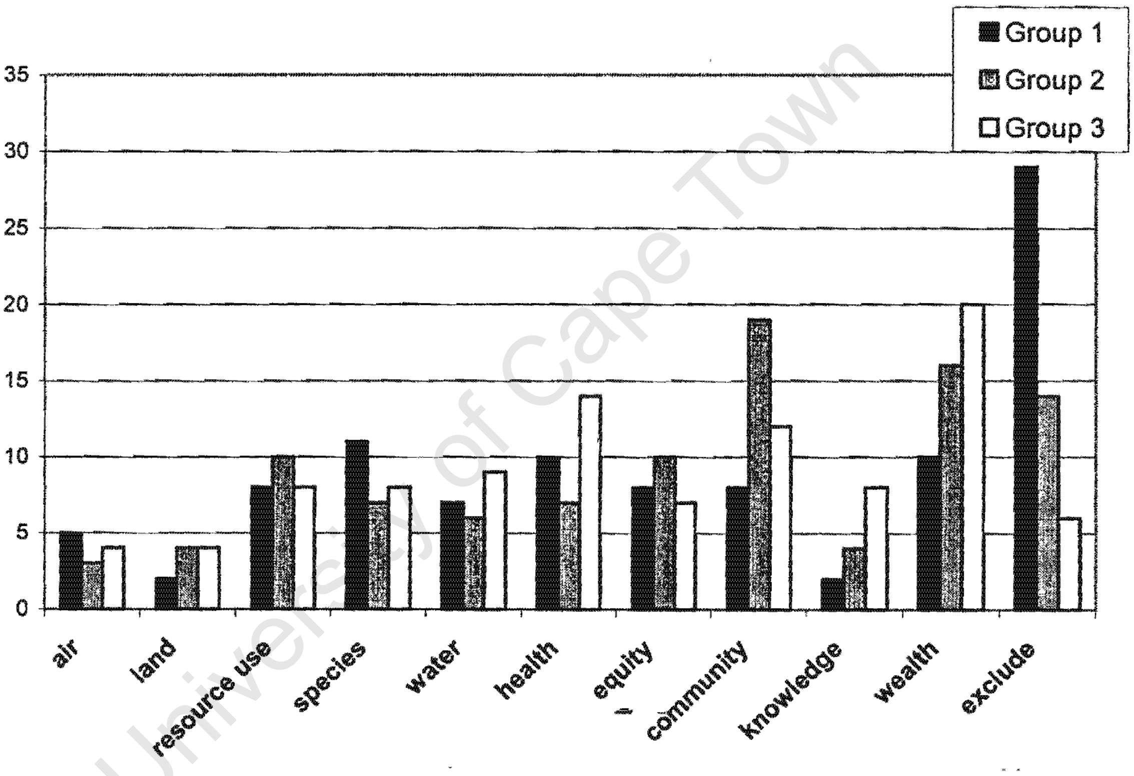


Figure 5.5: Distribution of Indicators Across the Ten Dimensions and Those Excluded

Group 1, the university staff and students, excluded the highest number of indicators. They assigned the second highest number of indicators to the "species" dimension and the lowest number to "land" and "knowledge" dimensions of the Barometer, respectively.

Group 2, the local government officials, assigned the highest number of indicators to the "community" dimension. The second highest number of indicators was placed in the "wealth" dimension with the lowest in "air", "land" and "knowledge" dimensions, respectively.

Group 3, the environmental NGOs, placed the most indicators in the "wealth" dimension. The second highest number of indicators in "health" and the least in "air" and "land" dimensions, respectively. This assignment shows a bias toward human indicators.

The group hierarchies are presented and discussed in more detail below. The indicators are identified in the hierarchies using their assigned number. **Box 5.1** contains a list of the 1998 indicator numbers and descriptive names.

Box 5.1 1998 CMC SOE Indicator Numbers and Descriptive Names

1	Commuter trip length (Ave)
2	Property appreciation
3	CMA Population (people)
4	Ecological Classes-River
5	Ecological Classes- Coastal Lakes & Estuaries
6	Number of harmful algal blooms
7	Water Quality Statistics
8	Faecal Coliform Counts
9	Volume of water being used- Water demand in m^3/yr
10	% Capacity of dams being used to fulfil water demand
11	% Population with potable water supply
12	Wastewater produced (as % of total water used)
13	Car ownership- No. of vehicles per 1000 people
14	Overall Air Quality
15	SO_2 exceedances
16	% Households with access to electricity
17	Lead average measurement in the CBD (ug/m3)
18	Particulate Matter exceedances
19	Number of complaints about air pollution
20	Number of acute respiratory chest infections
21	NO_2 exceedances
22	Use of wood & parafin & gas as fuel
23	Koeberg -Safety Rating
24	Koeberg - Number of reported leaks
25	Demand for energy per year
26	Cost of electricity
27	Future capacity of existing waste sites
28	% Waste sites officially licensed
29	Volume of waste in the landfill
30	% Waste re-used or recycled per person per day
31	% Waste water re-used or recycled
32	Capacity of waste water treatment potential being used
33	% Estimated medical waste not handled correctly
34	Volume of medical waste incinerated
35	Capacity in hazardous waste sites (m^3)
36	Amount of hazardous waste being generated
37	Nuclear waste being produced
38	Items of litter per day
39	Tonnes of goods dumped illegally per year
40	Sewage effluent released (average litres per day)
41	Solids into the sea
42	% Mussels in which the Cadmium limit was exceeded
43	% Coastline protected by Marine Protected Area (MPA)
44	Marine species rated critical within Marine Protected Areas
45	Amount of land with conservation status
46	Mammals in red data book
47	Avifauna in red data book
48	Invertebrates in red data book- butterflies
49	Amphibians in red data book- frogs
50	Reptiles in red data book
51	Sand Plain Fynbos (area remaining)
52	Renosterveld
53	Strandveld
54	Dependency ratio
55	Percentage of the population in poverty
56	Percentage population unemployed
57	Employment overall in the formal sector
58	Total output Gross Geographic Product (GGP)
59	Annual average growth
60	% Labour professional or highly skilled
61	% Semi-low skilled
62	Informal Economy (contribution)
63	Tuberculosis rate (per 100 000)
64	% Population without access to adequate sanitation
65	Meningococcal Meningitis rate (annual number of cases)
66	% Population without adequate drinking water
67	Bacterial exceedances- Bulk Milk
68	Bacterial exceedances- Packaged Milk
69	% Commuters using private transport
70	% Commuters using buses & minibuses
71	% Commuters utilising rail
72	Ave. public transport subsidy increases per year
73	Safety & security on public transport
74	Capacity of buses utilised during peak
75	Capacity of minibus taxis utilised during peak
76	Number of fatalities due to road accidents (per 100 000 people)
77	Number of road accidents
78	% Accidents involving pedestrians
79	Harbour throughput (total tonnage/year)
80	Number of international flights
81	Number passengers per annum at airport
82	Number of dwellings without adequate drainage
83	Access to telephones
84	Access to refuse removal
85	% Population exceeding WHO indoor pollution standards
86	Formal housing stock
87	Shacks
88	Hostels (other)
89	Population growth per year
90	Estimated housing backlog
91	Property crime
92	Vehicle crime
93	Violent crime
94	Social fabric crime
95	Pupil to teacher ratio
96	Number of schools per 1000 people
97	Adult literacy rate
98	Number of full EIAs
99	Number of EIA applications/scoping reports
100	People in local government dedicated to environmental management

5.3 Year One (1998) Results

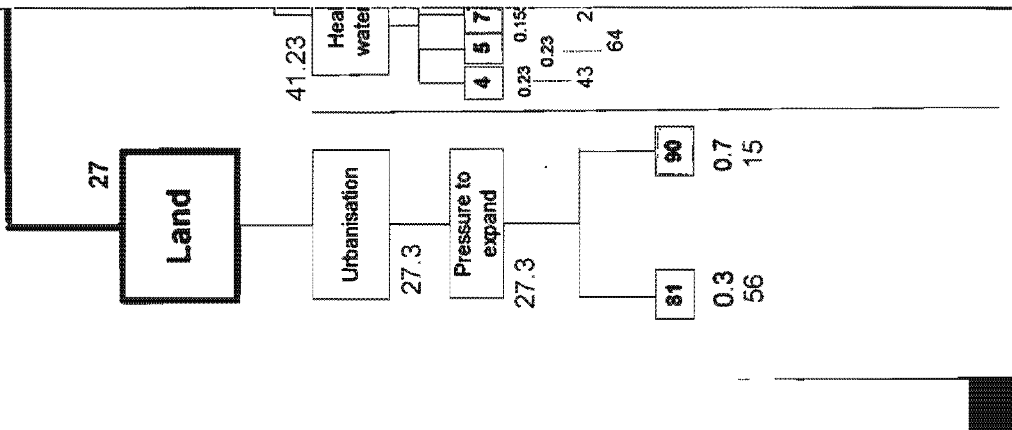
5.3.1 Group 1

The hierarchical structure developed by this group is shown in **Figures 5.6** and **5.7** for the 1998 SOE. This reference group excluded twenty-nine indicators, the highest number of indicators out of the three reference groups. The hierarchy displays the simplest form of the three groups. The Human System hierarchy has only four levels and the Ecosystem hierarchy five levels, with "Resource Use" being the only dimension with a more complex branching.

There are a total of thirty-eight indicators represented on the Human System hierarchy. In the 1998 hierarchy seventeen of these are rated "Bad", seven are "Poor", five are "Medium", eight are "OK" and one is "Good". The overall rating for the Human Wellbeing is 30 Barometer points placing it in the "Poor" category.

There are thirty-three indicators represented on the Ecosystem hierarchy. In the 1998 hierarchy nine of these are rated "Bad", four are "Poor", eleven are "Medium", six are "OK" and three are "Good". The overall rating for Ecosystem Wellbeing is 42 Barometer points placing it in the "Medium" category.

Group 1 participants' comments about the 1998 SOE indicators and suggestions for further indicators are included in **Appendix 6**.



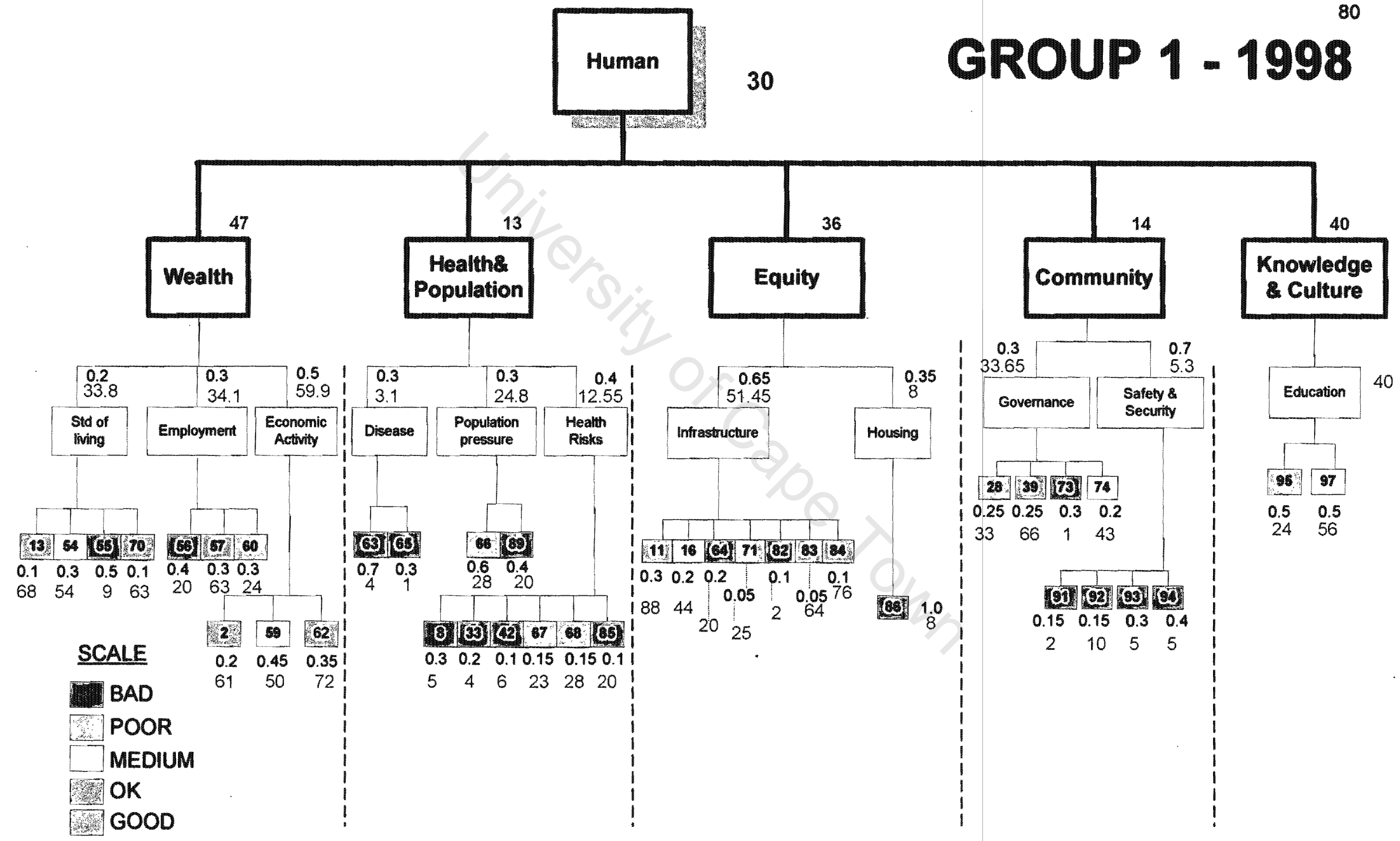


Figure 5.7: Group 1 - Human System Hierarchy (1998)

GROUP 2- 1998

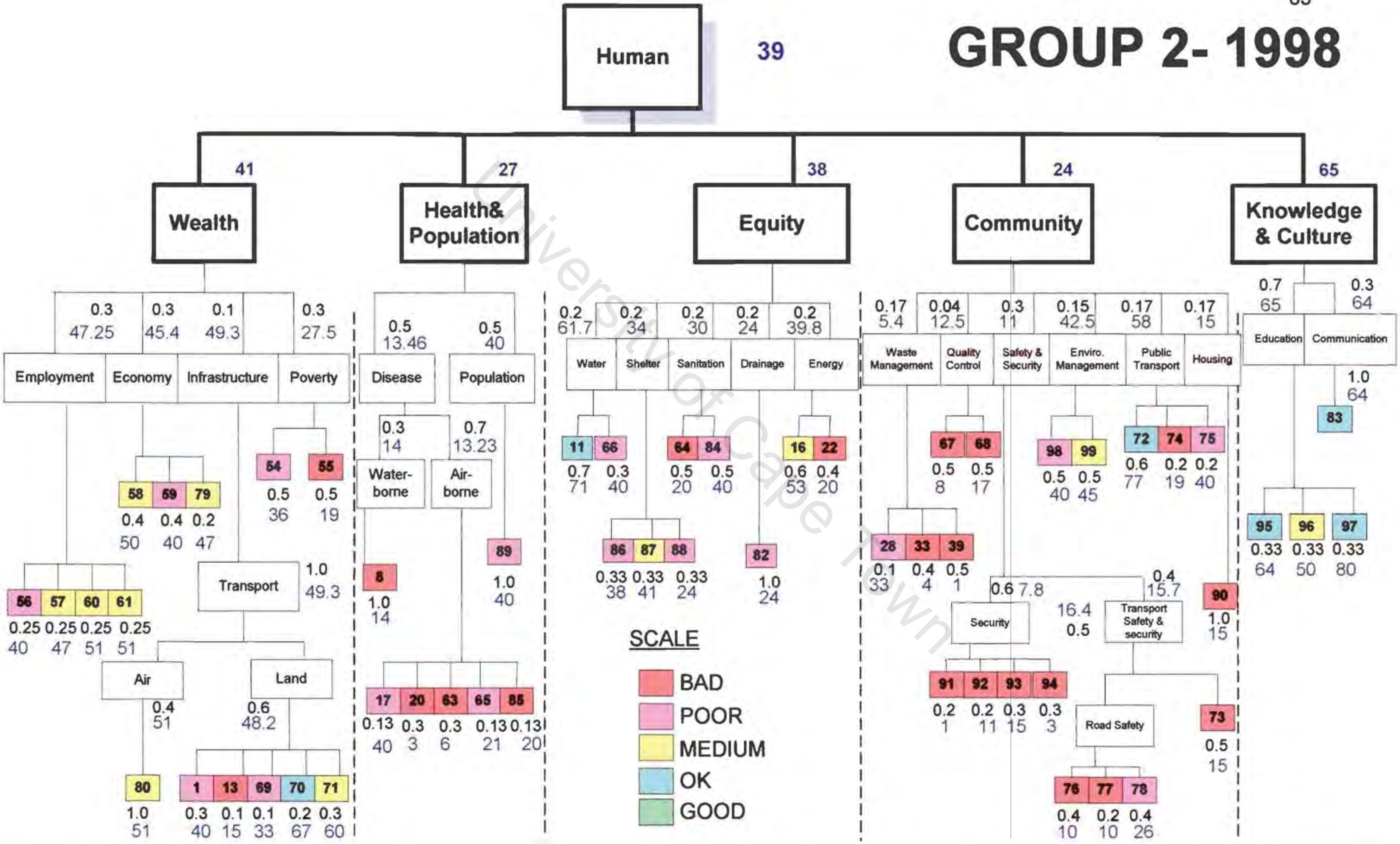


Figure 5.9: Group 2 - Human System Hierarchy (1998)

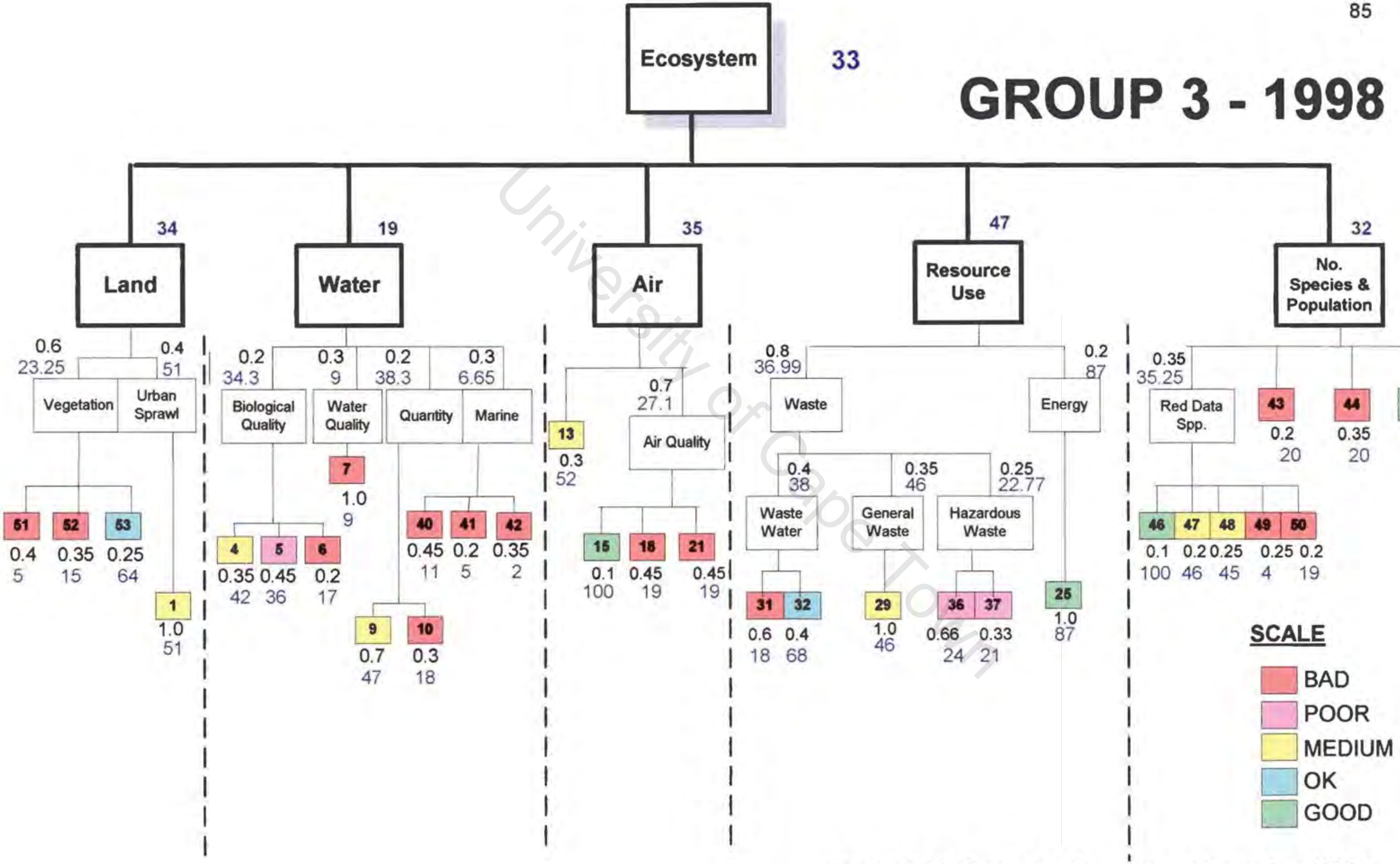


Figure 5.10: Group 3 - Ecosystem Hierarchy (1998)

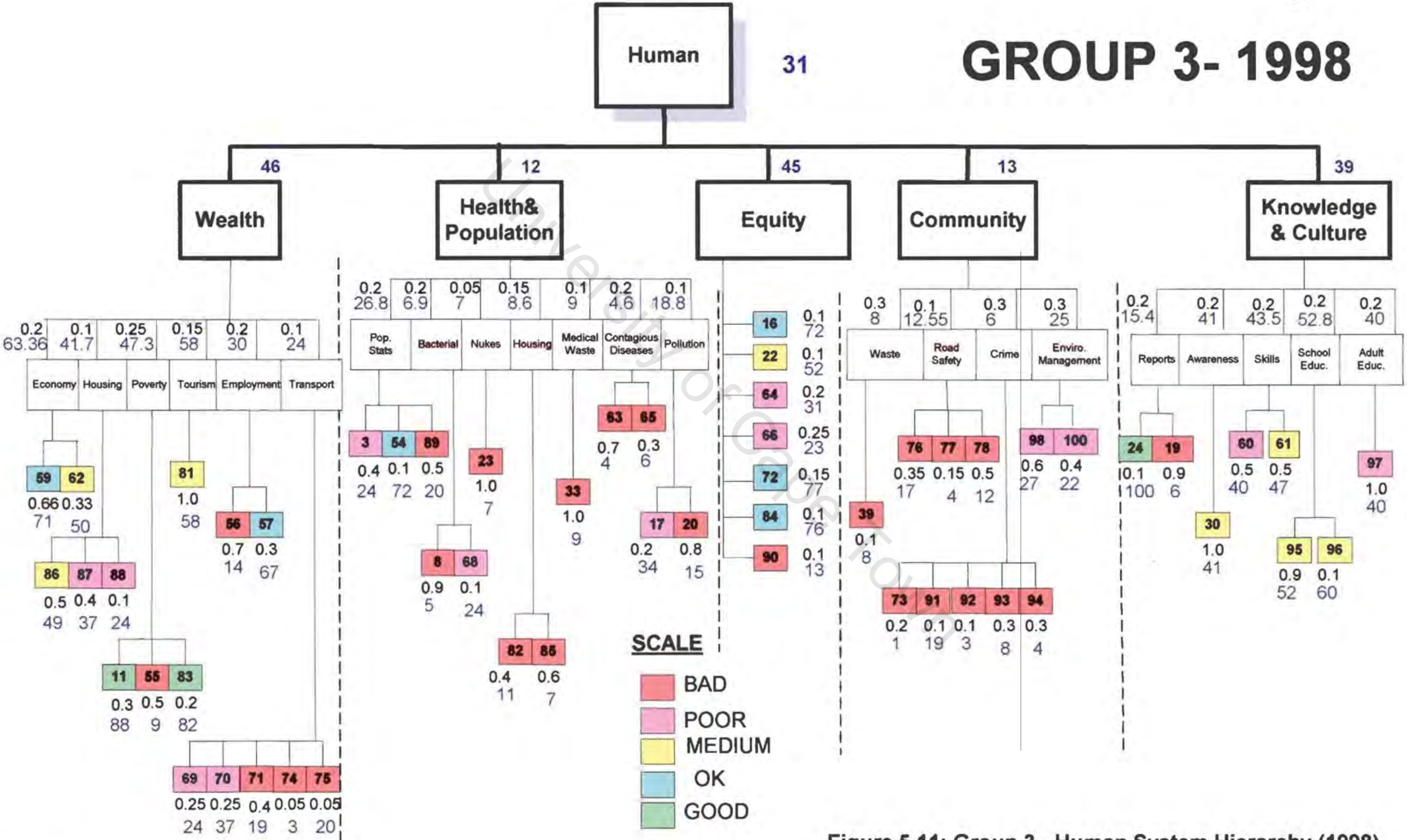


Figure 5.11: Group 3 - Human System Hierarchy (1998)

5.4 Year Two (1999) Results

Although the focus of this research was the 1998 SOE report, it is valuable to consider whether the hierarchies developed by the reference groups in this study could be adapted to the 1999 SOE report. As mentioned earlier, only 60% of the indicators overlapped between the Year One (1998) and Year Two (1999) reports. The change in the indicators used was due to several factors. Firstly, certain types of data were not available on an annual basis and therefore some indicators were not updated between 1998 and 1999. Secondly, some of the data reported in 1998 was found to be unsubstantiated and was therefore retracted in the 1999 report. Thirdly, new indicators were introduced as part of the long-term goal of developing a rich database for SOE reporting.

5.4.1 Group 1

The 1999 hierarchies for Group 1 are given as **Figures 5.12** and **5.13**. The indicators which have 1999 data are shaded in grey for easy identification. In the 1999 SOE only fourteen (42%) of the indicators used in the Ecosystem hierarchy had 1999 data provided for them but this resulted in a drop of three points overall in Ecosystem Wellbeing for this group. Twenty-two (58%) of the indicators in the Human System hierarchy had 1999 data and this resulted in a five point drop for Human Wellbeing. **Table 5.3** shows the variation between dimension points for Year One (1998) and Year Two (1999) for Group 1's hierarchy.

Table 5.3: Variation in the Results for the Dimensions between Group 1 Year One (1998) and Year Two (1999) SOE

Dimension	1998	1999
Air	50	52
Land	27	6
Resource Use	53	55
Species	40	45
Water	40	39
Ecosystem result	**42**	**39**
Health	13	13
Equity	36	38
Community	14	14
Knowledge	40	24
Wealth	47	37
Human system result	**30**	**25**

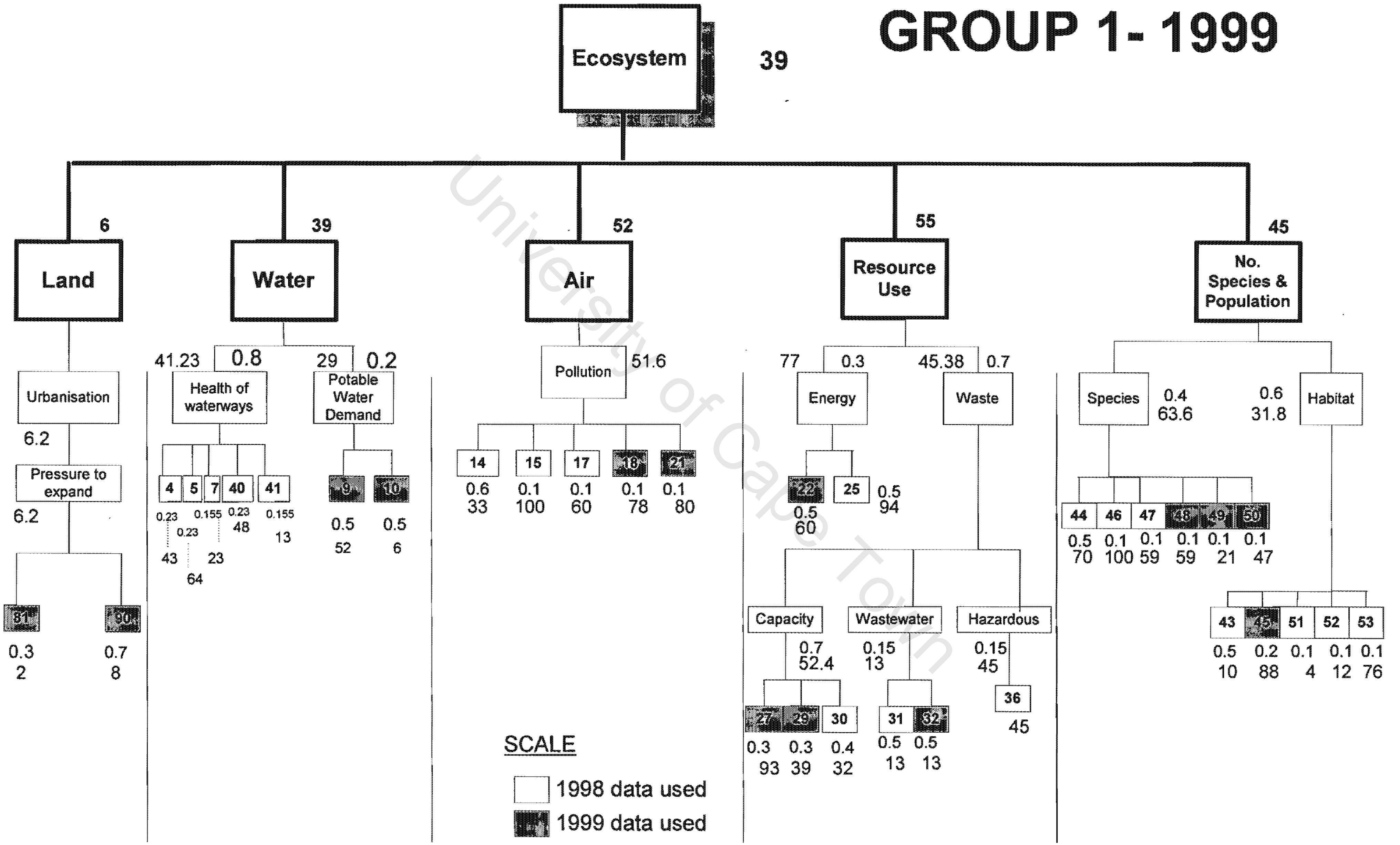


Figure 5.12: Group 1 - Ecosystem Hierarchy (1999)

GROUP 1 - 1999

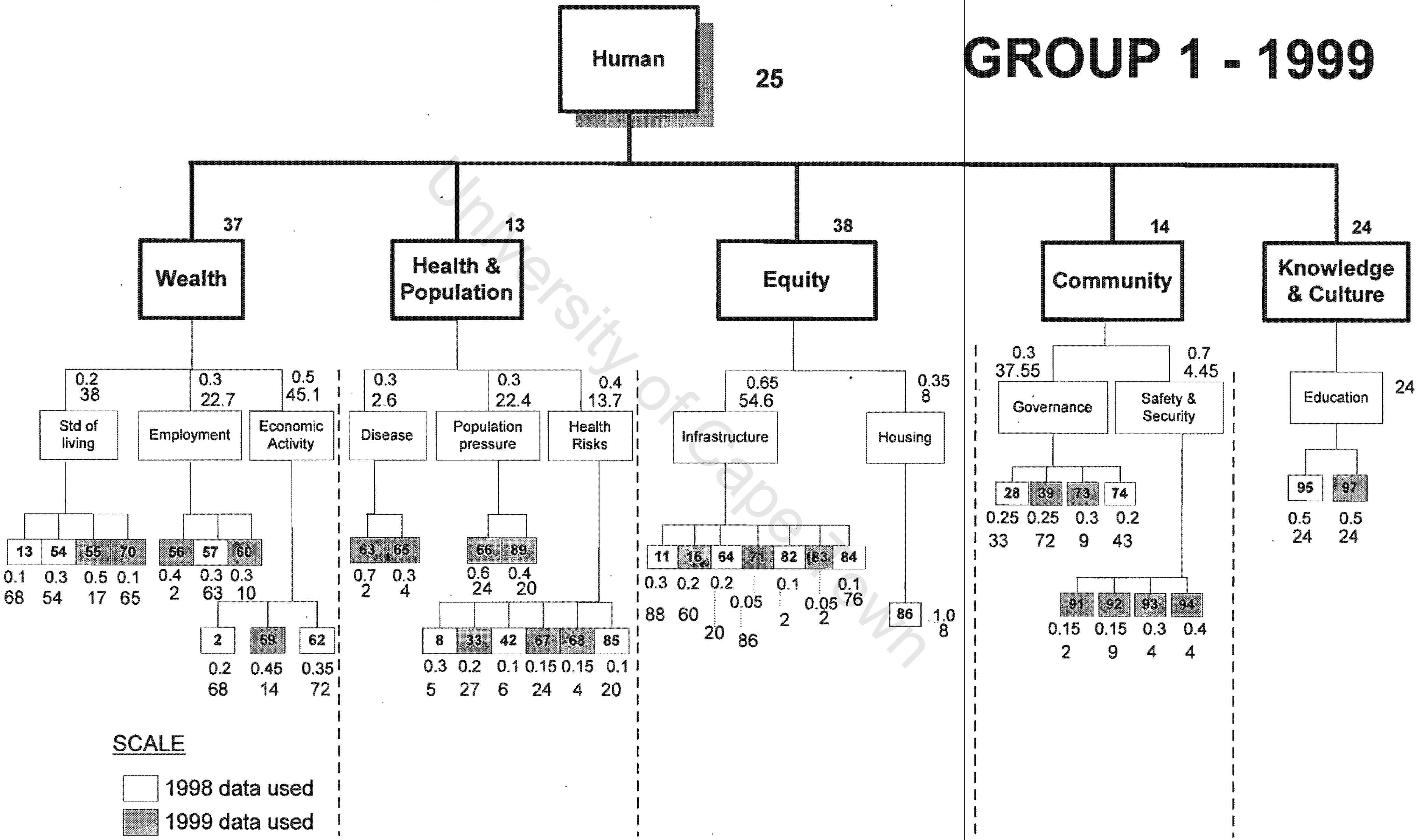


Figure 5.13: Group 1 - Ecosystem Hierarchy (1999)

5.4.2 Group 2

The adapted 1999 hierarchy is given as **Figures 5.14** and **5.15.** The indicators, which have 1999 data, are shaded in grey.

In the 1999 SOE only ten (34%) of the indicators used in the Ecosystem hierarchy had 1999 data provided for them but this resulted in an increase of three points in the group's overall Ecosystem Wellbeing points. Thirty-five (63%) indicators in the Human hierarchy had 1999 data which resulted in no overall change for Human Wellbeing. **Table 5.4** provides details of the variation at a dimension level in Group 2's hierarchy between Year One and Year Two.

Table 5.4: Variation in the results for the dimensions for Group 2 between Year One (1998) and Year Two (1999) SOE

Dimension	1998	1999
Air	70	77
Land	49	56
Resource Use	63	63
Species	58	61
Water	20	18
Ecosystem result	**52**	**55**
Health	27	36
Equity	38	42
Community	24	29
Knowledge	65	40
Wealth	41	46
Human system result	**39**	**39**

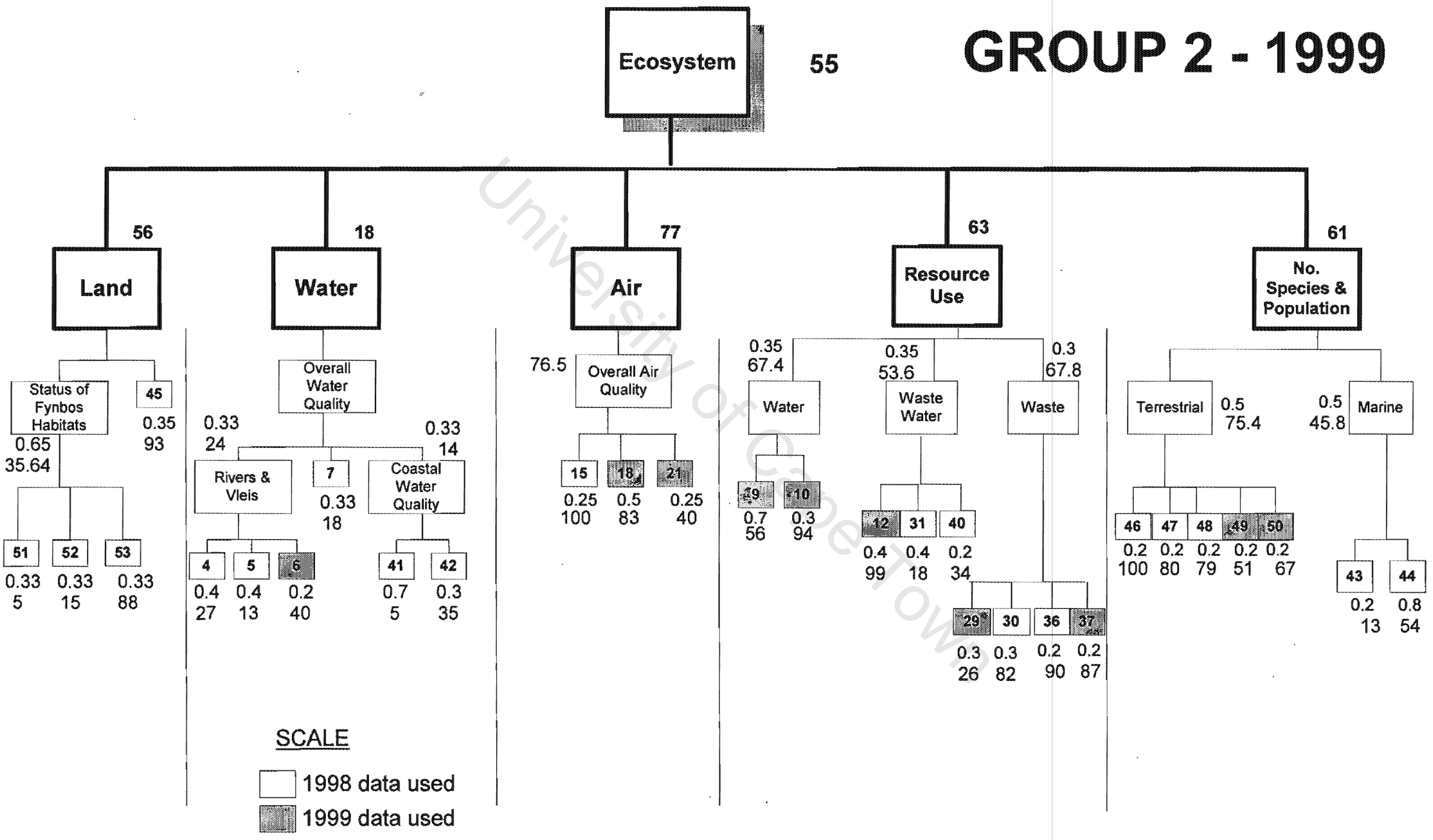


Figure 5.14: Group 2 - Ecosystem Hierarchy (1999)

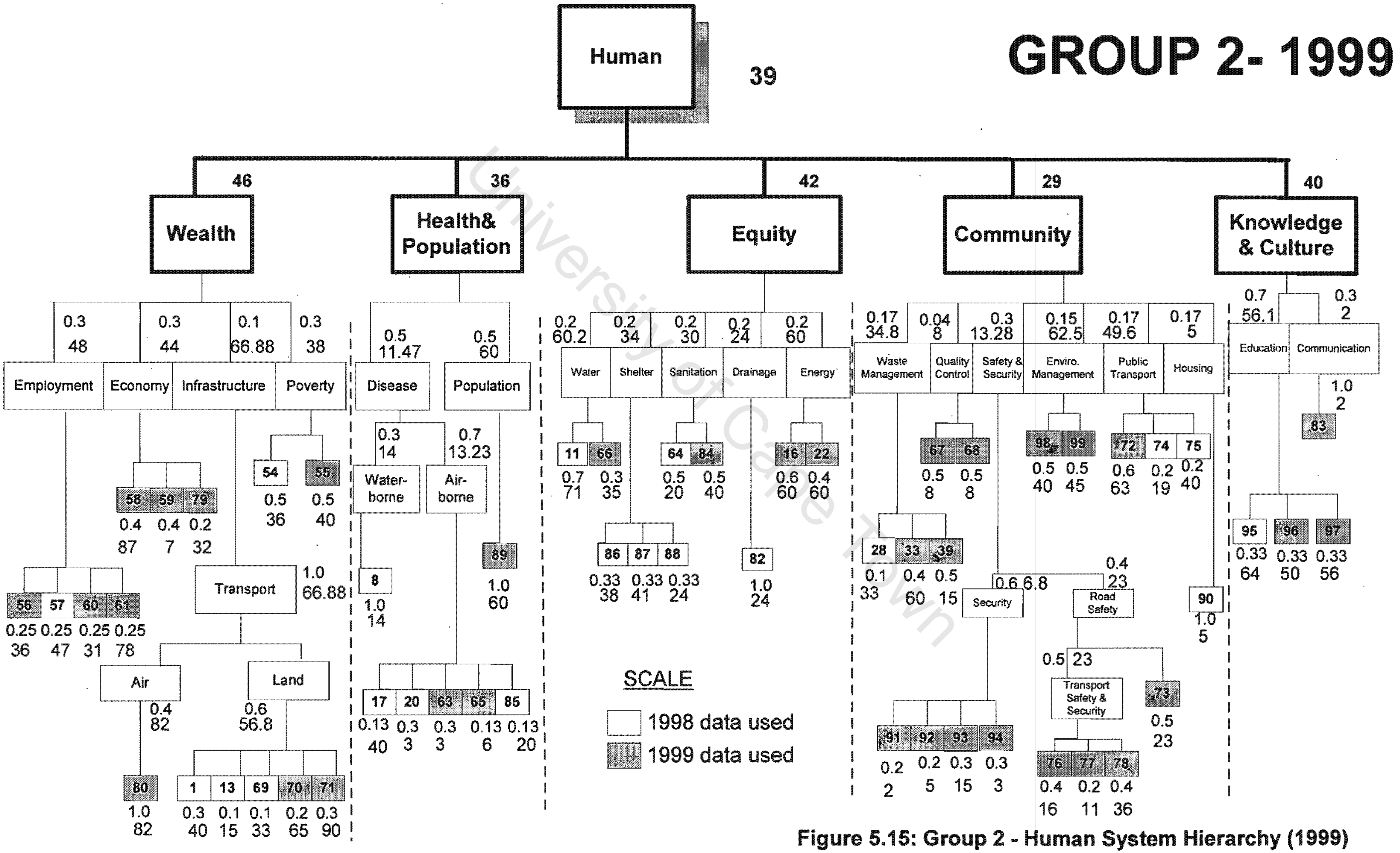


Figure 5.15: Group 2 - Human System Hierarchy (1999)

5.4.3 Group 3

The adapted 1999 hierarchy is given as **Figures 5.16** and **5.17.** The indicators which have 1999 data are shaded in grey.

In the 1999 SOE only twelve (39%) of the indicators used in the Ecosystem hierarchy had 1999 data and this resulted in a drop of one point in the group's overall Ecosystem Wellbeing. Thirty-three (60%) indicators in the human hierarchy had 1999 data and this resulted in a one point drop for Human Wellbeing. The table below provides details of the variation at a dimension level for Group 3's hierarchy between Year One and Year Two.

Table 5.5: Variation in the Results for the Group 3 Dimensions between Year One (1998) and Year Two (1999) SOE

Dimension	1998	1999
Air	35	35
Land	34	34
Resource Use	47	38
Species	32	34
Water	19	18
Ecosystem result	**33**	**32**
Health	14	12
Equity	45	39
Community	16	18
Knowledge	39	33
Wealth	47	52
Human system result	**32**	**31**

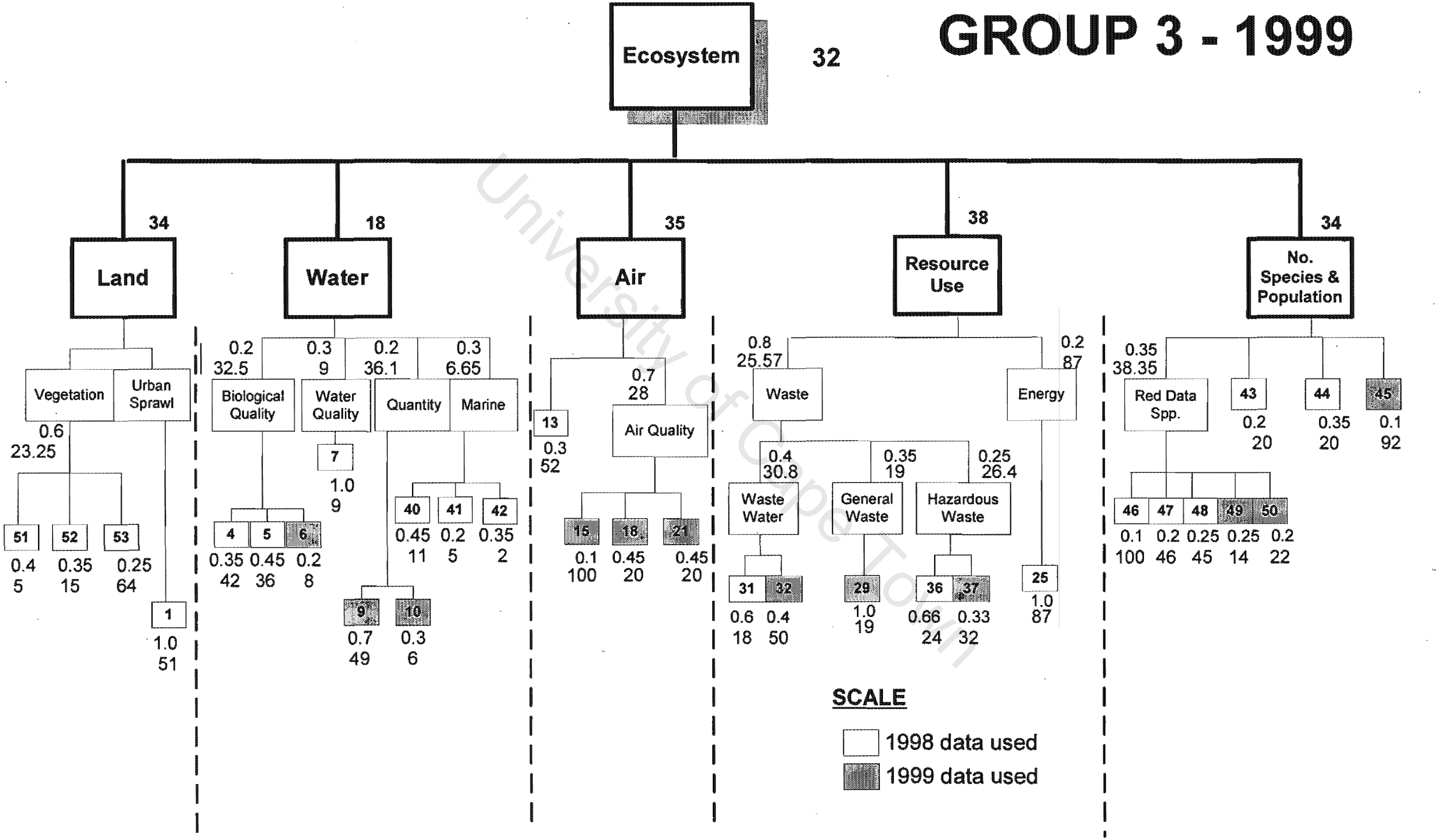


Figure 5.16: Group 3 - Ecosystem Hierarchy (1999)

GROUP 3- 1999

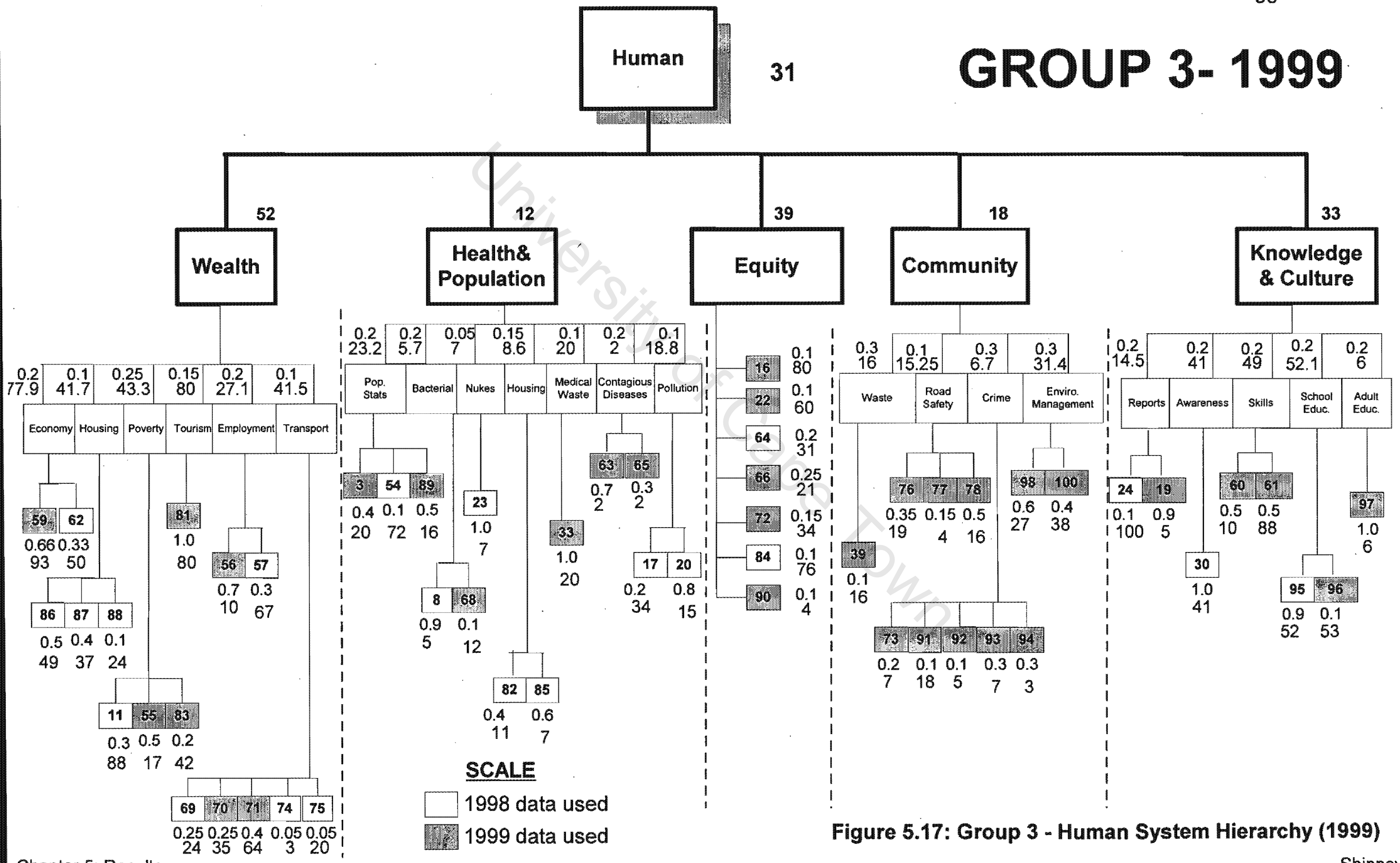


Figure 5.17: Group 3 - Human System Hierarchy (1999)

Chapter 6 discusses the results presented in this chapter as well as the group dynamics, and explores the suggestions and comments of the members of the groups.

CHAPTER 6
DISCUSSION

"Development and sustainability are old problems; now they come together on a global scale and in an urgent time frame. Sustainability indicators must be more than environmental indicators; they must be about time and/or thresholds. Development indicators should be more than growth indicators; they should be about efficiency, sufficiency, equity and quality of life" (D. Meadows, 1998).

This chapter details the outcome of the three workshops held to validate the Barometer of Sustainability. It also critiques the Barometer of Sustainability as a process and as a tool. The IUCN Barometer of Sustainability process requires that a hierarchy be developed prior to the selection of indicators. In this study, however, a pre-selected set of indicators was used and reference groups worked completely independently. These adaptations are responsible for some of the challenges experienced and are discussed in this chapter. General observations are made regarding the results, and the details of each group workshop are examined in turn, namely, the group dynamics, hierarchy, Barometer graph and group responses to the outcome.

6.1 Results of the Research Project

An initial examination of the results reveals that the three groups produced similar Barometer of Sustainability outcomes. All of the groups were in accord that Cape Town falls into the "Poor" or "Mostly Unsustainable" category, and that Human Wellbeing is lower than Ecosystem Wellbeing. This accord occurs despite the differences in indicator point and weighting assignments and varying hierarchical structures formulated by the groups.

A common theme in discussions was that participants were suspicious of the 1998 SOE indicator results. There were two main reasons for this. Firstly, some of the indicator results were contrary to popular belief. Participants considered such results "too good to be true". Secondly, some of the indicators did not have clear definitions, or lacked information regarding how the data had been collected.

The perceived untrustworthiness of the 1998 SOE was fuelled by the 1999 SOE, which contained statements that retracted some of the data reported in 1998. Some of the retractions had little explanation as to where the previous year's figures had been obtained, or why they had been used. An example of this is the "access to telephones" statistic (CMC 2000 p63), as the 1998 calculation was untraceable by the writers of the 1999 report (Pers Comm. Craig Haskins, November 2000), and therefore the indicator was changed in 1999 to a much lower value. Such changes to certain indicators resulted in an overall drop in Barometer points for Groups 1 and 2 and a slight increase for Group 3, as can be seen in **Figure 6.1**. This will be discussed in greater detail later in this chapter.

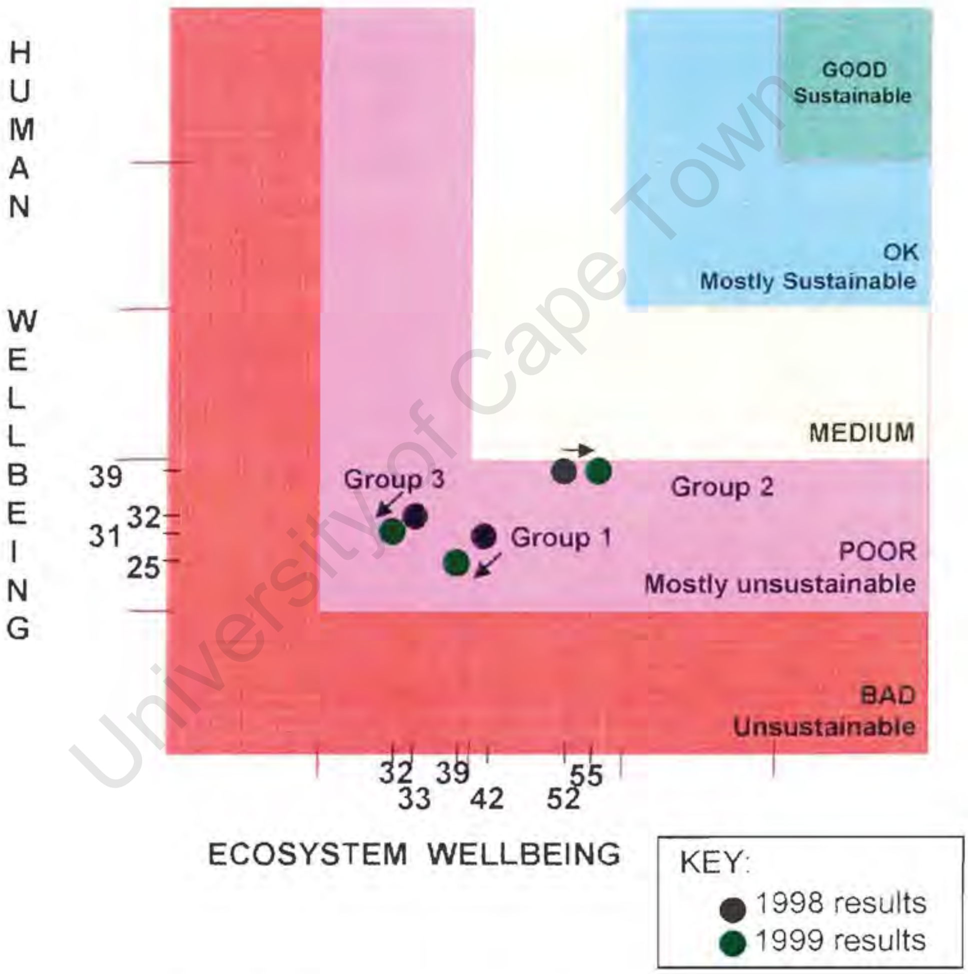


Figure 6.1: Summary Diagram of the Barometer Points as Determined by the Reference Groups

6.2 Hierarchical Structure

The hierarchies developed by each of the groups are given in **Chapter 5**. The Barometer results and distinct hierarchies for the three groups can be related to the various value judgements each group introduced during its workshop discussions. There are trends in both indicator and point distribution which are evident when the hierarchies are closely examined.

Group 1, the university staff and students, excluded the highest number of indicators. This was verbalised as being due to a lack of security in making decisions based on the information provided. This could be directly linked to a lack of professional experience but it is also a product of mistrust of the data provided. Another aspect, however, is that most of the students were being trained as natural scientists and may have been trained to exclude what is unknown or uncertain, rather than to make assumptions.

Group 1 assigned the greatest number of indicators to the "species" dimension. They assigned the lowest number of indicators to "land" and "knowledge" dimensions, respectively.

Group 2, the officials, assigned the highest number of indicators to the "community" dimension. There was a noticeable influence from the Social Science trained officials participating in the workshop. There was also a sense that the social issues were being measured by multiple indicators because they are difficult to define. Comments were made during the workshop which indicated that the ecosystem elements are better understood, and therefore complex aggregated indicators were sufficient to represent these factors. Thus, a lower number of indicators are required to represent ecosystem dimensions. The second highest number of indicators was placed in the "wealth" dimension with the lowest in "air", "land" and "knowledge" dimensions, respectively.

Group 3, the environmental NGO's, placed the most indicators in the "wealth" dimension. The second highest number of indicators in "health" and least in the "air" and "land" dimensions, respectively. Participants introduced a distinct anti-capitalist sentiment during workshop discussions and a strong emphasis on social consciousness emerged. The NGO's were particularly confident in their assignments and seemed to feel that their decisions were based on experience and knowledge.

The point values on the Barometer of Sustainability therefore reflect, in some measure, the group's attitudes and approaches described above. The NGO group showed the lowest point ratings of all the groups. They openly admitted to being suspicious of the State of the Environment Report and the indicators. The next group was the university staff and students, who were more tentative about the allocation of indicators and points, but tended toward similar distrust of the SOE and indicators, as did the NGO group. The CMC officials' results show noticeably higher scores than the other groups. This may be because, for them, this was an exercise in self-criticism. The officials admitted to having knowledge of projects, policies and budgets affecting the indicator results and considered the results to be satisfactory in the light of these constraints. They therefore judged themselves less harshly than the other groups.

Two things are particularly noteworthy:

- Despite having widely varying worldviews the results show a clustering on the Barometer of Sustainability and agreement in the overall categorisation of Cape Town's index.

- There was closer agreement amongst the groups between human wellbeing points than ecosystem wellbeing points.

From the above comments it may be concluded that although the Barometer's components are sensitive to the value judgments being adopted by groups, the overall index is robust. It is therefore essential that the participants who are used to formulate a local Barometer should be representative of all interests in the community. This may require that several workshops be undertaken to understand the relative positions of the differing interests within a community. This study was limited to three reference groups representing three distinct sectors of society only (**Section 4.10**).

6.2.1 Sensitivity

An attempt was made to model the hierarchies using a MCDA computer programme (Refer to **Section 4.9**). This was unsuccessful as there appear to be too many variables operating in the Barometer of Sustainability process. The sensitivity of the Barometer to change in indicator measurements was therefore tested by manual calculation. The 1999 SOE data was introduced into the 1998 hierarchies which had been established by each of the groups. The 1999 hierarchies have been included in **Chapter 5** and the list of 1999 indicators is included as **Appendix 7**.

It was found that the Barometer of Sustainability result for the 1999 data showed a small overall drop in position. The decrease is expected because data inaccuracies in the 1998 SOE were corrected in the 1999 SOE. This resulted in some poorer indicator results. A significant indicator, however, was Indicator 45: "Amount of Land with Conservation Status" as it influenced the overall status of the Ecosystem Wellbeing and is responsible for Group 2's overall increase in Ecosystem Wellbeing in 1999. This indicator registered an exponential increase in the 1999 data reflecting the formalisation of the Cape Peninsula National Park. This boosted the "Land" dimension points, particularly in Group 2, thereby giving an inflated result. It is nonetheless correct to state that the average result of the Barometer of Sustainability showed a decline in overall sustainability.

It should be noted that only 60% of the indicators used in 1998 and 1999 overlapped. It is these common indicators that were used to plot the 1999 values shown in **Chapter 5** and in **Figure 6.1**. For the sake of inter-annual comparison, the SOE indicators should be as stable as possible from one year to the next.

Another issue directly related to the Barometer of Sustainability's ability to measure change in the environment, is the timeframe on which the indicators focus. A range of indicators needs to be specifically selected to measure varying timeframes of environmental change, as well as cumulative effects of small changes to the system. It is therefore appropriate to have some sensitive indicators that would react to short-term events such as a minor fire or flood, others to react to medium term disasters such as an oil spill, and others for long-term changes such as the complete loss of a species. Some of the dimensions used in the Barometer are only monitored on a very rough scale in the CMA SOE report e.g. loss of species. This decreases the ability of any aggregation process to reflect critical change before it is too late to mitigate the effects. It is important however to note that the indicators chosen for sensitivity to temporal change should not double count less sensitive indicators.

6.2.2 *Sub-dimension Level Structuring*

The System Assessment Method (SAM), as described in Chapter 3 and illustrated in Figure 3.3 and 3.4 is the basic structure which the IUCN suggests for the Barometer. It defines the 10 dimensions under which the indicators are arranged by the test groups. SAM is again illustrated below in **Figure 6.2**.

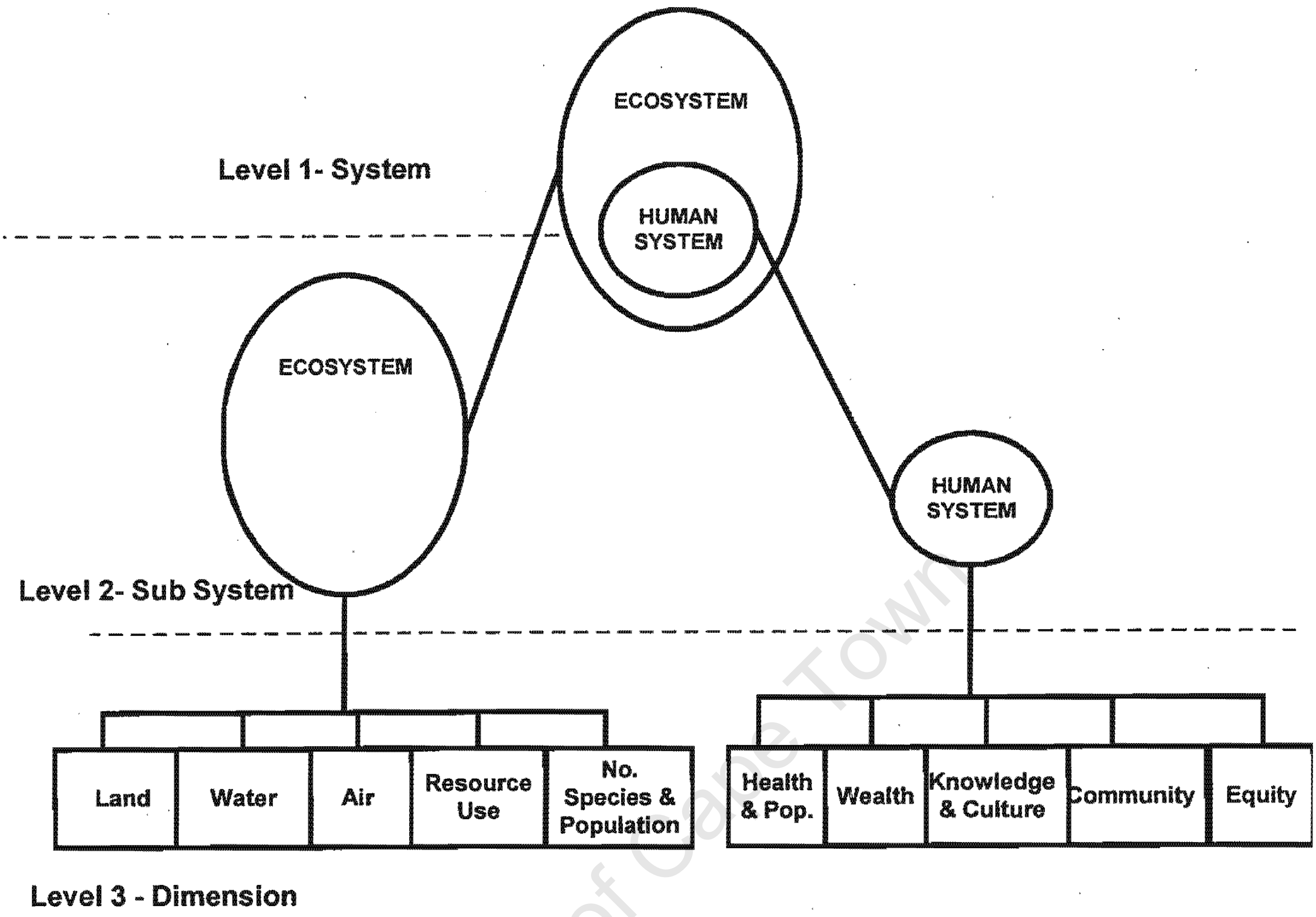


Figure 6.2: The System Assessment Method (SAM) is the suggested IUCN structure for the top three tiers of the Barometer of Sustainability hierarchy to ensure comparability between projects (Adapted from IUCN, 1999).

Implementing the SAM structure to the top three levels of the hierarchy means that there was purposefully no deviation between the groups above the sub-dimension level of the hierarchy. It is therefore the sub-dimension level structuring and weighting which created the variation in points seen in the overall Barometer of Sustainability. As mentioned earlier in **Section 6.2**, the hierarchy structuring reflects the values and knowledge of the participants and the variation in these structures is best demonstrated by introducing new indicator results into the structure to observe how it is reflected.

Overall variation between 1998 and 1999 results for the three groups shows that at the subsystem level (Ecosystem and Human System) there is agreement that there is a decrease in Barometer points, although there is a slight discrepancy as to how much change is caused. The more interesting variation occurs at the dimension level. This can be seen in **Figure 6.3 and 6.4** below.

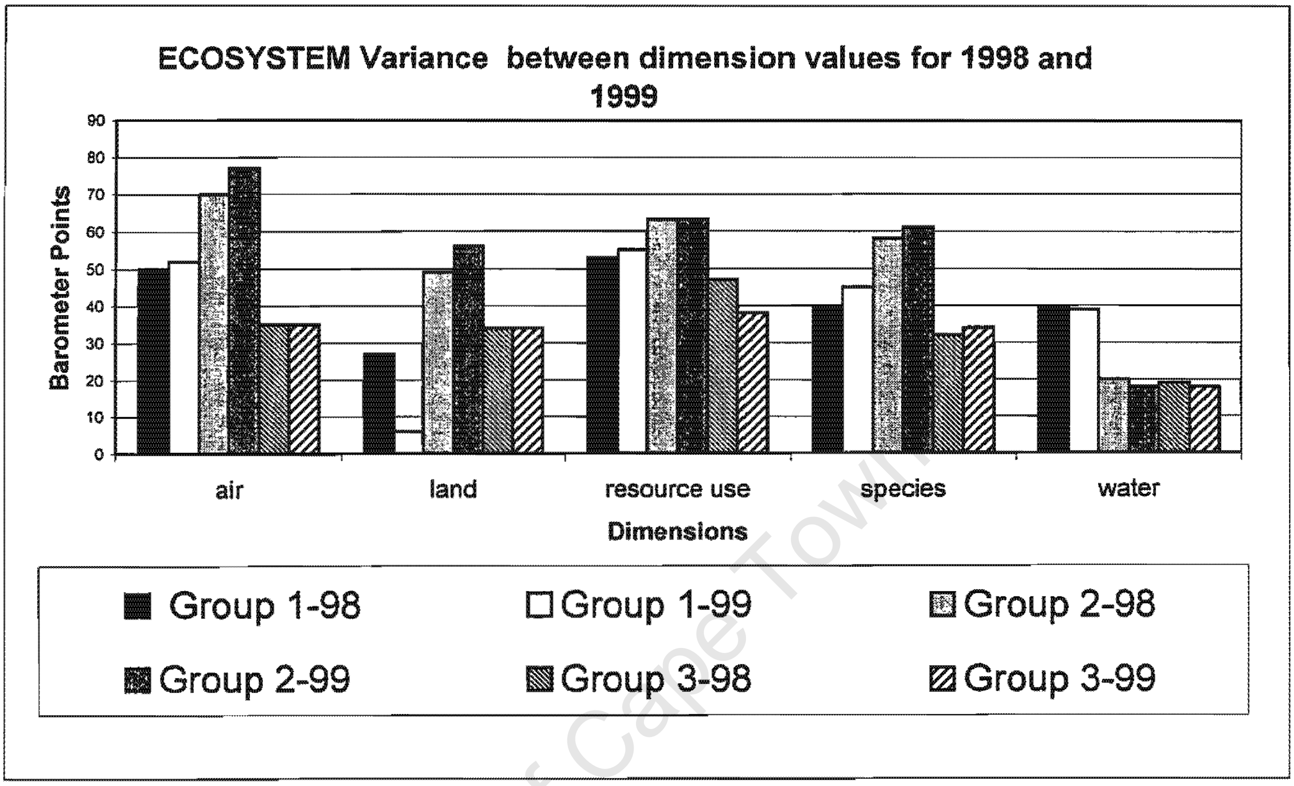


Figure 6.3 Variance between Dimension Point Values for 1998 and 1999 in The Ecosystem Wellbeing Subsystem

The reactions of the different groups to the new data reflects the specific sensitivities and complexities of the individual hierarchies and suggests that there is more consensus between the Ecosystem dimension hierarchies than the Human dimension hierarchies. This agrees with earlier comments about the groups which feel more confident about assigning and ranking Ecosystem indicators. Despite this the results show that the values of the groups' overall points for the Human System Wellbeing were closer to each other than those for Ecosystem Wellbeing.

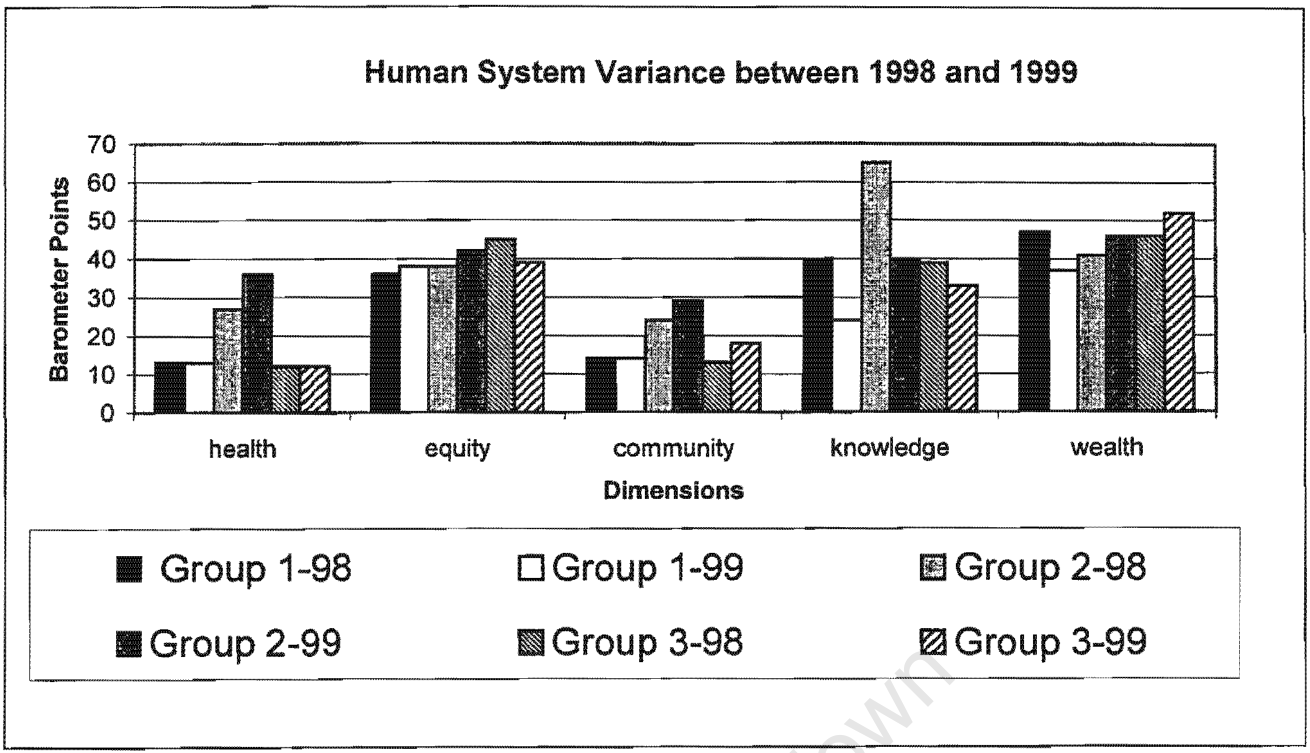


Figure 6.4 Variance between Dimension Point Values for 1998 and 1999 in The Human Wellbeing Subsystem

6.2.3 What does the Hierarchy Structure tell us about the Indicators?

There is 81% agreement between groups in the allocation of indicators to the subsystem level (human or environment) as can be seen in **Appendix 5**. This may, in part, be due to the fact that the dimension definitions provided by the IUCN guided the type of information required by each dimension.

In each of the workshops, the participants indicated that they felt confident that aggregated Ecosystem dimension indicators were reflective of ambient conditions. The Human indicators were considered to be less representative and co-ordinated. The multiplicity of Human Wellbeing indicators at the sub-dimension level may thus indicate a less well-understood aspect of the environment, or possibly a duplication of effort in obtaining information from various sources, which does not add any distinctly new information to the aggregate. An example of this is the multiplicity of traffic indicators .

The hierarchy structure also reflects the associations or linkages which the indicators invoke for the participants. This is closely related to their worldview. For example Group 3, the NGOs, placed Indicator Number 23 (Number of nuclear accidents) in the "Health" dimension under a category they insisted be called "Nukes", whereas Group 2, the officials, placed all nuclear indicators under the "Resource Use" dimension as they perceived them to relate to energy provision.

6.2.4 Are Hierarchies and Barometer of Sustainability Results Comparable between Regions?

It has been established that the structure and weighting used to formulate a Barometer of Sustainability index is unique to the group developing it. The SAM approach ensures that there is an approximate level of comparability. The differences, however, reflect the value judgements and worldview of the group. Despite these differences, the overall Barometer of Sustainability results did partially accord with one another.

The participants considered the ability of the Barometer of Sustainability to reflect value judgements as both a strength and a weakness. A strength because communities could use their own value systems in the determination of sustainability, but also a weakness because in doing so, it makes it difficult to compare Barometer of Sustainability results between cities or countries, since the indicators, structure and weighting used would be different.

Comparative assessments and individual assessments are treated differently. Comparative assessments require a common set of indicators, performance criteria and combining procedures. Individual assessments do not since their purpose is to inform local decision-making, not to provide comparisons with other localities.

6.2.5 Are Hierarchies and Barometer of Sustainability Results Comparable between Groups?

In **Chapter 5,** the results from this research, using the three different groups, were averaged to produce an overall Barometer of Sustainability result. The question should be asked whether it is appropriate to average group results. A larger scale attempt to formulate a Barometer of Sustainability for the Metropolitan area might have produced even more divergent results if more groups, representative of the Metropolitan society, had been used. With more groups, an averaged final result or an agreed compromise hierarchy, weighting and point values, would have to be used for a clear picture to be obtained. However, although it is fairly easy to average Barometer results, scalings and point assignments, it is impossible to average the hierarchy structures. Using the groups as subsets of society for the purpose of formulating a local Barometer of Sustainability, is therefore not ideal.

Taking groups and averaging results is less satisfactory than obtaining consensus in one forum so as to avoid differing conceptualisation of linkages between indicators amongst different groups. In a non-experimental attempt to develop a widely accepted Barometer of Sustainability it would have to be carefully considered whether multiple Barometer of Sustainability results should be averaged or whether a single group should undertake the exercise. It is believed, however, that at a metropolitan scale, averaged results would be accepted by the majority of participants.

An inherent weakness in the Barometer of Sustainability was identified by the participants. They recognised that if sectors of society contributing to the process had ulterior motives or, were unable to view the system holistically, or exerted undue political influence on the process, a Barometer of Sustainability could be formulated which does not represent an accurate measure of sustainability. Strong technical and scientific guidance and input would help to alleviate this potential problem. For this research project, groups were chosen because of their previous exposure to environmental matters and because they had an interest in a sustainable future. All participants had some background and understanding of environmental systems and system interactions. However, in a situation where there was little understanding of environmental linkages, participants may require prior education. This could introduce bias.

Chapter 4 postulated that large groups rarely reach satisfactory conclusions for complex problems and that the ideal group size is less than ten (Stech and Ratcliffe, 1979). However, in order to be inclusive and utilise the Barometer as an educational tool, determination of the Barometer should be undertaken by a wide range of people. It is also essential that the Barometer of Sustainability used by the CMA officials reflect all the communities from the region or its results will not be accepted by the public.

To overcome some of these shortcomings, a three-phased process is suggested for a complex social structure such as a large city. The first phase could consist of a series of small workshops using sector representatives and elected officials to define the system and goals and to identify issues and objectives. This framework should be widely communicated and re-worked until a satisfactory hierarchy has been established. As part of this process the existing SOE indicators would have to be reviewed and appropriate indicators selected or created.

The second phase could consist of various sectors of society undertaking workshops to develop their own Barometer of Sustainability for the city. This would allow discussion, focused thought and information dissemination. In the third phase, a representative group could be selected from the communities participating to undertake a final version of the Barometer which would take into account the weighting and performance criteria utlised in the sector workshops and develop a compromise set of weightings and criteria which are broadly acceptable. This would allow the values of various groups to be incorporated in a joint Barometer of Sustainability and therefore gain acceptance from the broader public.

6.2.6 The Barometer of Sustainability Over Time

A measurement gains usefulness if it is undertaken at regular intervals, as this helps to establish whether a clear trend exists. An aggregated measurement of sustainability may also therefore be able to show a trend if it is undertaken for several years in succession. However, value judgements and the priorities of a community may also change over time. Thus, the Barometer of Sustainability scalings would need to be updated to reflect such change. This could be linked to the political system in which a new local government is voted in every four years. If the indicators or performance criteria are altered it will become necessary to "backcast" to ensure that the trend is reliant on a continuous set of data.

6.3 Critique of the Barometer of Sustainability Overall Process

Participants questioned several aspects of the theory supporting the Barometer of Sustainability during the workshops. These are discussed below.

6.3.1 Interlinkages

The Barometer theory underpinning the hierarchy structure was challenged on the basis that it was an oversimplification of a complex environment. This criticism was based on a perceived inability of the Barometer of Sustainability to deal with interaction between aspects of the environment. The Barometer of Sustainability specifically guards against double counting. One indicator can only be assigned to either "ecosystem" or "human" subsystems. This was a cause of frustration in all the workshops and the participants commented that some of the indicators had a great influence on both subsystems and should be reflected on both sides. This issue could be overcome by careful selection of indicators, allowing slightly different indicators measuring similar issues to be placed into both subsystems. In the present study, an opportunity to test this proposal was not provided.

Several natural science trained participants were concerned that biological and physical limits of the world's systems were not being adequately dealt with and that the perceived psychological and cultural aspects were given more significance because of the importance placed on value judgements rather than specialist knowledge. This is largely reflective of the participants involved in developing a particular Barometer of Sustainability — whether they are trained specialists or members of the local community. Since the Barometer of Sustainability is clearly focused on community inclusion, it is assumed that the base data should be influenced by scientific knowledge. The community needs to be informed when scientific knowledge is available but the value of local observation should not be underestimated. Ideally, a combination of scientific expertise, local knowledge and observation should be used to develop the Barometer of Sustainability hierarchy.

6.3.2 Complexity of the Indicator Hierarchy

As has been discussed earlier in this chapter, the hierarchies are influenced by both the base data and the participants' worldview and cannot simply be seen as mathematical structures. The hierarchies are complicated and are difficult to interpret without a thorough understanding of the process used to develop them. An attempt to remedy this was the adoption of colour coding in the hierarchies as illustrated in **Figure 6.5** and used in **Chapter 5**. This introduction of colour resulted in the participants being able to quickly identify low-scoring indicators. This was found to be useful because the participants began to identify trends in the dimensions and discuss their implications for sustainability.

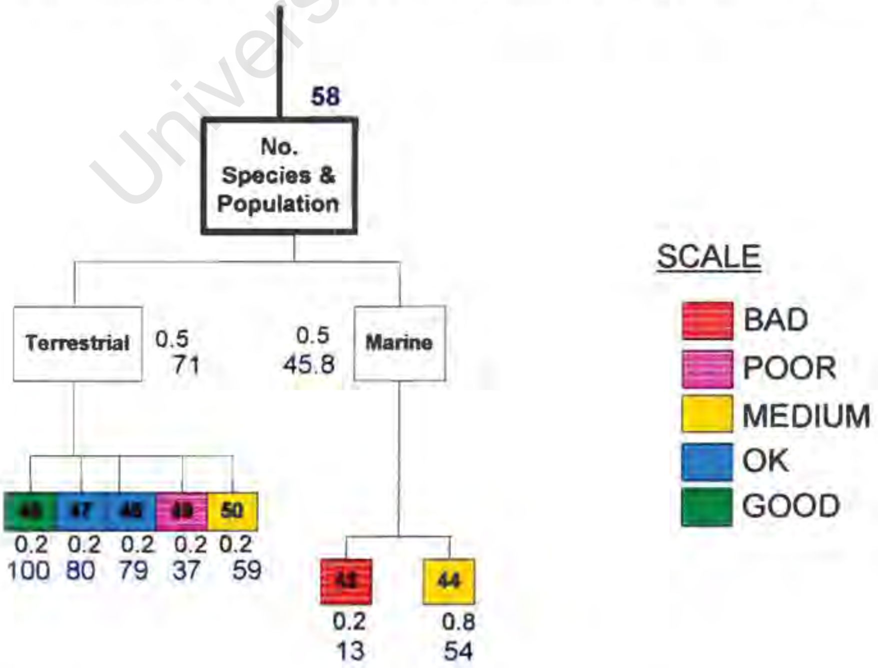


Figure 6.5: Colour Coded Assisted Interpretation of Hierarchies

Another complication was the vast amount of information required to complete a hierarchy. To assist the participants a table of indicators, corresponding to the numbers used on the hierarchy, was developed to be able to decrease the size of the resulting hierarchies. This was found to be beneficial.

EXAMPLE

The indicator descriptions for Indicator numbers 43 and 44 shown in Figure 6.5 above

No.	Indicator	SOE result	Information
43	% Coastline protected by Marine Protected Area (MPA)	2%	
44	Marine spp rated critical within MPA's	4	**Spp.= species**

6.3.3 Loss of Information

6.3.3a *Detail*

A further criticism of the Barometer of Sustainability approach was that it does not enable the recognition of geographic distribution of environmental problems. An indicator used in the Barometer of Sustainability may comprise of a series of very good and very bad results across a region. The averaged value may therefore be a distortion of reality. In complex situations the geographic distribution of values should be available for better management of specific problems.

The composition of the indicator set should be such that it can correctly identify possible problems at an aggregated level and provide further detailed information at a lower level of aggregation. The Barometer of Sustainability is a tool for ascertaining the overall sustainability and is not supposed to be used as a tool for detailed micro-management of the urban environment.

6.3.3b *Significance*

All of the reference groups commented that the structuring and weighting of the hierarchies occasionally did not allow sufficient significance to be placed on particular indicators. If several critical indicators fall under the same dimension they may be perceived as no more important than the indicators in the other dimensions. For example, indicators of 'TB rates' and 'Population growth' both fall under the "Health" dimension. These are both critical human wellbeing indicators. The "Community" dimension contains indicators such as 'Number of traffic accidents' and '% commuters using rail'. When the hierarchy calculation is undertaken the "Community" dimension and the "Health" dimension are weighted equally. It could be argued that the health indicators are significantly more important than the community indicators, but this is not reflected.

The specification that all dimensions are weighted equally is directly related to the adoption of the IUCN SAM structure. The IUCN (1999) argues that all ten dimensions are required for a sustainable society to develop. The above example does, however, raise concerns regarding whether they should all receive the same weighting.

6.3.4 Scope

Another issue raised was the point that the physical boundary adopted for the SOE, and therefore the Barometer of Sustainability exercise, was the Metropolitan political boundary. The point was made that environmental issues extend beyond the boundaries of the city and that the focus should extend to the "ecological footprint" of the city if the results were to be holistic and truly reflect sustainability of the city. It is possible to select indicators which measure the impacts on the wider ecosystem but this was not done in the CMA SOE report.. This study was limited to the SOE data due to logistical and financial constraints.. Although this is a valid criticism of the SOE it would be costly and difficult to achieve a comprehensive measurement of all impacts throughout the ecological footprint of the CMA.

6.4 Critique of the 1998 CMA SOE as a Base for an Aggregated Sustainability Index

One of the objectives of this study was to determine whether it was feasible to use the indicators reported in the 1998 CMA State of the Environment Report to develop an aggregated sustainability index. The research undertaken for this dissertation, as detailed in Chapter 4, 5 and 6, showed that it was feasible, although some shortcomings in the SOE and the indicators selected are identified during the process of developing the Barometer of Sustainability.

These shortcomings include:

1. Many of the SOE indicators are poorly defined or no definition is given.
2. Source data was in several instances was unconfirmed or determined in a non-repeatable manner.
3. Formulae to show how indicators were calculated, are not given.
4. Indicators were drawn from information collected for other purposes. Strategic thinking needs to be undertaken to collect information to provide more useful indicator purposes.

5. There is only a 60% overlap of indicators between the 1998 and 1999 SOE. The indicators need to be finalised and retained for a few years to allow some basis for comparison from one year to the next.
6. The indicators do not provide sufficient coverage of the ten dimensions required by the IUCN SAM structure. This means that there are parts of the environment which are not adequately measured. The SOE indicators were not developed for the Barometer of Sustainability framework, if a Metropolitan Barometer was to be developed a review of the indicators would have to be undertaken.
7. The indicators do not provide a range of time-frames which would ensure that short, medium and long term changes are sufficiently monitored to act as timeous warning of imminent problems.

6.4.1 Institutional Adaptation

For the sake of developing institutional memory, as well as information for the public, it is recommended that a guide or manual be developed for the SOE. This should contain details of the indicators used, including at least:

- Definition of the indicator;
- Methodology for collection and calculation for SOE purposes;
- Authority responsible for collection of data ;
- Brief history of indicator (e.g documented since...);
- Other comments about certainty of results, problems experienced, data missing.

This document should be in the form of a manual which could be used by a local authority to keep track of all the information used for the SOE and it should be available, on request, to other authorities and the public.

6.4.2 Indicator Adaptation

The reference group participants provided insight and comments regarding the 1998 indicators. Detailed comments are given in Appendix 3. Specific dimensions identified by the groups as having missing monitoring elements were the "Land", "Health", Community" and "Resource Use" dimensions.

6.4.2.a ***Land Indicators***

The "Land" dimension had the fewest indicators in all groups. The 1999 SOE introduced some indicators for this issue (refer to the table of indicators in **Appendix 2**), however, the participants provided further suggestions of indicators which could be added:

Issue	**Description**	**Suggested Indicator**
Agriculture	Quality of soils	Dept of Agriculture arability measure.
Information on planning regulations	Measure of enforcement of planning regulations	Number of fines under planning and building regulations

6.4.2b ***Health indicators***

The "Health" dimension contained several good indicators but the reference groups felt that there were some missing which would be useful. Significantly an indicator on HIV/Aids status was missing. Also, mental health is not indicated. A suggestion was made that this could be measured by recording suicide rates. Number of acute respiratory chest infections in children under six years indicator was included in 1998 and excluded in 1999 — this should be re-introduced.

Issue	**Description**	**Suggested Indicator**
HIV/AIDS	Infection rate	Number of recorded HIV infections per annum
Mental health		Number deaths by suicide per annum

6.4.2c ***Community Indicators***

Although there are several good indicators representing this dimension the following issues were seen by participants as necessary additions.

Issue	**Description**	**Suggested Indicator**
Social support	Access to social workers	Number of social workers registered/employed within the CMA
	Welfare payments	Number of registered individuals drawing welfare

	Disabilities grants and facilities	Number of registered individuals drawing disability grants
Access to justice		Number of police/ law enforcement officers operating within CMA
Access to health care	Access to hospitals or clinics	Average period spent waiting to be treated.

6.4.2.d *Resource Use Indicators*

The "Resource Use" dimension had reasonably good indicators for energy and waste issues but it was felt that agriculture, fisheries and marine resources should be included. The following indicators were suggested for inclusion:

Issue	**Description**	**Suggested Indicator**
Waste	More accurate information about recycling – separate industrial from domestic recycling	% industrial waste re-used per person per day
		% domestic waste re-used per person per day
Agriculture	Arable land within the CMA	% land zoned for agriculture being used for crops or grazing
	Subsistence gardening	Hectares of land being used for subsistence gardening
Fishing Industry	Tonnage being processed	Daily catch registered at harbours (Hout Bay, Cape Town, Simon's Town, Kalk Bay)

6.5 Conclusions

The Barometer of Sustainability produced a series of graphical, aggregated indices for the Cape Metropolitan Area reflecting the Human and Ecosystem Wellbeing of the area. As a tool it was successful because the participants felt that the results were reasonable and reflected their sense of the state of the environment and progress toward a desirable state. **Appendix 6** contains the correspondence and comments from the participants. The majority of participants felt that it was a good process. There was a high level of acceptance of the results. The next chapter draws conclusions from the research and offers suggestions for further research.

CHAPTER 7

SUMMARY AND CONCLUSIONS

> *"In our daily lives we accept a great deal of organisation. We pay taxes, we conform to laws, we inform one another about everything under the sun. Still, so far, we have proved incapable of finding an adequate answer to the threats facing our biosphere, our very future. Yet this can change!" (T. de la Court, 1990).*

This chapter provides an overview of the findings from the research exercise and presents the conclusions drawn. It also highlights recommendations for improvements to the Cape Metropolitan Area State of the Environment Report and identifies future research opportunities for the tool known as the Barometer of Sustainability.

The Barometer of Sustainability is an aggregation tool developed by Robert Prescott-Allen (IUCN,1997). It allows systematic organisation and combination of indicators in order to draw conclusions about the wellbeing of Human and Environmental Systems. The conclusions are presented visually, providing a "picture" of the State of the Environment.

The objectives of this dissertation are:

- To determine whether it is feasible to use the data already being collected in the Cape Metropolitan Area to produce a valuable measure of sustainability, and, to identify what, if any, critical monitoring elements are missing.

- To determine whether the Barometer of Sustainability can be used as an analytical tool to provide an intuitive picture of the results gathered for a State of the Environment report, which will assist in an understanding of environmental (ecosystem and human) issues in the Cape Metropolitan Area.

The indicators contained in the Cape Metropolitan Area 1998 State of the Environment Report (CMC,1999) were used as base data to undertake the Barometer. Three groups were identified from various sectors of society to undertake the Barometer process for this study. These groups were:

- University Staff and Students
- Cape Metropolitan Council Officials
- Environmental non-Governmental Organisations

These groups were selected as they have a knowledge of environmental systems and sustainability. Volunteers were used for all of the workshops. The groups were also expected to impart slightly different value systems to their Barometer and it was expected that this would influence the outcome. This was confirmed. The results from the three groups are shown on the sustainability graph in **Figure 7.1**

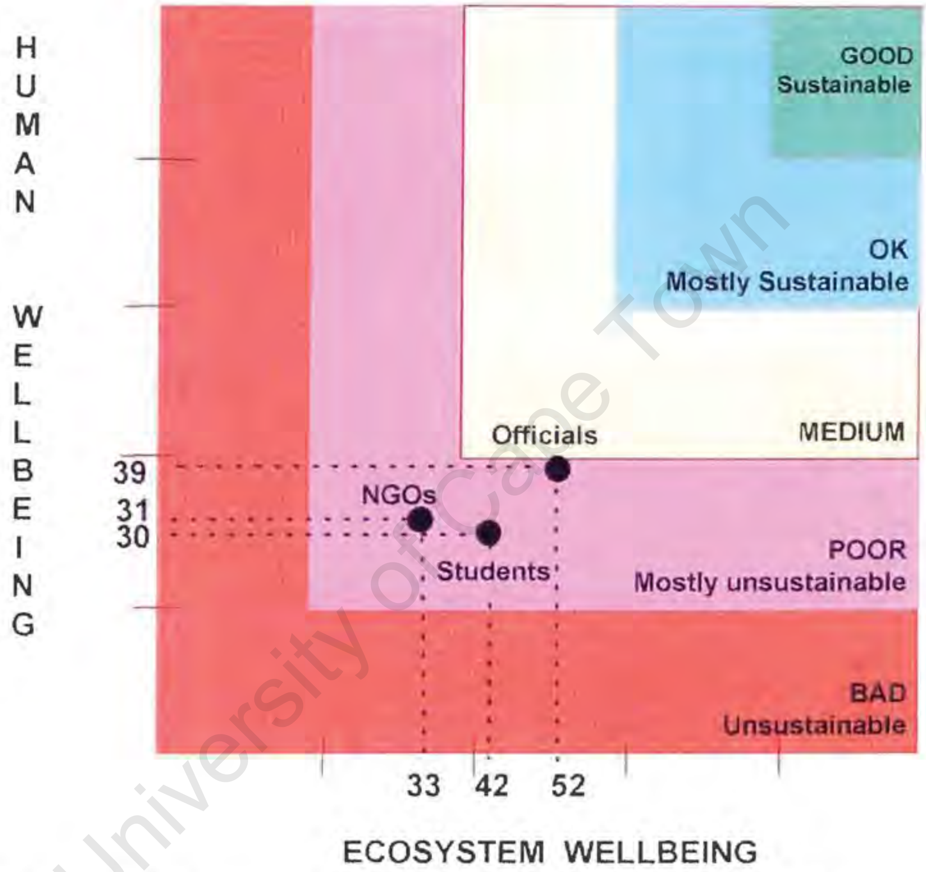


Figure 7.1 The 1998 CMA Barometer — Results of the Three Group Workshops

The detailed results of these workshops are documented in **Chapters 5 and 6**. It was found that the Barometer was an easily accessible tool which provided structure and focus for participants attempting to understand the implications of indicator data for sustainability. The tool is also sensitive to the value system applied in the organisation and for the calculation of the Barometer and this accounts for the variation in results seen in Figure 7.1 above. Despite the varying values used by the three groups undertaking this exercise, the results were all in the "Poor" or "Mostly Unsustainable" category of the Barometer. The 1999 SOE (CMC, 2000) data was tested using the 1998 structure developed by the three groups to verify the Barometer's ability to reflect change in the indicators.

There was a negative trend in the Barometer results, which was expected, as several of the CMA 1999 indicators were reported as being significantly lower than the reported 1998 results. The proclamation of a National Park within the CMA, however, had a significant positive effect on the results. This single indicator, accounts for the government official groups' increase in Environmental Wellbeing points between 1998 and 1999. The changes noted on the Barometer of Sustainability graph are shown in **Figure 7.2**.

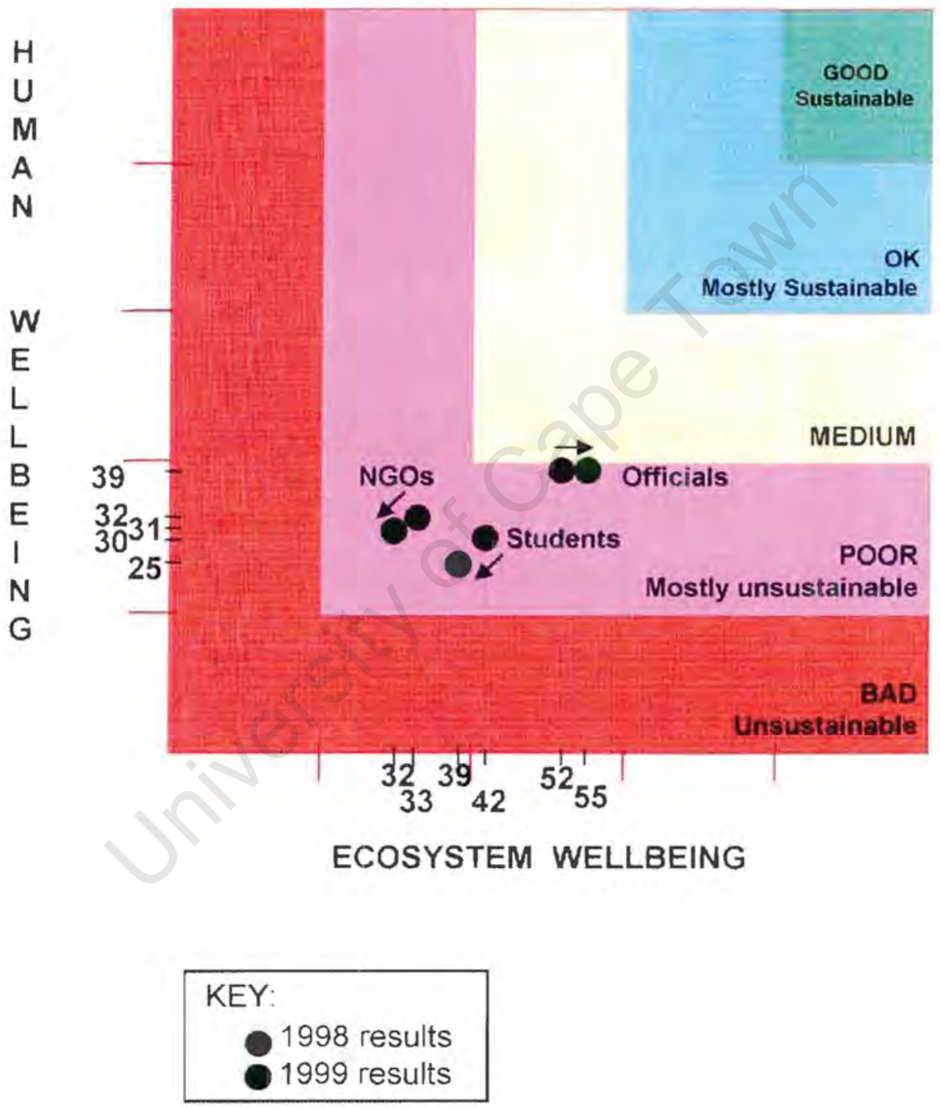


Figure 7.2: Barometer of Sustainability Change in Results between 1998 and 1999.

7.1 Feasibility of Using the 1998 SOE to Develop an Aggregated Sustainability Index

One of the objectives of this study was to determine whether the information already being collected for the SOE could be used in developing an aggregated index of sustainability for the CMA. It has been proven that it is possible to utilise the existing data as presented in the 1998 SOE, however, certain limitations for the SOE and the indicators were identified in terms of their use for this purpose.

The shortcomings listed below are discussed in **section 6.4**.

- Documentation of many of the SOE indicators is poor. Definitions and formulae to show how indicators were calculated, are not given.
- Source data was in several instances unconfirmed or determined in a non-repeatable manner.
- Indicators were drawn from information collected for other purposes and therefore are not always meaningful as indicators of sustainability.
- Indicators have been redefined or replaced in successive years making trend identification difficult.
- The indicators do not provide sufficient coverage of all the elements considered essential for a sustainable society.
- The indicators are not balanced to provide monitoring of a range of time horizons encompassing short-, medium-, and long-term changes.
- There is a perception that SOE information is inaccurate due to some of the problems listed above.

It is recommended that in order to overcome some of these criticisms a guide or manual be developed for the SOE. This should include details of the indicators used, including at least the following: definition of the indicator; methodology for collection and calculation for SOE purposes; responsibility for collection of data; history of indicator; and other comments about certainty of results, problems experienced and missing data.

Several of the individual indicators were criticised while additional indicators were suggested to assist in developing a more balanced measurement of the State of the Environment. Further discussion can be found in **Section 6.4** The mistrust of the results in the SOE expressed by participants was partially due to the lack of information and definitions for the indicators and partially because the information appeared to be contrary to "popular belief". This is an important finding as success of local government initiatives for sustainability relies on the backing of the community, and clearly there are still trust issues to be overcome.

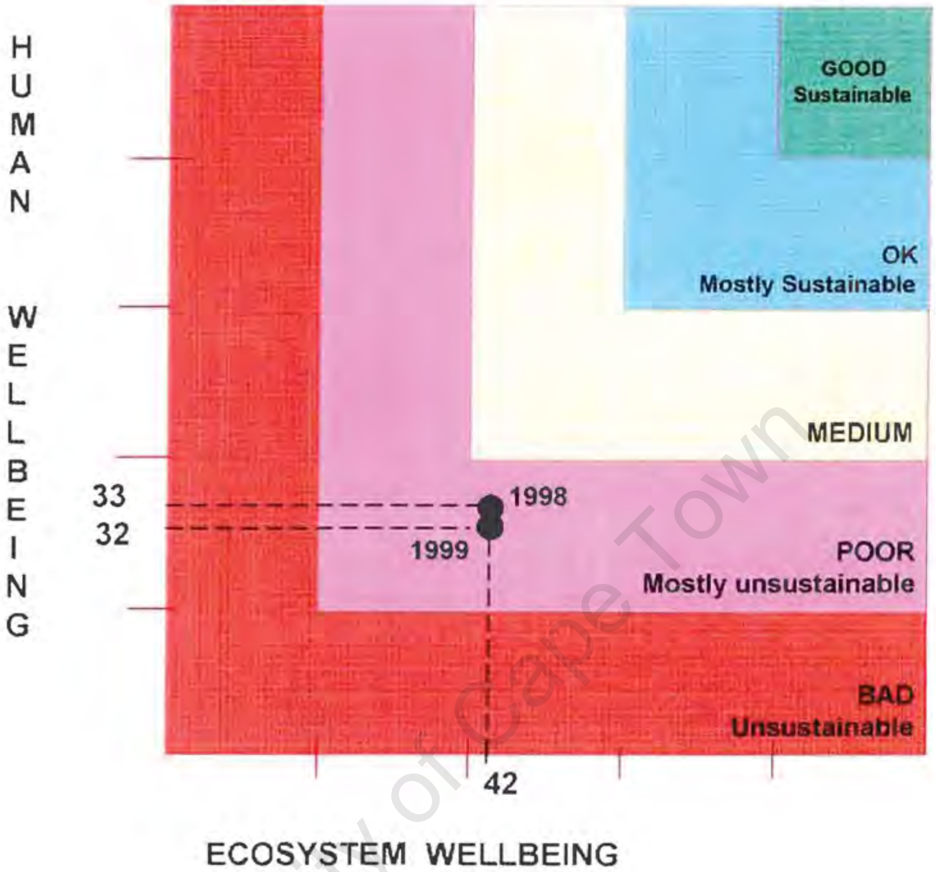


Figure 7.3 Barometer of Sustainability Average for 1998 and 1999

7.2 Barometer of Sustainability as an Analytical Tool for the Cape Metropolitan Area

The second objective of this study is to determine whether the Barometer of Sustainability could be used to develop an aggregated sustainability index for the Cape Metropolitan Area. The Barometer was proved to be able to focus the participants on the complexities of measuring sustainability. It provided a framework which allowed the problem to be approached through dimensions which were easily understood and dealt with. A detailed description of the Barometer theory and methodology is given in **Chapters 3 and 4**. The Barometer formulation exercise undertaken for this dissertation required the organisation of the SOE indicators into a hierarchical structure. This process allowed participants to highlight problem areas and missing indicators for the Cape Metropolitan Area.

Based on the participants' reactions and comments it can be concluded that the process encouraged them to engage with environmental issues on a holistic level forcing them to consider all factors, not just those of interest to the individual. The three distinct groups representing different sectors of society namely: university staff and students, local government officials and environmental NGO's all determined that the CMA has a sustainability rating of "Poor" meaning that it is mostly unsustainable. Furthermore, they all agreed that Human Wellbeing in the CMA is currently scoring lower than the Ecosystem Wellbeing.

The Barometer of Sustainability allows participants to introduce their worldview by assigning indicators to a hierarchy and weighting and scaling each indicator. In this way they are able to decide how important a particular factor is to them and how well they wish to see it perform. This approach led to a very high level of acceptance of the process and the results, by participants.

The Barometer of Sustainability also serves the purpose of assisting the officials in determining which indicators provide useful information and which require further development before they will be useful. It also helps to determine what type of information is missing from the State of the Environment Report.

Future research on the Barometer of Sustainability should focus on the tool's sensitivity to the value judgements used to develop the hierarchy and determine Barometer points, as well as the effect of minor and major environmental change on the hierarchy once it has been established. The Barometer of Sustainability results were seen by some of the participants as subjective and it was questioned whether the Barometer result were "scientific enough" to accept. The assumption is that value judgements do not reflect a balanced approach. Some participants felt that particularly the ecosystem elements required vast scientific knowledge to accurately determine their carrying capacity and sensitivities. The question is then raised: Is common sense, local knowledge and experience sufficient to assist development toward sustainability? The theory of the egg of sustainability on which the Barometer of Sustainability is based suggests that a balanced approach from both scientific and community values is required to move toward sustainability.

Values change over time, and are affected by circumstance, therefore it is important to realise that any Barometer which is used, needs to be regularly updated to ensure that it reflects the current judgements of the communities it represents.

The challenges of developing a Barometer of Sustainability for the Cape Metropolitan Area were highlighted in **Chapter 6**. In order to ensure acceptance of the measurement by the broader public it is necessary that all sectors of society understand and contribute to the process. Stech and Ratcliffe (1975) showed that large groups do not produce good quality results and therefore a three-phased process including small-scale workshops is recommended. The first phase could consist of a series of small workshops using sector representatives and elected officials to define the system and goals and to identify issues and objectives. This framework should be widely communicated and reworked until a satisfactory hierarchy has been established. As part of this process the existing SOE indicators would have to be reviewed and appropriate indicators selected or created.

The second phase could consist of various sectors of society undertaking workshops to develop their own Barometer of Sustainability for the city. This would allow discussion, focused thought and information dissemination. In the third phase, a representative group could be selected from the communities participating to undertake a final version of the Barometer which would take into account the weightings and performance criteria utilised in the sector workshops and develop a compromise set of weighting and criteria which are broadly acceptable. This could then be adopted as the Barometer of Sustainability for Cape Town.

It was emphasised in **Chapter 6** that the Barometer is a tool for the organisation and re-evaluation of the information provided by the base indicators. It is therefore essential therefore that the indicators used should provide sufficient coverage of all aspects of the environment and varying coarseness appropriate for measuring environmental change of different duration (short-, medium-, and long-term).

7.3 Conclusion

The Barometer of Sustainability is a flexible tool which can successfully incorporate information already collected in the CMA to develop a graphical summary of the State of the Environment. The graphical index is easily understood, and the process of obtaining it, is educational. The Barometer of Sustainability has thus provided a suitable and adequate aggregated sustainability index for the Cape Metropolitan Area.

BIBLIOGRAPHY

1. Adriaanse ,A (1993) *Environmental Policy Performance Indicators: A Study on the Development of Indicators for Environmental Policy in The Netherlands.* The Hague: Sdu Uitgeverij Kononginnegracht, 1993.

2. Agenda 21 (1992) *Programme of Action for Sustainable Development.* New York: United Nations, 1992.

3. Allen , R.G.D (1975) *Index Numbers in Theory and Practice.* Edinburgh: Macmillan Press Ltd, 1975.

4. AtKisson, A. (1996) "Developing Indicators of Sustainable Community: Lessons from Sustainable Seattle" [1996] *The Earthscan Reader in Sustainable Cities.* Ed. Satterthwaite D. London: Earthscan Publications Ltd, 1999, 352-363.
Reprinted from Environmental Impact Assessment Review Vol 16, 1996, 337-350.

5. ANZECC (Australian & New Zealand Environment and Conservation Council) (2000) *Core Environmental Indicators on the State of the Environment.* Australian & New Zealand Environment and Conservation Council State of the Environment Reporting Task Force, Canberra: ANZECC, March 2000.

6. Baker. S, Kousis. M, Richardson & Young S (eds) (1997) *The Politics of Sustainable Development: Theory, Policy and Practice within the European Union.* London: Routledge, 1997.

7. Bakkes , J. and van Woerden, J. (Eds) (1997) *The Future of the Global Environment: A Model-Based Analysis Supporting UNEP's First Global Environment Outlook.* Environment Information and Assessment Technical Report, RIVM/UNEP, RIVM Rapport 402001007, Nairobi: UNEP, 1997.

8. Bariloche Foundation (1974) *Limits to Poverty*, Argentina: Bariloche Foundation, 1974.

9. Bartelmus, P. (1997) "Greening the National Accounts." In *Sustainability Indicators: Report of the Project on Indicators of Sustainable Development*, Eds. Moldan B. and Billharz S., Chichester: John Wiley and Sons, 1997, 198-205.

10. Bartelmus, P. (1999) *Sustainable Development- Paradigm or Paranoia.* Wuppertal Institute for Climate, Environment and Energy. Germany: Wuppertal Institute, May 1999

11. Bates, Marston	(1962)	“The Human Environment.” The Horace M. Albright Conservation Lectureship. University of Berkeley, California, 23 Apr. 1962. [Online] Retrieved 26 June 2001 from Berkeley on the World Wide Web: http://www.cnr.berkeley.edu/forestry/bates.html
12. Bossel, H.	(1999)	*Indicators for Sustainable Development: Theory, Method, Applications.* A report to the Balaton Group. Canada: International Institute for Sustainable Development, 1999.
13. Carew-Reid, J.; Prescott-Allen,R., Bass S. and Dalal-Clayton D.B.	(1994)	*Strategies for National Sustainable Development: A Handbook for thei Planning and Implementation.* An IIED and IUCN publication London: Earthscan Publications, 1994.
14. Carson, R.	(1962)	*Silent Spring*, Boston: Houghton Mifflin Company, 1962.
15. CIA (U.S. Central Intelligence Burea)		*CIA World Factbook* U.S. Central Intelligence Burea [Online] Retrieved 20 November 2000 from U.S. Central Intelligence Burea on the World Wide Web: http://www.cia.gov/cia/publications/factbook/
16. CMA (Cape Metropolitan Administration)	(2000)	[Online] Retrieved 25 June 2001 from Cape Metropolitan Administration on the World Wide Web: http://www.capetown.gov.za/
17. CMC (Cape Metropolitan Council)	(1999)	*Year One 1998 State of the Environmental Report.* Cape Town: Cape Metropolitan Council, 1999.
18. CMC	(2000)	*Year One 1999 State of the Environmental Report.* Cape Town: Cape Metropolitan Council, 2000.
19. Cobb C. W., Halstead T., and Rowe J.	(1995)	*The Genuine Progress Indicator: Summary of Data and Methodology.* San Francisco: Redefining Progress, 1995.
20. Cobb C. W.	(2000)	*Measurement Tools and the Quality of Life.* San Francisco: Redefining Progress, June 2000.
21. Cole H.S.D; Freeman, C; Johoda, M; Pavitt KLR (Eds)	(1973)	*Thinking About the Future- A Critique of the Limits to Growth.* Sussex: Sussex University Press, 1973.
22. CPNP (Cape Peninsula National Park)	(2000)	[Online] Retrieved 10 November 2000 from Cape Peninsula National Park on the World Wide Web: http://www.cpnp.co.za/
23. Dalkey, N. C.	(1972).	“The Delphi method: an experimental application of group opinion.” *In N. C. Dalkey, D. L. Rourke, R. Lewis, & D. Snyder (Eds.) Studies in the Quality of Life.* Lexington, MA: Lexington Books.1972.

24. Daly, H.E. (1977) *Steady State Economics: The Political Economy of Biophysical Equilibrium and Moral Growth.* San Francisco: W.H. Freeman & Co, 1977.

25. de la Court, T. (1990) *Beyond Brundtland: Green development in the 1990s.* Trans. Bayens E. and Nigel H. London: Zed Books Ltd., 1990.

26. Dee, N, Baker, J, Drobny,N and Duke K (1973) "An Environmental Evaluation System for Water Resource Planning." Batelle Coloumbus Laboratories, *Water Resource Research*, Vol 9 No. 3, June 1973.

27. DMC (Durban Metropolitan Council) (1999) *Durban State of the Environment 1998* [Online] Retrieved 20 November 2000 from Durban Metropolitan Site on the World Wide Web: http://www.durban.gov.za/environment/index.htm

28. EEU (Environmental Evaluation Unit) (1998) *Guideline for SOE reporting in the CMA.* Environmental Evaluation Unit Report No 1/98/176b, University of Cape Town, Unpublished, 1998.

29. Elliot, J. A. (1994) *An Introduction to Sustainable Development: The Developing World.* London: Routledge, 1994

30. EPA (USA Environmental Protection Agency) (1997) *Health and Environmental Effects of Ground-Level Ozone* [Online] Retrieved 22 Jan 2001 from U.S.A Environmental Protection Agency on the World Wide Web: http://www.epa.gov/ttn/oarpg/naaqsfin/o3health.html

31. Freeman A.M, Haveman R.H.and Kneese A.V. (1973) *The Economics of Environmental Policy.* New York: John Wiley & Sons, 1973.

32. Friend A.M (1996) "Sustainable Development Indicators: Exploring the Objective Function." *Chemosphere* 33 (9), 1739-1748.

33. Gaffney, P (1999) *Gaffney's Local Government in South Africa 1999.* Johannesburg: The Gaffney Group, June 1999.

34. Robinson, M. (ed) (1996) *Chambers 21st Century Dictionary.* Edinburgh: Larousse plc., 1996.

35. Goudie, A. (1990) *The Human Impact on the Natural Environment.* 3^{rd} *ed.* Oxford: Basil Blackwell Ltd, 1990.

36. Hammond, A. Adriaanse,A. Roodenburg, E; Bryant D and Woodard R (1995) *Environmental Indicators: A Systematic Approach to Measuring and Reporting on Environmental Policy Performance in the Context of Sustainable Development.* Washington: World Resources Institute, 1995.

37. Hardi, P , Barg S, Hodge,T and Pinter,L (1997) *Measuring Sustainable Development: Review of Current Practice.* Occasional Paper No. 17, Canada: International Institute for Sustainable Development, 1997.

38. Hardi, P. and Zdan. T. (1997) *Assessing Sustainable Development Principles in Practice*. Winnipeg: International Institute for Sustainable Development, 1997.

39. Hart, M. (1997) *Sustainable Measures* [Online] Retrieved 12 April 2000 from Sustainable Measures on the World Wide Web: http://www.sustainablemeasures.com/

40. Hodge, R.A. (1995) *A Systematic Approach to Assessing Progress Toward Sustainability*, PhD Dissertation, School of Urban Planning, Faculty of Engineering McGill University, Montreal: Unpublished, 1995.

41. Huntley, B.J. (Ed) (1989) *Biotic Diversity in Southern Africa: Concepts and Conservation*. Cape Town: Oxford University Press, 1989.

42. IUCN (1997a) *Barometer of Sustainability and Communicating Wellbeing and Sustainable Development.* An Approach to Assessing Progress Towards Sustainability- Tools and Training Series, Prepared by Robert Prescott-Allen, Cambridge: IUCN, 1997.

43. IUCN (1997b) *Community-Based Indicators: A Guide for Field Workers Carrying Out Monitoring and Assessment at the Community Level.* An Approach to Assessing Progress Towards Sustainability- Tools and Training Series, Prepared by Diana Lee-Smith, May 1997. Cambridge: IUCN, 1997.

44. IUCN (1997c) *Assessing Rural Sustainability: A Companion Booklet to Planning Action for Rural Sustainability.* An Approach to Assessing Progress Towards Sustainability- Tools and Training Series, Prepared by Chimbuya,S; Prescott-Allen,R and Lee-Smith D, Cambridge: IUCN, 1997.

45. IUCN (1997d) *Questions of Survival: A Questioning Approach to Understanding Sustainable and Equitable Development.* An Approach to Assessing Progress Towards Sustainability- Tools and Training Series, Prepared by Dudley, E and Imbach, A, Cambridge: IUCN, 1997.

46. IUCN (1999) *Assessing Progress Toward Sustainability: The System Assessment Method Illustrated by The Wellbeing of Nations* Prepared by Prescott-Allen, R., June 1999. [Online] Retrieved 25 May 2000 from IUCN on the World Wide Web: http://www.iucn.org/themes/eval/english/

47. IUCN and IDRC (1997) *Participatory and Reflective Analytical Mapping for Sustainability (PRAM).* An Approach to Assessing Progress Towards Sustainability- Tools and Training Series, Prepared by Imbach, A.; Dudley, E.; Ortiz,N. and Sanchez,H. Cambridge: IUCN, 1997.

48. IUCN, UNEP and WWF (1980) *World Conservation Strategy: Living Resource Conservation for Sustainable Development.* Gland Switzerland: IUCN,1980.

49. IUCN, UNEP and WWF (1991) *Caring for the Earth. A Strategy for Sustainable Living* Gland Switzerland: IUCN,1991.

50. Inhaber, H. (1976) *Environmental Indices.* Ottowa :John Wiley & Sons, 1976.

51. Janis, I.L. (1954) "Problems of Theory in the Analysis of Stress Behaviour." *Journal of Social Issues* X (1954): 12-25.

52. JMC (Johannesburg Metropolitan Council) (1999) *Greater Johannesburg State of the Environment 1998* [Online] Retrieved 20 November 2000 from Johannesburg Metropolitan Site on the World Wide Web: http://www.csoe.co.za/csoe/Default.htm

53. Johnson, D & Johnson F (1997) *Joining Together: Group Theory and Group Skills.* 6th ed. Boston: Viacom Company, 1997.

54. Kneese A. V. , Ayres R.U. and D'Arge R.C. (1970) *Economics and the Environment: A Materials Balance Approach.* Washington D.C.: Resources for the Future Inc., 1970.

55. Latouche, S. (1993) *In the Wake of the Affluent Society:An Exploration of Post-Development.* London: Zed Press, 1993.

56. Laughlin, P.R. (1980) "Social combination processes of co-operative problem-solving groups on verbal intellective tasks." M. Fishbein (ed.) *Progress in Social Psychology* (Vol 1) Hillsday-New Jersey: Erbaum, 1980. 127-155.

57. Lélé , Sharachchandra M (1991) "Sustainable Development: A Critical Review." *World Development* 19 (1991): 607-621.

58. Luxem, M. and Bryld, B. (1997) "The CSD Work Programme on Indicators of Sustainable Development." *Sustainability Indicators: Report of the Project on Indicators of Sustainable Development,* Eds. Moldan B. and Billharz S., Chichester: John Wiley and Sons, 1997, 6-12.

59. Meadows DH, Randers J and Behrens W.W. (1972) *Limits to Growth.* London: Earth Island, 1972.

60. Meadows D., Meadows D. and Randers J. (1992) *Beyond the Limits.* London: Earthscan Publications, 1992.

61. Meadows, D. (1998) *Indicators and Information Systems for Sustainable Development.* A report to the Balaton Group. USA: The Sustainability Institute, September 1998.

62. Meadows, D. (1999) "Indicators and Information Systems for Sustainable Development." *The Earthscan Reader in Sustainable Cities.* Ed. Satterthwaite D. London: Earthscan Publications Ltd, 1999, 364-393.

63. Moldan, B. and Billharz, S. (eds) (1997) *Sustainability Indicators: Report of the Project on Indicators of Sustainable Development*, SCOPE 58, Chichester: John Wiley and Sons, 1997.

64. Moore D. M. and Dwyer F.M. (eds.) (1994) *Visual literacy: A Spectrum of Visual Learning.* New Jersey: Educational Technology Publications, 1994.

65. Murcott, S. (1997) *Sustainable Development: A Meta-Review of Definitions, Principles, Criteria Indicators, Conceptual Frameworks and Information Systems.* AAAS Annual Conference, "Sustainability Indicators Symposium," IIASA, Seattle, Feb 13-18,1997.
[Online] Retrieved 15 January 2001 from AAAS on the World Wide Web: http://www.aaas.org/meetings/1997/

66. NTREE (National Round Table on the Environment and the Economy) (1993) *Toward Reporting Progress on Sustainable Development in Canada- Report to the Prime Minister National Round Table on the Environment and the Economy.* Ottawa, Canada: Unpublished, 1993.

67. Nelson's Guides (2001) [Online] Retrieved 25 June 2001 from Nelson's Guides on the World Wide Web: http://www.nelsonsguides.co.za/maps2001/wc.gif

68. O'Riordon, T (1981) *Environmentalism.* 2nd ed. London: Pion Press, 1981.

69. O'Riordon, T; Preston-Whyte R., Hamann R. and Manqele M. (2000) "The transition to Sustainability: A South African Perspective" *The South African Geographical Journal*, Vol 82 No.2 (2000): 1-10.

70. Oelofse C, MacDonald S, Mohamed N. (1998) *LA21 Pilot Training Course,* Environmental Evaluation Unit, University of Cape Town, Unpublished, 1998.

71. Oregon State Progress Board (1992) *Oregon Benchmarks: Standards for Measuring Statewide Progress and Government Performance Initiative*, Oregon: Oregon State Progress Board, 1992.

72. Osborn, F. (1953) *Limits of the Earth*, Boston: Little, Brown and Co, 1953.

73. OECD (Organisation for Economic Co-operation and Development) (1993) *Environmental Indicators: Basic Concepts and Terminology*, Background Paper No. 1.
Proceedings of Workshop on Indicators for Use in Environmental Performance Reviews 1-2 February, Paris: OECD, 1993.

74. OSHA (U.S. Occupational Health and Safety Administration) (1993) *Regulations (Standards - 29 CFR) Cadmium in Workplace Atmospheres* [Online] Retrieved 20 November 2000 from Occupational Health and Safety Administration US Department of Labour on the World Wide Web: http://www.osha-slc.gov/OshStd_data/ 1910_1027_APP_E.html

75. Pearce, D. W. (1993) *Blueprint 3: Measuring Sustainable Development*, London: Earthscan Publications Ltd, 1993.

76. Pearce, D.W., Barbier, E.B., and Markandya, A., (1989) *Blueprint for a Green Economy.* London: Earthscan Publications Ltd., 1989.

77. Pearce, D.W. and Turner R.K (1990) *Economics of Natural Resources and the Environment.* Cornwall: Harvester Wheatsheaf, 1990.

78. Pezzey,J (1989) *Economic Analysis of Sustainable Growth and Sustainable Development.* World Bank Environment Department, Working Paper No. 15. Washington: World Bank, 1989.

79. Prescott-Allen, Robert (1995) *The Barometer of Sustainability: A Method of Assessing Progress Towards Sustainable Societies.* Gland Switerzerland: IUCN and PADATA , 1995.

80. Rapport & Friend (1979) "Towards a Comprehensive Framework for Environmental Statistics a Stress-Response Approach." *Statistics Canada Catalogue*, Canada: Minister of Supply and Services, 1979. 11-510.

81. Rees W.E. (1999) "Achieving Sustainability: Reform or Transformation?" In *The Earthscan Reader in Sustainable Cities.* Ed. Satterthwaite D. London: Earthscan Publications Ltd, 1999.

82. Samuel-Johnston, K (ed) (2001) *2001 Environmental Sustainability Index.* An Initiative of the Global Leaders of Tomorrow Environment Task Force, World Economic Foru.m, 2001. [Online] Retrieved 25 June 2001 from World Economic Forum on the World Wide Web: http://www.ciesin.colombia.edu/indicators/ESI

83. Satterwaithe, D. (ed) (1999) *Sustainable Cities*, London: Earthscan Publications, 1999.

84. Schumacher E.F. (1974) *Small is Beautiful*, London: Abacus, 1974.

85. Shaw, M. (1932) "A Comparison of Individuals and Small Groups in the Rational Solution of Complex Problems." *American Journal of Psychology* 44 (1932): 491-504.

86. Smith, H.A. (1887) "Chief Seattle's 1854 Oration." *Seattle Sunday Star* 29 Oct. 1887, [Online] Retrieved 10 July 2001 from Arbor Heights Elementary on the World Wide Web: http://www.halcyon.com/arborhts/chiefsea.html

87. Solow, R. (1974) "The Economics of Resources or the Resources of Economics." *American Economics Review 64:2* (1974): 1-14 (Papers and Proceedings of the 86th Annual Meeting of the American Economic Association)

88. Stead ,Edward W & Jean Garner Stead (1992) *Management for a Small Planet- Strategic Decision-making and the Environment.* USA: Sage Publications, 1992.

89. Stech E. and Ratcliffe S.A. (1979) *Working in Groups: A Communication Manual for Leaders and Participants in Task-orientated Groups.* Illinois: National Textbook Company, 1979.

90. Swart, R.J. and Bakkes, J.A. (eds) (1995) *Scanning the Global Environment: A Framework and Methodology for Integrated Environmental Reporting and Assessment.* United Nations Environment Assessment Technical Reports, UNEP/EAP.TR/95-01, Nairobi: UNEP, November 1995.

91. Thomas, William L. Jr (1956) *Man's Role in Changing the Face of the Earth* An International Symposium under the Co-Chairmanship of Carl O Sauer, Marston Bates and Lewis Mumford, Published for the Wenner-Gren Foundations for Anthropological Research & the National Science Foundation. Chicagio: University of Chicago Press, 1956.

92. Thorndike, R. (1938) "On what Type of Task will a Group do well?" *Journal of Abnormal Social Psychology* 30 (1938): 409-413.

93. Tietenberg, T. (1992) *Environmental and Natural Resource Economics* 3rd ed. New York: Harper Collins, 1992.

94. UNCHS (1998) *Habitat: Urban Indicators Programme Update 1998.* [Online] Retrieved 15 November 2000 from Urban Observatory Database on the World Wide Web: http://www.urbanobservatory.org/indicators/database/

95. UN CSD (United Nations Commission of Sustainable Development) (1996) *Indicators of Sustainable Development Framework and Methodologies*, New York: United Nations, 1996.

96. UNDP (United Nations Development Programme) (1990) *Human Development Report Series.* New York: Oxford University Press, 1990

97. UNDP (1991) *Human Development Report Series.* New York: Oxford University Press, 1991

98. UNDP (1994) *Human Development Report Series.* New York :Oxford University Press, 1994

99. UNDP (1996) *Human Development Report Series.* New York: Oxford University Press, 1996

100.UNDP	(1999)	*Human Development Report 1999.* [Online] Retrieved 14 November 2000 from United Nations Development Programme 1999 Human Development Report on the World Wide Web: http://www.undp.org/hdro/report.html
101.UNEP	(1994)	*An Overview of Environmental Indicators: State of the Art and Perspectives.* UNEP Environmental Assessment Sub-programme, UNEP/EATR 94-01 RIVM/402001001, Nairobi: UNEP, 1994.
102.UNEP	(1996)	*Indicators of sustainable development framework and Methodologies.* New York: United Nations, 1996.
103.V.I.S.A	(2000)	*Visual interactive Sensitivity Analysis Version 5.* Computer Software. Visual Thinking International Limited. 2000.
104.Vogt, William	(1949)	*Road to Survival.* London: Victor Gollancz Ltd, 1949.
105.Wackernagel M. and Rees W.	(1996)	*Our Ecological Footprint :Reducing Human Impact on the Earth.* Philadelphia: New Society Publishers, 1996.
106.Ward B. and Dubos R.	(1972)	*Only One Earth: The Care and Maintenance of a Small Planet.* Middlesex: Penguin Books Ltd, 1972.
107.Watson, G.	(1931)	"Do Groups Think more Effectively than Individuals?" In *G.Murphy & L. Murphy (Eds.) Experimental Social Psychology.* New york: Harper, 1931.
108.Watson, V.	(2000)	*Urban Integration and the Cape Metropolitan Area Report to the Unicity Commission (Urban Development Trends and Issues),* University of Cape Town, Unpublished, August 2000.
109.Weale, A.	(1992)	*The New Politics of Pollution,* Manchester: Manchester University Press, 1992.
110. Wicking-Baird, M. C., de Villiers, M. G. & Dutkiewicz, R. K	(1997)	*Cape Town Brown Haze Study:* Energy Research Institute Report GEN 182:1-118. University of Cape Town: Unpublished, 1997.
111.World Bank	(1993)	*System of National Accounts,* New York: World Bank, 1993.
112.World Bank	(1995)	*Monitoring Environmental Progress: A Report of Work Progress.* Washington: World Bank, 1995.
113.World Bank	(1996a)	*Monitoring Environmental Progress: Expanding the Measure of Wealth.* Washington: World Bank, 1996.
114.World Bank	(1996b)	*Toward Environmentally Sustainable Development in Sub-Saharan Africa: A World Bank Agenda.* USA : World Bank, 1996.

115. WCED (World Commission on Environment and Development) (1987) *Our Common Future*, Oxford: Oxford University Press, 1987.

116. WHO (World Health Orgnisation) (1998) *Epidemic Meningococcal Disease Fact Sheet No 105* Revised December 1998. [Online] Retrieved 20 November 2000 from World Health Organisation on the World Wide Web: http://www.who.int/inf-fs/en/fact105.html

117. WSU (Washington State University) (1998) *The Washington State University Sustainable Development Sourcebook.* [Online] Retrieved 20 June 2001 from Washington State University on the World Wide Web: http://www.wsu.edu:8080/~susdev/#welcome

APPENDIX 1

PARTICIPANTS IN THE GROUP WORKSHOPS

APPENDIX 1

Participants in the Barometer of Sustainability Workshops

Name	Group	Affiliation/Specialisation
Peter Johnston	University Staff & students	Climatology
Lynette Kruger	University Staff & students	Botany
Michelle Rundle	University Staff & students	Occupational Therapy
Debbie Shannon	University Staff & students	Climatology
Mark Wilson	University Staff & students	Business & IT
Alicia Matzener	University Staff & students	GIS
Glenn Ashton	Environmental NGO	Hout Bay Residents Assoc.
Neil Carr	Environmental NGO	Zoning Awareness Project
Liz Mcdaid	Environmental NGO	Wildlife & Environment Society
Julian Satow-Allen	Environmental NGO	Interested Party
Jeremy Burnham	Environmental NGO	The Natural Step
Tom Ellis	Local Govt. Officials	CMC-Catchment Management
Shirene Rosenberg	Local Govt. Officials	CMC- Spatial Planning
Candice Haskins	Local Govt. Officials	CMC-Scientific Services
Keith Wiseman	Local Govt. Officials	CMC-Enviro. Management Dept
Neil Rossouw	Local Govt. Officials	CMC- Air Pollution
Carol Wright	Local Govt. Officials	CMC- Economic & Social Dev.
Craig Haskins	Local Govt. Officials	CMC- Enviro. Management Dept

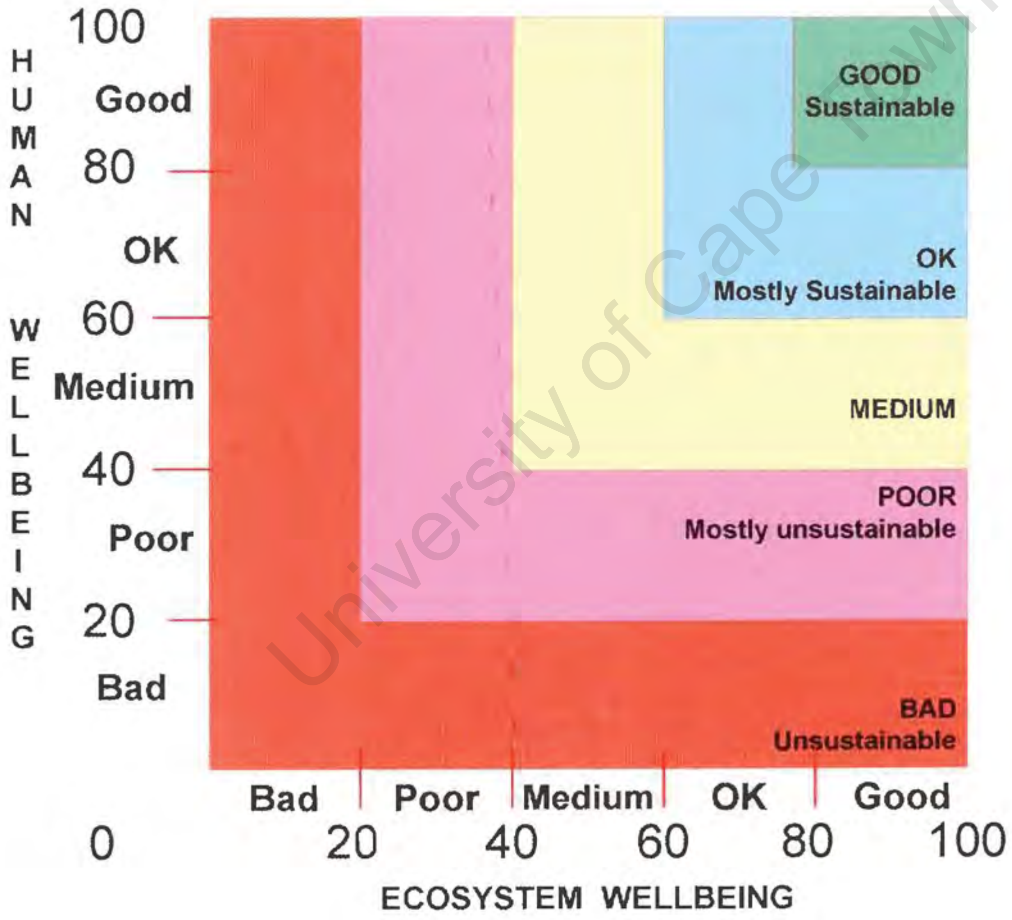
APPENDIX 2

BACKGROUND INFORMATION DOCUMENT

The methodology and indicator information given to the participants.

BAROMETER OF SUSTAINABILITY
CAPE METROPOLITAN AREA

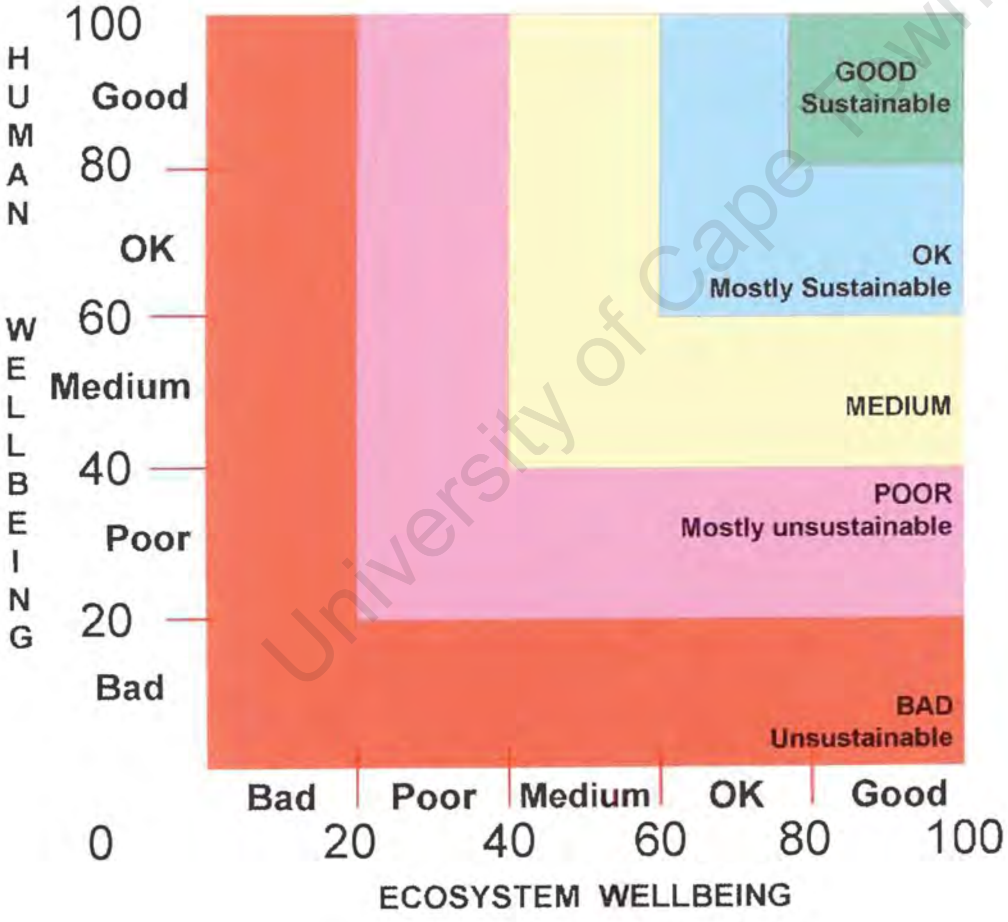
BACKGROUND INFORMATION DOCUMENT



FOCUS GROUP 3
January 2001

BAROMETER OF SUSTAINABILITY
CAPE METROPOLITAN AREA

BACKGROUND INFORMATION DOCUMENT



FOCUS GROUP 3
January 2001

BARAMETER OF SUSTAINABILITY- CAPE METROPOLITAN AREA BACKGROUND INFORMATION DOCUMENT

The concept of sustainability was developed in the early 1990's and has become a target for governments throughout the world to work toward. Achieving sustainability requires that the activities of the various aspects of the natural and social systems operate in relative harmony. This means that measurement of all the aspects is required to obtain an understanding of the "state of the environment". This, however, produces a vast amount of information, which is often highly scientific. By its very nature and volume, such measurements may be inaccessible to both laymen and decision-makers.

The Cape Metropolitan Council published its first State of the Environment (SOE) report in 1998 (CMC,1999). This was the result of an attempt at determining the state of the environment for the Cape Metropolitan Area (CMA) which includes the City of Cape Town, Cape Peninsula and surroundings. The report is a 233-page document, reporting on various aspects of the environment such as air, water, housing, health, etc. It can be argued that the public and politicians, faced with this much information, were still unable to tell whether they were moving towards or away from the overall goal of sustainability. If they had been provided with an aggregated index of the data, there may have been greater understanding in policy decisions taken to further sustainable development. The detailed information should be nested in the aggregated index and can be unpacked where appropriate to provide additional information.

Research Statement: Why Are We Here?

The research being undertaken is based on the sustainability indicators utilised in the Cape Metropolitan Area (CMA) 1998 State of the Environment (SOE) Report with a view to developing an aggregated sustainability index for the metropolitan area.

The objectives of the study are:

- To determine whether it is feasible to use the data already being collected in the CMA to produce a valuable measure of sustainability, and if not, to identify what critical monitoring elements are missing.

- To determine whether the Barometer of Sustainability can be used as an analytical tool to provide an intuitive picture of the results gathered for a SOE report, which will assist in an understanding of the problems and provide an appropriate response to current trends.

Barometer of Sustainability: What is it and How does it Work?

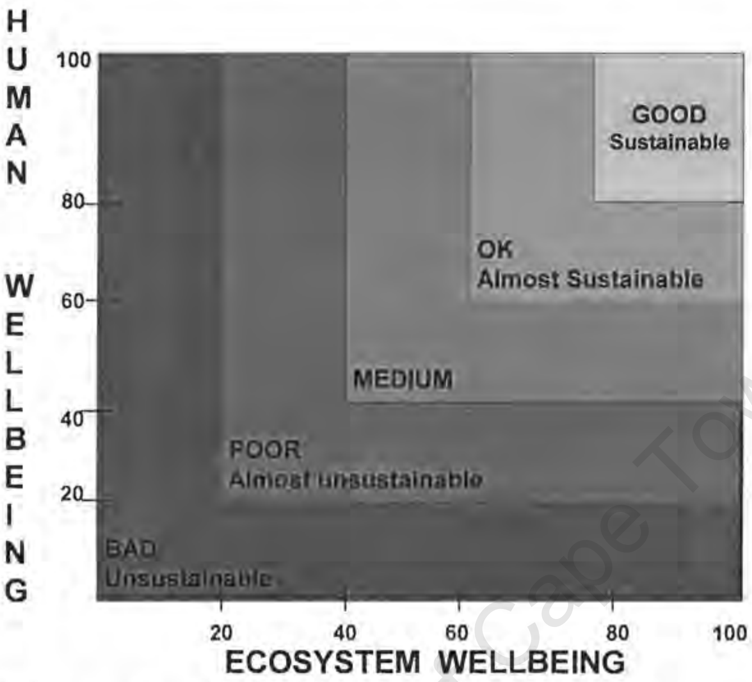


Figure 1: Barometer of Sustainability - "Sustainogram"

> *"The Barometer of Sustainability is a tool for measuring and communicating a society's wellbeing and progress toward sustainability. It provides a systematic way of organising and combining indicators so that users can draw conclusions about the conditions of people and the ecosystem and the effects of people-ecosystem interactions. It presents conclusions visually, providing anyone — from a villager to head of state — with an immediate picture of human and ecosystem wellbeing" (IUCN, 1997, p1).*

The specific tool that has been identified for investigation in this study is called the 'Barometer of Sustainability' and was developed by Robert Prescott-Allen in 1995 and adopted by the International Union for Conservation of Nature (IUCN) in 1997. The Barometer is described as being able to assess a region's progress toward sustainability through the integration of economic, biophysical and social health indicators (*Hardi et al.*, 1997). The calculation of the Barometer of Sustainability scale requires those developing the Barometer to state explicitly their assumptions about human and ecosystem wellbeing so that calculated sustainability ratings can be scored against desired levels. The Barometer of

Sustainability is a combination of ecosystem and human wellbeing, measured individually by their respective indices. Indicators for these indices are chosen **only** if it is possible to define them in numerical terms with regard to desirability, acceptability and unacceptability. This process allows the public to determine the level of sustainability it wants to achieve (*Hardi et al., 1997*).

In order to compute progress toward sustainability, the values of the index of ecosystem well-being and the index of human wellbeing must first be calculated, as well as the subindices which make up these two indices. A structure was adopted by the IUCN - termed the System Assessment Method (SAM) which contains five human dimensions and five ecosystem dimensions (Figure 2).

This SAM framework will be used in this study to ensure that results are comparable with other assessments and also to ensure that a wide range of sustainability concerns are included. The index of ecosystem wellbeing is a function of land, water, air, biodiversity and resource use indicators. The index of human wellbeing represents the overall level of human wellbeing and is a function of the wellness of individuals which includes health, wealth, knowledge & culture, community, equity. (*Hardi et al., 1997*)

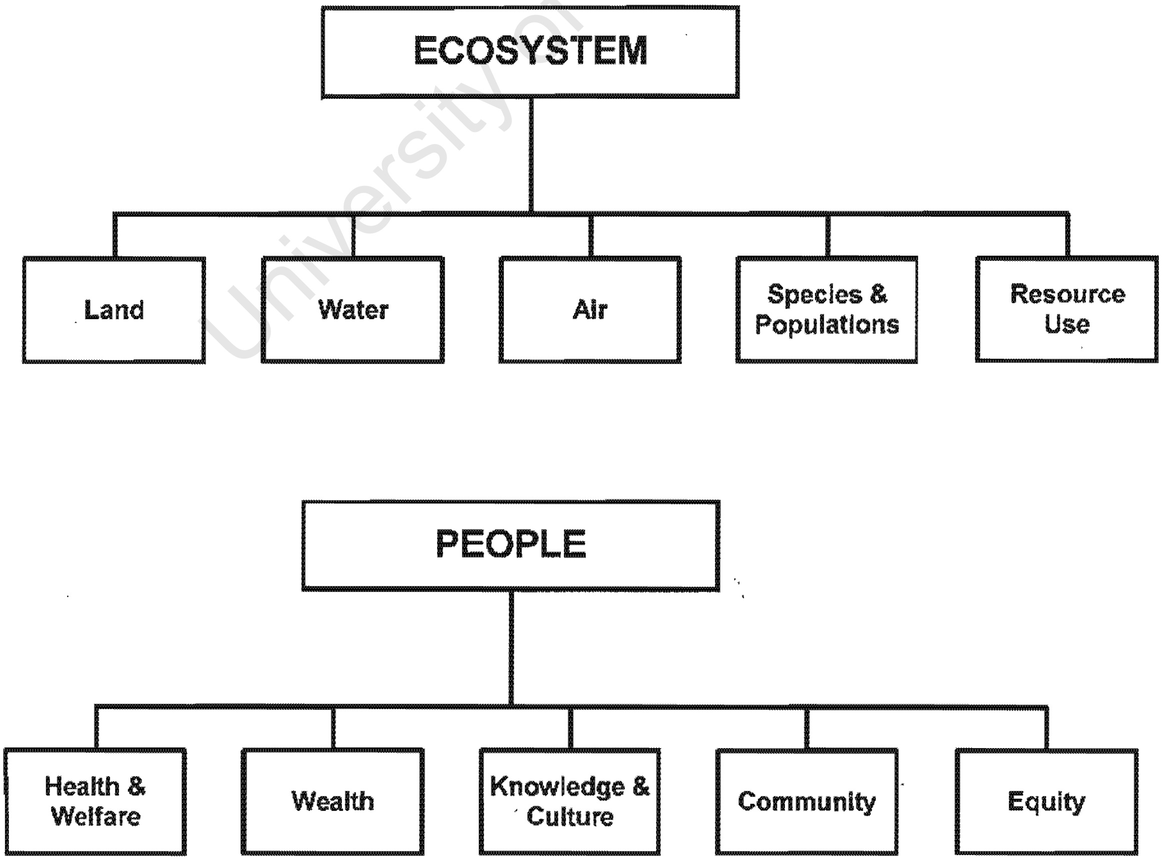


Figure 2 : System Assessment Method (IUCN,1999)

Barometer Dimension Definitions

LAND

The diversity and quality of land ecosystems, including their modification, conversion and degradation.

AIR

Local air quality and the global atmosphere.

WATER

The diversity and quality of inland water and marine ecosystems such as modification by dams, embankments, pollution and water withdrawal.

RESOURCE USE

Energy and materials, waste generation and disposal, recycling, resource sectors such as agriculture, fisheries, timber, mining and hunting.

SPECIES & POPULATIONS

Status of wild species and wild and domesticated crops, diversity and quality habitats.

WEALTH

The economy, income, material goods, infrastructure, basic needs for food, water, clothing and shelter.

HEALTH & POPULATION

Physical and mental health, disease, mortality, fertility, population growth.

EQUITY

Distribution of benefits and burdens between males and females and among households, ethnic groups and other social divisions.

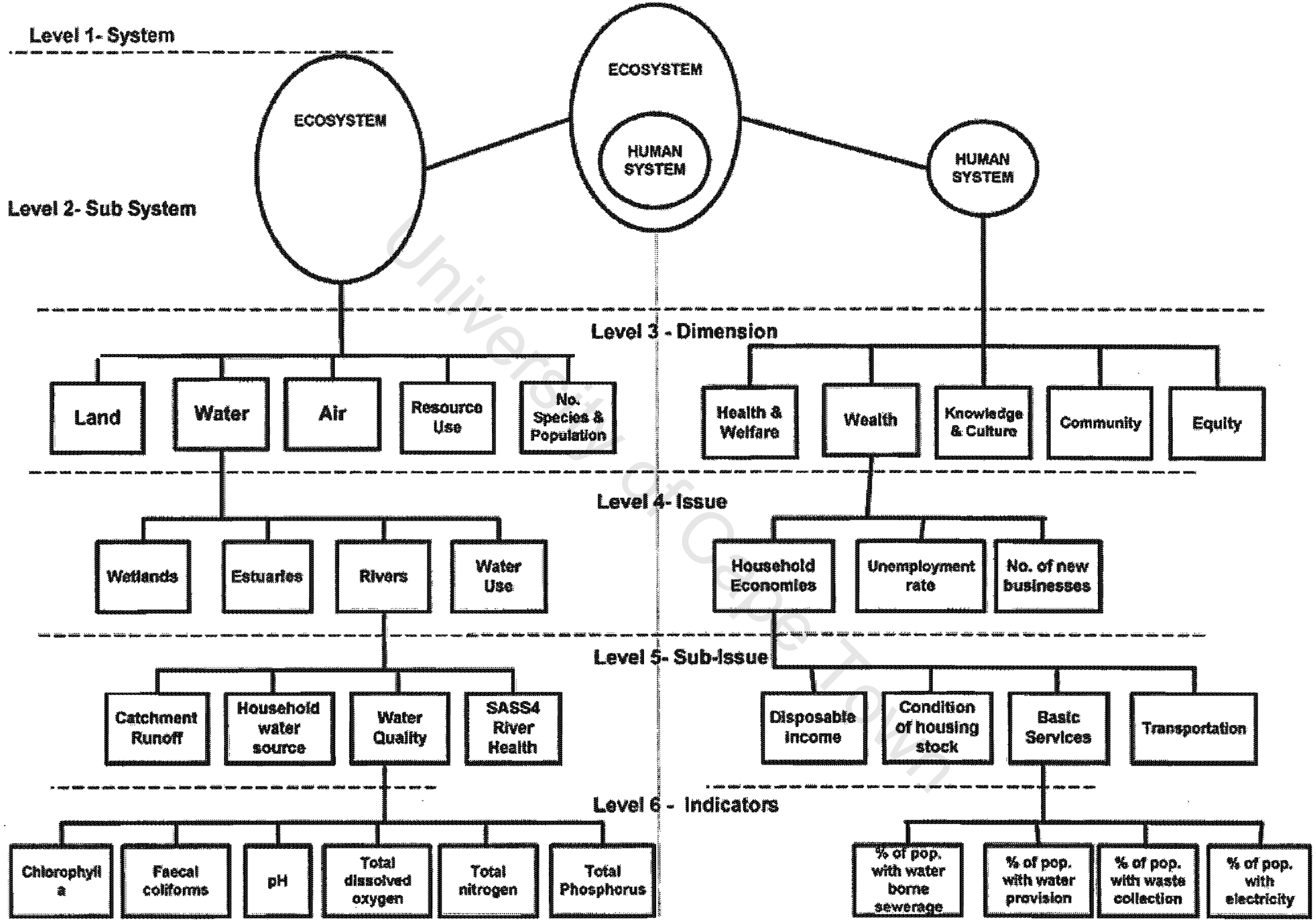
COMMUNITY

Rights and freedoms, governance, institutions, peace, crime, civil order.

KNOWLEDGE & CULTURE

Education, state of knowledge about people and the ecosystem, communication, systems of belief and expression.

(Source: IUCN , 1999)


Level 1- System
ECOSYSTEM
ECOSYSTEM
HUMAN SYSTEM
HUMAN SYSTEM
Level 2- Sub System
Level 3 - Dimension
Land
Water
Air
Resource Use
No. Species & Population
Health & Welfare
Wealth
Knowledge & Culture
Community
Equity
Level 4- Issue
Wetlands
Estuaries
Rivers
Water Use
Household Economies
Unemployment rate
No. of new businesses
Level 5- Sub-Issue
Catchment Runoff
Household water source
Water Quality
SASS4 River Health
Disposable income
Condition of housing stock
Basic Services
Transportation
Level 6 - Indicators
Chlorophyll a
Faecal coliforms
pH
Total dissolved oxygen
Total nitrogen
Total Phosphorus
% of pop. with water borne sewerage
% of pop. with water provision
% of pop. with waste collection
% of pop. with electricity

Once you have calculated scales for each indicator and decided on the importance of specific indicators you can calculate the value of the indicator on the barometer scale. The points calculated for each indicator are added together up the hierachical levels to provide you with a point value for the human wellbeing and a point value for the ecosystem wellbeing. Once the values of ecosystem and human wellbeing are calculated, they are plotted on their respective axes to present the rating on the Barometer of Sustainability's "Sustainogram".

Methodology: What Are We Going To Be Doing In The Workshop?

The workshop will comprise four sessions.

Session 1:

- We are going to place the indicators from the 1998 State of the Environment Report for the Cape Metropolitan Area into an hierarchical structure which will form the basis of a Barometer of Sustainability for the indicators found in the SOE.
- We will then give each indicator a weight to ensure that the calculation reflects the group consensus on how important particular indicators are.

Session 2 & 3:

- We will then develop a scale for each indicator, which reflects the group's decisions on appropriate performance for that indicator.
- For each indicator the actual measurement noted in the SOE will be converted into performance points using the group's scale from earlier in the session.
- The points and the weight given to each indicator at a particular level, is then used to calculate the point value of the issue they represent.
- The points from each level of indicators are calculated in this manner up the hierarchy to provide the point values for the ecosystem wellbeing and human wellbeing axes on the Barometer of Sustainability. Plotting these two points will indicate the progress toward sustainability.

Session 4:

- A discussion on the usefulness of the tool will follow. We will be considering some of the following issues:
    - (i) Does the outcome of the Barometer of Sustainability reflect your sense of the CMA state of the environment?
    - (ii) What did you learn by working through the barometer?
    - (iii) What shortcomings do you see in the SOE indicators used?
    - (iv) Is the Barometer a useful tool in determining a holistic picture of the SOE?
    - (v) Does the fact that it relies so heavily on value judgements invalidate it or make it more acceptable as a tool.

(vi) How could the barometer be used to improve SOE reporting?

Information supplied to scale CMA indicators

The information contained in **Appendix A** is a list of indicators as found in the CMA 1998 SOE . The indicator description is given together with the SOE result/measurement and where available, additional regional or global information to assist the group in establishing a scale

The two main sources of information used to provide the global context information were:

1. **The United Nations Development Programme Human Development Report 1999. (http://www.undp.org/hdro/report.html)**

   In the UNDP Human Development Report various indicators are used to calculate a Human Development Index (HDI). The information provided is then divided into countries considered to have a high, medium or low HDI. South Africa is considered to have a medium HDI. The information provided with the CMA data in **Appendix A** is the average measurement for high HDI countries, the average measurement for medium HDI countries and the lowest reading in the medium HDI countries.

2. **United Nations Centre for Human Settlements (UNCHS) Habitat : Urban Indicators Programme Update 1998 (http://www.urbanobservatory.org/indicators/database/)**

   The United Nations Centre for Human Settlements (Habitat) promotes sustainable urban development through policy advice, capacity-building, knowledge-creation and the strengthening of partnerships between governments and civil society. A database of urban indicators from more than 80 cities across the world has been established. Information shown in **Appendix A** has been calculated to show the mean and median, as well as the highest and lowest values, for a particular indicator across all cities included in the database. In some cases, information is also provided as the average value for particular continents.

References:

1. CMC (1999) *Year One 1998 State of the Environmental Report*. Cape Town: Cape Metropolitan Council, 1999.

2. IUCN (1997) *Barometer of Sustainability and Communicating Wellbeing and Sustainable Development*. An Approach to Assessing Progress Towards Sustainability- Tools and Training Series, Prepared by Robert Prescott- Allen, Cambridge: IUCN, 1997.

3. IUCN (1999) *Assessing Progress Toward Sustainability: The System Assessment Method Illustrated by The Wellbeing of Nations* Prepared by Prescott-Allen, R., June 1999. [Online] Retrieved 25 May 2000 from IUCN on the World Wide Web: http://www.iucn.org/themes/eval/english/

4. Hardi, P , Barg S, Hodge,T and Pinter,L (1997) *Measuring Sustainable Development: Review of Current Practice*. Occasional Paper No. 17, Canada: International Institute for Sustainable Development, 1997.

5. UNCHS (1998) *Habitat: Urban Indicators Programme Update 1998.* [Online] Retrieved 15 November 2000 from Urban Observatory Database on the World Wide Web: http://www.urbanobservatory.org/indicators/database/

6. UNDP (1999) *Human Development Report 1999*. [Online] Retrieved 14 November 2000 from United Nations Development Programme 1999 Human Development Report on the World Wide Web: http://www.undp.org/hdro/report.html

APPENDIX A

THE INDICATORS

BAROMETER OF SUSTAINABILITY INDICATOR LIST
CMC STATE OF THE ENVIRONMENT REPORT 1998 (CMC, 1999)

<table>
<tr><th>No.</th><th>Indicator</th><th>SOE result</th><th>Information</th><th>Comments</th></tr>
<tr><td>1.</td><td>Commuter trip length</td><td>CMA Average = 14km</td><td>• Average commuter trip length for low income areas = 15.5km
• Average commuter trip length for high income areas = 12.6km</td><td></td></tr>
<tr><td>2.</td><td>Property appreciation
Suggested interpretation of data: Average change in price</td><td> 16.96</td><td>Table 1: Average Price index
<table>
<tr><th>Area</th><th>1994</th><th>1995</th><th>1996</th><th>1997</th></tr>
<tr><td>Atlantic Seaboard</td><td>100.00</td><td>120.8</td><td>138.0</td><td>185.4</td></tr>
<tr><td>City Bowl</td><td>100.0</td><td>129.0</td><td>138.8</td><td>159.4</td></tr>
<tr><td>Southern Suburbs</td><td>100.0</td><td>108.3</td><td>113.7</td><td>126.8</td></tr>
<tr><td>Bellville</td><td>100.0</td><td>104.9</td><td>106.3</td><td>131.9</td></tr>
</table>

Property appreciation is the amount of money over and above the price paid for a house which can be recovered on purchase. The average price index shown measures the property appreciation similar to a percentage hence an index value of 120.8 would be 120.8 percent of what was paid for the house.
Average price definition "The total cost less total commission of all lots you own of a particular security divided by the total number of shares owned." (http://www.firstrade.com/Public/glossary.html, October 2000)</td><td></td></tr>
<tr><td>3.</td><td>CMA Population</td><td>2.9 million people</td><td>CMA= Cape Metropolitan Area</td><td></td></tr>
</table>

<table>
<tr>
<td>4.</td>
<td>Ecological Classes-River

**Suggested interpretation of data: Acceptable ecological class of rivers
Class 1+2+3 = 43%</td>
<td>Table 2</td>
<td>TABLE 2: Rehabilitation 'Ecological Potential' Classes- Rivers
<table>
<tr><th>Class</th><th>Definition</th><th>SOE result</th><th>Percentage</th></tr>
<tr><td>Class 1</td><td>100% of potential value, unmodified, natural</td><td>46.7km</td><td>13%</td></tr>
<tr><td>Class 2</td><td>80-99% of potential value, largely natural with few modifications</td><td>17.65km</td><td>4%</td></tr>
<tr><td>Class 3</td><td>60-79% of potential value, moderately modified</td><td>72.98km</td><td>26%</td></tr>
<tr><td>Class 4</td><td>40-59% of potential value, largely ~~un~~modified</td><td>147.71km</td><td>41%</td></tr>
<tr><td>Class 5</td><td>20-39% of potential value, seriously modified</td><td>68.21km</td><td>19%</td></tr>
<tr><td>Class 6</td><td>0-19% of potential value, modifications critical, almost complete loss of biota</td><td>0km</td><td>0%</td></tr>
</table>
</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Ecological Classes-Coastal Lakes & Estuaries

**Suggested interpretation of data: Acceptable ecological class of Coastal Lakes & Estuaries
Class 1+2+3 = 36%</td>
<td>Table 3</td>
<td>TABLE 3: Rehabilitation 'Ecological Potential' Classes- Coastal Lakes and Estuaries
<table>
<tr><th>Class</th><th>Definition</th><th>SOE result</th><th>Percentage</th></tr>
<tr><td>Class 1</td><td>100% of potential value, unmodified, natural</td><td>0</td><td>0%</td></tr>
<tr><td>Class 2</td><td>80-99% of potential value, largely natural with few modifications</td><td>0</td><td>0%</td></tr>
<tr><td>Class 3</td><td>60-79% of potential value, moderately modified</td><td>4</td><td>36%</td></tr>
<tr><td>Class 4</td><td>40-59% of potential value, largely unmodified</td><td>5</td><td>46%</td></tr>
<tr><td>Class 5</td><td>20-39% of potential value, seriously modified</td><td>2</td><td>18%</td></tr>
<tr><td>Class 6</td><td>0-19% of potential value, modifications critical, almost complete loss of biota</td><td>0</td><td>0%</td></tr>
</table>
</td>
<td>11 coastal lakes and estuaries were investigated</td>
</tr>
<tr>
<td>6.</td>
<td>Number of harmful algal blooms</td>
<td>2</td>
<td>Definition: A harmful algal bloom is the proliferation of a toxic or nuisance algae.</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Water Quality Stats
**Suggested interpretation of data</td>
<td>Table 4

**(64%)</td>
<td>**Suggested interpretation of data: Water Quality Statistics
% Samples which exceed water quality guidelines = 64%
(18 samples out of 28 exceed the guidelines)</td>
<td></td>
</tr>
</table>

Table 4: Water Quality

River/Vlei Location	pH	Dissolved Oxygen (%)	Total Nitrogen (mg/l)	Total Phosphorus (mg/l)	Chlorophyll A (mg/l)	Faecal Coliform (/100ml)
Zeekoeivlei Catchment						
Big Lotus River- Fisherman's Walk	8.2	78	6.57	0.543	-	**20 000**
Little Lotus River- 8th Avenue	8.0	76	2.72	0.142	-	**6 000**
Zeekoevlei- Home Bay	**8.8**	67	2.98	0.891	93	10
Rondevlei- at outlet weir	8.1	58	2.06	0.207	81	90
Princess vlei- vlei centre	**8.8**	80	1.66	0.210	135	80
Zandvlei Catchment						
Westlake River- cnr Chenel & Main Rd	7.4	64	2.35	0.058	-	400
Keysers River- Military Rd	7.6	54	1.40	0.092	-	325
Sand River- d/s Sand/Dipr confl.	7.9	84	2.36	0.082	-	**22 000**
Zandvlei- Imperial Yacht Club	8.4	92	1.08	0.084	46	170
Little Princess Vlei- south	7.9	61	1.23	0.052	3	200
Langevlei- at outlet weir	8.2	75	1.64	0.267	79	80
Salt River Catchment						
Jakkalsvlei River- nr Settlers Way	7.9	77	26.8	3.33	-	**129 000**
Vygekraal River- u/s Athlone WWTW	7.8	67	24.6	3.47	-	**1 700 000**
Vygekraal River- d/s Athlone WWTW	7.5	60	21.1	2.55	-	**500 000**
Elsieskraal River- Nightingale Way	9.1	-	-	0.190	-	**2 850**
Black River- Rdbosch Golf Course	8.3	111	2.35	0.111	-	**5 000**
Liesbeek River- nr Kirstenbosch	7.6	76	0.58	0.029	-	130
Liesbeek River- opp Hartleyvale	7.5	70	1.16	0.060	-	**2 000**
Salt River Canal- Marine Drive	7.6	58	14.5	1.43	-	**8 000**
Eerste-Kuils River Catchment7 000						
Kuils River- Eversdal Rd	7.4	74	-	0.070	-	**7 000**
Bottelary River- Amandel Rd	7.6	78	-	0.266	-	550
Kuils River- Stellenbosch Arterial	8.2	97	-	1.83	-	**32 000**
Eerste River- in Stellenbosch	7.5	86	-	0.041	-	300
Eerste River- d/s of conf with Kuils River	7.5	50	-	1.71	-	**3 000**
Disa River Catchment (Hout Bay)						
Disa River- Longkloof Rd	6.6	-	-	0.045	-	1 900
Tributary of Disa River	7.2	-	-	5.00	-	700
Glencairn vlei/ Elsies River						
Glencairn vlei- centre	7.8	70	1.60	0.127	7	40
Noordhoek Catchment						
Wildevoëlvlei- east vlei	**9.1**	95	3.78	1.70	156	100
Wildevoëlvlei- west vlei	**8.8**	50	2.88	1.34	176	80
(Source: CMC Scientific Services: 1999)						

EXPLANATORY NOTE:

(CMC SOE- 1998, p105)

BOLD figures indicate where samples exceed guideline

pH gives an indication of the acidity of water- it is measured on a scale of 0 to 14. A reading of less than 7 means that the water is acidic, while readings greater than 7 indicate alkaline conditions. Unpolluted waters could lie in the pH range from very acid (pH <4) to slightly akaline (pH <8 5)

Dissolved oxygen is essential for all aquatic life. The amount of oxygen dissolved in water may vary with time of day, season altitude temperature, salt content and other environmental factors. Organisms exposed to dissolved oxygen levels less than 40% for extended periods will tend to suffer severe adverse effects.

Faecal coliform - The presence of these organisms (which occur naturally in the intestines of humans, poultry, cats, dogs and rodents) in water is used as an indication of faecal pollution. Drinking water guidelines specify 0 coliform counts/l 00 ml as the Target Water Quality Range, while counts of 0 to 1000 are regarded as satisfactory for intermediate-contact recreation.

8.	Faecal Coliform Counts ****Suggested interpretation of data: Coliform Counts % Samples which exceed guidelines for contact recreation**	**Table 5** ** 50% (14 samples out of 28 exceed the guidelines)

Table 5: Coliform Counts

River/Vlei Location	**Faecal Coliform (/100ml)**
Zeekoeivlei Catchment	
Big Lotus River- Fisherman's Walk	**20 000**
Little Lotus River- 8th Avenue	**6 000**
Zeekoevlei- Home Bay	10
Rondevlei- at outlet weir	90
Princess vlei- vlei centre	80
Zandvlei Catchment	
Westlake River- cnr Chenel & Main Rd	400
Keysers River- Military Rd	325
Sand River- d/s Sand/Dipr confl.	**22 000**
Zandvlei- Imperial Yacht Club	170
Little Princess Vlei- south	200
Langevlei- at outlet weir	80
Salt River Catchment	
Jakkalsvlei River- nr Settlers Way	**129 000**
Vygekraal River- u/s Athlone WWTW	**1 700 000**
Vygekraal River- d/s Athlone WWTW	**500 000**
Elsieskraal River- Nightingale Way	**2 850**
Black River- Rdbosch Golf Course	**5 000**
Liesbeek River- nr Kirstenbosch	130
Liesbeek River- opp Hartleyvale	**2 000**
Salt River Canal- Marine Drive	**8 000**
Eerste-Kuils River Catchment	
Kuils River- Eversdal Rd	**7 000**
Bottelary River- Amandel Rd	550
Kuils River- Stellenbosch Arterial	**32 000**
Eerste River- in Stellenbosch	300
Eerste River- d/s of conf with Kuils River	**3 000**
Disa River Catchment (Hout Bay)	
Disa River- longkloof Rd	**1 900**
Tributary of Disa River	700
Glencairn vlei/ Elsies River	
Glencairn vlei- centre	40
Noordhoek Catchment	
Wildevoëlvlei- east vlei	100
Wildevoëlvlei- west vlei	80

(Source: CMC Scientific Services: 1999)

EXPLANATORY NOTE

Faecal coliform - The presence of these organisms (which occur naturally in the intestines of humans, poultry, cats, dogs and rodents) in water is used as an indication of faecal pollution Drinking water guidelines specify 0 coliform counts/l 00 ml as the Target Water Quality Range, while counts of 0 to 1000 are regarded as satisfactory for intermediate-contact recreation. (CMC SOE- 1998, p105)

BOLD figures indicate where sample exceed guideline

<table>
<tr><th>No.</th><th>Indicator</th><th>SOE result</th><th>Information</th><th>Comments</th></tr>
<tr><td>9.</td><td>Volume of water being used-
Water demand in m^3/yr</td><td>96.54 m^3/yr per capita</td><td>Annual freshwater withdrawals:
SA Result: 359 m^3/yr per capita
High HDI Ave Result: 997 m^3/yr per capita
Med HDI Ave Result: 596 m^3/yr per capita
Medium HDI Worst Result: 1 967.9 m^3/yr per capita</td><td>(279 985 352 m^3/yr /2.9 population = 96.54 m^3/yr per capita)</td></tr>
<tr><td>10.</td><td>% Capacity of dams being used to fulfil water demand</td><td>91%</td><td>None</td><td></td></tr>
<tr><td>11.</td><td>% Population with potable water supply within 50m of dwelling</td><td>97.1%</td><td>(Access to potable water <200m from dwelling)
Habitat II Mean = 84.38%
Habitat II Median = 92.90%
Habitat II Lowest = 12.90%
Habitat II Highest = 100%</td><td><i>Note: Potable water is clean and free of pollutants and sediment and of a high enough quality to drink.</i></td></tr>
<tr><td>12.</td><td>Wastewater produced
(As % of total water used)</td><td>528 000kl / 279 985 352kl= 0.18%</td><td>(% Wastewater treated)
Habitat II Mean = 8.55% Habitat II Median = 12%
Habitat II Lowest = 0% Habitat II Highest =100%</td><td>Definition: used water which must be treated before being returned to the environment</td></tr>
<tr><td>13.</td><td>Car ownership-
Number of vehicles per 1000 people</td><td>170</td><td>Habitat II Mean = 144.59
Habitat II Median = 68.75
Habitat II Lowest = 3
Habitat II Highest = 668</td><td></td></tr>
<tr><td>14.</td><td>Overall Air Quality
**Suggested interpretation of data: Pollutant measurements exceeding 50% level of the air quality guidelines more than 5% of the time</td><td>Table 6
**50%</td><td>Table 6: Air Quality in the CBD
<table>
<tr><th></th><th>NO_2 (1996)</th><th>SO_2 (1996)</th><th>PM_{10} (1997)</th><th>O_3 (1997)</th></tr>
<tr><td>Annual mean measurement exceeded guideline</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>No. measurements which exceeded 50% of guideline (1996)</td><td>650</td><td>0</td><td>38days</td><td>90</td></tr>
<tr><td>Percentage measurements which exceeded 50% of guideline</td><td>7.4%</td><td>0%</td><td>10.4%</td><td>1.14%</td></tr>
<tr><td>No. measurements which exceeded the guideline (1996)</td><td>40</td><td>0</td><td>-</td><td>0</td></tr>
<tr><td>Percentage measurements which exceeded the guideline</td><td>0.45%</td><td>0%</td><td>-</td><td>0%</td></tr>
</table></td><td>(2 pollutants out of 4 measured exceeded half of the guidelines more than 5% of the time.)</td></tr>
</table>

<table>
<tr><th>No.</th><th>Indicator</th><th>SOE result</th><th>Information</th><th>Comments</th></tr>
<tr><td>15.</td><td>SO_2 Exceedances
**Suggested interpretation of data:
% SO_2 measurements exceeding 50% level of the air quality guidelines</td><td>Table 7
**0%</td><td>SO_2 emissions per capita (kg)
High HDI Ave Result: 42.9
Med HDI Ave Result: 41.25
Medium HDI Worst Result: 178
Table 7: SO_2 exceedances
<table>
<tr><th></th><th>So_2 (1996)</th></tr>
<tr><td>No. of annual mean measurements which exceeded guideline</td><td>0</td></tr>
<tr><td>No. measurements which exceeded 50% of guideline (1996)</td><td>0</td></tr>
<tr><td>Percentage measurements which exceeded 50% of guideline</td><td>0%</td></tr>
<tr><td>No. measurements which exceeded the guideline (1996)</td><td>0</td></tr>
<tr><td>Percentage measurements which exceeded the guideline</td><td>0%</td></tr>
</table>
World Health Organisation Sulphur Dioxide Guideline: 125µmg/m^3 - 24 hour mean
Explanatory Note: "Sulphur dioxide ($S0_2$) is a colourless gas that is soluble in water and can be readily oxidised by coming into contact with water droplets in the atmosphere Therefore the health effects of the gas are often associated with the secondary aerosol pollutants such as ammonium sulphate [$(NH_4)_2S0_4$] which is linked to atmospheric visibility degradation. Atmospheric $S0_2$ results mainly from the combustion of fossil fuels such as in power stations, motor vehicles and industrial boilers. Due to its high solubility in water, $S0_2$ is readily absorbed in the mucous membranes of the nose and the upper respiratory tract. High occupational exposures (more than 10000 µg/m^3) to the gas give rise to severe brochoconstriction, chemical bronchitis and tracheitis. Lower concentrations (500-2700 µg/m^3) cause bronchospasm in asthmatics. Typical ambient levels are much lower than this (less than 100µg/m3) " (Wicking-Baird et al, 1997, p4).</td><td></td></tr>
<tr><td>16.</td><td>% Households with access to electricity</td><td>86%</td><td>Habitat II Mean= 76.64%
Habitat II Median= 93.8%
Habitat II Lowest = 3%
Habitat II Highest =100%</td><td></td></tr>
</table>

<table>
<tr><th>No.</th><th>Indicator</th><th>SOE result</th><th>Information</th><th>Comments</th></tr>
<tr><td>17.</td><td>Lead average measurement in the CBD</td><td>$0.4 mg/m^3$</td><td>WHO Lead Guideline: $0.5 \mu g/m^3$ -24 annual mean
WHO= World Health Organisation
CBD= City Business District</td><td></td></tr>
<tr><td>18.</td><td>Particulate Matter exceedances

**Suggested interpretation of data:

% of PM_{10} measurements exceeding 50% level of the air quality guidelines

PM_{10} = larger particles</td><td>Table 8

**10.4%</td><td>Table 8: Particulate Matter <10um
<table>
<tr><th></th><th>PM_{10}
(1997)</th></tr>
<tr><td>No. of annual mean measurements which exceeded guideline</td><td>0</td></tr>
<tr><td>No. measurements which exceeded 50% of guideline (1996)</td><td>38days</td></tr>
<tr><td>Percentage measurements which exceeded 50% of guideline</td><td>10.4%</td></tr>
<tr><td>No. measurements which exceeded the guideline (1996)</td><td>-</td></tr>
<tr><td>Percentage measurements which exceeded the guideline</td><td>-</td></tr>
<tr><td></td><td></td></tr>
</table>

Explanatory Note: "Particulate air pollution and its health effects are associated with complaints of the respiratory system. More specifically researchers have shown that particulates are linked to increased mortality and an increase in the hospital admissions for respiratory and cardio- vascular illnesses. Furthermore, particulates are associated with mutagenic activity which in turn indicates their cancer-causing potential. Coarse particles are associated with particulate deposition in the bronchial region while fine mode particles are deposited further into the respiratory system resulting in their slower clearance from the lung. Researchers have shown that smaller particles have a much stronger correlation to health effects. It is postulated that this is due to the greater penetration into the lung, the fact that fine particles readily infiltrate buildings cause indoor and outdoor levels to be similar and thus exposure times longer, and the larger number of particles in the fine mode may affect the ability of the respiratory system to clear out the particles efficiently" (Wicking-Baird et al, 1997, p4).</td><td></td></tr>
</table>

<table>
<tr><th>No.</th><th>Indicator</th><th>SOE result</th><th>Information</th><th>Comments</th></tr>
<tr><td>19.</td><td>Number of complaints about air pollution</td><td>303</td><td>None</td><td></td></tr>
<tr><td>20.</td><td>Number of acute respiratory chest infection in children under 6yrs</td><td>27 432</td><td>None</td><td></td></tr>
<tr><td>21.</td><td>NO2 exceedances
**Suggested interpretation of data:
% of NO_2 measurements exceeding 50% level of the air quality guidelines</td><td>Table 9
**7.4%</td><td>Table 9: NO_2 Exceedances
<table>
<tr><th></th><th>No_2 (1996)</th></tr>
<tr><td>No. annual mean measurements which exceeded guideline</td><td>0</td></tr>
<tr><td>No. measurements which exceeded 50% of guideline (1996)</td><td>650</td></tr>
<tr><td>Percentage measurements which exceeded 50% of guideline</td><td>7.4%</td></tr>
<tr><td>No. measurements which exceeded the guideline (1996)</td><td>40</td></tr>
<tr><td>Percentage measurements which exceeded the guideline</td><td>0.45%</td></tr>
<tr><td></td><td></td></tr>
</table>
World Health Organisation Nitrogen Dioxide Guideline: 200mg/m^3 -
Explanatory Note: Nitrogen dioxide ($N0_2$) is linked with health effects. NO is emitted from high temperature combustion, and later partially converted to $N0_2$ by photochemical reactions Sources of NO include motor vehicles and fossil fuel burning power plants Nitrogen oxides are less soluble in water than sulphur dioxide and are therefore associated with deep lung penetration as scrubbing of the gas in the nasal passages is not efficient. Animal experiments have shown that $N0_2$ causes alteration in lung metabolism, structure and function, and an increase in the susceptibility to pulmonary infections. Studies on humans have shown that, with asthmatics in particular, $N0_2$ has a bronco-constricting effect (Wicking-Baird et al, 1997, p4).</td><td></td></tr>
</table>

No.	Indicator	SOE result	Information	Comments
22.	Use of wood & paraffin & gas as fuel (heating & cooking)	14%	Traditional fuel consumption as % of total SA HDI result: 4% High HDI Ave Result: 3.5% Med HDI Ave Result: 27.6%	
23.	Koeberg Nuclear Power Station Safety Rating	95%	**None**	
24.	Koeberg Nuclear Power Station number of reported leaks	0	**None**	
25.	Demand for energy per yr (production / number of consumers = consumption per consumer)	0.64KWh per consumer	Electricity consumption per capita (Kilowatt hours) SA HDI result: 3.888 High HDI Ave Result 8.55 Med HDI Ave Result:: 1.147	
26.	Cost of electricity	23.19c/ KWh	**none**	
27.	Future capacity of existing waste sites (at current rate)	19yrs	**none**	
28.	% Waste sites officially licensed	33%	2 waste sites out of 6 are licensed. (Government waste sites)	

No.	Indicator	SOE result	Information	Comments
29.	Volume of waste in the landfill (Rate used = 1kg per person per day)	0.34t/yr per capita	Tons of waste per person per annum Habitat II Mean = 0.43 Habitat II Median = 0.29 Habitat II Lowest = 0.01 Habitat II Highest = 8.0 High HDI Ave Result: 536kg/per/day Med HDI Ave Result: unavailable	
30.	% Waste re-used or recycled per person per day (glass, paper, metal)	32%	(Disposal Methods for solid waste- % recycling) Habitat II Mean = 8% Habitat II Median = 1% Habitat II Lowest = 0% Habitat II Highest = 63%	
31.	% Waste water re-used or recycled	9%	**None**	
32.	Capacity of waste water treatment potential being used	83%	**None**	
33.	% Estimated medical waste not handled correctly	66%	**None**	
34.	Volume of medical waste incinerated	1700t/a	(Disposal Methods for solid waste- % incineration) Habitat II Mean = 11% Habitat II Median = 0% Habitat II Lowest = 0% Habitat II Highest = 71%	
35.	Capacity in hazardous waste sites (m^3)	13 000000	**None**	
36.	Amount of hazardous waste being generated	524 t/yr	(Hazardous waste) High HDI Ave Result: 255 385t/a Med HDI Ave Result: Unavailable	

No.	Indicator	SOE result	Information	Comments
37.	Nuclear waste being produced	1560m^3/yr	**None**	
38.	Items of litter per day	4 000 000	**None**	
39.	Tonnes of goods dumped illegally per year	38 700t	**None**	
40.	Sewage effluent released (average litres per day)	32877 *l*		
41.	Solids into the sea	87t/yr		
42.	Heavy Metal (Cadmium)- limit exceeded in mussles	42.3%	Explanatory note 1. Short-term (acute) exposure: Cadmium is much more dangerous by inhalation than by ingestion. High exposures to cadmium that may be immediately dangerous to life or health occur in jobs where workers handle large quantities of cadmium dust or fume; heat cadmium-containing compounds or cadmium-coated surfaces; welds with cadmium solders or cut cadmium-containing materials such as bolts. (US OSHA Regulations (Standards - 29 CFR) Substance Safety Data Sheet - Cadmium)	(11mussles out of 26 collected were beyond the limit)
43.	% Coastline protected by Marine Protected Area (MPA)	2%		
44.	Marine species rated critical within MPA's	4	**Spp.= species**	
45.	Amount of land with conservation status	14%		
46.	Mammals in red data book	0% (0 out of 41 species)	Red data species are those considered endangered	

No.	Indicator	SOE result	Information	Comments
47.	Avifauna in red data book	5.2% (8 out of 155 species)	Avifauna= birds	
48.	Invertebrates in red data book- butterflies	5.3% (4 out of 75 species)	Invertebrates = insects	
49.	Amphibians in red data book- frogs	22.2% (4 out of 18 species)		
50.	Reptiles in red data book	10.4% (5 out of 48 species)		
51.	Sand Plain Fynbos (area remaining)	< 1%		
52.	Renosterveld (area remaining)	< 3%		
53.	Strandveld (area remaining)	< 32%		
54.	Dependency ratio	52	SA Result: 64.4 High HDI Ave Result: 49.6 Med HDI Ave Result: 46.6 Medium HDI Worst Result: 86.3	The dependency ratio is defined as a ratio number of people under 15 and over 64 , to the working-age population, aged 15-64 (UNDP, 1991).
55.	Percentage of the population in poverty	37%	SA Result: 23.7% High HDI Ave Result: 16.95% Med HDI Ave Result: 22.5% Medium HDI Worst Result: 49.4%	Poverty is defined as that level of income below which a minimum nutritionally adequate diet plus essential non-food requirements are not affordable (UNDP, 1991).

No.	Indicator	SOE result	Information	Comments
56.	Percentage population unemployed	20%	SA Result: 30% High HDI Ave Result: 7.8% Worst Global Result: 70% (CIA World Factbook, 1999)	*All people above the age of 16 who are not in paid employment or self-employed, are available for paid employment and have taken specific steps to seek paid employment or self-employment (UNDP, 1999).*
57.	Employment overall in the formal sector	63%		
58.	Total output Gross Geographic Product	R64.7 billion		
59.	Annual Ave Economic Growth	2.5%	SA Result: 1.7% High HDI Ave Result: 2.7% Med HDI Ave Result: 3.6% Medium HDI Worst Result: -2%	
60.	% Labour professional or highly skilled	55%		
61.	% Semi-low skilled	45%		
62.	Informal Economy (contribution)	7%	Habitat II Median = 44.2% Habitat II Mean = 42.6% Habitat II Lowest = 0.2% Habitat II Highest = 90.0%	
63.	Tuberculosis rate (cases per 100 000 people)	**603** **(367 deaths)**	SA Result: 240.2 cases per 100 000 people High HDI Ave Result: (19.6 cases per 100 000 people) Med HDI Ave Result: 75.2 cases per 100 000 people Medium HDI Worst Result: 439.9 cases per 100 000 people	*Note: TB is a completely curable disease and medication is offered free at State hospitals.*
64.	% Population without access to adequate sanitation	12%	SA Result: 13% High HDI Ave Result: 12% Med HDI Ave Result: 57% Medium HDI Worst Result: 81%	

No.	Indicator	SOE result	Information	Comments
65.	Meningococcal Meningitis rate (Annual number of cases)	79	Meningococcal meningitis is the only form of bacterial meningitis which causes epidemics. Waning immunity among the population against a particular strain favours epidemics, as do overcrowding and climatic conditions such as the dry season or prolonged drought and dust storms. (WHO website, 2000) Influenced by overcrowding.	
66.	% population without adequate drinking water	18%	SA Result: 13% High HDI Ave Result: 14% Med HDI Ave Result: 26% Medium HDI Worst Result: 68%	
67.	Bacterial Exceedances- Bulk Milk	77%	**Number of times the bacteria count in tankers of milk exceeded the guidelines**	
68.	Bacterial Exceedances- Packaged Milk	18%	**Number of times the bacteria count in bottled milk exceeded the guidelines**	
69.	% Commuters using private transport	44%	Habitat II Mean = 22% Habitat II Median = 12% Habitat II Lowest = 0% Habitat II Highest = 81%	
70.	% Commuters using public road transport (buses & minibuses)	37%	Habitat II Mean = 30% Habitat II Median = 27% Habitat II Lowest = 0% Habitat II Highest = 84%	
71.	% Commuters utilising rail transport	19%	Habitat II Mean = 7% Habitat II Median = 0% Habitat II Lowest = 0% Habitat II Highest = 67%	

No.	Indicator	SOE result	Information	Comments
72.	Average public transport subsidy increases per year-bus & train	9.40%		
73.	Safety & security on public transport (Number of incidents per year)	587	**Reported incidents only**	
74.	Capacity of buses utilised during peak	43%		
75.	Capacity of minibus taxis utilised during peak	59%		
76.	Number of fatalities due to road accidents	24.9 per 100 000 people	High HDI Ave Result: 750 per 100 000 people Med HDI Ave Result: 120.4 per 100 000people Medium HDI Worst Result: 378 per 100 000people	
77.	Number of road accidents	62 561		
78.	% Accidents involving pedestrians	32%		
79.	Harbour throughput total tonnage/yr	11.7 million tons	**Increasing at a rate of 2.5% per annum (Wesgro, 2000)**	
80.	Number of international flights	1 953		
81.	Number passenger per annum at airport	3.9 million	**CTIA capacity is 3.5million hence they are operating at 112%**	

No.	Indicator	SOE result	Information	Comments
82.	Number of dwellings without adequate drainage (stormwater)	72 000		
83.	Access to Telephones	91%	Habitat II Mean = 38.17% Habitat II Median = 25.06% Habitat II Lowest = 0.01% Habitat II Highest = 100%	
84.	Access to refuse removal	94%	High HDI Ave Result: 99% Med HDI Ave Result: 85%	
85.	% Population exceeding WHO indoor pollution standards (informal housing)	80%		
86.	Formal housing stock	74%	Durban Metro = 69% JHB Metro = 72% SA = 65%	
87.	Shack dwellers	9.9%	Durban Metro = 11.5% JHB Metro = 3.9% SA = 4.6%	
88.	Hostels	2.8%	Durban Metro = 2.6% JHB Metro = 2.5% SA = 4.5%	
89.	Population growth per year	2%	SA Result: 2.1% High HDI Ave Result: 0.7% Med HDI Ave Result: 1.8% Medium HDI Worst Result: 4.5%	
90.	Estimated housing backlog	150 000		

No.	Indicator	SOE result	Information	Comments
91.	Property crime	9600 incidents	Theft: (per 1000) Habitat II Median = 41.95 Habitat II Mean = 45.11 Habitat II Lowest = 10.70 Habitat II Highest = 176.00	(63% of all crimes)
92.	Vehicle crime	900 incidents		(7% of all crimes)
93.	Violent crime	650 incidents	Murder: (per 1000) Habitat II Median = 2.8 Habitat II Mean = 17.29 Habitat II Lowest = 0.01 Habitat II Highest = 144.05	(5% of all crimes)
94.	Social fabric crime	2550 incidents	**Social fabric crimes include crimes such as rape, domestic violence, etc.**	(21% of all crimes)
95.	Pupil to teacher ratio	29 to 1		
96.	Number of schools per 1000 people	0.5		
97.	Adult literacy rate	5% illiterate (i.e. 95% literate)	Percentage illiteracy: SA Result: 16% High HDI Ave Result: 4.7% Med HDI Ave Result: 26.2% Medium HDI Worst Result: 35%	
98.	Number of full EIAs	20	**EIA= environmental impact assessment**	
99.	Number of EIA applications/Scoping Reports	112		
100.	Number of people in Local Government dedicated to environmental management	23		

Indicators which have been removed from the set as there was no data measurement given in the 1998 SOE

101.	Loss of soil due to urban expansion	**No measurement**		
102.	Loss of soil due to mining	**No measurement**		
103.	Lack of open space in poor areas	**No measurement**		
104.	Location of wealthy suburbs	**No measurement**		
105.	Invasion of development into wetlands	**No measurement**		
106.	Volatile Organic Compounds exceedances	**No measurement**		
107.	Odours	**No measurement**		
108.	Water Quality in coastal Waters- Oil in harbours	**No measurement**		
109.	Spatial inequity	**No measurement**		

FOR INFORMATION ONLY

1999 SOE Indicators- added to those in the 1998 Report

No.	Indicator	SOE 1999 result	Information	Comments
110.	Ozone exceedances (days)	12	Note: When inhaled, even at very low levels, ozone can: cause acute respiratory problems; aggravate asthma; cause significant temporary decreases in lung capacity of 15 to over 20 percent in some healthy adults; cause inflammation of lung tissue; lead to hospital admissions and emergency room; and impair the body's immune system defenses, making people more susceptible to respiratory illnesses, including bronchitis and pneumonia. (http://www.epa.gov/ttn/oarpg/naaqsfin/o3health.html, 22 Jan 2001)	
111.	Air pollution events (O_3+NO_2+PM_{10}) (days)	58		
112.	Air pollution prosecutions- notices served	78		
113.	SASS4-biological health of a river	table	**Note: South African Scoring System (SASS) is a biomonitoring method which is based on the aquatic macro-invertebrate community. SASS results are expressed both as an index score (SASS score) and the average score per recorded taxon (ASPT value).**	**(See table in CMC, 2000)**
114.	ASPT-biological health of a river	table	**(See table in CMC, 2000)**	
115.	Bacterial exceedances in prepared foods	10%		
116.	% Households with piped water	81%		
117.	Number of raw sewage spills	16		

118.	% CMA Coast with some form of protection	13.5%		
119.	Species officially classified as over-fished	12		
120.	Number of serviced shacks	23 000		
121.	Number of overcrowded houses	51 000		
122.	Number of shacks in backyard residences	61 000		
123.	Formal to informal housing ratio	78: 22		
124.	Number of amendments to zonings beyond the urban edge	17		
125.	Total growth of development on edge	3.8km^2		
126.	Rate of development percentage /yr	2.50%		
127.	Number of constructions completed	5 631		
128.	Number of mixed use zoning approvals	5		

129.	% Non-urban land	29%	**Percent of non-urban land in the CMA** **Total non-urban land area = 636 km^2** **Protected areas = 476 km^2** **Metropolitan Open Space = 160 km^2**	**Agricultural land accounts for a further 40% of the CMA land**
130.	Green area per capita	212m^2 per capita	**636km^2 / 3million people** **Pretoria= 0.01** m^2 **per capita** **Johannesburg= 10 - 21** m^2 per capita	
131.	Public transport movements per day	1.2 million		
132.	Number of containers (TEUs) moved as proportion of harbour capacity	83%		
133.	Proportion of CMA electricity supplied by Koeberg	100% (during summer)		
134.	Number of waste complaints	6809		
135.	Number of schools involved in litter projects	53		
136.	Number of new registered businesses	1 679		
137.	Average per capita income (Rands in 1996)	**R2169	**Population group-** Ave per capita income **Asian- R1178** **Black- R404** **Coloured - R693** **White- R2573**	** suggested interpretation of data:** **Difference between the highest and the lowest income pop. groups**

138.	Index of aging	** 52	**Population group- Index of aging** **Asian- 20** **Black- 9** **Coloured - 14** **White- 61**	** **suggested interpretation of data:** **Difference between the highest and the lowest index of aging in pop. groups**
139.	New enrolment rates for educational institutions	**820	**(See table in CMC,2000)** **Number public schools =651** **Number of public school learners = 533748**	** **suggested interpretation of data:** **Ave number of learners per public school**
140.	Quantity and type of dilution ratios of industrial effluent entering sewage works & ocean flow	32Ml		

Indicators which have been removed from the set as there was no data measurement given in the 1999 SOE

141.	% Sludge re-used	no data		
142.	Number of international tourists	no data		
143.	Number of convictions as a % of total number of arrests	no data		
144.	Quantity and type of litter in catchments	no data		
145.	Air traffic movements per year as proportion of capacity	no data		
146.	Total passengers as proportion of capacity	no data due to expansions		
147.	Land with formal MOSS status	no data		

APPENDIX 3

BAROMETER POINT SCALES AND CALCULATIONS

Appendix 3.1

Group 1: Barometer Point Scales

1 Commuter trip length (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

2 Property appreciation

Sector	Points	Scale
Good	81-100	21-40
OK	61-80	15.1-20
Medium	41-60	11-15
Poor	21-40	6-10
Bad	1-20	0-5

3 CMA Population (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

4 Ecological Classes-River (class1+2+3)

Sector	Points	Scale
Good	81-100	100-81
OK	61-80	61-80
Medium	41-60	41-60
Poor	21-40	21-40
Bad	1-20	1-20

5. Ecological Classes- Estuaries (class 3+4+5)

Sector	Points	Scale
Good	81-100	1-20
OK	61-80	21-40
Medium	41-60	41-60
Poor	21-40	61-80
Bad	1-20	81-100

6. Number of algal blooms (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

7 Water Quality Stats

Sector	Points	Scale
Good	81-100	0-10
OK	61-80	11-20
Medium	41-60	21-30
Poor	21-40	31-70
Bad	1-20	71-100

8 Faecal Coliform Counts

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	6-10
Medium	41-60	11-15
Poor	21-40	16-20
Bad	1-20	21-60

9 Water demand in m3/yr

Sector	Points	Scale
Good	81-100	60-70
OK	61-80	71-80
Medium	41-60	81-120
Poor	21-40	121-150
Bad	1-20	151-300

10 % Capacity of dams being used to fulfil water demand

Sector	Points	Scale
Good	81-100	65-75%
OK	61-80	76-80%
Medium	41-60	81-85%
Poor	21-40	86-90%
Bad	1-20	91-100%

11 % Population with potable water supply within 50m of dwelling

Sector	Points	Scale
Good	81-100	96-100
OK	61-80	91-95
Medium	41-60	86-90
Poor	21-40	81-85
Bad	1-20	75-80

12 Wastewater produced (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

13 Car ownership- vehicles/1000

Sector	Points	Scale
Good	81-100	201-250
OK	61-80	151-200
Medium	41-60	101-150
Poor	21-40	51-100
Bad	1-20	1-50

14 Overall Air Quality

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	6-15
Medium	41-60	16-40
Poor	21-40	41-70
Bad	1-20	71-100

Appendix 3.1

Group 1: Barometer Point Scales

15 SO_2 Exceedances

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	6-15
Medium	41-60	16-40
Poor	21-40	41-70
Bad	1-20	71-100

16 % Households with access to electricity

Sector	Points	Scale
Good	81-100	96-100
OK	61-80	91-95
Medium	41-60	86-90
Poor	21-40	81-85
Bad	1-20	75-80

17 Lead - average measurement in the CBD

Sector	Points	Scale
Good	81-100	0-0.20
OK	61-80	0.21-0.4
Medium	41-60	0.41-0.45
Poor	21-40	0.46-0.48
Bad	1-20	0.49-0.6

18 Particulate Matter exceedances

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	6-15
Medium	41-60	16-40
Poor	21-40	41-70
Bad	1-20	71-100

19 Number of complaints about air pollution (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

20 Number of acute respiratory chest infections in children under 6yrs (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

21 NO_2 exceedances

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	6-15
Medium	41-60	16-40
Poor	21-40	41-70
Bad	1-20	71-100

22 Use of wood & paraffin & gas as fuel (heating & cooking)

Sector	Points	Scale
Good	81-100	1-5%
OK	61-80	6-10%
Medium	41-60	11-15%
Poor	21-40	16-20%
Bad	1-20	21-25%

23 Koeberg Nuclear Power Station Safety Rating

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

24 Koeberg Nuclear Power Station number of reported leaks (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

25 Demand for energy per yr

Sector	Points	Scale
Good	81-100	0.5-1
OK	61-80	1-2
Medium	41-60	3-4
Poor	21-40	5-8
Bad	1-20	9-10

26 Cost of electricity (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

27 Future capacity of existing waste sites

Sector	Points	Scale
Good	81-100	21-25yrs
OK	61-80	16-20
Medium	41-60	11-15
Poor	21-40	6-10
Bad	1-20	0-5

28 % Waste sites licensed

Sector	Points	Scale
Good	81-100	81-100%
OK	61-80	61-80%
Medium	41-60	41-60
Poor	21-40	21-40
Bad	1-20	0-20

Appendix 3.1

Group 1: Barometer Point Scales

29 Volume in landfill (1kg per person per day)

Sector	Points	Scale
Good	81-100	0-0.2
OK	61-80	0.21-0.3
Medium	41-60	0.31-0.5
Poor	21-40	0.51-0.8
Bad	1-20	>0.8

30 % Waste re-used or recycled per person per day

Sector	Points	Scale
Good	81-100	81-100
OK	61-80	61-80
Medium	41-60	41-60
Poor	21-40	21-40
Bad	1-20	0-20

31 % Waste water re-used or recycled

Sector	Points	Scale (%)
Good	81-100	71-100
OK	61-80	51-70
Medium	41-60	31-50
Poor	21-40	15-30
Bad	1-20	0-14

32 Capacity of waste water treatment potential being used

Sector	Points	Scale
Good	81-100	1-20
OK	61-80	21-40
Medium	41-60	41-60
Poor	21-40	61-80
Bad	1-20	81-100%

33 % Estimated medical waste not handled correctly

Sector	Points	Scale
Good	81-100	0
OK	61-80	1-5
Medium	41-60	6-10
Poor	21-40	11-25
Bad	1-20	26-75

34 Volume to incineration plants (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

35 Capacity in hazardous waste sites (m^3) (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

36 Amount of hazardous waste being generated

Sector	Points	Scale
Good	81-100	0-100
OK	61-80	101-300
Medium	41-60	301-600
Poor	21-40	601-800
Bad	1-20	801-1000

37 Nuclear waste being produced (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

38 Items of litter per day

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

39 Tonnes of goods dumped illegally per year

Sector	Points	Scale ('000)
Good	81-100	0- 10
OK	61-80	20-50
Medium	41-60	60-150
Poor	21-40	160-300
Bad	1-20	310-600

40 Sewage effluent released (average litres per day)

Sector	Points	Scale ('000)
Good	81-100	10-20
OK	61-80	21-30
Medium	41-60	31-35
Poor	21-40	36-40
Bad	1-20	41-50

41 Solids into the sea (t/yr)

Sector	Points	Scale
Good	81-100	0-20
OK	61-80	21-40
Medium	41-60	41-60
Poor	21-40	61-80
Bad	1-20	81-100

42 Heavy Metal (Cadmium)- limit exceeded in mussels

Sector	Points	Scale
Good	81-100	0
OK	61-80	1-5
Medium	41-60	6-10
Poor	21-40	11-25
Bad	1-20	26-50

Appendix 3.1

Group 1: Barometer Point Scales

43 % Coastline protected by Marine Protected Area

Sector	Points	Scale0
Good	81-100	20-25%
OK	61-80	19-15
Medium	41-60	14-10
Poor	21-40	9-5
Bad	1-20	0-4

44 Marine species rated critical within MPA's

Sector	Points	Scale
Good	81-100	0-2
OK	61-80	2.1-5
Medium	41-60	5.1-10
Poor	21-40	10.1- 15
Bad	1-20	15.1-20

45 Amount of land with conservation status

Sector	Points	Scale
Good	81-100	25-20
OK	61-80	19-15
Medium	41-60	14-10
Poor	21-40	9-5
Bad	1-20	4-0

46 Mammals in red data book

Sector	Points	Scale
Good	81-100	0-2
OK	61-80	2.1-5
Medium	41-60	5.1-10
Poor	21-40	10.1- 15
Bad	1-20	15.1-20

47 Avifauna in red data book

Sector	Points	Scale
Good	81-100	0-2
OK	61-80	2.1-5
Medium	41-60	5.1-10
Poor	21-40	10.1- 15
Bad	1-20	15.1-20

48 Invertebrates in red data book- butterflies

Sector	Points	Scale
Good	81-100	0-2
OK	61-80	2.1-5
Medium	41-60	5.1-10
Poor	21-40	10.1- 15
Bad	1-20	15.1-20

49 Amphibians in red data book- frogs

Sector	Points	Scale
Good	81-100	0-2
OK	61-80	2.1-5
Medium	41-60	5.1-10
Poor	21-40	10.1- 15
Bad	1-20	15.1-20

50 Reptiles in red data book

Sector	Points	Scale
Good	81-100	0-2
OK	61-80	2.1-5
Medium	41-60	5.1-10
Poor	21-40	10.1- 15
Bad	1-20	15.1-20

51 Sand Plain Fynbos (area remaining)

Sector	Points	Scale
Good	81-100	36-50
OK	61-80	21-35
Medium	41-60	11-20
Poor	21-40	6-10
Bad	1-20	0-5

52 Renosterveld

Sector	Points	Scale
Good	81-100	36-50
OK	61-80	21-35
Medium	41-60	11-20
Poor	21-40	6-10
Bad	1-20	0-5

53 Strandveld

Sector	Points	Scale
Good	81-100	36-50
OK	61-80	21-35
Medium	41-60	11-20
Poor	21-40	6-10
Bad	1-20	0-5

54 Dependency ratio

Sector	Points	Scale
Good	81-100	25-35
OK	61-80	36-45
Medium	41-60	46-55
Poor	21-40	56-60
Bad	1-20	61-75

55 Percentage of the population in poverty

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	6-10
Medium	41-60	11-15
Poor	21-40	16-20
Bad	1-20	21-50

56 Percentage population unemployed

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	6-10
Medium	41-60	11-15
Poor	21-40	16-20
Bad	1-20	21-25

Appendix 3.1

Group 1: Barometer Point Scales

57 Employment overall in the formal sector

Sector	Points	Scale
Good	81-100	81-100
OK	61-80	61-80
Medium	41-60	41-60
Poor	21-40	21-40
Bad	1-20	0-20

58 Total output GGP (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

59 Annual Ave Growth

Sector	Points	Scale
Good	81-100	5-7
OK	61-80	3-4
Medium	41-60	2-3
Poor	21-40	1-2
Bad	1-20	0-1

60 % Labour professional or highly skilled

Sector	Points	Scale
Good	81-100	70-75
OK	61-80	65-69
Medium	41-60	60-64
Poor	21-40	55-59
Bad	1-20	50-54

61 % Semi-low skilled (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

62 Informal Economy (contribution)

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	6-10
Medium	41-60	11-15
Poor	21-40	16-20
Bad	1-20	21-25

63 Tuberculosis rate

Sector	Points21-25	Scale
Good	81-100	0
OK	61-80	1-20
Medium	41-60	21-50
Poor	21-40	51-100
Bad	1-20	101-500

64 % Population without access to adequate sanitation

Sector	Points	Scale
Good	81-100	0-3
OK	61-80	4-6
Medium	41-60	7-9
Poor	21-40	10-12
Bad	1-20	13-15

65 Meningococcal Meningitis rate

Sector	Points	Scale
Good	81-100	0
OK	61-80	1-20
Medium	41-60	21-40
Poor	21-40	41-60
Bad	1-20	61-80

66 % Population Without adequate drinking water

Sector	Points	Scale
Good	81-100	1-5
OK	61-80	6-10
Medium	41-60	11-15
Poor	21-40	16-20
Bad	1-20	21-25

67 Bacterial exceedances- Bulk Milk

Sector	Points	Scale
Good	81-100	1-20
OK	61-80	21-40
Medium	41-60	41-60
Poor	21-40	61-80
Bad	1-20	81-100

68 Bacterial exceedances- Packaged Milk

Sector	Points	Scale
Good	81-100	1-5
OK	61-80	6-10
Medium	41-60	11-15
Poor	21-40	16-20
Bad	1-20	21-25

69 % Commuters using private transport (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

70 % Commuters using public road transport (buses & minibuses)

Sector	Points	Scale
Good	81-100	0-20
OK	61-80	21-40
Medium	41-60	41-60
Poor	21-40	61-80
Bad	1-20	81-100

Appendix 3.1

Group 1: Barometer Point Scales

71 % Commuters utilising rail

Sector	Points	Scale
Good	81-100	61-75
OK	61-80	46-60
Medium	41-60	31-45
Poor	21-40	16-30
Bad	1-20	1-15

72 Average public transport subsidy increases per year- bus & train (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

73 Safety & security on public transport

Sector	Points	Scale
Good	81-100	0-50
OK	61-80	51-100
Medium	41-60	101-150
Poor	21-40	151-200
Bad	1-20	201-600

74 Capacity of buses utilised during peak

Sector	Points	Scale
Good	81-100	81-100
OK	61-80	61-80
Medium	41-60	41-60
Poor	21-40	21-40
Bad	1-20	0-20

75 Capacity of minibus taxis utilised during peak (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

76 Number of fatalities due to road accidents (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

77 Number of road accidents (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

78 % Accidents involving pedestrians (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

79 Harbour throughput total tonnage/yr (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

80 Number of international flights

Sector	Points	Scale (%)
Good	81-100	80-100
OK	61-80	101-110
Medium	41-60	111-120
Poor	21-40	121-130
Bad	1-20	131-140

81 Number passengers per annum at airport (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

82 Number of dwellings without adequate drainage

Sector	Points	Scale ('000)
Good	81-100	0-1
OK	61-80	1.1-5
Medium	41-60	6-20
Poor	21-40	21-50
Bad	1-20	51-75

83 Access to Telephones

Sector	Points	Scale
Good	81-100	96-100
OK	61-80	91-95
Medium	41-60	86-90
Poor	21-40	81-85
Bad	1-20	75-80

84 Access to Waste Removal

Sector	Points	Scale
Good	81-100	96-100
OK	61-80	91-95
Medium	41-60	86-90
Poor	21-40	81-85
Bad	1-20	75-80

Appendix 3.1

Group 1: Barometer Point Scales

85 % Informal housing exceeding WHO indoor pollution standards

Sector	Points	Scale
Good	81-100	0-20
OK	61-80	21-40
Medium	41-60	41-60
Poor	21-40	61-80
Bad	1-20	81-100

86 Formal housing stock

Sector	Points	Scale
Good	81-100	96-100
OK	61-80	91-95
Medium	41-60	86-90
Poor	21-40	81-85
Bad	1-20	70-80

87 Shack dwellers (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

88 Hostels (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

89 Population growth per year

Sector	Points	Scale
Good	81-100	0-0.5
OK	61-80	0.51-1.0
Medium	41-60	1.1-1.5
Poor	21-40	1.6-2
Bad	1-20	2.1-2.5

90 Estimated housing backlog

Sector	Points	Scale
Good	81-100	0-10000
OK	61-80	10001-25000
Medium	41-60	25001-50000
Poor	21-40	50001-100000
Bad	1-20	100001-300000

91 Property crime

Sector	Points	Scale
Good	81-100	0-50
OK	61-80	51-500
Medium	41-60	501-1000
Poor	21-40	1001-5000
Bad	1-20	5001-10000

92 Vehicle crime

Sector	Points	Scale
Good	81-100	0-50
OK	61-80	51-200
Medium	41-60	201-500
Poor	21-40	501-800
Bad	1-20	801-1000

93 Violent crime

Sector	Points	Scale
Good	81-100	0-10
OK	61-80	11-50
Medium	41-60	51-100
Poor	21-40	101-250
Bad	1-20	251-800

94 Social fabric crime

Sector	Points	Scale
Good	81-100	0-100
OK	61-80	101-250
Medium	41-60	251-500
Poor	21-40	501-1000
Bad	1-20	1001-3000

95 Pupil to teacher ratio

Sector	Points	Scale
Good	81-100	10-15
OK	61-80	16-20
Medium	41-60	21-25
Poor	21-40	26-30
Bad	1-20	31-35

96 Number of schools per 1000 people (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

97 Adult literacy rate

Sector	Points	Scale
Good	81-100	0-2
OK	61-80	3-4
Medium	41-60	5-9
Poor	21-40	10-19
Bad	1-20	20-25

98 Number of full EIA's (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

Appendix 3.1

Group 1: Barometer Point Scales

99 Number of EIA applications/Scoping Reports (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

100 Number of people in Local Government dedicated to environment management (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

Appendix 3.2

Group 1
1998 Calculations

Appendix 3.2

Group 1: 1998 Calculations

No.	Indicator	Min	Max	Value	Max of previous sector	Scaling Up or Down	Barometer Points	Index Weighting	Final points	Dimension
1	Commuter trip length						0	0	0.00	Excluded
2	Property appreciation	15	20	15.15	60	1	61	0.2	12.12	Wealth
3	CMA Population							0		Excluded
4	Ecological Classes-River	40	60	43	40	1	43	0.23	9.89	Water
5	Ecological Classes- Coastal Lakes & Estuaries	20	40	36	60	2	64	0.23	14.72	Water
6	Number of harmful algal blooms							0	0.00	Excluded
7	Water Quality Stats	30	70	64	20	2	23	0.155	3.57	Water
8	Faecal Coliform Counts	20	60	50	0	2	5	0.3	1.50	Health
9	Volume of water being used- Water demand in m3/yr	80	120	96.54	40	2	52	0.5	25.87	Water
10	% Capacity of dams being used to fulfil water demand	90	100	91	0	2	18	0.5	9.00	Water
11	% Population with potable water supply	95	100	97.1	80	1	88	0.3	26.52	Equity
12	Wastewater produced (as % of total water used)									Excluded
13	Car ownership- Number of vehicles per 1000 people	150	200	170	60	1	68	0.1	6.80	Wealth
14	Overall Air Quality	40	70	50	20	2	33	0.6	20.00	Air
15	SO_2 exceedances	0	5	0	80	2	100	0.1	10.00	Air
16	% Households with access to electricity	85	90	86	40	1	44	0.2	8.80	Equity
17	Lead - average measurement in the CBD	0.2	0.4	0.4	60	2	60	0.1	6.00	Air
18	Particulate Matter exceedances	5	15	10.4	60	2	69	0.1	6.92	Air
19	Number of complaints about air pollution							0		Excluded
20	Number of acute respiratory chest infections							0		Excluded
21	NO_2 exceedances	5	15	7.4	60	2	75	0.1	7.52	Air
22	Use of wood & paraffin & gas as fuel	10	15	14	40	2	44	0.5	22.00	Resource
23	Koeberg -Safety Rating							0		Excluded
24	Koeberg - Number of reported leaks							0		Excluded
25	Demand for energy per yr	0.5	1	0.64	80	2	94	0.5	47.20	Resource
26	Cost of electricity							0		Excluded
27	Future Capacity of existing waste sites	15	20	19	60	1	76	0.3	22.80	Resource

Appendix 3.2

Group 1: 1998 Calculations

No.	Indicator	Min	Max	Value	Max of previous sector	Scaling Up or Down	Barometer Points	Index Weighting	Final points	Dimension
28	% Waste sites officially licensed	20	40	33	20	1	33	0.25	8.25	Community
29	Volume of waste in the landfill	0.3	0.5	0.34	40	2	56	0.3	16.80	Resource
30	% Waste re-used or recycled per person per day	20	40	32	20	1	32	0.4	12.80	Resource
31	% Waste water re-used or recycled	0	14	9	0	1	13	0.5	6.43	Resource
32	Capacity of waste water treatment potential being used	80	100	83	0	2	17	0.5	8.50	Resource
33	% Estimated medical waste not handled correctly	25	75	66	0	2	4	0.2	0.72	Health
34	Volume of medical waste incinerated							0		Excluded
35	Capacity in hazardous waste sites (m^3)							0		Excluded
36	Amount of hazardous waste being generated	300	600	524	40	2	45	1	45.07	Resource
37	Nuclear waste being produced							1		Excluded
38	Items of litter per day							0		Excluded
39	Tonnes of goods dumped illegally per year	10000	50000	38700	60	2	66	0.25	16.41	Community
40	Sewage effluent released (average litres per day)	30000	35000	32877	40	2	48	0.23	11.15	Water
41	Solids into the sea	80	100	87	0	2	13	0.155	2.02	Water
42	Heavy Metal (Cadmium)- limit exceeded in mussels	25	50	42.3	0	2	6	0.1	0.62	Health
43	% Coastline protected by Marine Protected Area (MPA)	0	4	2	0	1	10	0.5	5.00	Species
44	Marine species rated critical within MPA's	3	5	4	60	2	70	0.5	35.00	Species
45	Amount of land with conservation status	10	14	14	40	1	60	0.2	12.00	Species
46	Mammals in red data book	0	2	0	80	2	100	0.1	10.00	Species
47	Avifauna in red data book	5	10	5.2	40	2	59	0.1	5.92	Species
48	Invertebrates in red data book- butterflies	5	10	5.3	40	2	59	0.1	5.88	Species
49	Amphibians in red data book- frogs	15	25	22.2	0	2	6	0.1	0.56	Species
50	Reptiles in red data book	10	15	10.4	20	2	38	0.1	3.84	Species
51	Sand Plain Fynbos (area remaining)	0	5	1	0	1	4	0.1	0.40	Species
52	Renosterveld	0	5	3	0	1	12	0.1	1.20	Species
53	Strandveld	20	35	32	60	1	76	0.1	7.60	Species

Appendix 3.2

Group 1: 1998 Calculations

No.	Indicator	Min	Max	Value	Max of previous sector	Scaling Up or Down	Barometer Points	Index Weighting	Final points	Dimension
54	Dependency ratio	45	55	52	40	1	54	0.3	16.20	Wealth
55	Percentage of the population in poverty	20	50	37	0	2	9	0.5	4.33	Wealth
56	Percentage population unemployed	15	20	20	20	2	20	0.4	8.00	Wealth
57	Employment overall in the formal sector	60	80	63	60	1	63	0.3	18.90	Wealth
58	Total output Gross Geographic Product (GGP)							0.2		Excluded
59	Annual Ave Growth	2	3	2.5	40	1	50	0.45	22.50	Wealth
60	% Labour professional or highly skilled	54	59	55	20	1	24	0.3	7.20	Wealth
61	% Semi-low skilled							0		Excluded
62	Informal Economy (contribution)	5	10	7	60	2	72	0.35	25.20	Wealth
63	Tuberculosis rate	250	700	603	0	2	4	0.7	3.02	Health
64	% Population without access to adequate sanitation	9	12	12	20	2	20	0.2	4.00	Equity
65	Meningococcal Meningitis rate (Annual Number of cases)	60	80	79	0	2	1	0.3	0.30	Health
66	% Population without adequate drinking water	15	20	18	20	2	28	0.6	16.80	Health
67	Bacterial exceedances- Bulk Milk	60	80	77	20	2	23	0.15	3.45	Health
68	Bacterial exceedances- Packaged Milk	15	20	18	20	2	28	0.15	4.20	Health
69	% Commuters using private transport							0		Excluded
70	% Commuters using buses & minibuses	20	40	37	60	2	63	0.1	6.30	Wealth
71	% Commuters utilising rail	15	30	19	20	1	25	0.05	1.27	Equity
72	Ave public transport subsidy increases per year							0		Excluded
73	Safety & security on public transport	200	600	587	0	2	1	0.3	0.20	Community
74	Capacity of buses utilised during peak	40	60	43	40	1	43	0.2	8.60	Community
75	Capacity of minibus taxis utilised during peak							0		Excluded
76	Number of fatalities due to road accidents							0		Excluded
77	Number of road accidents							0		Excluded
78	% Accidents involving pedestrians							0		Excluded
79	Harbour throughput (total tonnage/year)							0.1		Excluded
80	Number of international flights							0.1		Excluded

Appendix 3.2

Group 1: 1998 Calculations

No.	Indicator	Min	Max	Value	Max of previous sector	Scaling Up or Down	Barometer Points	Index Weighting	Final points	Dimension
81	Number passengers per annum at airport	110	120	112	40	2	56	0.3	16.80	Land
82	Number of dwellings without adequate drainage	50000	75000	72000	0	2	2	0.1	0.24	Equity
83	Access to telephones	90	95	91	60	1	64	0.05	3.20	Equity
84	Access to refuse removal	90	95	94	60	1	76	0.1	7.60	Equity
85	% Population exceeding WHO indoor pollution standards- informal housing	60	80	80	20	2	20	0.1	2.00	Health
86	Formal housing stock	70	80	74	0	1	8	1	8.00	Equity
87	Shack dwellers							0		Excluded
88	Hostels							0		Excluded
89	Population growth per year	1.5	2	2	20	2	20	0.4	8.00	Health
90	Estimated housing backlog	100000	300000	150000	0	2	15	0.7	10.50	Land
91	Property crime	5000	10000	9600	0	2	2	0.15	0.24	Community
92	Vehicle crime	801	1000	900	0	2	10	0.15	1.51	Community
93	Violent crime	251	800	650	0	2	5	0.3	1.64	Community
94	Social fabric crime	1001	3000	2550	0	2	5	0.4	1.80	Community
95	Pupil to teacher ratio	25	30	29	20	2	24	0.5	12.00	Knowledge
96	Number of schools per 1000 people							0		Excluded
97	Adult literacy rate	4	9	5	40	2	56	0.5	28.00	Knowledge
98	Number of full EIA's							0		Excluded
99	Number of EIA applications/Scoping Reports							0		Excluded
100	People in Local Govt. dedicated to enviro. management									Excluded

Appendix 3.3

Group 1
1999 Calculations

Appendix 3.3

Group 1: 1999 Calculations

No.	Indicator	Min	Max	Value	Max of previous sector	Scaling Up or Down	Barometer Points	Index Weighting	Final points	Dimension
27	Future Capacity of existing waste sites	21	40	33.5	80	1	93.16	0.3	27.95	Resource
28	% Waste sites officially licensed	20	40	33	20	1	33.00	0.25	8.25	Community
29	Volume of waste in the landfill	0.51	0.8	0.53	20	2	21.38	0.3	11.59	Resource
30	% Waste re-used or recycled per person per day	20	40	32	20	1	32.00	0.4	12.80	Resource
31	% Waste water re-used or recycled	0	14	9	0	1	12.86	0.5	6.43	Resource
32	Capacity of waste water treatment potential being used	80	100	87	0	2	7.00	0.5	6.50	Resource
33	% Estimated medical waste not handled correctly	11	25	20	20	2	32.86	0.2	5.43	Health
34	Volume of medical waste incinerated			2490				0		Excluded
35	Capacity in hazardous waste sites (m^3)			13 000000				0		Excluded
36	Amount of hazardous waste being generated	300	600	524	40	2	54.93	1	45.07	Resource
37	Nuclear waste being produced			645				1		Excluded
38	Items of litter per day			4 000 000				0		Excluded
39	Tonnes of goods dumped illegally per year	10000	50000	25350	60	2	67.68	0.25	18.08	Community
40	Sewage effluent released (average litres per day)	30000	35000	32877	40	2	51.51	0.23	11.15	Water
41	Solids into the sea	80	100	87	0	2	7.00	0.155	2.02	Water
42	Heavy Metal (Cadmium)- limit exceeded in mussels	25	50	42.3	0	2	13.84	0.1	0.62	Health
43	% Coastline protected by Marine Protected Area (MPA)	0	4	2	0	1	10.00	0.5	5.00	Species
44	Marine species rated critical within MPA's	3	5	4	60	2	70.00	0.5	35.00	Species
45	Amount of land with conservation status	20	25	22	80	1	88.00	0.2	17.60	Species
46	Mammals in red data book	0	2	0	80	2	80.00	0.1	10.00	Species
47	Avifauna in red data book	5	10	5.2	40	2	40.80	0.1	5.92	Species
48	Invertebrates in red data book- butterflies	5	10	5.3	40	2	41.20	0.1	5.88	Species
49	Amphibians in red data book- frogs	10.1	15	14.8	20	2	39.18	0.1	2.08	Species
50	Reptiles in red data book	5.1	10	8.3	40	2	53.06	0.1	4.69	Species
51	Sand Plain Fynbos (area remaining)	0	5	1	0	1	4.00	0.1	0.40	Species
52	Renosterveld	0	5	3	0	1	12.00	0.1	1.20	Species
53	Strandveld	20	35	32	60	1	76.00	0.1	7.60	Species

Appendix 3.3

Group 1: 1999 Calculations

No.	Indicator	Min	Max	Value	Max of previous sector	Scaling Up or Down	Barometer Points	Index Weighting	Final points	Dimension
1	Commuter trip length			14				0	0.00	Excluded
2	Property appreciation	15	20	16.96	60	1	67.84	0.2	13.57	Wealth
3	CMA Population			3 000 000				0		Excluded
4	Ecological Classes-River	40	60	43	40	1	43.00	0.23	9.89	Water
5	Ecological Classes- Coastal Lakes & Estuaries	20	40	36	60	2	76.00	0.23	14.72	Water
6	Number of harmful algal blooms			3				0		Excluded
7	Water Quality Stats	30	70	64	20	2	37.00	0.155	3.57	Water
8	Faecal Coliform Counts	20	60	50	0	2	15.00	0.3	1.50	Health
9	Volume of water being used- Water demand in m3/yr	80	120	95.58	40	2	47.79	0.5	26.11	Water
10	% Capacity of dams being used to fulfil water demand	90	100	97	0	2	14.00	0.5	3.00	Water
11	% Population with potable water supply	95	100	97.1	80	1	88.40	0.3	26.52	Equity
12	Wastewater produced (as % of total water used)			0.17						Excluded
13	Car ownership- Number of vehicles per 1000 people	150	200	170	60	1	68.00	0.1	6.80	Wealth
14	Overall Air Quality	40	70	50	20	2	26.67	0.6	20.00	Air
15	SO_2 Exceedances	0	5	0	80	2	80.00	0.1	10.00	Air
16	% Households with access to electricity	85	90	90	40	1	60.00	0.2	12.00	Equity
17	Lead -average measurement in the CBD	0.2	0.4	0.4	60	2	80.00	0.1	6.00	Air
18	Particulate Matter exceedances	5	15	6.0	60	2	62.05	0.1	7.79	Air
19	Number of complaints about air pollution			258				0	0.00	Excluded
20	Number of acute respiratory chest infections			27 432				0		Excluded
21	NO_2 exceedances	5	15	5.2	60	2	60.41	0.1	7.96	Air
22	Use of wood & paraffin & gas as fuel	10	15	10	40	2	40.00	0.5	30.00	Resource
23	Koeberg -Safety Rating							0		Excluded
24	Koeberg - Number of reported leaks			0				0		Excluded
25	Demand for energy per yr	0.5	1	0.64	80	2	85.60	0.5	47.20	Resource
26	Cost of electricity			35.89				0		Excluded

Appendix 3.3

Group 1: 1999 Calculations

No.	Indicator	Min	Max	Value	Max of previous sector	Scaling Up or Down	Barometer Points	Index Weighting	Final points	Dimension
54	Dependency ratio	45	55	52	40	1	54.00	0.3	16.20	Wealth
55	Percentage of the population in poverty	20	50	25	0	2	3.33	0.5	8.33	Wealth
56	Percentage population unemployed	21	25	24.6	0	2	18.00	0.4	0.80	Wealth
57	Employment overall in the formal sector	60	80	63	60	1	63.00	0.3	18.90	Wealth
58	Total output Gross Geographic product			86.5				0.2		Excluded
59	Annual Ave Growth	0	1	0.7	0	1	14.00	0.45	6.30	Wealth
60	% Labour professional or highly skilled	40	50	45	0	1	10.00	0.3	3.00	Wealth
61	% Semi-low skilled			32				0		Excluded
62	Informal Economy (contribution)	5	10	7	60	2	68.00	0.35	25.20	Wealth
63	Tuberculosis rate	250	700	660	0	2	18.22	0.7	1.24	Health
64	% Population without access to adequate sanitation	9	12	12	20	2	40.00	0.2	4.00	Equity
65	Meningococcal Meningitis rate (Annual Number of cases)	60	120	109	0	2	16.33	0.3	1.10	Health
66	% Population without adequate drinking water	15	20	19	20	2	36.00	0.6	14.40	Health
67	Bacterial Exceedances- Bulk Milk	60	80	76	20	2	36.00	0.15	3.60	Health
68	Bacterial Exceedances- Packaged Milk	21	40	36	0	2	15.79	0.15	0.63	Health
69	% Commuters using private transport			44				0		Excluded
70	% Commuters using buses & minibuses	20	40	35	60	2	75.00	0.1	6.50	Wealth
71	% Commuters utilising rail	61	75	65	80	1	85.71	0.05	4.29	Equity
72	Ave public transport subsidy increases per year			3.4				0		Excluded
73	Safety & security on public transport	200	600	428	0	2	11.40	0.3	2.58	Community
74	Capacity of buses utilised during peak	40	60	43	40	1	43.00	0.2	8.60	Community
75	Capacity of minibus taxis utilised during peak			59				0		Excluded
76	Number of fatalities due to road accidents			22.13				0		Excluded
77	Number of road accidents			61 056				0		Excluded
78	% Accidents involving pedestrians			27				0		Excluded
79	Harbour throughput (total tonnage/yr)			10.2				0.1		Excluded
80	Number of international flights			2600				0.1		Excluded

Appendix 3.3

Group 1: 1999 Calculations

No.	Indicator	Min	Max	Value	Max of previous sector	Scaling Up or Down	Barometer Points	Index Weighting	Final points	Dimension
81	Number passengers per annum at airport	131	140	139	0	2	17.53	0.3	0.74	Land
82	Number of dwellings without adequate drainage	50000	75000	72000	0	2	17.60	0.1	0.24	Equity
83	Access to Telephones	70	80	71	0	1	2.00	0.05	0.10	Equity
84	Access to refuse removal	90	95	94	60	1	76.00	0.1	7.60	Equity
85	% Population exceeding WHO indoor pollution standards	60	80	80	20	2	40.00	0.1	2.00	Health
86	Formal housing stock	70	80	74	0	1	8.00	1	8.00	Equity
87	Shack dwellers			9.9				0		Excluded
88	Hostels			2.8				0		Excluded
89	Population growth per year	2.1	2.5	2.1	0	2	0.00	0.4	8.00	Health
90	Estimated housing backlog	100000	300000	220000	0	2	12.00	0.7	5.60	Land
91	Property crime	5000	10000	9400	0	2	17.60	0.15	0.36	Community
92	Vehicle crime	800	1500	1200	0	2	11.43	0.15	1.29	Community
93	Violent crime	251	800	700	0	2	16.36	0.3	1.09	Community
94	Social fabric crime	1001	3000	2600	0	2	16.00	0.4	1.60	Community
95	Pupil to teacher ratio	25	30	29	20	2	36.00	0.5	12.00	Knowledge
96	Number of schools per 1000 people			0.4				0		Excluded
97	Adult literacy rate	10	19	17	20	2	35.56	0.5	12.22	Knowledge
98	Number of full EIA's			20				0		Excluded
99	Number of EIA applications/Scoping Reports			268				0		Excluded
100	People in Local Government dedicated to environmental management			38				0		Excluded

Appendix 3.4

Group 2: Barometer Point Scales

1 Commuter trip length

Sector	Points	Scale
Good	81-100	<10
OK	61-80	10--12
Medium	41-60	12-14
Poor	21-40	14-16
Bad	1-20	>16

2 Property appreciation

Sector	Points	Scale
Good	81-100	21-40
OK	61-80	15.1-20
Medium	41-60	11-15
Poor	21-40	6-10
Bad	1-20	0-5

3 CMA Population (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

4 Ecological Classes-River (class1+2+3)

Sector	Points	Scale
Good	81-100	70-79
OK	61-80	60-69
Medium	41-60	50-59
Poor	21-40	40-49
Bad	1-20	30-39

7. Ecological Classes- Estuaries (class 1+2+3)

Sector	Points	Scale
Good	81-100	70-79
OK	61-80	60-69
Medium	41-60	50-59
Poor	21-40	40-49
Bad	1-20	30-39

8. Number of algal blooms

Sector	Points	Scale
Good	81-100	0-0.9
OK	61-80	1.1-1.9
Medium	41-60	2-2.9
Poor	21-40	3-3.9
Bad	1-20	4-4.9

7 Water Quality Stats

Sector	Points	Scale
Good	81-100	0-9
OK	61-80	10-19
Medium	41-60	20-29
Poor	21-40	30-59
Bad	1-20	60-100

8 Faecal Coliform Counts

Sector	Points	Scale
Good	81-100	0-1
OK	61-80	1-10
Medium	41-60	11-15
Poor	21-40	16-30
Bad	1-20	>31

9 Water demand in m^3/yr

Sector	Points	Scale
Good	81-100	30-70
OK	61-80	70-89
Medium	41-60	120-90
Poor	21-40	121-150
Bad	1-20	>150

10 % Capacity of dams being used to fulfil water demand

Sector	Points	Scale
Good	81-100	90-100
OK	61-80	80-89
Medium	41-60	70-79
Poor	21-40	60-69
Bad	1-20	50-59

11 % Population with potable water supply within 50m of dwelling

Sector	Points	Scale
Good	81-100	99-100
OK	61-80	96-98
Medium	41-60	94-96
Poor	21-40	92-94
Bad	1-20	90-92

12 Wastewater produced

Sector	Points	Scale
Good	81-100	0-3
OK	61-80	4-5
Medium	41-60	6-13
Poor	21-40	13-70
Bad	1-20	70-100

13 Car ownership- vehicles/1000

Sector	Points	Scale
Good	81-100	<100
OK	61-80	101-120
Medium	41-60	121-140
Poor	21-40	141-160
Bad	1-20	>160

14 Overall Air Quality

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	6-15
Medium	41-60	16-40
Poor	21-40	41-70
Bad	1-20	71-100

Appendix 3.4

Group 2: Barometer Point Scales

15 SO$_2$ Exceedances

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	6-10
Medium	41-60	11-15
Poor	21-40	16-20
Bad	1-20	21-25

16 % Households with access to electricity

Sector	Points	Scale
Good	81-100	96-100
OK	61-80	90-95
Medium	41-60	80-89
Poor	21-40	70-79
Bad	1-20	60-69

17 Lead - average measurement in the CBD

Sector	Points	Scale
Good	81-100	0-0.20
OK	61-80	0.21-0.3
Medium	41-60	0.31-0.40
Poor	21-40	0.41-0.5
Bad	1-20	>0.51

18 Particulate Matter exceedances

Sector	Points	Scale
Good	81-100	0-7
OK	61-80	8-15
Medium	41-60	16-25
Poor	21-40	26-31
Bad	1-20	32-40

19 Number of complaints about air pollution (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

20 Number of acute respiratory chest infections in children under 6yrs

Sector	Points	Scale
Good	81-100	0-2000
OK	61-80	2000-5000
Medium	41-60	5000-10000
Poor	21-40	1000-15000
Bad	1-20	15000-30000

21 NO$_2$ exceedances

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	6-10
Medium	41-60	11-15
Poor	21-40	16-20
Bad	1-20	21-100

22 Use of wood & paraffin & gas as fuel (heating & cooking)

Sector	Points	Scale
Good	81-100	1-5%
OK	61-80	6-10%
Medium	41-60	11-15%
Poor	21-40	16-20%
Bad	1-20	21-25%

23 Koeberg Nuclear Power Station Safety Rating

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	6-10
Medium	41-60	11-12
Poor	21-40	12-14
Bad	1-20	14-20

24 Koeberg Nuclear Power Station Number of reported leaks (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

25 Demand for energy per yr (excluded)

Sector	Points	Scale
Good	81-100	0.5-1
OK	61-80	1-2
Medium	41-60	3-4
Poor	21-40	5-8
Bad	1-20	9-10

26 Cost of electricity (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

27 Future Capacity of existing waste sites

Sector	Points	Scale
Good	81-100	21-25yrs
OK	61-80	16-20
Medium	41-60	11-15
Poor	21-40	6-10
Bad	1-20	0-5

28 % Waste sites licensed

Sector	Points	Scale
Good	81-100	81-100%
OK	61-80	61-80%
Medium	41-60	41-60
Poor	21-40	21-40
Bad	1-20	0-20

Appendix 3.4

Group 2: Barometer Point Scales

29 Volume in landfill (1kg per person per day)

Sector	Points	Scale
Good	81-100	0-0.1
OK	61-80	0.11-0.29
Medium	41-60	0.3-0.39
Poor	21-40	0.4-0.59
Bad	1-20	>0.6

30 % Waste re-used or recycled per person per day

Sector	Points	Scale
Good	81-100	30-50
OK	61-80	20-29
Medium	41-60	10-19
Poor	21-40	5-9
Bad	1-20	0-4

31 % Waste water re-used or recycled

Sector	Points	Scale (%)
Good	81-100	41-100
OK	61-80	31-40
Medium	41-60	21-30
Poor	21-40	11-20
Bad	1-20	0-10

32 Capacity of waste water treatment potential being used

Sector	Points	Scale
Good	81-100	1-20
OK	61-80	21-40
Medium	41-60	41-60
Poor	21-40	61-80
Bad	1-20	81-100%

33 % Estimated medical waste not handled correctly

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	6-19
Medium	41-60	20-35
Poor	21-40	36-50
Bad	1-20	51-70

34 Vol. to incineration plants

Sector	Points	Scale
Good	81-100	90-100
OK	61-80	66-89
Medium	41-60	51-65
Poor	21-40	41-50
Bad	1-20	0-40

35 Capacity in hazardous waste sites (m^3) (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

36 Amount of hazardous waste being generated

Sector	Points	Scale
Good	81-100	0-1000
OK	61-80	1001-5000
Medium	41-60	5001-50 000
Poor	21-40	50000-100000
Bad	1-20	100001-500 000

37 Nuclear waste being produced

Sector	Points	Scale
Good	81-100	0-1000
OK	61-80	1001-2000
Medium	41-60	2001-3000
Poor	21-40	3001-4000
Bad	1-20	4001-5000

38 Items of litter per day (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

39 Tonnes of goods dumped illegally per year

Sector	Points	Scale ('000)
Good	81-100	0- 5
OK	61-80	6-10
Medium	41-60	11-15
Poor	21-40	16-20
Bad	1-20	20-40

40 Sewage effluent released (average litres per day)

Sector	Points	Scale ('000)
Good	81-100	0-10
OK	61-80	10001-20
Medium	41-60	20.1-30
Poor	21-40	30.1-40
Bad	1-20	40.1-50

41 Solids into the sea (t/yr)

Sector	Points	Scale
Good	81-100	0-10
OK	61-80	11-25
Medium	41-60	26-39
Poor	21-40	40-49
Bad	1-20	50-100

42 Heavy Metal (Cadmium)- limit exceeded in mussels

Sector	Points	Scale
Good	81-100	0-10
OK	61-80	11-20
Medium	41-60	21-39
Poor	21-40	40-50
Bad	1-20	>50

Appendix 3.4

Group 2: Barometer Point Scales

43 % Coastline protected by Marine Protected Area

Sector	Points	Scale0
Good	81-100	>10
OK	61-80	8-9
Medium	41-60	6-7
Poor	21-40	4-5
Bad	1-20	0-3

44 Marine species rated critical within MPA's

Sector	Points	Scale
Good	81-100	0
OK	61-80	1-3
Medium	41-60	3.1-6
Poor	21-40	6.1- 9
Bad	1-20	>10

45 Amount of land with conservation status

Sector	Points	Scale
Good	81-100	16-20
OK	61-80	12-15
Medium	41-60	8-11
Poor	21-40	4-7
Bad	1-20	0-3

46 Mammals in red data book

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	6-10
Medium	41-60	11-20
Poor	21-40	21- 30
Bad	1-20	>31

47 Avifauna in red data book (%)

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	6-10
Medium	41-60	11-20
Poor	21-40	21-30
Bad	1-20	31-50

48 Invertebrates in red data book- butterflies (%)

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	6-10
Medium	41-60	11-20
Poor	21-40	21-30
Bad	1-20	31-50

49 Amphibians in red data book- frogs (%)

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	6-10
Medium	41-60	11-20
Poor	21-40	21-30
Bad	1-20	31-50

50 Reptiles in red data book (%)

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	6-10
Medium	41-60	11-20
Poor	21-40	21-30
Bad	1-20	31-50

51 Sand Plain Fynbos (area remaining)

Sector	Points	Scale
Good	81-100	20-25
OK	61-80	15-19
Medium	41-60	10-14
Poor	21-40	5-9
Bad	1-20	0-4

52 Renosterveld

Sector	Points	Scale
Good	81-100	20-25
OK	61-80	15-19
Medium	41-60	10-14
Poor	21-40	5-9
Bad	1-20	0-4

53 Strandveld

Sector	Points	Scale
Good	81-100	20-25
OK	61-80	15-19
Medium	41-60	10-14
Poor	21-40	5-9
Bad	1-20	0-4

54 Dependency ratio

Sector	Points	Scale
Good	81-100	>29
OK	61-80	30-39
Medium	41-60	40-49
Poor	21-40	50-59
Bad	1-20	>60

55 Percentage of the population in poverty

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	6-15
Medium	41-60	16-25
Poor	21-40	26-35
Bad	1-20	>35

56 Percentage population unemployed

Sector	Points	Scale
Good	81-100	0-10
OK	61-80	11-15
Medium	41-60	16-20
Poor	21-40	21-40
Bad	1-20	>40

Appendix 3.4

Group 2: Barometer Point Scales

57 Employment overall in the formal sector

Sector	Points	Scale
Good	81-100	81-100
OK	61-80	70-80
Medium	41-60	60-70
Poor	21-40	60-50
Bad	1-20	<50

58 Total output GGP (billions)

Sector	Points	Scale
Good	81-100	>80
OK	61-80	70-79
Medium	41-60	60-69
Poor	21-40	50-59
Bad	1-20	>50

59 Annual Average Economic Growth

Sector	Points	Scale
Good	81-100	>3.5
OK	61-80	3-3.5
Medium	41-60	2.5-3
Poor	21-40	2-2.5
Bad	1-20	0-2

60 % Labour professional or highly skilled

Sector	Points	Scale
Good	81-100	70-80
OK	61-80	60-69
Medium	41-60	50-59
Poor	21-40	40-49
Bad	1-20	0-40

61 % Semi-low skilled (excluded)

Sector	Points	Scale
Good	81-100	0-30
OK	61-80	31-40
Medium	41-60	41-50
Poor	21-40	51-60
Bad	1-20	>60

62 Informal Economy (contribution)

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	6-10
Medium	41-60	11-15
Poor	21-40	16-20
Bad	1-20	21-25

63 Tuberculosis rate

Sector	Points21-25	Scale
Good	81-100	0-100
OK	61-80	101-200
Medium	41-60	201-300
Poor	21-40	301-400
Bad	1-20	401-700

64 % Pop. without access to adequate sanitation

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	6-8
Medium	41-60	8.1-10
Poor	21-40	10.1-12
Bad	1-20	12.1-15

65 Meningococcal Meningitis rate

Sector	Points	Scale
Good	81-100	0-19
OK	61-80	20-39
Medium	41-60	40-59
Poor	21-40	60-80
Bad	1-20	>81

66 % Population without adequate drinking water

Sector	Points	Scale
Good	81-100	0-10
OK	61-80	10.1-14
Medium	41-60	14.1-18
Poor	21-40	18.1-20
Bad	1-20	20.1-22

67 Bacterial Exceedances- Bulk Milk

Sector	Points	Scale
Good	81-100	1-10
OK	61-80	11-20
Medium	41-60	21-30
Poor	21-40	31-40
Bad	1-20	41-100

68 Bacterial Exceedances- Packaged Milk (%)

Sector	Points	Scale
Good	81-100	0-2
OK	61-80	3-5
Medium	41-60	6-9
Poor	21-40	10-12
Bad	1-20	13-50

69 % Commuters using private transport

Sector	Points	Scale
Good	81-100	20
OK	61-80	21-30
Medium	41-60	31-40
Poor	21-40	41-50
Bad	1-20	>50

70 % Commuters using public road transport (buses & minibuses)

Sector	Points	Scale
Good	81-100	>50
OK	61-80	49-30
Medium	41-60	29-20
Poor	21-40	19-10
Bad	1-20	0-9

Appendix 3.4

Group 2: Barometer Point Scales

71 % Commuters utilising rail

Sector	Points	Scale
Good	81-100	>30
OK	61-80	20-29
Medium	41-60	10-19
Poor	21-40	5-9
Bad	1-20	0-5

72 Average public transport subsidy increases per year- bus & train

Sector	Points	Scale
Good	81-100	10-15
OK	61-80	6-10
Medium	41-60	3-6
Poor	21-40	3-2
Bad	1-20	<2

73 Safety & security on public transport

Sector	Points	Scale
Good	81-100	0-100
OK	61-80	101-200
Medium	41-60	201-300
Poor	21-40	301-450
Bad	1-20	451-1000

74 Capacity of buses utilised during peak

Sector	Points	Scale
Good	81-100	91-100
OK	61-80	75-90
Medium	41-60	60-74
Poor	21-40	45-59
Bad	1-20	0-45

75 Capacity of minibus taxis utilised during peak

Sector	Points	Scale
Good	81-100	91-100
OK	61-80	75-90
Medium	41-60	60-74
Poor	21-40	45-59
Bad	1-20	0-45

76 Number of fatalities due to road accidents

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	5-10
Medium	41-60	10-15
Poor	21-40	15-20
Bad	1-20	20-30

77 Number of road accidents

Sector	Points	Scale
Good	81-100	0-5000
OK	61-80	5001-15000
Medium	41-60	15001-30000
Poor	21-40	30001-45000
Bad	1-20	45001-80000

78 % Accidents involving pedestrians

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	5-15
Medium	41-60	15-25
Poor	21-40	25-35
Bad	1-20	35-45

79 Harbour throughput (total tonnage/yr)

Sector	Points	Scale
Good	81-100	>15
OK	61-80	13-15
Medium	41-60	11-13
Poor	21-40	11-9
Bad	1-20	0-9

80 Number of international flights

Sector	Points	Scale
Good	81-100	25001
OK	61-80	2001-2500
Medium	41-60	1900-2000
Poor	21-40	1899-1700
Bad	1-20	1699

81 Number passengers per annum at airport

Sector	Points	Scale
Good	81-100	>90
OK	61-80	70-89
Medium	41-60	50-69
Poor	21-40	30-49
Bad	1-20	0-29

82 Number of dwellings without adequate drainage

Sector	Points	Scale ('000)
Good	81-100	0-10
OK	61-80	11-20
Medium	41-60	20-40
Poor	21-40	41-80
Bad	1-20	81-100

83 Access to Telephones

Sector	Points	Scale
Good	81-100	96-100
OK	61-80	90-95
Medium	41-60	85-89
Poor	21-40	80-84
Bad	1-20	75-79

84 Access to Waste Removal

Sector	Points	Scale
Good	81-100	98.1-100
OK	61-80	96.1-98
Medium	41-60	94.1-96
Poor	21-40	92.1-94
Bad	1-20	90-92

Appendix 3.4

Group 2: Barometer Point Scales

85 % Informal housing exceeding WHO indoor pollution standards

Sector	Points	Scale
Good	81-100	0-20
OK	61-80	21-40
Medium	41-60	41-60
Poor	21-40	61-80
Bad	1-20	81-100

86 Formal housing stock

Sector	Points	Scale
Good	81-100	96-100
OK	61-80	85-95
Medium	41-60	75-85
Poor	21-40	65-75
Bad	1-20	55-65

87 Shack dwellers

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	6-9
Medium	41-60	10-12
Poor	21-40	13-15
Bad	1-20	>15

88 Hostels

Sector	Points	Scale
Good	81-100	0
OK	61-80	0-1
Medium	41-60	1-2
Poor	21-40	2-3
Bad	1-20	>3

89 Population growth per year

Sector	Points	Scale
Good	81-100	1.5
OK	61-80	1.5-2
Medium	41-60	2.1-2.5
Poor	21-40	2.6-3
Bad	1-20	>3

90 Estimated housing backlog

Sector	Points	Scale
Good	81-100	0-3000
OK	61-80	3001-6000
Medium	41-60	6001-9000
Poor	21-40	9001-120 000
Bad	1-20	120001-250 000

91 Property crime

Sector	Points	Scale
Good	81-100	0-1000
OK	61-80	1001-2000
Medium	41-60	2001-3000
Poor	21-40	3001-4000
Bad	1-20	4000-10000

92 Vehicle crime

Sector	Points	Scale
Good	81-100	0-100
OK	61-80	101-200
Medium	41-60	201-300
Poor	21-40	301-400
Bad	1-20	401-1500

93 Violent crime

Sector	Points	Scale
Good	81-100	0-100
OK	61-80	101-200
Medium	41-60	201-300
Poor	21-40	301-400
Bad	1-20	401-1500

94 Social fabric crime

Sector	Points	Scale
Good	81-100	0-100
OK	61-80	101-200
Medium	41-60	201-300
Poor	21-40	301-400
Bad	1-20	401-3000

95 Pupil to teacher ratio

Sector	Points	Scale
Good	81-100	>25
OK	61-80	25-30
Medium	41-60	30-35
Poor	21-40	35-45
Bad	1-20	>45

96 Number of schools per 1000 people

Sector	Points	Scale
Good	81-100	>I
OK	61-80	0.8-0.6
Medium	41-60	0.6-0.4
Poor	21-40	0.4-0.2
Bad	1-20	<0.2

97 Adult literacy rate

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	5-10
Medium	41-60	10-15
Poor	21-40	15-25
Bad	1-20	>25

98 Number of full EIA's (excluded)

Sector	Points	Scale
Good	81-100	<10
OK	61-80	10-15
Medium	41-60	15-20
Poor	21-40	20-25
Bad	1-20	25-30

Appendix 3.4

Group 2: Barometer Point Scales

99 Number of EIA applications/Scoping Reports

Sector	**Points**	**Scale**
Good	81-100	>200
OK	61-80	200-150
Medium	41-60	150-100
Poor	21-40	100-50
Bad	1-20	0-50

100 Number of people in Local Government dedicated to environment management (excluded)

Sector	**Points**	**Scale**
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

14 excluded

Appendix 3.5

Group 2
1998 Calculations

Appendix 3.5

Group 2: 1998 Calculations

No.	Indicator	Min	Max	Value	Max of previous sector	Scaling Up or Down	Barometer Points	Index Weighting	Final points	Dimension
1	Commuter trip length	12	14	14	40	2	40	0.3	12.00	Wealth
2	Property appreciation									Exclude
3	CMA Population			2.9						Exclude
4	Ecological Classes-River	40	49	43	20	1	27	0.4	10.67	Water
5	Ecological Classes- Coastal Lakes & Estuaries	30	39	36	0	1	13	0.4	5.33	Water
6	Number of harmful algal blooms	2	2.9	2	40	2	60	0.2	12.00	Water
7	Water Quality Stats	60	100	64	0	2	18	0.33	5.94	Water
8	Faecal Coliform Counts	30	100	50	0	2	14	1	14.29	Health
9	Volume of water being used- Water demand in m^3/yr	90	120	96.54	40	2	56	0.7	38.95	Resource
10	% Capacity of dams being used to fulfil water demand	90	100	91	80	1	82	0.3	24.60	Resource
11	% Population with potable water supply	96	98	97.1	60	1	71	0.7	49.70	Equity
12	Wastewater produced (as % of total water used)	0	3	0.18	80	2	99	0.4	39.52	Resource
13	Car ownership- Number of vehicles per 1000 people	160	200	170	0	2	15	0.1	1.50	Wealth
14	Overall Air Quality									Exclude
15	SO_2 Exceedances	0	5	0	80	2	100	0.25	25.00	Air
16	% Households with access to electricity	80	89	86	40	1	53	0.6	32.00	Equity
17	Lead - average measurement in the CBD	0.31	0.4	0.4	40	2	40	0.133	5.32	Health
18	Particulate Matter exceedances	8	15	10.4	60	2	73	0.5	36.57	Air
19	Number of complaints about air pollution			303						Exclude
20	Number of acute respiratory chest infections	15000	30000	27432	0	2	3	0.3	1.03	Health
21	NO_2 exceedances	6	10	7.4	20	2	33	0.25	8.25	Air
22	Use of wood & paraffin & gas as fuel	12.1	14	14	20	2	20	0.4	8.00	Equity
23	Koeberg -Safety Rating			95						Exclude
24	Koeberg - Number of reported leaks			0						Exclude
25	Demand for energy per yr			0.64						Exclude
26	Cost of electricity									Exclude

Appendix 3.5

Group 2: 1998 Calculations

No.	Indicator	Min	Max	Value	Max of previous sector	Scaling Up or Down	Barometer Points	Index Weighting	Final points	Dimension
27	Future Capacity of existing waste sites									Exclude
28	% Waste sites officially licensed	21	40	33	20	1	33	0.1	3.26	Community
29	Volume of waste in the landfill	0.3	0.39	0.34	40	2	51	0.3	15.33	Resource
30	% Waste re-used or recycled per person per day	30	50	32	80	1	82	0.3	24.60	Resource
31	% Waste water re-used or recycled	0	10	9	0	1	18	0.4	7.20	Resource
32	Capacity of waste water treatment potential being used			83						Exclude
33	% Estimated medical waste not handled correctly	51	70	66	0	2	4	0.4	1.68	Community
34	Volume of medical waste incinerated			1700				0.133		Resource
35	Capacity in hazardous waste sites (m^3)									Exclude
36	Amount of hazardous waste being generated	0	1000	524	80	2	90	0.2	17.90	Resource
37	Nuclear waste being produced	1001	2000	1560	60	2	69	0.2	13.76	Resource
38	Items of litter per day									Exclude
39	Tonnes of goods dumped illegally per year	20000	40000	38700	0	2	1	0.5	0.65	Community
40	Sewage effluent released (average litres per day)	30001	40000	32877	20	2	34	0.2	6.85	Resource
41	Solids into the sea	50	100	87	0	2	5	0.7	3.64	Water
42	Heavy Metal (Cadmium)- limit exceeded in mussels	40	50	42.3	20	2	35	0.3	10.62	Water
43	% Coastline protected by Marine Protected Area (MPA)	0	3	2	0	1	13	0.2	2.67	Species
44	Marine species rated critical within MPA's	3.1	6	4	40	2	54	0.8	43.03	Species
45	Amount of land with conservation status	12	15	14	60	1	73	0.35	25.67	Land
46	Mammals in red data book	0	5	0	80	2	100	0.2	20.00	Species
47	Avifauna in red data book	5.1	10	5.2	60	2	80	0.2	15.92	Species
48	Invertebrates in red data book- butterflies	5.1	10	5.3	60	2	79	0.2	15.84	Species
49	Amphibians in red data book- frogs	21	30	22.2	20	2	37	0.2	7.47	Species
50	Reptiles in red data book	10.1	20	10.4	40	2	59	0.2	11.88	Species
51	Sand Plain Fynbos (area remaining)	0	4	1	0	1	5	0.33	1.65	Land
52	Renosterveld	0	4	3	0	1	15	0.33	4.95	Land
53	Strandveld	21	50	32	80	1	88	0.33	28.90	Land

Appendix 3.5

Group 2: 1998 Calculations

No.	Indicator	Min	Max	Value	Max of previous sector	Scaling Up or Down	Barometer Points	Index Weighting	Final points	Dimension
54	Dependency ratio	50	59	52	20	2	36	0.5	17.78	Wealth
55	Percentage of the population in poverty	35	100	37	0	2	19	0.5	9.69	Wealth
56	Percentage population unemployed	16	20	20	40	2	40	0.25	10.00	Wealth
57	Employment overall in the formal sector	60	69	63	40	1	47	0.25	11.67	Wealth
58	Total output Gross Geographic product	60	69	64.7	40	1	50	0.4	20.18	Wealth
59	Annual Ave Growth	2.5	3	2.5	40	1	40	0.4	16.00	Wealth
60	% Labour professional or highly skilled	50	59	55	40	1	51	0.25	12.78	Wealth
61	% Semi-low skilled	41	50	45	40	2	51	0.25	12.78	Wealth
62	Informal Economy (contribution)			7						Exclude
63	Tuberculosis rate	401	700	603	0	2	6	0.3	1.95	Health
64	% Population without access to adequate sanitation	10.1	12	12	20	2	20	0.5	10.00	Equity
65	Meningococcal Meningitis rate (Annual Number of cases)	60	80	79	20	2	21	0.133	2.79	Health
66	% Population without adequate drinking water	14.1	18	18	40	2	40	0.3	12.00	Equity
67	Bacterial Exceedances- Bulk Milk	41	100	77	0	2	8	0.5	3.90	Community
68	Bacterial Exceedances- Packaged Milk	13	50	18	0	2	17	0.5	8.65	Community
69	% Commuters using private transport	41	50	44	20	2	33	0.1	3.33	Wealth
70	% Commuters using buses & minibuses	30	49	37	60	1	67	0.2	13.47	Wealth
71	% Commuters utilising rail	10	19	19	40	1	60	0.3	18.00	Wealth
72	Ave public transport subsidy increases per year	6	10	9.4	60	1	77	0.6	46.20	Community
73	Safety & security on public transport	451	1000	587	0	2	15	0.5	7.52	Community
74	Capacity of buses utilised during peak	0	45	43	0	1	19	0.2	3.82	Community
75	Capacity of minibus taxis utilised during peak	45	59	59	20	1	40	0.2	8.00	Community
76	Number of fatalities due to road accidents	20	30	24.9	0	2	10	0.4	4.08	Community
77	Number of road accidents	45001	80000	62561	0	2	10	0.2	1.99	Community
78	% Accidents involving pedestrians	25	35	32	20	2	26	0.4	10.40	Community
79	Harbour throughput (total tonnage/yr)	11	13	11.7	40	1	47	0.2	9.40	Wealth
80	Number of international flights	1900	2000	1953	40	1	51	0.6	30.36	Wealth

Appendix 3.5

Group 2: 1998 Calculations

No.	Indicator	Min	Max	Value	Max of previous sector	Scaling Up or Down	Barometer Points	Index Weighting	Final points	Dimension
81	Number passengers per annum at airport			3.9				0.4		Exclude
82	Number of dwellings without adequate drainage	40001	80000	72000	20	2	24	1	24.00	Equity
83	Access to Telephones	90	95	91	60	1	64	1	64.00	Knowledge
84	Access to refuse removal	92.1	94	94	20	1	40	0.5	20.00	Equity
85	% Population exceeding WHO indoor pollution standards	61	80	80	20	2	20	0.133	2.66	Health
86	Formal housing stock	65	75	74	20	1	38	0.33	12.54	Equity
87	Shack dwellers	6	10	9.9	40	2	41	0.33	13.37	Equity
88	Hostels	2	3	2.8	20	2	24	0.33	7.92	Equity
89	Population growth per year	1.5	2	2	40	2	40	1	40.00	Health
90	Estimated housing backlog	120001	250000	150000	0	2	15	1	15.38	Community
91	Property crime	4000	10000	9600	0	2	1	0.2	0.27	Community
92	Vehicle crime	401	1500	900	0	2	11	0.2	2.18	Community
93	Violent crime	401	1500	650	0	2	15	0.3	4.64	Community
94	Social fabric crime	401	3000	2550	0	2	3	0.3	1.04	Community
95	Pupil to teacher ratio	25	30	29	60	2	64	0.33	21.12	Knowledge
96	Number of schools per 1000 people	0.4	0.6	0.5	40	1	50	0.33	16.50	Knowledge
97	Adult literacy rate	0	5	5	80	2	80	0.33	26.40	Knowledge
98	Number of full EIA's	20	25	20	20	2	40	0.5	20.00	Community
99	Number of EIA applications/Scoping Reports	100	150	112	40	1	45	0.5	22.40	Community
100	People in Local Government dedicated to environmental management			23						Exclude

Appendix 3.6

Group 2
1999 Calculations

Appendix 3.6

Group 2: 1999 Calculations

No.	Indicator	Min	Max	Value	Max of previous sector	Scaling Up or Down	Barometer Points	Index Weighting	Final points	Dimension
1	Commuter trip length	12	14	14	40	2	40	0.3	12.00	Wealth
2	Property appreciation			16.96						Exclude
3	CMA Population			3 000 000						Exclude
4	Ecological Classes-River	40	49	43	20	1	27	0.4	10.67	Water
5	Ecological Classes- Coastal Lakes & Estuaries	30	39	36	0	1	13	0.4	5.33	Water
6	Number of harmful algal blooms	3	3.9	3	20	2	40	0.2	8.00	Water
7	Water Quality Stats	60	100	64	0	2	18	0.33	5.94	Water
8	Faecal Coliform Counts	30	100	50	0	2	14	1	14.29	Health
9	Volume of water being used- Water demand in m^3/yr	90	120	95.58	40	2	56	0.7	39.40	Resource
10	% Capacity of dams being used to fulfil water demand	90	100	97	80	1	94	0.3	28.20	Resource
11	% Population with potable water supply	96	98	97.1	60	1	71	0.7	49.70	Equity
12	Wastewater produced (as % of total water used)	0	3	0.17	80	2	99	0.4	39.55	Resource
13	Car ownership- Number of vehicles per 1000 people	160	200	170	0	2	15	0.1	1.50	Wealth
14	Overall Air Quality			50						Exclude
15	SO_2 Exceedances	0	5	0	80	2	100	0.25	25.00	Air
16	% Households with access to electricity	90	95	90	60	1	60	0.6	36.00	Equity
17	Lead - average measurement in the CBD	0.31	0.4	0.4	40	2	40	0.133	5.32	Health
18	Particulate Matter exceedances	0	7	6.0	80	2	83	0.5	41.39	Air
19	Number of complaints about air pollution			258						Exclude
20	Number of acute respiratory chest infections	15000	30000	27432	0	2	3	0.3	1.03	Health
21	NO_2 exceedances	5.1	10	5.2	20	2	40	0.25	9.89	Air
22	Use of wood & paraffin & gas as fuel	6	10	10	60	2	60	0.4	24.00	Equity
23	Koeberg -Safety Rating									Exclude
24	Koeberg - Number of reported leaks			0						Exclude
25	Demand for energy per yr			0.64						Exclude

Appendix 3.6

Group 2: 1999 Calculations

No.	Indicator	Min	Max	Value	Max of previous sector	Scaling Up or Down	Barometer Points	Index Weighting	Final points	Dimension
26	Cost of electricity			35.89						Exclude
27	Future Capacity of existing waste sites			33.5						Exclude
28	% Waste sites officially licensed	21	40	33	20	1	33	0.1	3.26	Community
29	Volume of waste in the landfill	0.4	0.59	0.53	20	2	26	0.3	7.89	Resource
30	% Waste re-used or recycled per person per day	30	50	32	80	1	82	0.3	24.60	Resource
31	% Waste water re-used or recycled	0	10	9	0	1	18	0.4	7.20	Resource
32	Capacity of waste water treatment potential being used			87						Exclude
33	% Estimated medical waste not handled correctly	20	35	20	40	2	60	0.4	24.00	Community
34	Volume of medical waste incinerated			2490				0.133		Exclude
35	Capacity in hazardous waste sites (m^3)			13 000000						Exclude
36	Amount of hazardous waste being generated	0	1000	524	80	2	90	0.2	17.90	Resource
37	Nuclear waste being produced	0	1000	645	80	2	87	0.2	17.42	Resource
38	Items of litter per day			4 000 000						Exclude
39	Tonnes of goods dumped illegally per year	20000	40000	25350	0	2	15	0.5	7.33	Community
40	Sewage effluent released (average litres per day)	30001	40000	32877	20	2	34	0.2	6.85	Resource
41	Solids into the sea	50	100	87	0	2	5	0.7	3.64	Water
42	Heavy Metal (Cadmium)- limit exceeded in mussels	40	50	42.3	20	2	35	0.3	10.62	Water
43	% Coastline protected by Marine Protected Area (MPA)	0	3	2	0	1	13	0.2	2.67	Species
44	Marine species rated critical within MPA's	3.1	6	4	40	2	54	0.8	43.03	Species
45	Amount of land with conservation status	16	25	22	80	1	93	0.35	32.67	Land
46	Mammals in red data book	0	5	0	80	2	100	0.2	20.00	Species
47	Avifauna in red data book	5.1	10	5.2	60	2	80	0.2	15.92	Species
48	Invertebrates in red data book- butterflies	5.1	10	5.3	60	2	79	0.2	15.84	Species
49	Amphibians in red data book- frogs	10.1	20	14.8	40	2	51	0.2	10.10	Species
50	Reptiles in red data book	5.1	10	8.3	60	2	67	0.2	13.39	Species

Appendix 3.6

Group 2: 1999 Calculations

No.	Indicator	Min	Max	Value	Max of previous sector	Scaling Up or Down	Barometer Points	Index Weighting	Final points	Dimension
51	Sand Plain Fynbos (area remaining)	0	4	1	0	1	5	0.33	1.65	Land
52	Renosterveld	0	4	3	0	1	15	0.33	4.95	Land
53	Strandveld	21	50	32	80	1	88	0.33	28.90	Land
54	Dependency ratio	50	59	52	20	2	36	0.5	17.78	Wealth
55	Percentage of the population in poverty	16	25	25	40	2	40	0.5	20.00	Wealth
56	Percentage population unemployed	21	40	24.6	20	2	36	0.25	9.05	Wealth
57	Employment overall in the formal sector	60	69	63	40	1	47	0.25	11.67	Wealth
58	Total output Gross Geographic product	80	100	86.5	80	1	87	0.4	34.60	Wealth
59	Annual Ave Growth	0	2	0.7	0	1	7	0.4	2.80	Wealth
60	% Labour professional or highly skilled	40	49	45	20	1	31	0.25	7.78	Wealth
61	% Semi-low skilled	31	40	32	60	2	78	0.25	19.44	Wealth
62	Informal Economy (contribution)			7						Exclude
63	Tuberculosis rate	401	700	660	0	2	3	0.3	0.80	Health
64	% Population without access to adequate sanitation	10.1	12	12	20	2	20	0.5	10.00	Equity
65	Meningococcal Meningitis rate (Annual Number of cases)	81	120	109	0	2	6	0.133	0.75	Health
66	% Population without adequate drinking water	14.1	18	19	40	2	35	0.3	10.46	Equity
67	Bacterial Exceedances- Bulk Milk	41	100	76	0	2	8	0.5	4.07	Community
68	Bacterial Exceedances- Packaged Milk	13	50	36	0	2	8	0.5	3.78	Community
69	% Commuters using private transport	41	50	44	20	2	33	0.1	3.33	Wealth
70	% Commuters using buses & minibuses	30	49	35	60	1	65	0.2	13.05	Wealth
71	% Commuters utilising rail	30	100	65	80	1	90	0.3	27.00	Wealth
72	Ave public transport subsidy increases per year	3	6	3.4	60	1	63	0.6	37.60	Community
73	Safety & security on public transport	301	450	428	20	2	23	0.5	11.48	Community
74	Capacity of buses utilised during peak	0	45	43	0	1	19	0.2	3.82	Community
75	Capacity of minibus taxis utilised during peak	45	59	59	20	1	40	0.2	8.00	Community
76	Number of fatalities due to road accidents	20	30	22.13	0	2	16	0.4	6.30	Community

Appendix 3.6

Group 2: 1999 Calculations

No.	Indicator	Min	Max	Value	Max of previous sector	Scaling Up or Down	Barometer Points	Index Weighting	Final points	Dimension
77	Number of road accidents	45001	80000	61056	0	2	11	0.2	2.17	Community
78	% Accidents involving pedestrians	25	35	27	20	2	36	0.4	14.40	Community
79	Harbour throughput (total tonnage/yr)	9	11	10.2	20	1	32	0.2	6.40	Wealth
80	Number of international flights	2501	3500	2600	80	1	82	0.6	49.19	Wealth
81	Number passengers per annum at airport			138.8889				0.4		Exclude
82	Number of dwellings without adequate drainage	40001	80000	72000	20	2	24	1	24.00	Equity
83	Access to Telephones	70	79	71	0	1	2	1	2.22	Knowledge
84	Access to refuse removal	92.1	94	94	20	1	40	0.5	20.00	Equity
85	% Population exceeding WHO indoor pollution standards	61	80	80	20	2	20	0.133	2.66	Health
86	Formal housing stock	65	75	74	20	1	38	0.33	12.54	Equity
87	Shack dwellers	6	10	9.9	40	2	41	0.33	13.37	Equity
88	Hostels	2	3	2.8	20	2	24	0.33	7.92	Equity
89	Population growth per year	2.1	2.5	2.1	40	2	60	1	60.00	Health
90	Estimated housing backlog	120001	250000	220000	0	2	5	1	4.62	Community
91	Property crime	4000	10000	9400	0	2	2	0.2	0.40	Community
92	Vehicle crime	401	1500	1200	0	2	5	0.2	1.09	Community
93	Violent crime	401	1500	700	0	2	15	0.3	4.37	Community
94	Social fabric crime	401	3000	2600	0	2	3	0.3	0.92	Community
95	Pupil to teacher ratio	25	30	29	60	2	64	0.33	21.12	Knowledge
96	Number of schools per 1000 people	0.4	0.6	0.4	40	1	40	0.33	13.20	Knowledge
97	Adult literacy rate	15	25	17	40	2	56	0.33	18.48	Knowledge
98	Number of full EIA's	20	25	20	20	2	40	0.5	20.00	Community
99	Number of EIA applications/Scoping Reports	200	500	268	80	1	85	0.5	42.27	Community
100	People in Local Government dedicated to environmental management			38						Exclude

Appendix 3.7

Group 3: Barometer Point Scales

1 Commuter trip length

Sector	Points	Scale
Good	81-100	0-4
OK	61-80	5-9
Medium	41-60	10-19
Poor	21-40	20-44
Bad	1-20	45-60

2 Property appreciation (excluded)

Sector	Points	Scale
Good	81-100	21-40
OK	61-80	15.1-20
Medium	41-60	11-15
Poor	21-40	6-10
Bad	1-20	0-5

3 CMA Population

Sector	Points	Scale
Good	81-100	1.5-1.7
OK	61-80	1.7-2
Medium	41-60	2-2.5
Poor	21-40	2.5-3
Bad	1-20	>3M

4 Ecological Classes-River (class1+2+3)

Sector	Points	Scale
Good	81-100	81-100
OK	61-80	61-80
Medium	41-60	41-60
Poor	21-40	21-40
Bad	1-20	1-20

5. Ecological Classes- Estuaries (class 1+2+3)

Sector	Points	Scale
Good	81-100	81-100
OK	61-80	61-80
Medium	41-60	41-60
Poor	21-40	21-40
Bad	1-20	1-20

6. Number of algal blooms

Sector	Points	Scale
Good	81-100	0
OK	61-80	0.1-0.5
Medium	41-60	0.6-1
Poor	21-40	1.1-1.5
Bad	1-20	1.6-4

7 Water Quality Stats

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	6-15
Medium	41-60	16-30
Poor	21-40	31-49
Bad	1-20	50-75

8 Faecal Coliform Counts

Sector	Points	Scale (%)
Good	81-100	0-1
OK	61-80	1-5
Medium	41-60	5.1-10
Poor	21-40	11-20
Bad	1-20	20.1-60

9 Water demand in m^3/yr

Sector	Points	Scale
Good	81-100	20-49
OK	61-80	50-89
Medium	41-60	90-100
Poor	21-40	101-120
Bad	1-20	121-150

10 % Capacity of dams being used to fulfil water demand

Sector	Points	Scale
Good	81-100	40-50
OK	61-80	51-60
Medium	41-60	61-74
Poor	21-40	75-89
Bad	1-20	90-100

11 % Population with potable water supply within 50m of dwelling

Sector	Points	Scale
Good	81-100	95.1-100
OK	61-80	90-95
Medium	41-60	85-90
Poor	21-40	80-85
Bad	1-20	70-79

12 Wastewater produced (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

13 Car ownership- vehicles/1000

Sector	Points	Scale
Good	81-100	50-99
OK	61-80	100-149
Medium	41-60	150-200
Poor	21-40	201-599
Bad	1-20	600-1000

14 Overall Air Quality (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

Appendix 3.7

Group 3: Barometer Point Scales

15 SO_2 Exceedances

Sector	Points	Scale
Good	81-100	0-1
OK	61-80	1.1-2
Medium	41-60	2.1-3
Poor	21-40	3.1-4
Bad	1-20	4-5

16 % Households with access to electricity

Sector	Points	Scale
Good	81-100	91-100
OK	61-80	80-90
Medium	41-60	70-79
Poor	21-40	60-69
Bad	1-20	50-59

17 Lead -average measurement in the CBD

Sector	Points	Scale
Good	81-100	0-0.15
OK	61-80	0.16-0.25
Medium	41-60	0.26-0.35
Poor	21-40	0.36-0.49
Bad	1-20	0.5-0.6

18 Particulate Matter exceedances

Sector	Points	Scale
Good	81-100	0-1
OK	61-80	1.1-2
Medium	41-60	2.1-3
Poor	21-40	3.1-4
Bad	1-20	4.1-100

19 Number of complaints about air pollution

Sector	Points	Scale
Good	81-100	100 001-300000
OK	61-80	10000-100000
Medium	41-60	5000-9 999
Poor	21-40	1000-4999
Bad	1-20	0-1000

20 Number of acute respiratory chest infections in children under 6yrs

Sector	Points	Scale
Good	81-100	0- 10 000
OK	61-80	10 001-15000
Medium	41-60	15001-20000
Poor	21-40	2000-25000
Bad	1-20	25001-35000

21 NO_2 exceedances

Sector	Points	Scale
Good	81-100	0-1
OK	61-80	1.1-2
Medium	41-60	2.1-3
Poor	21-40	3.1-4
Bad	1-20	4.1-100

22 Use of wood & paraffin & gas as fuel (heating & cooking)

Sector	Points	Scale
Good	81-100	0-5%
OK	61-80	6-10%
Medium	41-60	11-20%
Poor	21-40	21-25%
Bad	1-20	26-30%

23 Koeberg Nuclear Power Station Safety Rating

Sector	Points	Scale
Good	81-100	100
OK	61-80	99-100
Medium	41-60	98-99
Poor	21-40	97-98
Bad	1-20	94-97

24 Koeberg Nuclear Power Station Number of reported leaks

Sector	Points	Scale
Good	81-100	0-0.1
OK	61-80	0.11-0.2
Medium	41-60	0.21-0.3
Poor	21-40	0.31-0.4
Bad	1-20	0.41-0.5

25 Demand for energy per yr

Sector	Points	Scale
Good	81-100	0-1
OK	61-80	1.1-2
Medium	41-60	2.1-3
Poor	21-40	3.1-4
Bad	1-20	4.1-5

26 Cost of electricity (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

27 Future Capacity of existing waste sites (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

28 % Waste sites licensed (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

Appendix 3.7

Group 3: Barometer Point Scales

29 Volume in landfill (1kg per person per day)

Sector	Points	Scale
Good	81-100	0-0.1
OK	61-80	0.11-0.2
Medium	41-60	0.21-0.39
Poor	21-40	0.4-0.49
Bad	1-20	0.51-1.0

30 % Waste re-used or recycled per person per day

Sector	Points	Scale (%)
Good	81-100	100-91
OK	61-80	90-71
Medium	41-60	70-31
Poor	21-40	15-30
Bad	1-20	0-14

31 % Waste water re-used or recycled

Sector	Points	Scale (%)
Good	81-100	85-100
OK	61-80	60-84
Medium	41-60	35-59
Poor	21-40	11-34
Bad	1-20	0-10

32 Capacity of waste water treatment potential being used

Sector	Points	Scale
Good	81-100	75-80
OK	61-80	80-85
Medium	41-60	86-88
Poor	21-40	89-95
Bad	1-20	96-100%

33 % Estimated medical waste not handled correctly

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	6-9
Medium	41-60	10-15
Poor	21-40	16-20
Bad	1-20	20-100

34 Volume to incineration plants (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

35 Capacity in hazardous waste sites (m^3) (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

36 Amount of hazardous waste being generated

Sector	Points	Scale
Good	81-100	0-0.1
OK	61-80	0.11-50
Medium	41-60	51-250
Poor	21-40	251-600
Bad	1-20	601-1000

37 Nuclear waste being produced

Sector	Points	Scale
Good	81-100	0-0.01
OK	61-80	0.011-0.02
Medium	41-60	0.0021-0.003
Poor	21-40	0.0031-1600
Bad	1-20	>1600

38 Items of litter per day (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

39 Tonnes of goods dumped illegally per year

Sector	Points	Scale
Good	81-100	0- 50
OK	61-80	51-1000
Medium	41-60	1001-5000
Poor	21-40	5001-20000
Bad	1-20	20001-50000

40 Sewage effluent released (average litres per day)

Sector	Points	Scale ('000)
Good	81-100	0-5
OK	61-80	5001-10
Medium	41-60	10.1-15
Poor	21-40	15.1-20
Bad	1-20	20.1-50

41 Solids into the sea (t/yr)

Sector	Points	Scale
Good	81-100	0-1
OK	61-80	1.1-5
Medium	41-60	5.1-15
Poor	21-40	16-50
Bad	1-20	51-100

42 Heavy Metal (Cadmium)- limit exceeded in mussels

Sector	Points	Scale
Good	81-100	0-0.1
OK	61-80	0.11-3
Medium	41-60	3.1-9
Poor	21-40	9.1-19
Bad	1-20	19.1-45

Appendix 3.7

Group 3: Barometer Point Scales

43 % Coastline protected by Marine Protected Area

Sector	Points	Scale0
Good	81-100	10-15
OK	61-80	5-9
Medium	41-60	3-5
Poor	21-40	2-3
Bad	1-20	1-1.9

44 Marine species rated critical within MPA's

Sector	Points	Scale
Good	81-100	0-1
OK	61-80	1.1-2
Medium	41-60	2.1-3
Poor	21-40	3.1- 4
Bad	1-20	4-5

45 Amount of land with conservation status

Sector	Points	Scale
Good	81-100	10-30
OK	61-80	5-9
Medium	41-60	3-5
Poor	21-40	2-3
Bad	1-20	1-2

46 Mammals in red data book

Sector	Points	Scale
Good	81-100	0-0.2
OK	61-80	0.21-0.4
Medium	41-60	0.41-0.6
Poor	21-40	0.61-0.8
Bad	1-20	0.8-1.0

47 Avifauna in red data book (%)

Sector	Points	Scale
Good	81-100	0-1
OK	61-80	1.1-3
Medium	41-60	3.1-6
Poor	21-40	6.1-9
Bad	1-20	>9

48 Invertebrates in red data book- butterflies (%)

Sector	Points	Scale
Good	81-100	0-1
OK	61-80	1.1-3
Medium	41-60	3.1-6
Poor	21-40	6.1-9
Bad	1-20	>9

49 Amphibians in red data book- frogs (%)

Sector	Points	Scale
Good	81-100	0-1
OK	61-80	1.1-3
Medium	41-60	3.1-6
Poor	21-40	6.1-9
Bad	1-20	10-25

50 Reptiles in red data book (%)

Sector	Points	Scale
Good	81-100	0-1
OK	61-80	1.1-3
Medium	41-60	3.1-6
Poor	21-40	6.1-9
Bad	1-20	10-25

51 Sand Plain Fynbos (area remaining)

Sector	Points	Scale
Good	81-100	30-50
OK	61-80	15-29
Medium	41-60	10-14
Poor	21-40	5-9
Bad	1-20	0-4

52 Renosterveld

Sector	Points	Scale
Good	81-100	30-50
OK	61-80	15-29
Medium	41-60	10-14
Poor	21-40	5-9
Bad	1-20	0-4

53 Strandveld

Sector	Points	Scale
Good	81-100	40-60
OK	61-80	30-39
Medium	41-60	20-29
Poor	21-40	15-19
Bad	1-20	10-14

54 Dependency ratio

Sector	Points	Scale
Good	81-100	45-50
OK	61-80	50.1-55
Medium	41-60	55.1-60
Poor	21-40	60.1-65
Bad	1-20	65.1-70

55 Percentage of the population in poverty

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	6-10
Medium	41-60	11-15
Poor	21-40	16-20
Bad	1-20	21-50

56 Percentage population unemployed

Sector	Points	Scale
Good	81-100	0-2
OK	61-80	2.1-4
Medium	41-60	4.1-9
Poor	21-40	9.1-14
Bad	1-200	14.1-35

Appendix 3.7

Group 3: Barometer Point Scales

57 Employment overall in the formal sector

Sector	Points	Scale
Good	81-100	70-80
OK	61-80	60-69
Medium	41-60	50-59
Poor	21-40	40-49
Bad	1-20	30-39

58 Total output GGP (billions) (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

59 Annual Ave Growth

Sector	Points	Scale
Good	81-100	1-2
OK	61-80	2.1-3
Medium	41-60	3.1-4
Poor	21-40	4.1-5
Bad	1-20	5.1-6

60 % Labour professional or highly skilled

Sector	Points	Scale
Good	81-100	61-80
OK	61-80	57.1-60
Medium	41-60	55-57
Poor	21-40	50-54
Bad	1-20	40-50

61 % Semi-low skilled

Sector	Points	Scale
Good	81-100	20-40
OK	61-80	40.1-43
Medium	41-60	43.1-46
Poor	21-40	46.1-50
Bad	1-20	50-55

62 Informal Economy (contribution)

Sector	Points	Scale
Good	81-100	20-30
OK	61-80	10-19
Medium	41-60	5-9
Poor	21-40	2.1-4
Bad	1-20	0-2

63 Tuberculosis rate

Sector	Points21-25	Scale
Good	81-100	0-20
OK	61-80	21-50
Medium	41-60	51-100
Poor	21-40	101-200
Bad	1-20	201-700

64 % Pop. without access to adequate sanitation

Sector	Points	Scale
Good	81-100	0-1
OK	61-80	1.1-3
Medium	41-60	3.1-5
Poor	21-40	5.1-20
Bad	1-20	>20

65 Meningococcal Meningitis rate

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	6-10
Medium	41-60	11-15
Poor	21-40	16-30
Bad	1-20	30-100

66 % Pop. without adequate drinking water

Sector	Points	Scale
Good	81-100	0-1
OK	61-80	1.1-3
Medium	41-60	3.1-5
Poor	21-40	5.1-20
Bad	1-20	>20

67 Bacterial Exceedances- Bulk Milk (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

68 Bacterial Exceedances- Packaged Milk (%)

Sector	Points	Scale
Good	81-100	0-1
OK	61-80	1.1-5
Medium	41-60	5.1-10
Poor	21-40	10.1-20
Bad	1-20	21-60

69 % Commuters using private transport

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	5.1-10
Medium	41-60	10.1-20
Poor	21-40	20.1-50
Bad	1-20	>50

70 % Commuters using public road transport (buses & minibuses)

Sector	Points	Scale
Good	81-100	80-85
OK	61-80	61-80
Medium	41-60	41-60
Poor	21-40	21-40
Bad	1-20	0-20

Appendix 3.7

Group 3: Barometer Point Scales

71 % Commuters utilising rail

Sector	Points	Scale
Good	81-100	80-85
OK	61-80	61-80
Medium	41-60	41-60
Poor	21-40	21-40
Bad	1-20	0-20

72 Ave public transport subsidy increases per year- bus & train

Sector	Points	Scale
Good	81-100	10.1-15
OK	61-80	6-10
Medium	41-60	4.1-6
Poor	21-40	4-2
Bad	1-20	0-2

73 Safety & security on public transport

Sector	Points	Scale
Good	81-100	0-1
OK	61-80	1-2
Medium	41-60	2-10
Poor	21-40	10-100
Bad	1-20	101-600

74 Capacity of buses utilised during peak

Sector	Points	Scale
Good	81-100	85-90
OK	61-80	80-84
Medium	41-60	70-79
Poor	21-40	60-69
Bad	1-20	40-60

75 Capacity of minibus taxis utilised during peak

Sector	Points	Scale
Good	81-100	85-90
OK	61-80	80-84
Medium	41-60	70-79
Poor	21-40	60-69
Bad	1-20	40-59

76 Number of fatalities due to road accidents

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	5-10
Medium	41-60	10-15
Poor	21-40	15-20
Bad	1-20	20-50

77 Number of road accidents

Sector	Points	Scale
Good	81-100	0-5000
OK	61-80	5001-10000
Medium	41-60	10001-20000
Poor	21-40	20001-30000
Bad	1-20	30001-70000

78 % Accidents involving pedestrians

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	6-10
Medium	41-60	11-15
Poor	21-40	16-20
Bad	1-20	21-50

79 Harbour throughput (total tonnage/yr) (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

80 Number of international flights (excluded)

Sector	Points	Scale
Good	81-100	
OK	61-80	
Medium	41-60	
Poor	21-40	
Bad	1-20	

81 Number passengers per annum at airport

Sector	Points	Scale
Good	81-100	5-6M
OK	61-80	4-5
Medium	41-60	3-4
Poor	21-40	2-3
Bad	1-20	0-1

82 Number of dwellings without adequate drainage

Sector	Points	Scale ('000)
Good	81-100	0
OK	61-80	0.1-10
Medium	41-60	10.1-20
Poor	21-40	20.1-50
Bad	1-20	50.1-100

83 Access to telephones

Sector	Points	Scale
Good	81-100	90-100
OK	61-80	80-89
Medium	41-60	70-79
Poor	21-40	60-69
Bad	1-20	50-59

84 Access to waste removal

Sector	Points	Scale
Good	81-100	98.1-100
OK	61-80	96.1-98
Medium	41-60	94.1-96
Poor	21-40	92.1-94
Bad	1-20	90-92

Appendix 3.7

Group 3: Barometer Point Scales

85 % Informal housing exceeding WHO indoor pollution standards

Sector	Points	Scale
Good	81-100	0-5
OK	61-80	6-10
Medium	41-60	11-20
Poor	21-40	21-40
Bad	1-20	41-100

86 Formal housing stock

Sector	Points	Scale
Good	81-100	90-100
OK	61-80	80-89
Medium	41-60	70-79
Poor	21-40	60-69
Bad	1-20	50-59

87 Shack dwellers

Sector	Points	Scale
Good	81-100	0-2
OK	61-80	2.1-5
Medium	41-60	5.1-9
Poor	21-40	9.1-15
Bad	1-20	>15

88 Hostels

Sector	Points	Scale
Good	81-100	0-1
OK	61-80	1.1-1.5
Medium	41-60	1.6-2
Poor	21-40	2.1-3
Bad	1-20	>3

89 Population growth per year

Sector	Points	Scale
Good	81-100	0-0.5
OK	61-80	0.6-1
Medium	41-60	1.1-1.5
Poor	21-40	1.6-2
Bad	1-20	2-2.5

90 Estimated housing backlog

Sector	Points	Scale
Good	81-100	0-5000
OK	61-80	5001-10 000
Medium	41-60	10 001-40 000
Poor	21-40	40 001-100 000
Bad	1-20	100 001-250 000

91 Property crime

Sector	Points	Scale
Good	81-100	0-1000
OK	61-80	1001-2000
Medium	41-60	2001-3000
Poor	21-40	3001-4000
Bad	1-20	4000-10000

92 Vehicle crime

Sector	Points	Scale
Good	81-100	0-100
OK	61-80	101-200
Medium	41-60	201-300
Poor	21-40	301-400
Bad	1-20	401-1000

93 Violent crime

Sector	Points	Scale
Good	81-100	0-1
OK	61-80	1-2
Medium	41-60	2-20
Poor	21-40	21-100
Bad	1-20	101-1000

94 Social fabric crime

Sector	Points	Scale
Good	81-100	0-1
OK	61-80	1-2
Medium	41-60	2-20
Poor	21-40	21-500
Bad	1-20	501-3000

95 Pupil to teacher ratio

Sector	Points	Scale
Good	81-100	10-15
OK	61-80	15-25
Medium	41-60	25-35
Poor	21-40	36-40
Bad	1-20	>40

96 Number of schools per 1000 people

Sector	Points	Scale
Good	81-100	1-075
OK	61-80	076-0.5
Medium	41-60	0.49-0.25
Poor	21-40	0.24-0.15
Bad	1-20	0.14-0

97 Adult literacy rate

Sector	Points	Scale
Good	81-100	0-0.1
OK	61-80	0.11-1
Medium	41-60	1-5
Poor	21-40	5.1-10
Bad	1-20	10-20

98 Number of full EIA's

Sector	Points	Scale
Good	81-100	>60
OK	61-80	60-45
Medium	41-60	30-44
Poor	21-40	15-29
Bad	1-20	0-15

Group 3: Barometer Point Scales

99 Number of EIA applications/Scoping Reports (excluded)

Sector	**Points**	**Scale**
Good	81-100	>200
OK	61-80	200-150
Medium	41-60	150-100
Poor	21-40	100-50
Bad	1-20	0-50

100 Number of people in Local Government dedicated to environmental management

Sector	**Points**	**Scale**
Good	81-100	81-100
OK	61-80	61-80
Medium	41-60	41-60
Poor	21-40	21-40
Bad	1-20	1-20

15 excluded by the group

Appendix 3.8

Group 3
1998 Calculations

Appendix 3.8

Group 3: 1998 Calculations

No.	Indicator	Min	Max	Value	Max of previous sector	Scaling Up or Down	Barometer Points	Index Weighting	Final points	Dimension
1	Commuter trip length	10	19	14	40	2	51	1	51.11	Land
2	Property appreciation							0.1		Excluded
3	CMA Population	2.5	3	2.9	20	2	24	0.4	9.60	Health
4	Ecological Classes-River	41	60	43	40	1	42	0.35	14.74	Water
5	Ecological Classes- Coastal Lakes & Estuaries	21	40	36	20	1	36	0.45	16.11	Water
6	Number of harmful algal blooms	1.6	4	2	0	2	17	0.2	3.33	Water
7	Water Quality Stats	50	75	64	0	2	9	0.3	2.64	Water
8	Faecal Coliform Counts	20	60	50	0	2	5	0.9	4.50	Health
9	Volume of water being used- Water demand in m3/yr	90	100	96.54	40	2	47	0.7	32.84	Water
10	% Capacity of dams being used to fulfil water demand	90	100	91	0	2	18	0.3	5.40	Water
11	% Population with potable water supply	95.1	100	97.1	80	1	88	0.3	26.45	Wealth
12	Wastewater produced (as % of total water used)									Excluded
13	Car ownership- Number of vehicles per 1000 people	150	200	170	40	2	52	0.3	15.60	Air
14	Overall Air Quality									Excluded
15	SO_2 Exceedances	0	1	0	80	2	100	0.1	10.00	Air
16	% Households with access to electricity	80	90	86	60	1	72	0.1	7.20	Equity
17	Lead - average measurement in the CBD	0.36	0.49	0.4	20	2	34	0.2	6.77	Health
18	Particulate Matter exceedances	4.1	100	10.4	0	2	19	0.45	8.41	Air
19	Number of complaints about air pollution	0	1000	303	0	1	6	0.9	17.38	Knowledge
20	Number of acute respiratory chest infections	25001	35000	27432	0	2	15	0.8	12.11	Health
21	NO_2 exceedances	4.1	100	7.4	0	2	19	0.45	8.69	Air
22	Use of wood & paraffin & gas as fuel	10	20	14	40	2	52	0.1	5.20	Equity
23	Koeberg -Safety Rating	94	97	95	0	1	7	1	6.67	Health
24	Koeberg - Number of reported leaks	0	0.1	0	80	2	100	0.1	10.00	Knowledge
25	Demand for energy per yr	0	1	0.64	80	2	87	1	87.20	Resource
26	Cost of electricity							0.1		Excluded

Appendix 3.8

Group 3: 1998 Calculations

No.	Indicator	Min	Max	Value	Max of previous sector	Scaling Up or Down	Barometer Points	Index Weighting	Final points	Dimension
27	Future capacity of existing waste sites									Excluded
28	% Waste sites officially licensed							0.1		Excluded
29	Volume of waste in the landfill	0.21	0.39	0.34	40	2	46	1	45.56	Resource
30	% Waste re-used or recycled per person per day	31	70	32	40	1	41	1	40.51	Knowledge
31	% Waste water re-used or recycled	0	10	9	0	1	18	0.6	10.80	Resource
32	Capacity of waste water treatment potential being used	80	85	83	60	2	68	0.4	27.20	Resource
33	% Estimated medical waste not handled correctly	20	100	66	0	2	9	1	8.50	Health
34	Volume of medical waste incinerated							0.3		Excluded
35	Capacity in hazardous waste sites (m^3)							0.1		Excluded
36	Amount of hazardous waste being generated	251	600	524	20	2	24	0.66	16.07	Resource
37	Nuclear waste being produced	0.031	1600	1560	20	2	21	0.33	6.77	Resource
38	Items of litter per day									Excluded
39	Tonnes of goods dumped illegally per year	20001	50000	38700	0	2	8	1	7.53	Community
40	Sewage effluent released (average litres per day)	20001	50000	32877	0	2	11	0.45	5.14	Water
41	Solids into the sea	51	100	87	0	2	5	0.2	1.06	Water
42	Heavy Metal (Cadmium)- limit exceeded in mussels	19.1	45	42.3	0	2	2	0.35	0.73	Water
43	% Coastline protected by Marine Protected Area (MPA)	2	3	2	20	1	20	0.2	4.00	Species
44	Marine species rated critical within MPA's	3.1	4	4	20	2	20	0.35	7.00	Species
45	Amount of land with conservation status	10	30	14	80	1	84	0.1	8.40	Species
46	Mammals in red data book	0	0.2	0	80	2	100	0.1	10.00	Species
47	Avifauna in red data book	3.1	6	5.2	40	2	46	0.2	9.10	Species
48	Invertebrates in red data book- butterflies	3.1	6	5.3	40	2	45	0.25	11.21	Species
49	Amphibians in red data book- frogs	10	25	22.2	0	2	4	0.25	0.93	Species
50	Reptiles in red data book	10	25	10.4	0	2	19	0.2	3.89	Species
51	Sand Plain Fynbos (area remaining)	0	4	1	0	1	5	0.4	2.00	Land
52	Renosterveld	0	4	3	0	1	15	0.35	5.25	Land
53	Strandveld	30	39	32	60	1	64	0.25	16.11	Land

Appendix 3.8

Group 3: 1998 Calculations

No.	Indicator	Min	Max	Value	Max of previous sector	Scaling Up or Down	Barometer Points	Index Weighting	Final points	Dimension
54	Dependency ratio	50.1	55	52	60	2	72	0.1	7.22	Health
55	Percentage of the population in poverty	21	50	37	0	2	9	0.5	4.48	Wealth
56	Percentage population unemployed	14.1	35	20	0	2	14	0.7	10.05	Wealth
57	Employment overall in the formal sector	60	69	63	60	1	67	0.3	20.00	Wealth
58	Total output Gross Geographic product							0.4		Excluded
59	Annual Ave Growth	2.1	3	2.5	60	2	71	0.66	46.93	Wealth
60	% Labour professional or highly skilled	55	57	55	40	1	40	0.5	20.00	Knowledge
61	% Semi-low skilled	43.1	46	45	40	2	47	0.5	23.45	Knowledge
62	Informal Economy (contribution)	5	9	7	40	1	50	0.33	16.50	Wealth
63	Tuberculosis rate	201	700	603	0	2	4	0.7	2.72	Health
64	% Population without access to adequate sanitation	5.1	20	12	20	2	31	0.2	6.15	Equity
65	Meningococcal Meningitis rate (Annual Number of cases)	30	100	79	0	2	6	0.3	1.80	Health
66	% Population without adequate drinking water	5	20	18	20	2	23	0.25	5.67	Equity
67	Bacterial Exceedances- Bulk Milk									Excluded
68	Bacterial Exceedances- Packaged Milk	10.1	20	18	20	2	24	0.1	2.40	Health
69	% Commuters using private transport	20.1	50	44	20	2	24	0.25	6.00	Wealth
70	% Commuters using buses & minibuses	21	40	37	20	1	37	0.25	9.21	Wealth
71	% Commuters utilising rail	0	20	19	0	1	19	0.4	7.60	Wealth
72	Ave public transport subsidy increases per year	6	10	9.4	60	1	77	0.15	11.55	Equity
73	Safety & security on public transport	100	600	587	0	2	1	0.2	0.10	Community
74	Capacity of buses utilised during peak	40	60	43	0	1	3	0.05	0.15	Wealth
75	Capacity of minibus taxis utilised during peak	40	59	59	0	1	20	0.05	1.00	Wealth
76	Number of fatalities due to road accidents	20	50	24.9	0	2	17	0.35	5.86	Community
77	Number of road accidents	30001	70000	62561	0	2	4	0.15	0.56	Community
78	% Accidents involving pedestrians	21	50	32	0	2	12	0.5	6.21	Community
79	Harbour throughput (total tonnage/yr)							1		Excluded
80	Number of international flights							0.6		Excluded

Appendix 3.8

Group 3: 1998 Calculations

No.	Indicator	Min	Max	Value	Max of previous sector	Scaling Up or Down	Barometer Points	Index Weighting	Final points	Dimension
81	Number passengers per annum at airport	3.1	4	3.9	40	1	58	1	57.78	Wealth
82	Number of dwellings without adequate drainage	50001	100000	72000	0	2	11	0.4	4.48	Health
83	Access to telephones	90	100	91	80	1	82	0.2	16.40	Wealth
84	Access to refuse removal	90	95	94	60	1	76	0.1	7.60	Equity
85	% Population exceeding WHO indoor pollution standards	41	100	80	0	2	7	0.6	4.07	Health
86	Formal housing stock	70	79	74	40	1	49	0.5	24.44	Wealth
87	Shack dwellers	9.1	15	9.9	20	2	37	0.4	14.92	Wealth
88	Hostels	2.1	3	2.8	20	2	24	0.1	2.44	Wealth
89	Population growth per year	1.6	2	2	20	2	20	0.5	10.00	Health
90	Estimated housing backlog	100001	250000	150000	0	2	13	0.1	1.33	Equity
91	Property crime	40000	100000	96000	0	1	19	0.1	1.87	Community
92	Vehicle crime	401	1000	900	0	2	3	0.1	0.33	Community
93	Violent crime	101	1000	650	0	2	8	0.3	2.34	Community
94	Social fabric crime	501	3000	2550	0	2	4	0.3	1.08	Community
95	Pupil to teacher ratio	25	35	29	40	2	52	0.9	46.80	Knowledge
96	Number of schools per 1000 people	0.5	0.74	0.5	60	1	60	0.1	6.00	Knowledge
97	Adult literacy rate	1	5	5	40	2	40	1	40.00	Knowledge
98	Number of full EIA's	15	29	20	20	1	27	0.6	16.29	Community
99	Number of EIA applications/Scoping Reports							0		Excluded
100	People in Local Govt. dedicated to enviro management	21	40	23	20	1	22	0.4	8.84	Community

Appendix 3.9

Group 3
1999 Calculations

Appendix 3.9

Group 3: 1999 Calculations

No.	Indicator	Min	Max	Value	Max of previous sector	Scaling Up or Down	Barometer Points	Index Weighting	Final points	Dimension
1	Commuter trip length	10	19	14	40	2	51	1	51.11	Land
2	Property appreciation			16.96				0.1		Excluded
3	CMA Population	2.5	3	3	20	2	20	0.4	8.00	Health
4	Ecological Classes-River	41	60	43	40	1	42	0.35	14.74	Water
5	Ecological Classes- Coastal Lakes & Estuaries	21	40	36	20	1	36	0.45	16.11	Water
6	Number of harmful algal blooms	1.6	4	3	0	2	8	0.2	1.67	Water
7	Water Quality Stats	50	75	64	0	2	9	0.3	2.64	Water
8	Faecal Coliform Counts	20	60	50	0	2	5	0.9	4.50	Health
9	Volume of water being used- Water demand in m^3/yr	90	100	95.58	40	2	49	0.7	34.19	Water
10	% Capacity of dams being used to fulfil water demand	90	100	97	0	2	6	0.3	1.80	Water
11	% Population with potable water supply	95.1	100	97.1	80	1	88	0.3	26.45	Wealth
12	Wastewater produced (as % of total water used)			0.17						Excluded
13	Car ownership- Number of vehicles per 1000 people	150	200	170	40	2	52	0.3	15.60	Air
14	Overall Air Quality			50						Excluded
15	SO_2 Exceedances	0	1	0	80	2	100	0.1	10.00	Air
16	% Households with access to electricity	80	90	90	60	1	80	0.1	8.00	Equity
17	Lead - average measurement in the CBD	0.36	0.49	0.4	20	2	34	0.2	6.77	Health
18	Particulate Matter exceedances	4.1	100	6.0	0	2	20	0.45	8.82	Air
19	Number of complaints about air pollution	0	1000	258	0	1	5	0.9	17.79	Knowledge
20	Number of acute respiratory chest infections	25001	35000	27432	0	2	15	0.8	12.11	Health
21	NO_2 exceedances	4.1	100	5.2	0	2	20	0.45	8.90	Air
22	Use of wood & paraffin & gas as fuel	10	20	10	40	2	60	0.1	6.00	Equity
23	Koeberg -Safety Rating	94	97	95	0	1	7	1	6.67	Health
24	Koeberg - Number of reported leaks	0	0.1	0	80	2	100	0.1	10.00	Knowledge
25	Demand for energy per yr	0	1	0.64	80	2	87	1	87.20	Resource

Appendix 3.9

Group 3: 1999 Calculations

No.	Indicator	Min	Max	Value	Max of previous sector	Scaling Up or Down	Barometer Points	Index Weighting	Final points	Dimension
26	Cost of electricity			35.89				0.1		Excluded
27	Future Capacity of existing waste sites			33.5						Excluded
28	% Waste sites officially licensed			33				0.1		Excluded
29	Volume of waste in the landfill	0.51	1	0.53	0	2	19	1	19.18	Resource
30	% Waste re-used or recycled per person per day	31	70	32	40	1	41	1	40.51	Knowledge
31	% Waste water re-used or recycled	0	10	9	0	1	18	0.6	10.80	Resource
32	Capacity of waste water treatment potential being used	86	88	87	40	2	50	0.4	20.00	Resource
33	% Estimated medical waste not handled correctly	20	100	20	0	2	20	1	20.00	Health
34	Volume of medical waste incinerated			2490				0.3		Excluded
35	Capacity in hazardous waste sites (m^3)			13 000000				0.1		Excluded
36	Amount of hazardous waste being generated	251	600	524	20	2	24	0.66	16.07	Resource
37	Nuclear waste being produced	0.031	1600	645	20	2	32	0.33	10.54	Resource
38	Items of litter per day			4 000 000						Excluded
39	Tonnes of goods dumped illegally per year	20001	50000	25350	0	2	16	1	16.43	Community
40	Sewage effluent released (average litres per day)	20001	50000	32877	0	2	11	0.45	5.14	Water
41	Solids into the sea	51	100	87	0	2	5	0.2	1.06	Water
42	Heavy Metal (Cadmium)- limit exceeded in mussels	19.1	45	42.3	0	2	2	0.35	0.73	Water
43	% Coastline protected by Marine Protected Area (MPA)	2	3	2	20	1	20	0.2	4.00	Species
44	Marine species rated critical within MPA's	3.1	4	4	20	2	20	0.35	7.00	Species
45	Amount of land with conservation status	10	30	22	80	1	92	0.1	9.20	Species
46	Mammals in red data book	0	0.2	0	80	2	100	0.1	10.00	Species
47	Avifauna in red data book	3.1	6	5.2	40	2	46	0.2	9.10	Species
48	Invertebrates in red data book- butterflies	3.1	6	5.3	40	2	45	0.25	11.21	Species
49	Amphibians in red data book- frogs	10	25	14.8	0	2	14	0.25	3.40	Species
50	Reptiles in red data book	10	25	8.3	0	2	22	0.2	4.45	Species

Appendix 3.9

Group 3: 1999 Calculations

No.	Indicator	Min	Max	Value	Max of previous sector	Scaling Up or Down	Barometer Points	Index Weighting	Final points	Dimension
51	Sand Plain Fynbos (area remaining)	0	4	1	0	1	5	0.4	2.00	Land
52	Renosterveld	0	4	3	0	1	15	0.35	5.25	Land
53	Strandveld	30	39	32	60	1	64	0.25	16.11	Land
54	Dependency ratio	50.1	55	52	60	2	72	0.1	7.22	Health
55	Percentage of the population in poverty	21	50	25	0	2	17	0.5	8.62	Wealth
56	Percentage population unemployed	14.1	35	24.6	0	2	10	0.7	6.97	Wealth
57	Employment overall in the formal sector	60	69	63	60	1	67	0.3	20.00	Wealth
58	Total output Gross Geographic product			86.5				0.4		Excluded
59	Annual Ave Growth	0	2	0.7	80	2	93	0.66	61.38	Wealth
60	% Labour professional or highly skilled	40	50	45	0	1	10	0.5	5.00	Knowledge
61	% Semi-low skilled	20	40	32	80	2	88	0.5	44.00	Knowledge
62	Informal Economy (contribution)	5	9	7	40	1	50	0.33	16.50	Wealth
63	Tuberculosis rate	201	700	660	0	2	2	0.7	1.12	Health
64	% Population without access to adequate sanitation	5.1	20	12	20	2	31	0.2	6.15	Equity
65	Meningococcal Meningitis rate (Annual Number of cases)	30	120	109	0	2	2	0.3	0.73	Health
66	% Population without adequate drinking water	5	20	19	20	2	21	0.25	5.33	Equity
67	Bacterial Exceedances- Bulk Milk			76						Excluded
68	Bacterial Exceedances- Packaged Milk	21	60	36	0	2	12	0.1	1.23	Health
69	% Commuters using private transport	20.1	50	44	20	2	24	0.25	6.00	Wealth
70	% Commuters using buses & minibuses	21	40	35	20	1	35	0.25	8.68	Wealth
71	% Commuters utilising rail	61	80	65	60	1	64	0.4	25.68	Wealth
72	Ave public transport subsidy increases per year	2	4	3.4	20	1	34	0.15	5.10	Equity
73	Safety & security on public transport	100	600	428	0	2	7	0.2	1.38	Community
74	Capacity of buses utilised during peak	40	60	43	0	1	3	0.05	0.15	Wealth
75	Capacity of minibus taxis utilised during peak	40	59	59	0	1	20	0.05	1.00	Wealth

Appendix 3.9

Group 3: 1999 Calculations

No.	Indicator	Min	Max	Value	Max of previous sector	Scaling Up or Down	Barometer Points	Index Weighting	Final points	Dimension
76	Number of fatalities due to road accidents	20	50	22.13	0	2	19	0.35	6.50	Community
77	Number of road accidents	30001	70000	61056	0	2	4	0.15	0.67	Community
78	% Accidents involving pedestrians	21	50	27	0	2	16	0.5	7.93	Community
79	Harbour throughput (total tonnage/yr)			10.2				1		Excluded
80	Number of international flights			2600				0.6		Excluded
81	Number passengers per annum at airport	4	5	5	60	1	80	1	80.00	Wealth
82	Number of dwellings without adequate drainage	50001	100000	72000	0	2	11	0.4	4.48	Health
83	Access to Telephones	70	79	71	40	1	42	0.2	8.44	Wealth
84	Access to refuse removal	90	95	94	60	1	76	0.1	7.60	Equity
85	% Population exceeding WHO indoor pollution standards	41	100	80	0	2	7	0.6	4.07	Health
86	Formal housing stock	70	79	74	40	1	49	0.5	24.44	Wealth
87	Shack dwellers	9.1	15	9.9	20	2	37	0.4	14.92	Wealth
88	Hostels	2.1	3	2.8	20	2	24	0.1	2.44	Wealth
89	Population growth per year	2	2.5	2.1	0	2	16	0.5	8.00	Health
90	Estimated housing backlog	100001	250000	220000	0	2	4	0.1	0.40	Equity
91	Property crime	4000	10000	9400	0	1	18	0.1	1.80	Community
92	Vehicle crime	401	1500	1200	0	2	5	0.1	0.55	Community
93	Violent crime	101	1000	700	0	2	7	0.3	2.00	Community
94	Social fabric crime	501	3000	2600	0	2	3	0.3	0.96	Community
95	Pupil to teacher ratio	25	35	29	40	2	52	0.9	46.80	Knowledge
96	Number of schools per 1000 people	0.25	0.49	0.4	40	1	53	0.1	5.25	Knowledge
97	Adult literacy rate	10	20	17	0	2	6	1	6.00	Knowledge
98	Number of full EIA's	15	29	20	20	1	27	0.6	16.29	Community
99	Number of EIA applications/Scoping Reports			268				0		Excluded
100	People in Local Govt. dedicated to enviro management	21	40	38	20	1	38	0.4	15.16	Community

APPENDIX 4

FACILITATOR'S NOTES FROM THE GROUP WORKSHOPS

Group 1

Completed in a single eight hour session, 14 December 2000, Room 2.27 ENGEO, UCT
The dynamics of this group were fascinating. There were two extremely strong willed individuals according to their descriptions of themselves. One was extremely idealistic, and the other, a realist. The rest of the group was lead by these two for a great deal of the decision-making.

There was a common feeling that many of the indicators were untrustworthy but there was also general agreement that, for the sake of the exercise, the group would have to accept the reported results as fact. There was discussion regarding the definitions given by the IUCN SAM for the ten dimensions. An ideological difference emerged when the dimension "Equity" was discussed. One group member felt that this dimension was redundant since all inequity was a subgroup of wealth issues. The rest of the group, however, strongly disagreed with this and stated that there was historic injustice in South Africa which needed to be measured separately.

The group felt that definitions and explanations needed to be documented for all indicators presented in the SOE report. They rejected a total of 30 indicators which was twice the number rejected by the other groups. Group 1 appeared more idealistic and rigorous in the criteria which it felt necessary to adopt when deciding whether or not an indicator should remain. In the other groups some indicators were kept despite the group agreeing that it was not a good nor accurate measure, or that it was difficult to scale. Group 1 discarded indicators if they had insufficient information to judge them by or if it felt unable to scale them. Thus, their number of rejections probably reflects more accurately the number of indicators which do not comply with the criteria of the barometer.

Initial group responses indicated that this exercise piqued their interest in sustainability indicators. The group responded that the Sustainogram did, in fact, reflect their attitude toward the City of Cape Town and confirmed their concerns about the state of the environment. Two members of the group reflected afterwards that they felt that the group had judged Cape Town a bit too harshly and that the points should be higher.

Suggestions of additional indicators:
The group was horrified that AIDS/HIV was not reported on in any way and said that this should be included.

Governance- the group wanted more information about policing and monitoring and enforcement e.g. Planning legislation

Health: An indicator of access to hospitals/clinics per person
An indication of welfare — Disabilities/ grants/ facilities
Numbers of Welfare payments,
AIDS/HIV

Wealth
Tourism
People working with disabilities

Resource Use
Agriculture
Food
Tourism

Land
Complete revision/ reporting on indicators left unmeasured in 1998 (1999 report introduced many of these land indicators)

Criticisms:

1. Barometer graph should have curved lines instead of straight lines since the relationship between human and ecosystem wellbeing is logarithmic.
2. Barometer too subjective, uncomfortable for scientists, unable to compare it from one part of the world to another.

Group 2

Completed in a single six hour session, CMC Buildings, Wale Street, 25 January 2001.

Criticism and discussion of the Barometer was intense during the pre-workshop meeting. The issues raised were as follows:

- This gives an overview but no indication of regional/geographical differences across the CMA (hotspots go unidentified) in terms of management of the area, this is a limitation.
- Barometer is an oversimplification of reality.
- Doesn't show linkages; individual scaled indicators can be misleading in regards to system interrelationships.

- Question of "state of sustainability" — it is on one hand a physical/chemical carrying capacity/ viable ecological limit, and, on the other hand a psychological issue, this tool only addresses the "perceived" sustainability.
- Limitation that value judgements do not reflect a balanced approach — what if you have a community with self-interest at heart then you won't get a situation of sustainability by introducing those values.
- Calculations exclude interactions completely (indicator can be more than just one dimension — it may be indicative of several interrelationships — the Barometer does not take that into account).
- Physical boundary to measurable area. Sustainability and environmental issues extend past the boundaries of the CMA (ecological footprint of the city). How is that taken into account?
- 1999 used different indicators. How can this tool be useful to CMC if it focuses on the 1998 report?
- Has this been used in other cities and can we use it to compare cities?
- Does this tool assist us in prioritising issues?
- Spatial planner's comment: "I would like an indicator interaction map ".
- It will be interesting to see how far apart the groups are. Is it possible to come up with values which reflect a majority of Cape Townians needs?
- What information does the public want in order to understand the SOE?

This group was comprised several expert fields namely: environmental management, air pollution control, catchment management, social development, housing and scientific services. Many of the individuals involved with the workshop had been involved with either the 1998 or 199,9 or both, SOE's. When asked to complete the matrix to assign indicators the most telling comment was that of the social development representative: "I was amazed to see how big the gaps are" (Pers. Comm. Carol Wright, January 2001). Unfortunately the group included some members who were unable to attend the pre-workshop meeting. Many of the issues raised in the pre-workshop meeting were not explored further in the workshop as the individuals who raised them were unable to attend the actual workshop due to work constraints.

Again there seemed to be two dominant personalities in the group namely Carol Wright and Craig Haskins (notable as he is now the official in charge of writing the SOE report). At times, certain individuals were defensive during the workshop. They saw the interrogation of the SOE as a personal criticism as they had been directly involved in the SOE development.

The group was inclined to introduce its organisational structure into the hierarchy. The discussion indicated that the group felt that certain indicators should be grouped together since they fitted into a particular CMC function. The limited time provided for this group was overcome by splitting the group into two for the scaling exercise. The participants, some of whom had expressed their discomfort with having to comment on areas outside their expertise, felt comfortable with this as the dimensions where divided into essentially human and ecosystem dimensions. The specialists divided themselves along similar lines. This unfortunately limited the cross pollination between major disciplines. However, the informal rule which had been established in the group was that those trained in a particular field should have more influence in the placing, weighting and scaling of indicators. There is, therefore, every indication that the results would have been virtually the same had the entire group participated since individual specialists would have had more say in the scaling of their "speciality" indicators.

This group felt that transport should be specifically introduced into the wealth dimension as the members felt that it was a specialist area of infrastructure which had enormous implications for sustainable development. An AIDS/HIV indicator was requested under the "Health" dimension. It was further suggested that suicide rate also be introduced into the "Health" dimension as an indicator of mental health. Instead of milk bacterial exceedances it was suggested that perhaps the number of outlets passing health inspections could be used. A total of 14 indicators was rejected.

Again the issue of insecurity with the indicators was raised. Concerns were voiced regarding how the indicators had been measured or the result achieved. This was surprising since this group represented the organisation which publishes the SOE. However, it was obvious that institutional information was not being communicated or had been lost between the Year 1 (1998) and Year 2 (1999) SOE in terms of which indicators to use, how indicators are measured and by whom.

Group 3

Criticisms

- Other groups already doing this e.g. Natural Step
- AIDS missing
- Suspicious of the SOE results

Undertaken over two evenings , 25 and 26 January 2001, UCT Room 2.01, nine hours to complete

During the first evening the hierarchy and weighting were completed and the scaling undertaken during the second night. There was noticeably more discussion over each scaling than with the other groups.

All of the group members tended to be strongly opinioned and no clear leaders emerged. This group rejected the fewest number of indicators during the hierarchy building process. Only four were initially discarded although another eight were rejected during the scaling process. Group 3 was keen to use all available information, however, they questioned the validity of the following indicators:

Indicator 10	% Capacity of dams — Not well understood.
Indicator 12	Wastewater produced Data quality? — Unbelievable result.
Indicator 21	NO_2 daily max. suggested rather than number of measurements exceeding guidelines.
Indicator 25	Demand for energy — be careful when using the term "energy" instead of "electricity". SOE should measure efficiency of use rather than use per consumer.
Indicator 29	Volume in landfill — want information regarding volume of organics and non-organics.
Indicator 35	Capacity in hazardous waste sites — Question: what treatment does it undergo or is it just dumped?
Indicator 37	Nuclear waste — what of other sources? (Industrial e.g. x-rays), Koeberg only is misleading.
Indicator 40	Sewage released per day — pre- or post treatment?
Indicator 41	Solids into sea — what is the composition? (Organics or non-organics)
Indicator 42	Heavy metals in mussels — what of other heavy metals, heavy metals in fresh water bodies e.g. vleis, sample size on mussels is too low!

Indicator 44	Marine species critical — a percentage would be better.
Indicator 45	Land with conservation status — separate mountain areas from lowlands so that the distribution isn't hidden.
Indicator 76	Number of fatalities road accidents — data unbelievable.
Indicator 82	Dwellings without adequate drainage — a percentage would have been better than a number.
Indicator 93	Violent crime — data unbelievable.
Indicator 96	Distribution of schools is important not just the number of schools.
Indicator 97	Literacy — specify which definition of literacy.
Indicator 99	Number of EIA/Scoping applications — Should be compared to planning applications.
Indicator 100	Number of Environmental Management staff — Should be compared to other departments.

Again additional information was required although this group was much more prepared to make value judgements based on "common sense", than either of the other groups. This was the only group which wished to scale indicators to show that if they got too small or too large it was unacceptable i.e. the weighting was not unidirectional. Notably indicators 32 (capacity of wastewater plant being used), and 59 (annual economic growth) fell into this category. There was a strong socialist tendency amongst group members which was demonstrated by their strong arguments against commercialism and profit.

This group was extremely critical of some of the data and indicators, but were keen to support true environmental reporting "warts and all". There was a lack of trust in the authorities which were reporting and in the data being collected.

APPENDIX 5

RESULT ANALYSIS

Appendix 5.1

Indicator Dimension Assignment Results

Key:	
░	**Ecosystem**
▓	**Human System**

Indicator	Group1	Group2	Group3
1	Exclude	Wealth	Land
2	Wealth	Exclude	Wealth
3	Exclude	Exclude	Health
4	Water	Water	Water
5	Water	Water	Water
6	Exclude	Water	Water
7	Water	Water	Water
8	Health	Health	Health
9	Water	Resource	Water
10	Water	Resource	Water
11	Equity	Equity	Wealth
12	Exclude	Resource	Exclude
13	Wealth	Wealth	Air
14	Air	Exclude	Exclude
15	Air	Air	Air
16	Equity	Equity	Equity
17	Air	Health	Health
18	Air	Air	Air
19	Exclude	Exclude	Knowledge
20	Exclude	Health	Health
21	Air	Air	Air
22	Resource	Equity	Equity
23	Exclude	Exclude	Health
24	Exclude	Exclude	Knowledge
25	Resource	Exclude	Resource
26	Exclude	Exclude	Resource
27	Resource	Exclude	Exclude
28	Community	Community	Community
29	Resource	Resource	Resource
30	Resource	Resource	Knowledge
31	Resource	Resource	Resource
32	Resource	Exclude	Resource
33	Health	Community	Health
34	Exclude	Resource	Health
35	Exclude	Exclude	Resource
36	Resource	Resource	Resource
37	Exclude	Resource	Resource
38	Exclude	Exclude	Exclude
39	Community	Community	Community
40	Water	Resource	Water
41	Water	Water	Water
42	Health	Water	Water
43	Species	Species	Species
44	Species	Species	Species
45	Species	Land	Species
46	Species	Species	Species
47	Species	Species	Species
48	Species	Species	Species
49	Species	Species	Species
50	Species	Species	Species
51	Species	Land	Land
52	Species	Land	Land
53	Species	Land	Land
54	Wealth	Wealth	Health
55	Wealth	Wealth	Wealth
56	Wealth	Wealth	Wealth
57	Wealth	Wealth	Wealth
58	Exclude	Wealth	Wealth
59	Wealth	Wealth	Wealth
60	Wealth	Wealth	Knowledge
61	Exclude	Wealth	Knowledge
62	Wealth	Exclude	Wealth
63	Health	Health	Health
64	Equity	Equity	Equity
65	Health	Health	Health
66	Health	Equity	Equity
67	Health	Community	Exclude
68	Health	Community	Health
69	Exclude	Wealth	Wealth
70	Wealth	Wealth	Wealth
71	Equity	Wealth	Wealth
72	Exclude	Community	Equity
73	Community	Community	Community
74	Community	Community	Wealth
75	Exclude	Community	Wealth
76	Exclude	Community	Community
77	Exclude	Community	Community
78	Exclude	Community	Community
79	Exclude	Wealth	Wealth
80	Exclude	Wealth	Wealth
81	Land	Wealth	Wealth
82	Equity	Equity	Health
83	Equity	Knowledge	Wealth
84	Equity	Equity	Equity
85	Health	Health	Health
86	Equity	Equity	Wealth
87	Exclude	Equity	Wealth
88	Exclude	Equity	Wealth
89	Health	Health	Health
90	Land	Community	Equity

Appendix 5.1

Indicator Dimension Assignment Results

Key:	
░	Ecosystem
▓	Human System

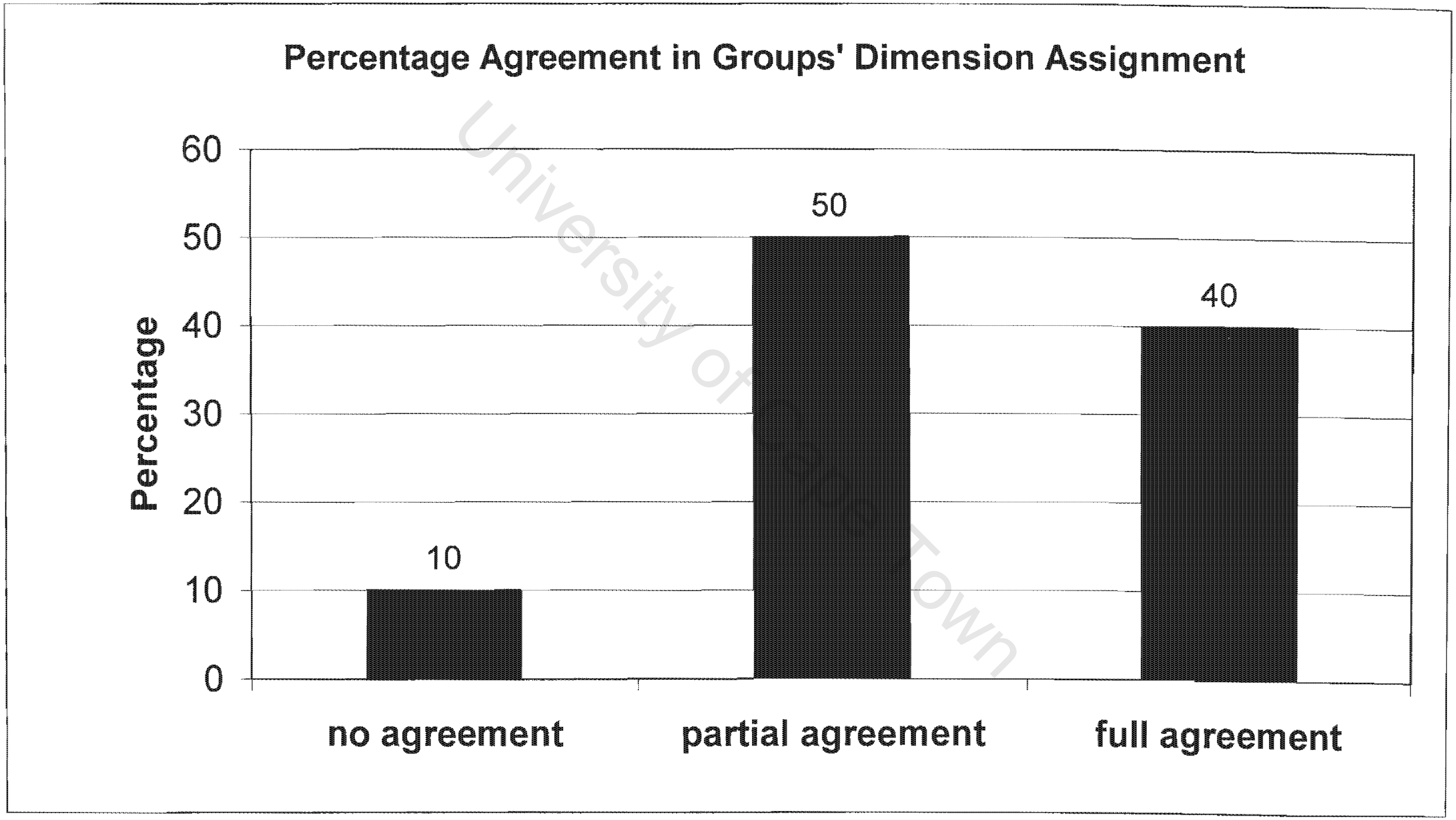
Indicator	Group1	Group2	Group3
91	Community	Community	Community
92	Community	Community	Community
93	Community	Community	Community
94	Community	Community	Community

Indicator	Group1	Group2	Group3
95	Knowledge	Knowledge	Knowledge
96	Exclude	Knowledge	Knowledge
97	Knowledge	Knowledge	Knowledge
98	Exclude	Community	Community
99	Exclude	Community	Exclude
100	Exclude	Exclude	Community

Number of indicators assigned to each of the Dimensions

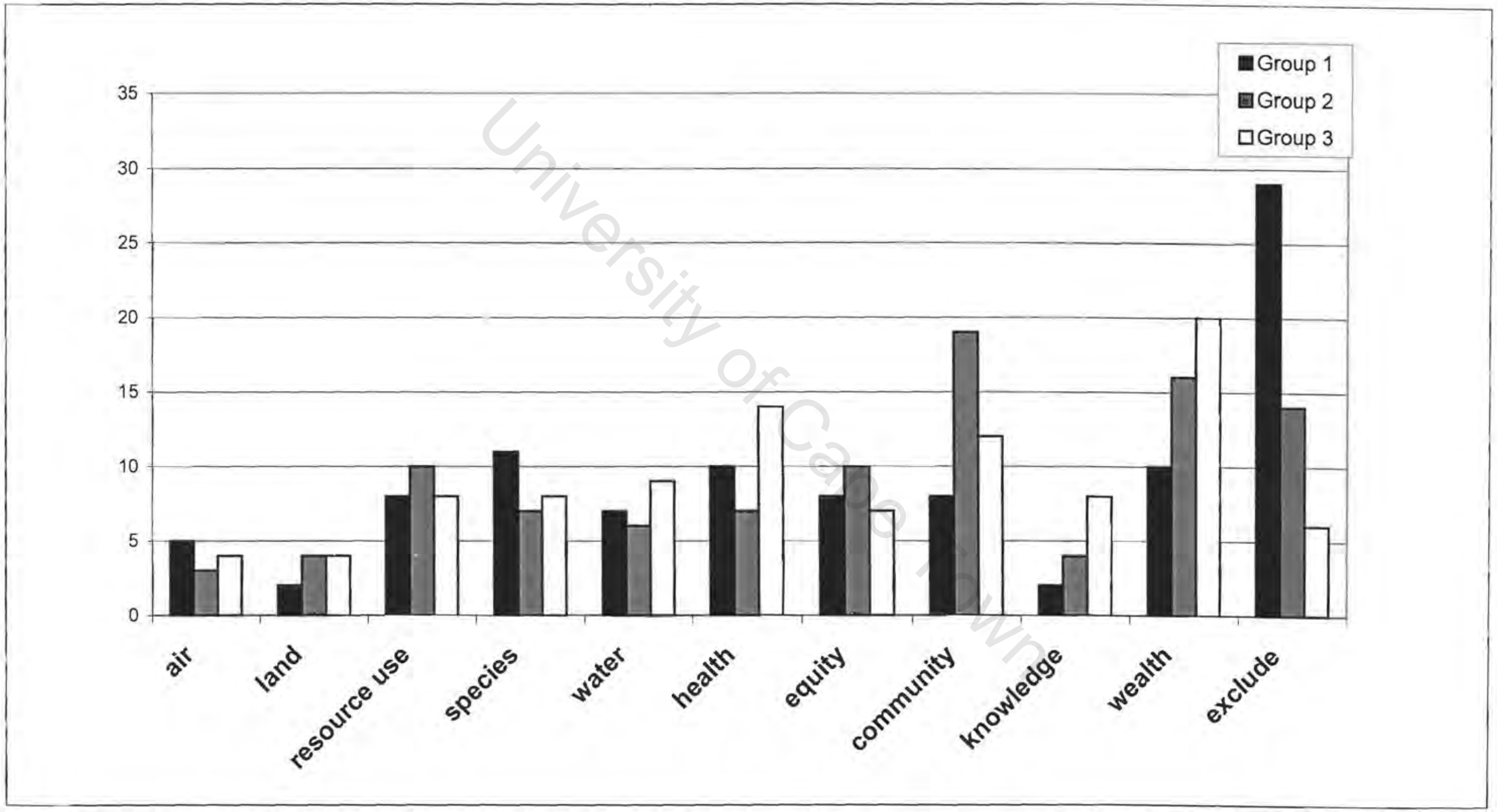
Dimensions	Group 1	Group 2	Group 3
Air	5	3	4
Land	2	4	4
Resource Use	8	10	8
Species	11	7	8
Water	7	6	9
Health	10	7	14
Equity	8	10	7
Community	8	19	12
Knowledge	2	4	8
Wealth	10	16	20
Exclude	29	14	6

Appendix 5.2


Percentage Agreement in Groups' Dimension Assignment
Percentage
60
50
40
30
20
10
0
10
50
40
no agreement
partial agreement
full agreement

Appendix 5.3

Graph of Dimension Assignment Distribution



Appendix 5.4

Table of Dimension Point Results

1998

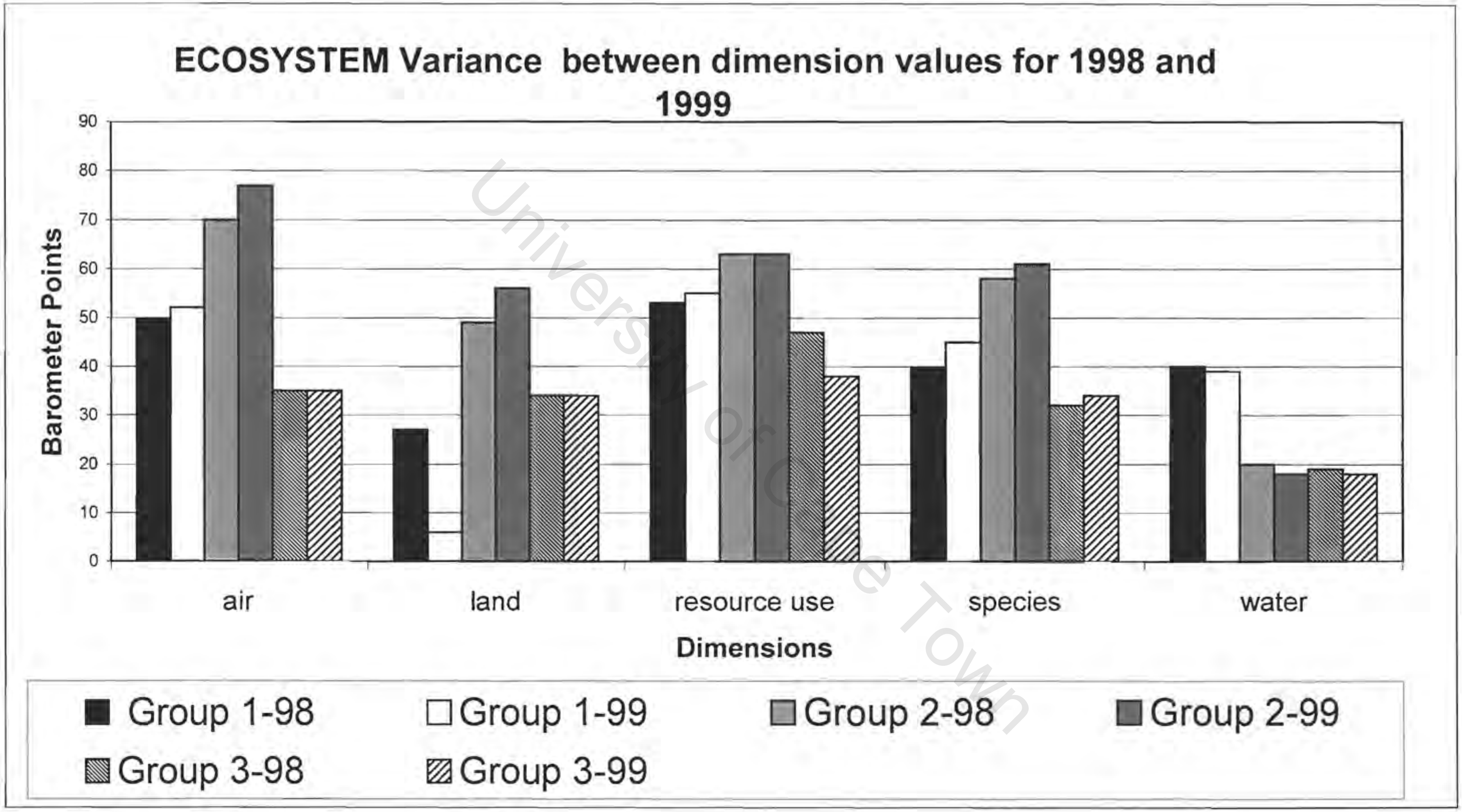
Average Of Dimensions- Calculation of a Generalised Index				
	Group 1	*Group 2*	*Group 3*	**Average**
Air	50	70	35	**52**
Land	27	49	34	**37**
Resource Use	53	63	47	**54**
Species	40	58	32	**43**
Water	40	20	19	**26**
Ecosystem Result	**42**	**52**	**33**	**42**
Health	13	27	12	**17**
Equity	36	38	45	**40**
Community	14	24	13	**17**
Knowledge	40	65	39	**48**
Wealth	47	41	47	**45**
Human System Result	**30**	**39**	**32**	**33**

1999

Average Of Dimensions- Calculation of a Generalised Index				
	Group 1	*Group 2*	*Group 3*	**Average**
Air	52	77	35	**55**
Land	6	56	34	**32**
Resource Use	55	63	38	**52**
Species	45	61	34	**47**
Water	39	18	18	**25**
Ecosystem Result	**39**	**55**	**32**	**42**
Health	13	36	12	**20**
Equity	38	42	39	**40**
Community	14	29	18	**20**
Knowledge	24	40	33	**32**
Wealth	37	46	52	**45**
Human System Result	**25**	**39**	**31**	**32**

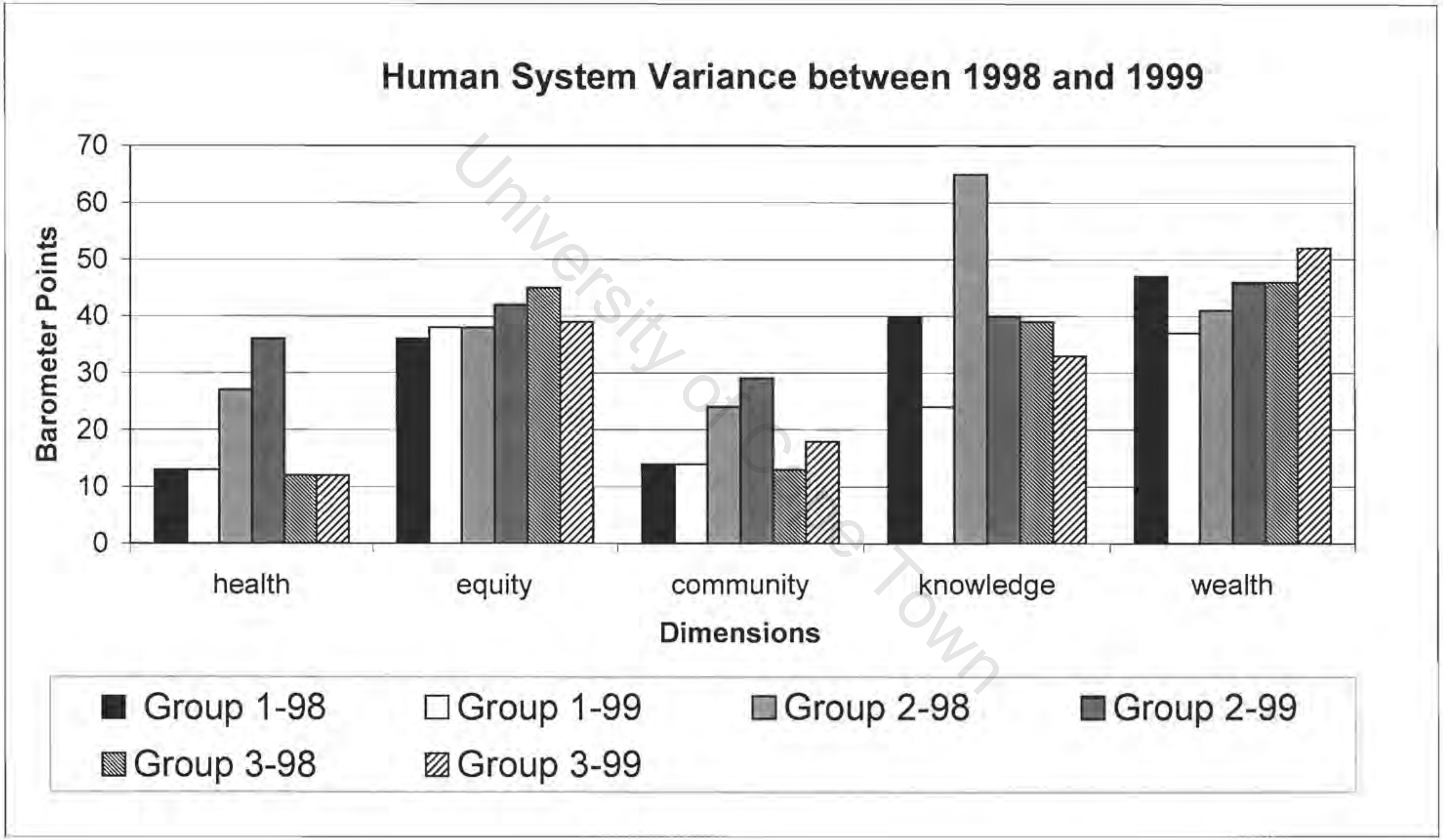
Appendix 5.4

Graphs of Variance in Dimension Point Results



Appendix 5.5

Graphs of Variance in Dimension Point Results



APPENDIX 6

PARTICIPANTS' COMMENTS

ON THE PROCESS AND RESULTS

(Submitted verbatim)

6.1 Group 1
6.2 Group 2
6.3 Group 3

APPENDIX 6.1

PARTICIPANTS' COMMENTS- GROUP 1

GROUP 1

Michelle Rundle Pers. Comm. 31 December 2000

- I found it fascinating although I felt out of my depth for a lot of the green issues. On the other hand I was shocked at how little knowledge the rest of the group seemed to have on social and health issues.
- There was a lot of idealism in the group.
- I think the Barometer outcome is realistic.
- I have started looking at the city differently since I did the workshop.

Lynette Kruger Email 10 Jan 2001

"...I've only briefly glanced at it, but it feels about right to me. I'm quite happy with that outcome from the group exercise."

Debbie Shannon Email 23 Jan 2001

"... I think perhaps we were a little hard on ourselves, as the barometer measurement by my gut feel was perhaps a little low."

Alicia Matzener Email 24 Jan 2001

"... as far as the state of the environment being "mostly unsustainable", I can well believe it - it agrees with the way I see the issue. Even though the group had to compromise on a lot of issues, the weighting was pretty much unanimous (from what I remember), and the overall feeling of the group was that the rankings made sense..."

"...we got 'the issues' confused every now and then (i.e. splitting hairs when we should've merely been deciding whether a parameter was USEFUL IN ITS CURRENT FORM). I did get the feeling that perhaps MORE parameters were necessary (although I understand that one has to be realistic about what is physically practicable given a certain budget) - but then again, this must be checked against the aims of the barometer...one can't get an accurate enough grasp on what is actually happening if too many corners are cut."

APPENDIX 6.1

PARTICIPANTS' COMMENTS- GROUP 1

Mark Wilson Email 6 Feb 2001

"The barometer is fine in my book."

Peter Johnston Email Pers. Comm. 6 Feb 2001

- Interesting and useful excerise
- I have concerns however about the Barometer display. If the lines were curves instead of straight there would be a better relationship between the change in a dimension and the overall progress towards sustainability.

APPENDIX 6.2

PARTICIPANTS COMMENTS- GROUP 2

GROUP 2

Keith Wiseman Email 16 Feb 2001

"Some initial comments:
The range of values for the three groups is interesting: They are consistent (in a way) since all groups rated ecosystem well being better than that for humans.

Group 2 - US! - seem to perhaps be the most "optimistic" about sustainability. There could be many reasons for the spread of results - perhaps that we are better informed? Or that we are somehow 'defensive' and rate things more highly in order to protect our interests?"

"The images are useful for a comparison, but I do not think that a non-specialist would perceive much value in a single point: Only when different points are presented does the image come alive. One way of improving the image might be to improve the scaling of points, making it finer (easier to see differences) or to include points representing other cities or analyses (e.g. last year - how have we moved, if at all?).

Much is 'hidden' - many assumptions and values - but that is the nature of a barometer - it is a single aggregate value for many variables.

In conclusion, I would point to the process being as important as the product. The setting of scales and values is an informative process. If this was linked to selected indicators and reporting processes (e.g. SOE) such that the image is part of a larger system of reporting, it could add value. However, it is essential to understand what lies underneath, otherwise the value is too abstract. It may be comparable to telling someone the air pressure in a car tyre - unless you know what the pressure-rubber-speed relationship is, the value is not meaningful."

" I do believe it has value as part of a sustainability reporting system".

APPENDIX 6.2

PARTICIPANTS COMMENTS- GROUP 2

Craig Haskins Email 19 Feb 2001

"The group responses are quite consistent…indicating the methodology works. I think the categorisiation is true i.e. that year one data reflect that we sit in 'mostly unsustainable'. Year 2 data would confirm this categorisation. Would be interesting to tease out the perceptions of the different groups in explaining their relative positions."

The only reservations I have with the process are:

- Too many indicators to wizz through - "less is more"
- The definitions and interpretation of each of the indicators led to ambiguities and misunderstandings, especially in my group. The ideal is for each indicator to have a clearly defined description of what is meant and the relevance to the broader reporting process. An alternative is to sit down with someone intimately involved with the SOE process and go through the indicators to ensure consistent interpretation
- The comparative stats (international examples) have a benefit and a cost - benefit = help to contextualise our numbers but sometimes inappropriate as comparing us with first world situations which is not always appropriate.
- cost = can be leading if used too much to help get a rating for the indicator (not critically analysed and contextualised)

Candice Haskins Email 7 March

"The result yielded by group 2 i.e. more or less on the border between poor and medium categories is interesting - it could be viewed as a threat in that the overall result could easily slip further into the "mostly unsustainable" / "poor" category OR the position could be viewed as an opportunity to improve. Perhaps with some small changes the situation could improve and move into the "medium" sustainability category.

However, how one would identify what changes would be necessary to improve the score might be difficult - especially in pinpointing what type of changes are likely to produce the best results and also what magnitude of change is likely to make a real difference to the score.

I can't really comment on the relative results obtained by the different groups. There may be some bias due to each group's particular background /perspective /point of reference /value-

PARTICIPANTS COMMENTS- GROUP 2

belief system. However it is interesting to note that the three groups did get results within the same overall category. How much would the result be affected by a lack of sensitivity in the method i.e. if the barometer is too coarse differences may not be as obvious?

It is also interesting (coincidental?) that each group rated ecosystem wellbeing higher than human wellbeing. "

Shirene Rosenberg Email 8 March 2001

"... I would say that it is a fairly accurate representation of the state of our environment, where the lack of attention to human wellbeing is increasingly leading to pressures on the ecosystem wellbeing and sustainable development activity in general. I found the process stimulating and also very illuminating..."

Neil Rossouw Pers. Comm. March 2001

It was a very interesting process. I was Interested to see how relatively well air pollution did in the Barometer. I would like my colleagues to hear about this techniques and the results.

Carol Wright Email 21 April 2001

"At first glance, I am quite surprised that we are placed on the edge of "poor/medium". One would possibly have expected the core to the well into the "poor" - mostly unsustainable category. Perhaps this reflects the dichotomy which is Cape Town - some elements which are excellent and others very poor. The fact that the wellbeing score is lower than the ecosystem well being scale is congruent with my perceptions, perhaps the well being scale is a little higher as an average than I would have expected.

I thought that it was an interesting and fruitful exercise. for me, the fact that we worked through the process as a multi-disciplinary group was most interesting and stimulating–where there was a lot of debate and discussion–which reflect the real choices and debates that are part of the sustainability issue. The clustering and ranking process was also very useful and the final product also so. The methodology gives one a number of layers and levels of information and indicators which can be used in a variety of ways. There is more and more emphasis on trying to get indicators of complex, inter-related issues which are simple to understand and use and this methodology assists with this process."

APPENDIX 6.3

PARTICIPANTS COMMENTS- GROUP 3

GROUP 3

Glenn Ashton Email 15 Feb 2001

"... it is good to have a graphical explanation of our ideas for those of us that can relate to that interpretation but the real question is whether the politicians and decision makers will be swayed or better informed by such interpretations. I think that your programme will in fact enhance the understanding of the data that we worked through but it will obviously have to be illustrated by background explanations that will further inform the target audience. That is where your real challenge lies with this project...we really need to get this information across to the decision makers in such a way that a prompt and proactive response to the problems we face can be encouraged.

That being said I think your workshop was well organised and run and could indeed be a most useful tool in aiding the above process. I think that some refinement of the topics we covered and expanding the ambit of the data used will make the process even more useful. Both groups seemed to find large chunks of data that really tell us very little on some important subjects. If your study helps to better define the questions that must be asked then that is a real move forward in governance and accountability.

I would say that with the data that we worked with, the graphic intersect is an accurate representation of where we are in managing the environment of the city presently. There is a danger however and that lies in asking questions for this sort of programme that may cause the outcome of a process such as we followed to become slanted to the extent that it will make things look better than they actually are in order to please the political/economic masters (and in this regard we must not forget the cosy relationship between business and politics, especially at present).

It could be strongly argued that studies such as yours should always be carried out by completely independent agencies. To give you a quote or two; "*All policymakers must be vigilant to the possibility of research data being manipulated by corporate bodies and of scientific colleagues being seduced by the material charms of industry. Trust is no defense against an aggressively deceptive corporate sector," THE LANCET, April 2000*

APPENDIX 6.3

PARTICIPANTS COMMENTS- GROUP 3

"We should be on our guard not to overestimate science and scientific methods when it is a question of human problems; and we should not assume that experts are the only ones who have a right to express themselves on questions affecting the organisation of society." — Albert Einstein; May 1949

Bearing all of the above in mind I think your masters dissertation would be most useful to civil society but protections must be built in as to the independence of the system. Any statistical analysis can be skewed in order to favour one or the other outcomes; creative stats perhaps, similar to creative accounting!! If you manage to build in such a guarantee of protection and independent objectivity you have done well…"

"I really enjoyed the process…"

Neil Carr Email 8 March 2001

"I thought it was a very useful exercise, I found it very interesting that though our group, and all the others, clearly were made up of a mixed group of people, our interpretations of the SOE were not all that different...all the final figures for the 3 groups were statistically very close, there wasn't any really divergent group...whether this speaks of conformity, or just the lowest common denominator emerging, it is still interesting. It's an exercise that I wouldn't mind doing again, and would encourage anyone to do, as the exercise of ranking indicators really distils one's thoughts on the SOE for oneself, not to mention the collective bargaining that takes place in the workshops being very revealing about how others feel about all sorts of issues."

Jeremy Burnham Email 29 March 2001

" No surprise that the CMC officials were the most optimistic…

I enjoyed the participative process…I think it could be a very interesting educational tool - get students to realise how subjective is most reporting, even when there are figures there.

My sense is that as a management tool it lacks specificity, but that it has at least two really useful possibilities: as a learning tool, as I said, I think it could be used really creatively

APPENDIX 6.3

PARTICIPANTS COMMENTS- GROUP 3

In the classroom—students like a visual, tangible result to their endeavours; and as a means of monitoring public or sectoral perceptions, a simplified version will give a thumb-nail impression of who thinks what about what, for instance, the Council is doing."

Liz McDaid Pers Comm. April 2001

- The educational potential of this is great. It really helps one to see things holistically.
- I think is this a super process and would like to share it with Local Government.

Appendix 7

1998 and 1999 Indicators from the CMC SOE

No.	Indicator	Indicator Status	1998	1999
1	Commuter trip length (Ave)	⊗	14km	n/a
2	Property appreciation	⊗	16.96 (Table 1)	n/a
3	CMA Population (people)		2 900 000	3 000 000
4	Ecological Classes-River	⊗	Table 2	n/a
5	Ecological Classes- Coastal Lakes & Estuaries	⊗	Table 3	n/a
6	Number of harmful algal blooms		2	3
7	Water Quality Statistics	⊗	Table 4- **(52%)	n/a
8	Faecal Coliform Counts	⊗	Table 5- ** 50%	n/a
9	Volume of water being used- Water demand in m3/yr		96.54 m3/yr per capita	95.58
10	% Capacity of dams being used to fulfil water demand		91%	97%
11	% Population with potable water supply		97.10%	97.10%
12	Wastewater produced (as % of total water used)		0.18%	0.17%
13	Car ownership- Number of vehicles per 1000 people		170	170
14	Overall Air Quality	⊕	Table 6- **50%	no data (replaced by Number of pollution events)
15	SO_2 Exceedances	⊕	Table 7- **0%	0%
16	% Households with access to electricity		86%	90%
KEY:	**⊗Indicator used in 1998 only**	**⊕ change of reporting parameters**		**∅ New indicator (1999)**

Appendix 7

1998 and 1999 Indicators from the CMC SOE

No.	Indicator	Indicator Status	1998	1999
17	Lead- average measurement in the CBD (µg/m3)		0.4	0.4
18	Particulate Matter exceedances		Table 8- **10.4%	(No.) 22
19	Number of complaints about air pollution		303	258
20	Number of acute respiratory chest infection	⊗	27 432	n/a
21	NO_2 exceedances	⊕	Table 9-**7.4%	(NO.) 19
22	Use of wood & paraffin & gas as fuel		14%	10%
23	Koeberg -Safety Rating		95%- 100%	95%- 100%
24	Koeberg - Number of reported leaks		0	0
25	Demand for energy per yr	⊗	0.64KWh per consumer	no data
26	Cost of electricity		23.19c/ KWh	35.89c/KWh
27	Future capacity of existing waste sites		19yrs	33.5yrs
28	% Waste sites officially licensed		33%	33%
29	Volume of waste in the landfill		0.34t/yr per capita	0.53t/yr
30	% Waste re-used or recycled per person per day	⊕	32%	no data
31	% Waste water re-used or recycled		9%	9%
32	Capacity of waste water treatment potential being used		83%	87%
33	% Estimated medical waste not handled correctly		66%	20%
34	Volume of medical waste incinerated		1700t/a	2490t

KEY: **⊗Indicator used in 1998 only** **⊕ change of reporting parameters** **∅ New indicator (1999)**

Appendix 7

1998 and 1999 Indicators from the CMC SOE

No.	Indicator	Indicator Status	1998	1999
35	Capacity in hazardous waste sites (m^3)	⊕	13 000000	12-18 yrs
36	Amount of hazardous waste being generated		524 t/yr	458 601t (special waste)
37	Nuclear waste being produced	⊕	1560m3/yr (1200 low level drums +24 intermediate level drums)	(360 low level drums + 144 intermediate level drums)
38	Items of litter per day	⊕	4 000 000	R100 000 000 (1999-cost of cleaning)
39	Tonnes of goods dumped illegally per year		38 700t	25 350t
40	Sewage effluent released (average litres per day)		32 877	32 877
41	Solids into the sea		87t/yr	no data
42	% Mussels in which the Cadmium limit was exceeded		42.30%	42.30%
43	% Coastline protected by Marine Protected Area (MPA)	⊗	2%	-
44	Marine species rated critical within Marine Protected Areas	⊗	4	-
45	Amount of land with conservation status		14%	22%
46	Mammals in red data book	⊕	0% (0 out of 41 species)	0% (0 out of 90 species)
47	Avifauna in red data book		5.2% (8 out of 155 species)	5.2% (8 out of 155 species)
48	Invertebrates in red data book- butterflies		5.3% (4 out of 75 species)	5.3% (4 out of 75 species)
49	Amphibians in red data book- frogs	⊕	22.2% (4 out of 18 species)	14.8% (4 out of 27 species)

KEY: **⊗Indicator used in 1998 only** **⊕ change of reporting parameters** **∅ New indicator (1999)**

1998 and 1999 Indicators from the CMC SOE

No.	Indicator	Indicator Status	1998	1999
50	Reptiles in red data book	⊕	10.4% (5 out of 48 species)	8.3% (5 out of 60 species)
51	Sand Plain Fynbos (area remaining)	⊗	< 1%	-
52	Renosterveld	⊗	< 3%	-
53	Strandveld	⊗	< 32%	-
54	Dependency ratio		52	Table
55	Percentage of the population in poverty		37%	25% (table-races)
56	Percentage population unemployed		20%	24.60%
57	Employment overall in the formal sector		63%	no data
58	Total output Gross Geographic Product (GGP)		R64.7 billion	R86.5 billion
59	Annual average growth		2.50%	0.70%
60	% Labour professional or highly skilled		55%	45%
61	% Semi-low skilled		45%	32%
62	Informal Economy (contribution)	⊗	7%	n/a
63	Tuberculosis rate (per 100 000)		620	660
64	% Population without access to adequate sanitation		12%	12%
65	Meningococcal Meningitis rate (annual number of cases)		79	109
66	% Population without adequate drinking water		18%	19%
67	Bacterial exceedances- Bulk Milk		77%	76%

KEY: **⊗Indicator used in 1998 only** **⊕ change of reporting parameters** **∅ New indicator (1999)**

Appendix 7

1998 and 1999 Indicators from the CMC SOE

No.	Indicator	Indicator Status	1998	1999
68	Bacterial exceedances- Packaged Milk		18%	36%
69	% Commuters using private transport	⊕	44%	n/a
70	% Commuters using buses & minibuses	⊕	37%	35%
71	% Commuters utilising rail	⊕	19%	65%
72	Ave public transport subsidy increases per year		9.40%	3.40%
73	Safety & security on public transport		587	428 (estimate from graph)
74	Capacity of buses utilised during peak	⊗	43%	n/a
75	Capacity of minibus taxis utilised during peak	⊗	59%	n/a
76	Number of fatalities due to road accidents (per 100 000 people)		24.9	22.13
77	Number of road accidents		62 561	61 056
78	% Accidents involving pedestrians		32%	27%
79	Harbour throughput (total tonnage/year)		11.7 million t	10.2 million t
80	Number of international flights		1 953	2600 (estimate from graph)
81	Number passengers per annum at airport		3.9 million	5 million
82	Number of dwellings without adequate drainage	⊗	72 000	n/a
83	Access to telephones	⊕	91%	71% (in home +cellphones)

KEY: ⊗**Indicator used in 1998 only** ⊕ **change of reporting parameters** ∅ **New indicator (1999)**

Appendix 7

1998 and 1999 Indicators from the CMC SOE

No.	Indicator	Indicator Status	1998	1999
84	Access to refuse removal		94%	94%
85	% Population exceeding WHO indoor pollution standards	⊗	80%	-
86	Formal housing stock	⊕	74%	640 000 units
87	Shacks	⊕	9.90%	78 000 units
88	Hostels (other)	⊕	2.80%	7000
89	Population growth per year		2%	2.1% (1% growth +1.1% inmigration)
90	Estimated housing backlog		150 000	220 000
91	Property crime		(63%) 9600 (estimate from graph)	9400 (estimate from graph)
92	Vehicle crime		(7%) 900 (estimate from graph)	1200 (estimate from graph)
93	Violent crime		(5%) 650 (estimate from graph)	700 (estimate from graph)
94	Social fabric crime		(21%) 2550 (estimate from graph)	2600 (estimate from graph)
95	Pupil to teacher ratio		29 to 1	no data
96	Number of schools per 1000 people		0.5	0.4
97	Adult literacy rate		95%	83%
98	Number of full EIA's	⊗	20	n/a
99	Number of EIA applications/scoping reports		112	268
100	People in local govt. dedicated to enviro. management		23	38

KEY: **⊗Indicator used in 1998 only** **⊕ change of reporting parameters** **∅ New indicator (1999)**

Appendix 7

1998 and 1999 Indicators from the CMC SOE

No.	Indicator	Indicator Status	1998	1999
101	Loss of soil due to mining		no data	no data
102	Lack of open space in poor areas		no data	no data
103	Location of wealthy suburbs		no data	no data
104	Invasion of development into wetlands		no data	no data
105	Volatile Organic Compounds (VOC) exceedances		no data	no data
106	Odours		no data	no data
107	Water Quality in coastal Waters-		no data	no data
108	Oil in harbours		no data	no data
109	Spatial inequity		no data	no data
110	Ozone exceedances (days)	∅	n/a	12
111	Air pollution events (O3+NO+PM10)	∅	n/a	58
112	Air pollution prosecutions- notices served	∅	n/a	78
113	SASS4-biological health of a river	∅	n/a	Table in CMC, 2000
114	ASPT-biological health of a river	∅	n/a	Table in CMC, 2000
115	Bacterial exceedances in prepared foods	∅	n/a	10%
116	Piped water to house	∅	n/a	81%
117	Number of raw sewage sills	∅	n/a	16
118	% CMA Coast with some form of protection	∅	n/a	13.50%

KEY: **⊗Indicator used in 1998 only** **⊕ change of reporting parameters** **∅ New indicator (1999)**

1998 and 1999 Indicators from the CMC SOE

No.	Indicator	Indicator Status	1998	1999
119	Species officially classified as over-fished	∅	n/a	12
120	Serviced shacks	∅	n/a	23 000
121	Over-crowded houses	∅	n/a	51 000
122	Shacks in backyard residences	∅	n/a	61 000
123	Formal to informal housing ratio	∅	n/a	78: 22
124	Number of amendments beyond the urban edge	∅	n/a	17
125	Total growth of development on edge	∅	n/a	3.8km2
126	Rate of development % /yr	∅	n/a	2.50%
127	Number of constructions completed	∅	n/a	5631
128	Number of mixed use zoning approvals	∅	n/a	5
129	% non-urban land	∅	n/a	Table in CMC,2000
130	Green area per capita	∅	n/a	212m2/person
131	Land with formal MOSS status	∅	n/a	no data
132	Public transport movements per day	∅	n/a	1.2 million
133	Number of TEUs moved as proportion of capacity	∅	n/a	83%
134	Air traffic movements per year as proportion of capacity	∅	n/a	no data
135	Total passengers as proportion of capacity	∅	112%	no data due to expansions
136	Proportion of CMA electricity supplied by Koeberg	∅	n/a	100% (during summer)
KEY:	**⊗Indicator used in 1998 only**	**⊕ change of reporting parameters**		**∅ New indicator (1999)**

Appendix 7

1998 and 1999 Indicators from the CMC SOE

No.	Indicator	Indicator Status	1998	1999
137	Number of waste complaints	∅	n/a	6809
138	Quantity and type of litter in catchments	∅	n/a	no data
139	Number of schools involved in litter projects	∅	n/a	53
140	Number of new registered businesses	∅	n/a	1679
141	Number of international tourists	∅	n/a	no data
142	Ave per capita income	∅	n/a	Table in CMC,2000 - races
143	Index of aging	∅	n/a	Table in CMC,2000-races
144	New enrolment rates for educational institutions	∅	n/a	Table in CMC,2000
145	Number of convictions as a % of total number of arrests	∅	n/a	no data
146	Quantity and type of dilution ratios of industrial effluent entering sewage works & ocean flow	∅	n/a	32Ml
147	% Sludge re-used	∅	n/a	no data
KEY:	**⊗Indicator used in 1998 only**	**⊕ change of reporting parameters**		**∅ New indicator (1999)**