Makana Municipality
Local Environmental Action Plan
Comprehensive Audit Report Executive Summary
Submitted 17 November 2004

UNILEVER CENTRE FOR ENVIRONMENTAL WATER QUALITY
amanzi amyoli

ARC • LNR

RHODES UNIVERSITY
Where leaders learn

GSS
Geographical Information Specialists

Table of Contents

1. Introduction 3
2. Comprehensive water resource status audit 3
   - 2.1 Water Quantity 3
   - 2.2 Water Quality 4
   - 2.3 Results of the Water Quality Audit 4
   - 2.4 Habitats Within the Rivers 5
3. Wetlands 5
4. Vegetation of Makana District 6
5. Assessment of the state of endangered species in Makana 6
6. Wildlife management 7
7. Use of domestic energy in Makana with emphasis on fuelwood 8
   - 7.1 Household energy forms 8
   - 7.2 Fuelwood use 8
   - 7.3 Availability and accessing fuelwood 8
   - 7.4 Expressed advantages and disadvantages of using fuelwood energy 9
   - 7.5 Value of fuelwood use 9
8. Solar energy 9
   - 8.1 The demand for solar panel systems and solar water heaters 9
   - 8.2 People's perceptions of the advantages and disadvantages of solar panel systems and solar water heaters 10
   - 8.3 Current energy use in Grahamstown and solar energy as an alternative 10
   - 8.4 The passive energy characteristics of houses in the formal and informal areas 10
9. Waste management 10
10. Urban green spaces and recreational facilities 12
11. The importance of multiple habitats to overall biodiversity in the Grahamstown Botanical Gardens 13

1. Introduction

The comprehensive audit report builds on the preliminary audit document that was submitted to the Makana Municipality in July 2004. It is divided into four parts. Part I discusses the status of water resources and wetlands in Makana. Part II describes the vegetation types, endangered plant and animal species, and wildlife management in Makana. Part III describes the use of domestic energy, potential use of solar power, and waste management in the Makana Municipality. Part IV describes the urban green spaces and recreational facilities, and the importance of multiple habitats to biodiversity in the Grahamstown Botanical Gardens. The individual studies making up the four parts conclude by giving recommendations that the Makana Municipality should consider to address the issues that are highlighted.

We hope by dividing the report into four sections we have improved its user-friendliness. This document summarises the rationale, study methods, and findings of the ten studies that make up each of the parts of the report described above. The authors for each report are given. Several individuals and organisations provided information and assistance during the studies. We are grateful for their support and assistance.

2. Comprehensive water resource status audit

The 'water resource' is defined by the National Water Act (Act 36 of 1998) to include all water in the hydrological cycle. At the national level this includes rainfall and runoff; and water in ecosystems including rivers, lakes or dams, wetlands, estuaries and groundwater. At the Makana level, this includes rivers, dams and groundwater, with small pockets of wetlands.

Three main aspects to the water resource include water quantity (flow and storage); water quality (chemistry and biotic indicators); and habitat structure. Water quality related decisions invariably involve water quantity effects and vice versa. These in turn relate to water use decisions such as discharge of effluent and development of surface water resources. Conversely, changes in flow patterns, re-routing of water resources and changes to water allocation profiles may all affect water quality.

The National Water Act legislates the resource management. There are two approaches:

- Resource Directed Measures (RDM), which provide descriptive and quantitative goals for the state of the resource; and
- Source Directed Controls (SDC), which specify the criteria for controlling impacts such as waste discharge licences and abstraction licences.

Both of these require knowledge of the present state so that ecological objectives can be set; and use can be controlled. An audit is therefore necessary to determine what is termed the *'Present Ecological State'*.

2.1 Water Quantity

Over-abstraction of surface and groundwater is a key concern in Makana. The Department of Water Affairs and Forestry (DWAF) are responsible for the monitoring of surface and groundwater quantity. However the data from these monitoring points are insufficient for water resource planning and complete assessment. Environmental flows and water allocations for domestic, agricultural and industrial use have therefore still to be determined. There is also:

- no assessment of existing lawful use of water including that used for agricultural use;
- no collated data on the present water reserves, and demands, within Makana that has been made accessible to the LEAP team, or is available in an accessible form to stakeholders; and

- no model for projected estimates of domestic, educational (in particular Rhodes University's projected numbers of entrees), industrial and agricultural growth and therefore water demands.

Auditing of water quantity within Makana is of concern in the Monitoring and Implementation Plans presented. A hydrological model and a water use model are therefore to be suggested for the Implementation Plan.

2.2 Water Quality

Traditionally, the term 'water quality' has meant water physico-chemistry. However, water quality is more than this, and the term 'environmental water quality' (EWQ) is now used. The EWQ approach involves understanding how the chemical, microbiological, radiological and physical characteristics of water (water quality) link to the responses of living organisms and ecosystem processes (environment). The primary abiotic factors that shape aquatic ecosystems (water quality, flow, and physical or habitat structure) provide the conditions for the biotic processes.

These combined bio-physical processes link to social and economic processes through the human use of water resources.

To obtain an integrated EWQ picture there are three main kinds of information required:

- information about the *physico-chemistry* of the water;
- the presence, absence and abundance of biota in the ecosystem (*biomonitoring*),
- and the responses of specific biota to specific concentrations of chemicals or mixtures (*ecotoxicology*).

The physico-chemistry and biomonitoring together indicate whether there is a need for ecotoxicological assessments, which was the case with the Grahamstown Sewage Treatment Works. Analysis and interpretation of all water quality data followed the ecological reserve assessment method.

2.3 Results of the Water Quality Audit

- The Bloukrans river downstream of Grahamstown residential and industrial areas and the sewage treatment works is in a *Poor ecological state* according to the physico-chemical, biomonitoring and ecotoxicological data. The state of the river was also a primary stakeholder concern.
- There was *no nutrient enrichment* (total inorganic nitrogen and soluble ortho-phosphates) at any of the DWAF water quality monitoring sites. *However,* there were no DWAF water quality monitoring data available for the Bloukrans river to date [input still ongoing by DWAF] but the algal growth within the river is indicative of enrichment.
- There was *measurable ecotoxicity* of the influent and effluents around the Grahamstown Sewage Treatment Works (STW). This preliminary study indicates the outlet pipe into the STW dam was *less* toxic than the outlet pipe into the river. An ecotoxicity risk assessment is an urgent priority. The need for physico-chemical data collection and collation around the Grahamstown Sewage Treatment Works is therefore also a priority.
- At various sites on the Bushmans and Kariega rivers, the water is too *salty* to irrigate or for use in domestic or livestock consumption.
- There is significant evidence of *toxic salt levels* at many of the DWAF water quality sites within Makana, dominated by magnesium sulphate and sodium chloride. However, there is a need to determine whether these values are just indicative of low flows combined with abstraction and evaporation; and/or the natural state, reflecting the ancient marine shales underlying parts of Makana. The introduction of reference sites above possible point sources of pollution would be of value.

- The Alicedale tannery effluents, and other potential effluents with recent developments, are also of concern. More data points are needed upstream and downstream of Alicedale on the Bushmans river for both water quality monitoring (DWAF), in conjunction with biomonitoring sites that will potentially facilitate any red flag scenarios of concern.

2.4 Habitats Within the Rivers

This was assessed within the Bloukrans river and the confluence of the Berg and Palmiet rivers, as part of the biomonitoring assessments completed. Alien vegetation encroachment, a stakeholder concern, is included in the Monitoring Framework Report.

3. Wetlands

Wetlands provide a multitude of valuable functions and services, both ecological and socio-economic in nature. Their value is of particular significance in drier climates, where they act to regulate and prolong stream flows, increasing the length of time that water is available in the catchment. They are similarly instrumental in water purification, agricultural production, drought relief, and the provision of harvestable resources. Consequently, their loss should be viewed in a serious light.

South Africa has lost 50% of the wetlands in the last century. The highest rates of loss have occurred within the semi- arid regions of the inland margin zones, which comprises Makana municipality. The lack of information regarding spatial distribution and classification of wetlands in the country has been identified as the major obstacle to the development of conservation strategies at national, provincial and local levels.

This study, in line with a drive to compile a national wetland database by a subsidiary of the Department of Environmental Affairs and Tourism, the South African Wetlands Conservation Programme, attempts to provide a basis to facilitate the development of a wetland inventory. By digitally modelling the predicted distribution of wetlands within the Makana municipality, Eastern Cape, and providing an assessment of the risks facing wetlands in the region based on the prevailing land-cover and the land-use pressures they imply, a platform for further inventory work is established and an indication of priority areas provided.

Modelling predicted the potential wetland distribution to occur largely in areas associated with low land-use pressures, such as bushland and thicket, grassland and fynbos. High-risk land-uses, such as intensive cultivation and grazing, and urbanisation comprised a significantly lower proportion of modelled distribution. Thus, although situated in an area traditionally assumed to be a high risk in terms of wetland loss, the low intensity land-use practices prevalent mean that Makana municipality is probably exempt from this assumption.

There was evidence of erosional degradation of wetlands on commonage areas due to subsistence grazing, facilitated by the ease of access to these areas by subsistence farmers. Currently, no policy is maintained by the municipality regarding wetland use on commonage areas, and a framework needs to be developed regarding sustainable use of wetland resources.

Alien vegetation encroachment has been identified as a major cause of wetland destruction, although the extent of encroachment is undetermined due to lack of data. Cooperation by wetland conservation bodies with the Department of Water Affairs and Forestry should shed light on the nature of threats facing wetlands in the region.

Endorheic pans in the south of the municipality seem to be experiencing extended and uncharacteristic levels of desiccation. Whether this is due to climatic factors or catchment

management practices is not known, but close monitoring of potential drivers of this situation should be undertaken.

Threats facing wetlands occur on a catchment-wide basis, and thus may originate from outside Makana's boundaries. Catchment management practices need to be studied on a wider scale than attempted in the scope of this project. It is possible that, although water abstraction and land-use pressures within modelled distribution were found to be negligible, collectively they may represent a threat to wetland health on a catchment-wide basis.

4. Vegetation of Makana District

The Makana District has diverse and unique vegetation, comprising ten vegetation types, representing all of the major southern African biomes. It is this diversity which makes it essential that the efforts to conserve and manage this natural resource for the benefit of all the people of Makana be coordinated within a single authority. The district contains 136 red data book (higher plant) taxa, and is an important centre of endemism in southern Africa (2548 native plant taxa). There are 27 endemics of which 17 are vulnerable, 5 are endangered and 5 are critical.

The biodiversity of the thicket within Makana is threatened by four major driving variables, namely:

- overgrazing by domestic livestock;
- development of new lands for arable crop production;
- collection of native species for medicinal purposes, and
- encroachment of invasive alien plants.

Initiatives to reverse these trends should be driven by LEAP and Makana Municipality. These include the effective implementation of the Conservation of Agricultural Resources Act 43 of 1983, which provides for:

i) setting carrying capacity norms for farms in the district;
ii) the control of invasive plants, and
iii) the cultivation of new lands.

The Cape Provincial Conservation Ordinance should be applied rigorously to control the harvesting of plants for medicinal purposes, and the monitoring and protection of rare and endangered taxa. This will be achieved by the appointment of a permanent conservation officer within Makana. This officer should address the wider environmental issues within the district, focusing on effective implementation of all environmental legislation.

5. Assessment of the state of endangered species in Makana

Biodiversity is an important issue the world over, as it deals with the differences between all living organisms, as well as their ecological habitats, and can apply to all hierarchical levels from genes to whole ecosystems. The major threats to biodiversity in the Makana Municipality were identified by a wide range of stakeholders (see the Preliminary Audit report). These include habitat loss through preparation of cultivated lands, urbanisation, invasion by alien plants, collection of ornamental plants and harvesting of medicinal plants. The Makana Municipality is of global biodiversity importance as it is situated in the Albany Centre of Endemism and this hotspot contains many endemic plant species. Furthermore, a large number of the species that occur in this region are classified as endangered. This study classified endangered species according to the World Conservation Union's categories of critically endangered, endangered and vulnerable.

We compiled the lists of endangered fauna and flora from literature reviews and consultation with external specialists. Where possible, these lists have been transposed onto maps for easier identification of the areas where these species are located. Additionally, several threats that are

particularly relevant to the species within the Makana region were identified. The threats that affect the widest range of species were: urbanisation, unsustainable resource use, alien invasion, and rural land transformation.

Despite South Africa having progressive legislation according to international standards, the current conservation methods in the Makana Municipality do not address specific environmental issues. A detailed list of recommendations was provided to enable future planning strategies to incorporate measures to ensure sustainability of biodiversity. The recommendations which affect the widest range of species include: effective enforcement of legislation, education about endangered species, the establishment of improved data records and stakeholder engagement involving both interested and affected parties. It must be reinforced that the importance of endangered species cannot be underestimated. As a result it is necessary to do all in our power to ensure their survival for the benefit of both present and future generations.

6. Wildlife management

South Africa is an exceptionally rich and diverse country in terms of both its flora and fauna and the Eastern Cape is no exception. In fact it is fast becoming one of the prime game and wildlife areas in the country (Makana.gov). There is a growing need for a greater awareness of the current situation of the wildlife industry within the boundary of the Makana Municipality. This sector is fast becoming one of the largest contributors to the local economy and covers a vast area of land. With the recent and rapid growth of this sector within the Makana Municipality, greater control and government involvement is needed.

The Makana municipality is one of the many municipalities in the Eastern Cape Province. Due to the number of farms in the Makana District converting to game, it is important to be aware of management issues as well as concerns surrounding conservation. Both eco-tourism and hunting activities take place in the area, and wildlife areas can be divided into government run parks and privately owned land.

Government parks are set aside for conservation, whereas many privately owned areas are used for hunting and/or eco-tourism activities. Some of the main government-run parks include Thomas Baines, Beggars Bush and the Great Fish River Complex, which includes Andries Vosloo and Sam Knott. The larger, better known privately owned parks include Kwandwe, Coombs View, Shamwari, Burchell Game Reserve and Bushman Sands Game Reserve. There are numerous smaller privately owned farms that have naturally occurring game or game that they have introduced to the land. With regards to management, the private farm owners are able to do as they please with their game as long as they have a certificate of adequate enclosure, and are not subject to intervention by government officials. Government parks are subject to far more complex management strategies and there are often many levels of influence on management decisions. Our study investigated wildlife management in the public and private sectors within the Makana Municipality.

Questionnaire surveys and key informant group discussions with private game farmers, professional hunters, government reserve managers and other relative authorities were used to obtain data on wildlife management. We found that private game farmers (based on hunting and ecotourism) were fairly well established in the running, up keep and overall management of their reserves. Meanwhile, public/governmental reserves tend to face more problems (such as poaching and lack of employees) than private reserves with regards to management issues. Amongst numerous concerns, one of the main points raised was that communication between private landowners and government officials hindered effective reserve management.

7. Use of domestic energy in Makana with emphasis on fuelwood

The energy sector in South Africa has both first world and third world elements. On the one hand South Africa produces and consumes over 60% of the electricity on the African continent and is the twelfth highest carbon emitter in the world. One the other hand, almost half of South African households use fuelwood energy to a greater or less degree. Even with the substantial household electrification programmes in the last ten years and one of the lowest electricity prices in the world to local consumers, most newly electrified households continue to use fuelwood because they cannot afford the appliances and/or the monthly costs. Internationally, and in southern Africa the poorest and most vulnerable communities and households make most use of fuelwood with only limited use of other energy forms. Remote rural communities still rely extensively on fuelwood.

A household energy audit was conducted in Riebeeck East, Alicedale and Grahamstown East. Households were selected randomly from municipal survey maps. So far 171 households have been interviewed, 34 in Riebeeck East, 61 in Alicedale and 76 in Grahamstown East. At each randomly selected household a pre-prepared structured interview schedule was conducted in either Xhosa or Afrikaans, whichever was the home language of the respondent.

7.1 Household energy forms

Most households in Makana use a variety of energy forms within the domestic setting. Electricity is the primary and preferred source for lighting. This is backed up with candles during times when the electricity power is interrupted, or when households cannot afford to buy electricity, especially towards the end of the month. Paraffin is also used instead of candles, and is commonly used by houses as yet unelectrified.

In terms of cooking, paraffin and electricity are dominant forms within households in Alicedale and Grahamstown East, whilst in Riebeeck East fuelwood is second to paraffin. Many users of fuelwood in Grahamstown East said that they used it relatively irregularly, either for recreational braais, or for brewing of traditional beer and at traditional ceremonies.

7.2 Fuelwood use

Of those households using fuelwood, daily household and per capita consumption was highest at Alicedale and lowest at Grahamstown East. The greater household consumption at Alicedale can seemingly be explained by the larger household size, but not so the per capita consumption. The frequency of fuelwood collection trips per week is highest in Riebeeck East. Estimated yearly demand by fuelwood users was highest at Riebeeck East because of the greater frequency of use, and least in Grahamstown East.

7.3 Availability and accessing fuelwood

There was a strong gradient in fuelwood accessibility between the three towns, with the most rural (Riebeeck East) having the least developed fuelwood markets, the least respondents complaining that fuelwood was declining, and the shortest time per collection trip. In contrast, residents of Grahamstown East mainly buy fuelwood. Of those that collect most stated that it was harder now then a few years ago, and the mean duration of a collection trip was one hour longer than at Riebeeck East. A significant factor perceived to be causing local declines in fuelwood is a change in land use. At Alicedale, the new estate development has cut people off from harvesting areas. In Grahamstown East new housing developments are frequently in wooded areas, which are lost when building commences.

7.4 Expressed advantages and disadvantages of using fuelwood energy

Overall, a greater number of advantages than disadvantages were reported. The most frequently expressed advantage was that fuelwood is a free energy source, or that it is cheap when compared to other sources. This is also related to its importance as a fall back when cash is scarce preventing the purchase of electricity or paraffin. Almost one-third of respondents also felt that it makes a particularly good heat compared to other sources. These need to be weighed against the disadvantage expressed by one-quarter of respondents relating to the fact that the smoke from fuelwood fires is smelly and dirty and it stains clothes and paintwork.

7.5 Value of fuelwood use

The most common unit of sale for fuelwood was a 50 kg sack. No empirical measurements of the weight of 50 kg sack have yet been made in the study area, but using extrapolations from other studies it is probably approximately 35 kg. This equates to a fuelwood unit price of 24c/kg in Riebeeck East, 28c/kg in Alicedale and 47c/kg in Grahamstown East. Thus, the gross annual direct-use value of fuelwood used by households in these three towns is R489, R626 and R168, respectively. This is only slightly lower than the reported monthly expenditure on electricity in Riebeeck East (R43 per month) and Alicedale (R77 per month), but significantly lower than electricity purchases in Grahamstown East (R61 per month). Thus, the availability of fuelwood is a significant resource for poorer households. This direct expenditure on electricity represents approximately 6 – 7.6% of mean household cash income. However, there are a few households for which it represents over 20% of monthly cash income.

8. Solar energy

Enough energy from the sun radiates the earth in a single day to power the world's population for 27 years. Solar energy is a form of renewable energy constantly provided by the sun. It may potentially play a very important role in meeting general electricity needs. Solar-powered electricity generation is clean, renewable, and produces no greenhouse gasses or hazardous wastes whilst in operation and it has therefore been noted as an important form of energy use.

The main forms of solar energy use are photovoltaic (PV) cells or modules, and passive solar energy. The aims of our study were to investigate the feasibility of implementing solar power systems and solar water heaters in Grahamstown. In addition, we aimed to investigate the feasibility of increasing the passive energy characteristics of houses. We also wanted to determine the current forms of energy used by the population. We conducted literature reviews and then interviewed a number of households in the formal area, electrified, informal area and non-electrified informal area.

8.1 The demand for solar panel systems and solar water heaters

The demand for solar panels was not high with 11 out of 30 households in the formal area, 10 out of 26 households in the electrified informal area and 4 out of 26 households in the non-electrified informal area wanting one. In addition the prices people were prepared to pay varied greatly. Only 25% of people in the formal area stated that they would be willing to pay the full price for the solar panels and this percentage decreased dramatically in the informal electrified and again in the informal non-electrified areas.

There was a large interest in the formal areas for solar water heaters with 28 out of 30 households expressing interest in them and out of these almost 50% were willing to pay the full price. In the electrified, informal area the number of people who expressed interest dropped to

16 out of 26 and peoples' willingness to pay the full price was far lower. In the non-electrified informal area only 7 out of 26 households were interested.

8.2 People's perceptions of the advantages and disadvantages of solar panel systems and solar water heaters

In the non-electrified informal areas people's biggest concern with solar panels was that they did not believe that they would work on cloudy days. The unknown factor was also a big reason for not wanting solar panels due to the fact that not many people had ever heard of them before. The concerns with solar water heaters were expense, the weather and the possibility of theft and vandalism.

In the electrified informal area disadvantages stated for solar water heaters included expense, theft and vandalism, the weather, the unknown factor and not enough space in their homes. For solar panels expense, theft and vandalism and the weather were the biggest disadvantages mentioned. Numerous people believed that if an instalment payment system was introduced then it would make solar panel use economical in the long run.

In the formal area there is a strong perception that solar water heaters are economical and good value for money in the long run. A few people were concerned with theft, expense and vandalism. For solar panels the main concern was expense and concern over them not being powerful enough. Advantages mentioned included the possibility of environmental and economical benefits.

8.3 Current energy use in Grahamstown and solar energy as an alternative

Solar panels can make the largest difference in replacing other energy sources used for lighting as lighting requires relatively low input. The use of solar panels in both the formal and informal areas can potentially reduce environmental damage through the lowering of emissions produced during the production of electricity. When it comes to energy resources used for cooking, solar energy cannot make a difference as it is not powerful enough. With heating, many people used fuel wood in the informal area -- although solar water heaters could be used to heat water this will have a limited environmental benefit as alien species are mainly used for fuel wood. Fuel wood smoke can, however, be hazardous to human health and thus implementing solar water heaters could improve peoples' living conditions.

8.4 The passive energy characteristics of houses in the formal and informal areas

We conducted a survey of eight different criteria that are synonymous with energy efficient houses. We found that the houses in the formal area had better energy efficiency in comparison to those in the informal area. If the energy efficiency of homes in the informal area were improved, this would reduce the need for energy.

9. Waste management

The current status of waste management, sanitation, water services and industrial environmental management in Makana Municipality has been investigated as part of the Local Environmental Action Plan (LEAP).

The most common observations are that littering and illegal dumping occur throughout urban areas in Makana Municipality. This not only affects urban areas themselves, in terms of health

and aesthetics, but also greatly affects property values and the quality of rivers and streams around the towns. This has a dramatic effect on the ability of rivers and streams to sustain biodiversity.

The municipal skips serve to contain waste to be collected in limited areas, these however are often badly sited and waste spills out of skips due to animals and people searching for recyclables. These skips are also meant for garden refuse only but are used extensively for general refuse.

Three permitted landfill sites exist in Makana namely, Grahamstown, Alicedale and Riebeeck East. The Grahamstown landfill site is the largest and produces leachate which is controlled by two dams downstream of the site. The biggest issue at this site is the fact that there are people living on and around the site, some of which are permanent residents, others are reportedly 'hiding' and using the leachate water for domestic purposes. Alicedale and Riebeeck East sites are very small and both burn waste as part of permit conditions. This is not the ideal means of disposal of waste due to the release of greenhouse and other noxious gases during burning.

The municipality has recorded that approximately 39500 m^3 of vegetable waste is disposed of in the Grahamstown landfill site annually. A project has been started through the Centre for Entrepreneurship at Rhodes to turn this waste into compost.

Two recycling businesses operate in Grahamstown only, namely: Grahamstown Recycling and Eastern Cape Bottle Buyers (ECBB). These businesses are often marginal and need community and municipal support to remain viable.

Hazardous waste is of little concern in Makana Municipality due to the lack of heavy industries. However, light industries and other institutions produce various types of hazardous waste and the disposal methods of these substances have been investigated. Although in many cases the disposal methods of hazardous waste were adequate, in a number of sites improper disposal methods were being undertaken. Noteworthy hazardous waste observed at the Grahamstown Landfill Site includes sewage sludge, animal carcasses and abattoir waste. There is currently no other means of disposal of such wastes.

In Makana Municipality not all households have the RDP sanitation standard according to Census 2001 figures. The municipality has embarked on a "bucket system eradication programme". However, this is estimated to take a number of years. The major environmental problem that occurs with this system is when collections are late many people dispose of sewage on streets or in stormwater drains leading to negative health and environmental impacts.

In Makana Municipality there are two sewage treatment works in Grahamstown and one in Alicedale. Current disposal methods of hazardous sludge pose a major environmental hazard as there is a possibility that sewage sludge is getting back into the river systems after treatment. On average the Grahamstown Disposal Works has achieved the General Limits for most parameters tested over the last four years. Mayfield STW has a sludge drying system which leads to large volumes of hazardous sludge which presents disposal problems. It was found that there is no co-operation between the institutions which test the treated effluent, this has created a situation in which information is not shared and no coherent database of treatment works function exists.

There is no database available on water resources for developments in Makana Municipality. According to the Census 2001, 10% of households in Makana Municipality fall below the RDP levels. Only 22% of people have water inside their houses. In Grahamstown, the water is purified at the Waainek and Jan Kleinhans purifications works. In Alicedale, water is purified in a plant close to the Bushman's river on the west side of town. Riebeeck East's water is obtained from boreholes and is not treated.

Industrial Environmental Management practices were investigated. It was found that the larger corporately owned businesses and franchises often have environmental policies and codes of practice in place. The extent of compliance to these codes of practice is unknown.

The industries most in need of industrial environmental management are those which have hazardous waste and toxic waste waters. These include dry cleaners, tanneries, printing shops, garages and restaurants. All these industries require some level of training on appropriate waste handling and disposal methods. There is potential for co-operation between various businesses to have waste exchanges with existing waste recycling companies in Port Elizabeth or elsewhere. Many businesses also seem open to being audited for compliance to local and national environmental standards and legislation. Bylaws for trade effluents are currently being drafted. Bylaws on correct waste disposal practices should also be promulgated.

Air quality is not an issue currently but this will have to be monitored by the municipalities in future, especially to comply with updated legislation (not yet promulgated) and to take advantage of international protocols (Kyoto). To date, no bylaws exist for the control of emissions which affect air quality or zonation of businesses which produce emissions.

10. Urban green spaces and recreational facilities

Urban green spaces include buildings as well as hard surfaced areas. However, the term is usually applied to areas that are permeable and green, and have soil, grass, trees and shrubs. Included within urban green spaces are areas of parks, play areas and other green spaces intended for recreational use. Urban green spaces can thus be defined as those spaces associated with human settlement where wildlife can flourish. Thus they are the collection of habitats that are found within urban areas. Urban green spaces include those that are privately owned and managed (private golf courses, business parks, company premises, and gardens), as well as those that are publicly owned and managed. Publicly managed green spaces are those owned by the municipality and include public parks, squares, parks in residential areas and school grounds. Public green spaces are primarily used by members of the public and are of considerable local importance for education and recreational purposes. These spaces and facilities are referred to as ‘green infrastructure’.

Urban recreational planning is prompted by the need for energy conservation. Urban recreational planning can be defined as the structural and functional planning of the city, including provisions for sporting and recreational facilities and amenities, as well as green corridors that facilitate transportation and urban conservation.

Our study investigated the problems experienced by the communities, predominantly those of Grahamstown East, with regards to the provision, location and condition of green recreational facilities. In this context, research was undertaken to identify existing green recreational infrastructure, as well as the needs and requirements of the public. Disparities in the provision and maintenance of recreational facilities between different socio-economic were identified. Due to time constraints and guidance from Mr Kevin Bates of Makana’s Department of Parks and Recreation, focussed on the Grahamstown area. Data were gathered using questionnaires and key informant interviews.

Our results show that there is a huge gap when it comes to recreational facilities between the different socio-economic zones. Higher income zones were found to have better facilities as well as better accessibility to a wider range of facilities. Most people in higher income brackets viewed the existing facilities to be adequate and of sufficient quality. However, lower income zones felt that there was a greater need for recreational facilities in their communities. As green spaces and recreational facilities are viewed very highly, amongst both socio-economic classes there is definitely a need for further developments in the future as well as the constant refurbishing of existing facilities. These facilities will not only improve the aesthetic quality of the

communities but will also create the necessary spin off of job creation, and the provision of basic needs.

Our study has shown that recreational facilities can play a role in improving people's perceptions of the communities in which they live in. With the necessary funding, municipalities can improve the quality of life in the Makana municipal region.

11. The importance of multiple habitats to overall biodiversity in the Grahamstown Botanical Gardens

Concern over the loss of biodiversity has increased in recent years. The reasons for biodiversity loss are varied but most stem from increasing human populations and the expansion of urban centres. It has been recognised by the UN and other international bodies that a loss or reduction in biodiversity has consequences for mankind, many of which are not fully understood. In addition, to achieve sustainable development the ecosystems on which it is based must be fully functioning and thus their biodiversity must be intact. South Africa has committed itself to achieving sustainable development and has acknowledged the link between sustainability and biodiversity by subscribing to the principles enshrined in Agenda 21, the National Environmental Management Act (NEMA) 1998 and the Local Environmental Action Plans (LEAPs).

As part of the Makana LEAP this project assessed the insect biodiversity present in the Grahamstown Botanical Gardens. This can be used as an indicator of the biodiversity of the Gardens although more work needs to be done in order to collect more comprehensive data. However, this project could be seen as providing baseline data for work which is to be carried out on the development and rehabilitation of the Gardens. The development of the Gardens can be viewed as an improvement on the urban green spaces of the Municipality and possibly it could be seen as a model for the development of future green spaces in the Municipality as well as promoting the sustainable use of natural resources in line with the aims of LEAPs. In addition, the development of the Gardens and the conservation of the biodiversity within them will provide valuable hands-on experience in the sphere of biodiversity conservation and infrastructure development. The Gardens can also be used as a valuable educational tool for illustrating the concepts of ecosystems and ecosystem management, climate, and geology. This basic study of the insect diversity can also be used as a mini-baseline study for looking at the effects that the developments in the Gardens may have.

This study looked at the collections of insects found in different types of habitats and tested the hypothesis that a large number of different habitats would result in a higher overall biodiversity, and thus would illustrate the need to conserve a number of different natural habitats to maintain a high level of biodiversity. Of the three sites studied, each had a different vegetation or habitat type. It was also found that each of the habitats studied contributed a different collection of Insect Families. This means that the overall biodiversity was greatest when there were more habitats and the biodiversity in each individual habitat only contributed a small amount to the total biodiversity. Without multiple habitats, the overall biodiversity would have been far lower than was found. Further studies should be carried out to test the hypothesis that this trend should hold true for other types of organisms including the vegetation and vertebrates.

However, there are several issues which need to be addressed in order for the Municipality to promote and conserve biodiversity within the Gardens specifically, but also within the greater Municipal area. The most pressing of these is the need to address the serious invasion of alien plant species into the Gardens. The Municipality also needs to consider development actions and programs which will contribute to greater community participation and promote the transfer of skills and aid in poverty alleviation. The proposed development of a restaurant, educational facility as well as a visitor's centre will all help meet these aspects of the LEAP.