

GOLF ESTATE DEVELOPMENT

DYASON HOPKINS

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Golf Estate Development

By: Dyason Hopkins

25014252

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Study Leader: Mr. J.H. Cruywagen

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Declaration by student

I, the undersigned, hereby confirm that the attached treatise in my own work and any sources are adequately acknowledged in the text and listed in the bibliography.

Signature of acceptance and conformation by student.

Abstract

Title of treatise : Golf Estate Development
Name of author : Mr. D Hopkins
Name of study leader : Mr. J H Cruywagen
Institution : Faculty of Engineering, Built
Environment and Information
Technology
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Golf estate developments are seen as liabilities in the building industry with regards to damage to the environment, waste of water, destruction of natural heritage and as communities created only for the rich.

The objective of this treatise is to identify various ways to solve problems surrounding golf estate development, especially with regards to water use/waste and environmental impacts, plus identifying other institutions (mining, informal settlements) that cause more damage to natural heritage and environment than golf estates. Another aspect discussed is the security factor supplied to people living in golf estates. It is said because of South Africa's high crime rate golf estates are a big success and cater only for the rich.

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CHAPTER 1:

Introduction

1.1 INTRODUCTION

Golf Estate Development is seen as an aspect in the construction industry that influences the community, infrastructure, and especially the environment in a very negative way. There are a number of Golf Estate and Golf Estate Developments in South Africa, from a developers point of view it is a massive business opportunity, it creates an environment to live in and provides as well as create jobs within the community. Golf Estate Developments must be seen as positive projects that will provide future opportunities and involve the community as a whole.

This chapter serves as basis for the study and identifies the main problem of Golf Estate Development projects, divided into 4 sub-problems with a hypothesis on each sub-problem. The importance of the study in terms of construction industry and research methodology will also be explained.

1.2 PROBLEM

Many people see Golf Estate Developments as negative projects that have a negative effect on the environment, community and infrastructure, just to make money? Why do we need more golf estates if they have a bad influence on all previously mentioned aspects?

1.3 SUB-PROBLEMS AND HYPOTHESES

1.3.1 New Golf estates are supposed to be “environmentally friendly”, but they use 1-2 million litres of water per day. Water supply and demand for golf courses are huge. There in not enough water for more golf estate developments and golf courses to exist?

With effective management, planning, implementing construction techniques and creating templates for provincial infrastructure developments the supply and demand can easily be solved. The biggest problems under infrastructure is water supply and demand, because on average golf courses use about 2 million litres of water a day! This can radically be reduced by recycling of the nearest town’s water or by extracting the salt from ocean water if the golf

course is near the ocean. These two techniques have the potential to reduce the water demand of a golf course as well as create new jobs.

1.3.2 Do Golf Estate Developments damage the environment through destruction of ecosystems, introduction of alien vegetation and pollution through pesticides and fertilisers?

One of the greatest challenges as humans on planet earth is to save the environment. Golf Estates can be used to generate new eco systems and rescue dying habitats. With specific rules and guidelines, regarding the environment, Golf Estate projects can be controlled to avoid pollution, loss of agricultural land and the elimination of alien vegetation. The technologies are available to implement the correct procedures and avoid impacting the environment in a negative way.

1.3.3 Golf courses cause the destruction of land and natural heritage? The land can be used for agriculture and informal settlements?

There is more damage done by mining and informal settlements to our land and natural heritage than the damage done by golf estates. Golf estates can be used to implement new bio-diversities and save our land and natural heritage for the future.

1.3.4 Are Golf Estate Developments such a big success because they feed of people's fear of crime and violence and the money of the rich?

South Africa is a paradise for criminals, everyday in the news you see and hear of someone who became just another gruesome crime statistic. Everyone in South Africa has at some point in their life been affected by crime. But, NO, Golf Estates are not a success because of people's fear of violence and crime. People do not want to live in cities anymore, and many Golf Estates are only used as holiday homes or just investments. A very small percentage of home owners on Golf Estates actually live in their houses. It is not a "new form of apartheid", it has been there for a long time now, and what is ironic is that a lot of government members are opposed to Golf Estate Developments, yet they all live in their expensive Residential Developments.

"Golf Estates are a playground for the rich, and socially cuts of people from the community"- John Yeld. Implement new legislation that provides a percentage of the Golf Estate project must consist of low-income housing. Create new communities which bring the rich and poor together as well as offering employment, education, health care, security and leisure to those communities. There are no differences between Normal Residential Developments and Golf Estate Developments, yet everyone implies that Golf Estate Developments are more negative than Normal Residential Developments.

1.4 IMPORTANCE OF STUDY IN TERMS ON THE CONSTRUCTION INDUSTRY.

The world's population is growing and expanding at rapid rates, new, improved ideas must be provided to create and improve our living space while caring for the environment or affecting it in any negative way. The objective of this study in terms of the construction industry is to create a positive light on Golf Estate Developments and similar construction projects as well as show that these kinds of projects may be the future in the construction of communities and at the same time protecting the environment.

1.5 RESEARCH METHODOLOGY

The research method used to achieve the most effective result was descriptive research, research of various different documents, literature, environmental analyses and environmental case studies. Revision of the documents based on sub-problems was used to determine the different perceptions and outcomes and they were thoroughly investigated to see if the required result was achieved.

1.6 CONCLUSION

The technology and building techniques are available today to solve and reduce the problems mentioned in this chapter. The following chapters will explain and show how to overturn the negativity surrounding Golf Estate Developments into positive aspects in regards with the communities, infrastructure, environment and the construction industry, if possible.

CHAPTER 2:

There is not enough water for more golf estate developments and golf courses to exist?

2.1 INTRODUCTION

It is hard to imagine that our globe consists of 71% of water, and yet there exists a problem with the availability of water. If this 71% of water is broken down the population on earth is only left with 0.3% of freshwater. Thus 84% of all global water is sea water, approximately 15% of this is underground water too low down to access, and 0.7% is water frozen in the polar ice caps and glaciers. This 0.3% would actually be enough, but uneven distribution, misuse and discrimination in supply creates problems with availability of water.

Another major contributor to water availability problems is that South Africa on average only gets 500mm rainfall annually; our country is of the “semi arid” kind.

According to a BBC report (www.gri.co.za, Garden Route Investments, Sept- Nov 2005 – Issue 11), one golf course uses as much water in a year as a town of 15 000 inhabitants. According to Melanie Grosling 2005, golf courses use an average of 2 million litres of water a day. The golf course (within the proposed Knysna Sport development) uses up in excess of 600 000 litres of water per day.

The conclusions that are drawn is that golf courses use a lot of water, and that there is not enough water on this planet to carry on like this, plus there is also the added factor of global warming.

This chapter will discuss recycle methods and waste water treatment technologies to create cheaper more efficient ways to save water and make sure that there is enough left for the next generation, and at the same time so that golf courses can live on.

2.2 SUB-PROBLEM

New Golf estates are supposed to be “environmentally friendly”, but they use 1-2 million litres of water per day. Water supply and demand for golf courses are huge. There is not enough water for more golf estate developments and golf courses to exist?

2.2.1 WATER SOURCES AND UNTREATED RESERVOIRS

Sources of water can be divided in mainly two categories:

- Surface water
- Sub-surface water (groundwater)

Surface water is water in a river, lake or fresh water wetland. Surface water is naturally lost through discharge through ocean, evaporation, and sub-surface discharge. The only natural input to any surface water system is through precipitation.

Human activities can have a large impact on the total quantity of water in the system. Humans often increase storage capacity by constructing reservoirs or importing surface water from another source. By paving certain areas the run-off quantities and their velocities are influenced. Another negative influence is that they decrease the quantity of water by draining wetlands. A natural factor which is important to consider is the permeability of the soil beneath these storage sources, as well as the size of the reservoir.

The total quantity of water available at any given time is an important consideration, because different applications need different quantities at different times, e.g. golf courses require large quantities of water daily.

Sub-surface is fresh water located in the pore space of soil and rocks, flowing below the water table.

The natural input to sub-surface water is seepage from surface water. The natural outputs from sub-surface water are springs and seepage to the oceans. The important difference between surface water and sub-surface water is: Sub-surface water has a slow rate of loss of possession. Thus sub-surface water storage is generally much larger compared to inputs than it is for surface water.

Humans can increase the input to a sub-surface water source by building reservoirs. An untreated reservoir is simply a container where liquids are kept in reserve, for later use. Most often, a reservoir refers to artificial dams, which is usually built from cement, earth, rock, or mixture of three. Once the dam is completed, a river is allowed to flow in it and eventually fill it to capacity.

2.2.2 DESCRIPTION OF WATER PURIFICATION WORKS

Water purification is the process of removing contaminants and any harmful microorganisms from an untreated water source. The goal is to produce water for a specific purpose – human consumption, and golf course watering.

Water purification may also be designed for a variety of other purposes, including meeting the requirements of medical-, chemical-, and industrial applications. Methods include: ultraviolet light, filtration, water softening, and deionization.

Water is normally treated in three steps:

- Clarification (the separation of particles)
- Filtration
- Disinfection (addition of chlorine)

Water purification removes: suspended particles of organic material; parasites, bacteria; algae; viruses; fungi; specific minerals (such as calcium or silica), and toxic metals like lead. Chlorine effectively kills bacteria and most viruses and maintains a residual to protect the water supply through the supply network. Smell, taste and appearance can also be controlled during purification works.

When water passes through a distribution system, the quality of the water can degrade due to chemical reactions and biological processes. When metal pipes are used as distribution system, corrosion can cause the release of metals into the water. As a result, the colour of the water can change; leading to undesirable aesthetic effects, a metallic taste and the user's health can be affected. To control the pH and alkalinity of the water, it produces water which is protected against corrosion.

2.2.3 HOW TO TURN SALT WATER INTO FRESH WATER (Sunbird Golf Estate, Cannon Rock Golf Estate)

a) Introduction

The ocean can be used as a sustainable source of water if a golf estate development is near the ocean. Thus the water supply can be created through the desalination of sea water.

Desalination refers to any process that removes the excess salt and other minerals from water in order to obtain fresh water suitable for animal consumption, irrigation and human consumption. Desalination of sea water is common in the Middle East and the Caribbean and is becoming popular in the USA, Singapore, North Africa, Spain, Australia and China. Desalination plants may use sea water (directly from the ocean through offshore intakes and pipelines, or from wells located on the beach or seafloor), brackish groundwater, or reclaimed water as input water, also called feed water. There are two well-recognized processes namely, Reverse Osmosis (RO) and Distillation. The preferred option for this development is the RO system while the distillation process is discussed here as a reasonable alternative.

b) Reverse Osmosis

In RO, feed water is pumped at high pressure through permeable membranes, separating salts from the water. The feed water is pretreated to remove particles that would clog the membranes. The quality of water produced depends on the pressure, the concentration of salts in the feed water, and the salt permeation constant of the membranes. Product water quality can be improved by adding a second pass of membranes, whereby product water from the first pass is fed to the second pass. For the RO plant to produce enough water to supply the proposed development at peak season, a minimum of 1125kl of water needs to be drawn from the sea to produce 750kl. This is calculated at optimum functioning. It will be necessary to determine the lowest recovery rate and highest demand that can be expected and build a plant that will provide the required water at that rate and volume.

c) Distillation

Distillation is a phase separation method whereby saline water is heated to produce water vapor, which is then condensed to produce freshwater. Various distillation processes can be used but they are all based on a common principle method.

d) Operation

The water for desalination plants may be used in its pure form or mixed with less pure water and used for drinking water, irrigation or other purposes. The desalinated product is generally more pure than drinking water standards and is therefore often mixed with water that contains higher levels of total dissolved solids if the product water is intended for municipal use. Pure desalination water is highly acidic and is thus corrosive to pipes, so it must be mixed with other sources of water that are piped onsite or else adjusted for pH, hardness and alkalinity before being piped offsite.

e) Intake of seawater

Two following examples for extracting water from the ocean in the vicinity of the development area:

- 1.** A suction pipeline in the ocean off the beach positioned below the low water level and feeding a pump station located on the beach but constructed below ground level and out of sight
- 2.** A flooded suction system of three collection wells, each equipped with a submersible pump and located above the high water mark, reaching down to bed rock. The wells will be constructed of 1.2m diameter concrete rings with the lower sections being perforated. The submersible pumps will be positioned inside the wells at a depth that ensures a flooded suction at all times. Gabion type rock filters will be positioned in the vicinity of the sumps to enhance water flow from the surrounding area. After consideration of the various positive and negative

factors involved with the two foregoing alternatives, it was decided to pursue the flooded suction system as per alternative two. In order to supply the required quantity of water to the desalination plant, i.e. approximately 18 liters per second, three wells each producing six liters per second are envisaged. Positioning the submersible pumps below ground level will eliminate the noise factor associated with pumping operations.

f) *Product water recovery*

The product water recovery relative to input water flow is 15 to 50% for most sea water desalination plants. For every 100 liters of sea water, 15 to 50 liters of pure water would be produced along with brine water containing dissolved solids. Recovery varies, in part because the particulars of the plant operations depend on site specific conditions.

g) *Pre-treatment processes*

Pre-treatment processes are needed to remove substances that would interfere with the desalting process. Algae and bacteria can grow in both RO and distillation plants, so a biocide (usually less than 1mg/L chlorine) is required to clean the system. Some RO membranes cannot tolerate chlorine so dechlorination techniques are required. Ozone or ultraviolet light may also be used to remove marine organisms. If ozone is used, it must be removed with chemicals before reaching the membranes. In RO plants, suspended solids and other particles in the feed water must be removed to reduce fouling of the membranes. Suspended solids are removed by coagulation and filtration. Metals in the feed water are rejected along with the salts by the membranes and are discharged in the brine. Some distillation plants may need to remove metals due to potential corrosion problems. Although the flooded suction / well system of sea water extraction serve as a pre-filtration step to the RO Plant, this is insufficient for rendering the raw sea water suitable as RO feed stock. Consequently the RO Plant will probably be equipped with a two-stage pre-filtration section.

h) *Cleaning*

The filters for the pre-treatment of feed water at RO plants must be cleaned every few days (backwashed) to clear accumulated sand and solids. The RO membranes must be cleaned approximately four times and year and replaced every three to five years. Alkaline cleaners are used to remove organic fouling, and acid cleaners are used to remove scale and other inorganic precipitates. All or a portion of the RO plants must be shut down when the membranes are replaced. The proposed RO plant will be oversized by approximately 20% to allow for fast catch up and maintenance down time.

i) *Waste discharges*

Desalination plants produce liquid wastes that may contain all or some of the following constituents: high salt concentrations and chemicals used during defouling of plant equipment and pre-treatment. Liquid wastes may be discharged directly into the sea, combined with other discharges prior to sea discharge (e.g. storm water), discharged into a sewer for treatment in a sewage treatment plant, or dried out and disposed of in a landfill. In order to minimize the quantity of brine generated by the RO plant, Ultra Filtration technology can be employed to purify and recycle the sewerage effluent. Effectively this will reduce the size of the required RO plant, thereby reducing significantly the quantity of brine discharged into the ocean. Generally a recovery efficiency of 40% may be expected when desalinating sea water using current RO technology. The concentration of salts in the brine stream at 40% recovery efficiency may be approximated by multiplying the concentration in the feed water by a factor of 1.67. i.e. if the salt concentration in the sea water is 36 000ppm, the brine salt concentration will be approximately 60 000ppm. The brine stream can be gravitated back to the ocean through a 150mm diameter pipeline and be discharged in the intertidal zone of the beach.

j) Energy use

The energy used in the desalination process is primarily electricity and heat. Energy requirements for desalination plants depend on the salinity and temperature of the feed water, the quality of water produced, and the desalting technology used.

With the construction of additional storage reservoirs, it will not be necessary to equip the plant with a standby electrical supply. Stability of supply will be maintained by the additional capacity and an electrical standby unit for the pressure booster pumps which will be employed to pressurize the water supply grid. (The minimum requirement for an electrical standby unit for the RO plant would be at least 250 KVA to be sufficient to cope with the starting current for the plant).

k) Comparison of distillation and reverse osmosis technologies:

Factor Reverse Osmosis Distillation

- Size Variable Large
- Cleaning/repair shut down plant shut down portions of plant
- Pre-treatment of water High Low
- Waste generation High Moderate
- Energy requirements Moderate High
- Corrosion High Low
- Rate of pure water recovery High Moderate
- Removal of contaminants High Moderate
- Capital costs Low High

- One advantage of distillation plants is that there is a greater potential for economies of scale.
- Distillation plants do not shut down a portion of their operations for cleaning or replacement of equipment as often as RO plants, although distillation plants can shut down for part replacement and cleaning. Pre-treatment requirements are greater for RO plants, because coagulants are needed to settle out particles before water passes through the membranes. Unlike RO plants, distillation plants do not generate waste from backwash of pre-treatment filters.
- Advantages of RO plants over distillation: RO plant feed water generally does not require heating, so the thermal impacts of discharges are lower; RO plants have fewer problems with corrosion; RO plants usually have lower energy requirements; RO plants tend to have higher rates of pure water recovery for sea water; the RO process can remove unwanted contaminants such as trihalomethane-precursors, pesticides and bacteria; and RO plants take up less surface area than distillation plants for the same amount of water purification. Capital costs for RO plants tend to be lower than for distillation plants.

2.2.4 SEWAGE RETICULATION SYSTEM

a) Introduction

Sewage reticulation system can grow to meet increased demand with time. Therefore a modular system can be employed. It is envisaged that sewage treatment works can serve the proposed golf estate development and the existing town so that everybody can benefit from the system. The system employs the extended aeration activated sludge principal using diffused aeration and air blowers to treat sewage from septic tanks. The activated sludge process is a suspended growth system comprising a mass of microorganisms constantly supplied with organic matter and oxygen. The microorganisms grow in flocs¹, and these microorganisms are responsible for the transformation of the organic material and nutrients into new bacteria, carbon dioxide and water. The flocks are constantly washed out of the reactor to the secondary sedimentation tank by the flow of incoming septic tank effluent. Here they flocculate and settle under quiescent conditions. A fraction of this settled sludge is recycled back to the aeration tank in order to provide sufficient biomass to achieve efficient biodegradable organic matter removal (Horan, 1990).

b) Operation (Sunbird Golf Estate, Cannon Rock Golf Estate)

Raw sewage from the housing units will discharge into a three chamber concrete septic tank with a 24-hour minimum retention time. The purpose of the septic tank is:

- To trap fat, rags and paper
- To reduce the organic loading by removal of faecal solids by approximately 30%
- To provide some degree of flow balancing

The reactor operates on the extended aeration diffused air activated sludge principle in which a culture of micro-organisms (activated sludge) are continuously mixed and aerated with the septic tank effluent. Air is provided via two blowers. The system is capable of producing a treated effluent that meets the South African General Limit and is suitable for irrigation or direct river discharge. An advantage of this system is that it requires a relatively small area (maximum size per unit is 234m²) since no evaporation ponds and solids disposal area are required. Waste sludge needs to be removed every six to twelve months by vacuum tanker. There are two primary ways in which the sludge can be disposed of.

- Firstly, it can be used as a fertilizer provided that the sludge meets regulations set out in the Permissible Utilization and Disposal of Sewage Sludge guidelines (DWAF, 1997 & 2002). If the sludge is in compliance with these guidelines, the sludge may be used as fertilizer at a maximum application rate of eight dry tons per hectare per year.
- Secondly, it can be taken to a municipal treatment works for disposal. It would be necessary to determine whether there is a treatment works in the vicinity of the development with the required capacity. Given the fact that the area is already water scarce, it would be beneficial if the treated effluent could be utilized rather than disposed to the sea. It is proposed that the effluent passes through an ultra-filtration process which will remove residual viruses, bacteria and suspended. Flocculation refers to the process by which fine particulates are caused to clump together into flock. The flock may then float to the top of the liquid, settle to the bottom of the liquid, or can be readily filtered from the liquid.

2.2.5 GENERAL

a) Disposal of treated effluent and sludge

The appropriate disposal of treated effluent and sludge must be determined. Incorrect disposal can pose serious health risks. If records provided by proposed system supplier show that ammonia contents above the threshold of <5mg/l prescribed by DWAF general limit, then is a concern and would have to be addressed by the suppliers before the system can be approved. If the treatment of the effluent includes chlorination, this could have a negative impact as residual chlorine is highly toxic to aquatic organisms. The level of impact would depend on the method of disposal.

b) Nuisance value

These types of treatment works are generally low odor producing and the distance from the development will mean that this may have very little impact. It will still require investigation as the issue has been raised by I&APs. In addition, sewage treatment works tend to attract flies which are disease vectors.

c) Pollution of ground or surface water

The possibility of leakages or spillages and the contamination of water bodies needs to be assessed. This includes sewage sludge, effluent, chemicals used to treat the sewage, oil and/or diesel from pumps and standby generators.

d) Atmospheric pollution

Although limited, methane release from the septic tanks does take place. Methane has been identified as one of the ozone-depleting gases responsible for global warming.

e) Management of treatment works

Local municipality must have the capacity to monitor and manage the treatment works efficiently. Meetings with the municipality must be held in this regard. The level of management required must be determined at each phase of the project in order to establish the level of management required.

2.3 SUMMARY

The little water we have is being continually polluted by households, industrial waste, and agricultural runoff. We have the technologies and methods to solve the problems. The inventions of these systems are one of our greatest engineering advances yet.

A water purification system should be energy efficient, i.e., should consume the least amount of energy per unit volume of purified water produced as is possible.

Table 1: Typical distribution of water use for an average city

Category	Average use (litres/day)/person
Residential	260
Commercial	90
Industrial	190
Public	70
Loss	50
Total	660

Sources: www.wikipedia.co.za, www.google.co.zs, www.environment.co.za

Systems and techniques are in place to stop and reduce water waste that will allow the use of golf courses, etc., without unnecessary waste of water. This will also create new job opportunities within the community, as well as save money, and most importantly water, without damage to our precious environment.

2.4 CONCLUSION

Everybody uses a lot of water as seen in Table 1, golf courses can use these two water saving techniques, discussed in this chapter, to solve problems created by water usage on golf estates. It is therefore an objective of the present invention of golf estate's to design and provide water purification system that can operate for a long time before cleaning or replacements of membranes, and are efficient in energy consumed per unit volume of purified water produced, and are environmentally friendly. The water problems are solved by implementing any one of these techniques

CHAPTER 3:

Do Golf Estate Developments damage the environment through destruction of ecosystems, introduction of alien vegetation and pollution through pesticides and fertilisers?

3.1 INTRODUCTION

In the 21st century one of the biggest problems relating to golf estate development will be the impact developments will have on the environment. With the availability of new technologies and procedures it is possible to create a greener construction industry ultimately leading to environmentally friendly golf estate developments. One of the greatest mistakes that can be made by architects and builders would be not to have the ability to adapt and ignore the demand for greener construction procedures and projects.

Until now golf estate developments have been seen as projects that damages and reduces the local biodiversity, ecosystem functioning and services, as well as the introduction of alien vegetation to the gardens of such development. These factors contribute to a major loss of grasslands and wetlands in South Africa. According to Eco Living(thebaygolf.co.za/Ecoliving), to enhance the biodiversity, the design and construction will at all times attempt to include wetlands, grasslands and some savannah/bushveld area into the construction of the golf course. This will allow all these areas to sustain a more diverse life for fauna and flora.

The public and most of all the environmentalists are very quick to point the finger and protest against the development of a golf course estate. Environmentalists claims regarding the waste of water and miss use of water, destruction of natural land, habitats and environment, limits public to access of open spaces.

3.2 SUB-PROBLEM

Golf Estate Developments damage the environment through destruction of ecosystems, introduction of alien vegetation and pollution through pesticides and fertilisers?

3.3 POLLUTION CAUSED BY PESTICIDES AND FERTILIZERS

Problems arising with the addition of nutrients, fertilizers or chemicals to the ecosystem are that it encourages the invasion and growth of alien vegetation in the surrounding area which in turn creates poor soil conditions for indigenous vegetation. While the use of sewage water, as described in the previous chapter, for irrigation purposes solve water problems, it creates new different problems which adds more chemicals and nutrients into the ecosystem, caused by the water treatment, thus creating a negative environmental impact on plant life.

The use of pesticides and herbicides may kill off all or specifically targeted insects, but creates more negative problems impacting the environment. Such problems comprises of, the killing of insects that spread seeds, natural fertilization, animals higher up the food chain suffers because animals dependant on insects for food does not have anything to eat, as well as pesticides, chemicals and herbicides leaking into rivers, dams, etc spreading to other water systems expanding and creating additional problems elsewhere.

A very good system to solve the majority of problems created by pesticides, chemicals and herbicides can be the introduction of a turfgrass system, which will be explained.

3.4 TURFGRASS SYSTEMS

(Information on turfgrass provided by Eco Living, The Bay Golf Estate (thebaygolf.co.za))

3.4.1 ENVIRONMENTAL BENEFITS OF TURFGRASS SYSTEMS

Although potential environmental risks have been identified for turfgrass management of lawns and golf courses, the overall benefits of turfgrass should be considered:

- Healthy turfgrass probably provides the greatest benefit to land surfaces in urban and suburban environments.
- Healthy turfgrass has the greatest resistance to disease, insect and weed infestations.
- Strong root systems use applied nutrients and water efficiently.
- Efficient use of nutrients and water limits the need for unnecessary irrigation, fertilization and pesticide applications.

One of the greatest influences of turfgrass is on water resources:

- Research on grasslands, pastures and turfgrass indicates that sediment and nutrient losses from these systems, is considerably less than losses from agricultural systems.
- Turfgrass is capable of entrapping and retaining large quantities of precipitation and reducing the rate and volume of surface run-off.
- Turfgrass is capable of reducing sediment losses and surface losses of residual pesticides and nutrients in the soil.

- Turfgrass is capable of scavenging nitrates and phosphates and therefore acting as a nitrate, phosphate filter and source of groundwater recharge.
- Turfgrass additionally removes sediment and heavy metals from treated effluent.
- Utilization of treated effluent on turfgrass reduces the demand on potable water resources.
- Turfgrass has a positive influence on the dissipation of solar energy in urban environments, leading to reduced temperatures as it absorbs infrared radiation.
- To a limited extent turfgrass also absorbs atmospheric contaminants without sustaining permanent injury.
- Turfgrass absorbs ozone, carbon dioxide and hydrogen fluoride and releases oxygen to the atmosphere.
- Turfgrass creates an “oasis” effect in urban areas, providing living greenery and aesthetic value to communities and residences.

3.4.2 BENEFITS OF IMPLEMENTING INTEGRATED TURFGRASS MANAGEMENT STRATEGIES.

Golf course and turfgrass managers are faced with the dilemma of maintaining cost effective operations and meeting user demands, whilst sharing the public’s concerns regarding environmental effects, effects on water supplies and potential health hazards.

The use of fertilizers, pesticides and water for irrigation is considered necessary for economically viable golf courses.

Sound management of water, nutrients, and pests involves practices designed to retain the applied chemicals onsite and within the soil root zone. Establishing a record regarding prevention of adverse environmental impacts and chemical losses not only reduces operational costs, but is vital to establishing credibility with environmental bodies.

3.4.3 CONSERVATION OF WATER RESOURCES

Groundwater, streams, lakes and dams are invaluable natural resources. They provide drinking water, supply water for irrigation and industry, and are a source of natural beauty and recreation.

Although the utilization of water for turfgrass is very small compared to agricultural and industrial use its utilization is highly visible through the irrigation of recreational and leisure turfgrass facilities. This is seen as a “luxury” of use by certain sectors of the community. The sensible and scientific application of water therefore on turfgrass is critical to the well being of the industry and its patrons.

3.4.4 USE OF TURFGRASS FERTILISERS AND ENVIRONMENTAL IMPACTS

The use of fertilizer for maintaining acceptable turfgrass growth rate and aesthetic quality is an important component of turfgrass management. Recent concern over the potential contamination of water supplies associated with turfgrass systems such as golf courses has

prompted scientists, health officials and others to evaluate the effect of turfgrass maintenance practices on the environment.

Nitrogen phosphorus and potassium are the most widely applied fertilizers in turfgrass maintenance. In general turfgrass is most responsive to nitrogen application, providing growth and colour to the sward. Due its dynamic nature in the soil, nitrogen levels tend to decrease over time and therefore require additions to maintain established levels.

Turfgrasses require potassium and recent research shows that increased potassium levels result in improved root growth; heat, drought and wear tolerance as well as reduced incidence of disease. Phosphorous enhances root growth but deficiencies are not as common as nitrogen or potassium.

Essentially management issues related to turfgrass fertilizers lie in the judicious application of these chemicals so that they remain within the root zone of the sward and are not carried in solution either through run off or into the ground water underlying the golf course. Utilization of organic fertilizers enhances bacterial activity within the root zone and results in a gradual slow release of nutrient that is taken up by the plant. The utilization of foliar fertilizers ensures that these chemicals are absorbed directly by the plant and not released to ground water.

It follows that the application of any fertilizers should not be carried out prior to anticipated rain or heavy irrigation and that conditions are favourable for their application. Cognisance must also be taken of items such as soil texture and organic matter content, surface crusting, slopes and water levels within the soil. Application of fertilizer is also critical in terms of meeting plant uptake requirements thereby reducing the potential for fertilizers to be transported outside of the root zone.

3.4.5 MANAGEMENT GUIDELINES RETATED TO PESTICIDES AND WATER QUALITY

- Only chemicals specifically labeled for application should be used.
- All pesticides should be registered “turfgrass” products.
- Any personnel utilising pesticides must be trained by a recognised institution in their use and receive refreshing training with the passage of time.
- Equipment maintenance and correct calibration is essential to ensure even distribution and correct application at determined rates.
- All label instructions, storage requirements, and regulations must be followed to ensure safe handling of the products.
- Proper mixing, handling and loading prior to application will reduce risk of fill site contamination.
- Closed systems for loading and mixing of pesticides are especially useful in reducing water source contamination.
- Proper disposal of unused chemicals and containers will ensure safety of the users, water resources and non-target organisms.
- Personnel involved in the application of pesticides should ensure that they are wearing

appropriate protective clothing, respirators, gloves and shoes.

- Avoidance of excess run off, the prevention of spraying pesticides in or near any standing water bodies is of paramount importance.
- Selection of pesticides should be based on efficiency of treatment and criteria that reduce off-site movement and potential adverse environmental impacts.
- Selection of less toxic, less mobile and less persistent chemicals with greater selective control of pests is an important management consideration.
- The rate and timing of application relative to irrigation or precipitation that may lead to run-off or leaching is vital so as to avoid such incidents. Light irrigation after application may ensure the pesticide is placed in the thatch and upper soil layer where it will be most effective and reduce opportunity for losses through run- off water.

Unless the soils are well compacted, turfgrass soils have high levels of water infiltration and conductivity. Numerous studies have proved that water run-off from turf grass is limited, it is therefore important that irrigation management prevents leaching through exceeding turfgrass water demand.

The movement of pesticides is related to:

- soil texture and degree of water conductivity
- thatch development
- the amount of sub-surface water movement
- pesticide adsorption and degradation
- cultural management characteristics.

Leaching of pesticides will occur when persistent and soluble pesticides are used at high rates on sandy soils.

Although extremely limited research has been carried out on the effects of pesticides in turfgrasses, it would indicate that there are very low levels of water related losses from turfgrass. Understanding the site-specific relationship of pesticide fate, persistence and transport is an essential component of understanding the environmental impacts of pesticide management.

3.4.6 INTEGRATED MANAGEMENT PRACTICE FOR TURFGRASS

The approach to turfgrass management today is to integrate the above factors including cultivar selection, soil building practices, nutrient management, biological management and pest management as a single and interrelated entity thereby maximising their utilization and minimising their effect on the surrounding environment. This combination of pest and nutrient control irrigation scheduling and other cultural practices when properly implemented will produce turfgrass practices that are economically feasible, profitable and acceptable to turfgrass managers and critics. These practices include a thorough knowledge of herbicides, pesticides and fertilizers their utilization, effects and properties and how their utilization is aided through scientific data such as chemical leaf analysis soil analysis and the utilization of

aids such as weather stations that determine evapo-transpiration and wind speeds. The data capture related to the above evolves a history of management to provide future knowledge for the maintenance of good grass of a particular site.

3.5 ALIEN VEGITATION

The problem with trees and plants in golf estates is that the golf courses are built in prime agricultural land, that can be used for farming, indigenous vegetation is taken out to make way for the golf course and houses and replaced with alien vegetation, especially in the private gardens of the houses within the golf estate.

An article written by Enviroadmin (24 May 2010) provided very important information about alien vegetation saying that: Invading alien plants are the single biggest threat to plant and animal biodiversity. Invading alien plants have become established in over 10 million hectares of land in South Africa. The cost of controlling invading alien plants in South Africa is estimated at R600 million a year over 20 years. If invading alien plants are left uncontrolled, the problem will double within 15 years. Invading alien plants waste 7% of our water resources, reduce our ability to farm, intensify flooding and fires, cause erosion, destruction of rivers, siltation of dams and estuaries, and poor water quality and can cause a mass extinction of indigenous plants and animals.

Key facts also provided by Enviroadmin 24 May 2010:

- 750 tree species and 8000 herbaceous species introduced into South Africa
- 1000 introduced species are naturalized, 200 are invasive
- 84 species introduced from South and Central America
- 14 from North America
- 30 from Australia
- 29 from Europe
- 36 from Asia
- 45% of species from Australia have become important pests

All of these problems can be reduced by implementing strong rules and regulations regarding the use and removal of alien vegetation in gardens. In the Western Cape the Atlantic Beach Estate implemented a strict environmental management plan: (Information provided by Atlantic Beach Estate)

After following the Environmental Impact Assessment's recommendations, an environmental management programme guide to development, resulting in Atlantic Beach' sense of harmony and balance with nature.

The Estates home owners have also established an operational environmental management plan that provides the home owners with the information and tools to manage their gardens, repair and replace damaged and lost indigenous vegetation thus restoring the estates grounds, and developing a pristine indigenous fauna and flora.

3.6 SUMMARY

The care of golf courses has become a professional occupation involving and integrating science, and technologies to provide organic fertilizers with a longer lasting effect and reduces the use of pesticides and fungicides. Specific pests can be targeted and only treated when they reach plague proportions. Microbes can be introduced to combat pests and specific areas can be targeted to reduce overspray. Some golf courses come with their own weather stations to see when rain is forecasted, reducing water waste. Probes and tensiometers can be installed to provide water directly to the rooting structure of the plants and grass reducing water runoff and waste.

Nowadays you can study for a degree in horticulture and become a greenkeeper at golf courses, using technologies and laboratories to do tests on soil, etc. to help and create an environmentally friendly golf course that not only sustains a healthy ecosystem but also provides opportunity to create and heal an environment.

3.7 CONCLUSION

A section in the article about eco living based on The Bay Golf Estate provided an equation on flexibility and adaptability of the potential that consists in golf courses:

GOLF COURSE = GREEN SPACE = BIO FILTERS = OXYGEN BANKS = NATURAL HABITAT FOR FAUNA AND FLORA = SPACE FOR RELAXING FOR MAN = STRESS RELIEF

Golf estates can be used to generate new eco systems and rescue dying habitats. With specific rules and guidelines, regarding the environment, Golf Estate projects can be controlled to avoid pollution, loss of agricultural land and the elimination of alien vegetation.

CHAPTER 4:

Golf courses cause the destruction of land and natural heritage? The land can be used for agriculture and informal settlements?

4.1 INTRODUCTION

People's actions are the number one cause for the degradation of land. The main reasons influenced by construction, contributing to degradation of land, are the building of houses developments, etc. and secondly by transforming the land for use of other social and economic purposes: for example, infrastructure and recreation, etc.

Pressure created by an increasing demand in the population growth and tourism industry filters down to create a demand for more and better infrastructure, activities and recreation to be sustained, especially in the field of sporting facilities like golf estates where there is also added benefits involved relating to economics, security, etc. The result caused by above mentioned scenarios changes the natural layout of the land and changes to the profile of different ground surfaces, plus disruption of different soil types.

Over the past few years there have been a lot of questions asked around golf estates, are they really necessary? How environmentally are golf estates in reality? Golf estates cause more harm than good, etc. But what about shifting the spotlight from golf estates to mining, informal settlements (squatter camps) and in some cases even agriculture. This chapter will show that mining, informal settlements, and agriculture can be seen as the 3 major contributors to the destruction of land, natural heritage and degrading of the land.

4.2 SUB-PROBLEM

Golf courses cause the destruction of land and natural heritage? The land can be used for agriculture and informal settlements?

4.3 MINING

Out of the 3 topics, mining; informal settlements and agriculture, mining has been well documented and a number of studies have been done on the environmental impacts caused by mining.

Mining is one of the main contributors to soil loss and erosion. According to GDACEL a great deal of illegal dumping takes place below the flood line and in the mining belt. The problem with this act is that a large number of mining properties are privately owned land and the management of the environmental impacts, etc. and rehabilitation of damaged soil falls under the jurisdiction of the department of minerals.

4.3.1 SEDIMENTATION

One of the biggest challenges for mining is to manage and reduce the waste of disturbed organic material that ends up in streams or other aquatic ecosystems. Erosion caused by waste rock pile ups or runoff water created after heavy rainfall can increase the sediment load of nearby water bodies. Mining can create modifications in stream flow patterns resulting in disruptions in channel, diverting streams in other directions, and changing the slopes or the banking stability of the water channel. The disruption caused by these factors can dramatically influence the characteristics of stream sediments. (Johnson, 1997a:149).

Mercy water is created because of high sediment concentrations in the water, reducing the light availability required by the aquatic plants for photosynthesis (Ripley, 1996). Another impact caused by increased sediment levels in water, is that the benthic organisms in streams and oceans can be smothered, thus influencing the circle of life by eliminating important food sources for predators and decreasing available habitat for fish to migrate and spawn (Johnson, 1997b). High sediment levels also decrease the depth of streams, resulting in greater risk of flooding during times of high stream flow (Mason, 1997).

4.3.2 ACID DRAINAGE

Acid drainage is one of the biggest environmental hazards caused by mining. It is formed when sulfide-bearing minerals, such as pyrite or pyrrhotite, are exposed to oxygen and or water, resulting in sulfuric acid being formed. There can be a presence of acid-ingesting bacteria that can result in an increase of the process. The acidic water can filter through and result in the contamination of both the surface and groundwater. Acid drainage is a result of poor waste management of waste rock piles, other exposed waste, mine openings, and pit walls on the mine site. The process happens very fast and continues until all remaining sulfides are gone, which can take years given the scale of the mine. Certain conditions can reduce likelihood of its occurrence. For example, if neutralizing minerals are present (e.g., carbonates), the prevailing pH environment is basic, or if preventative measures are taken, then acid drainage is less likely to occur (Schmiermund and Drozd, 1997:599).

4.3.3 BIODIVERSITY AND HABITAT

Mining can be the cause of environmental impacts many miles away. In order to provide charcoal for pig-iron smelters, Fearnside estimated that the Carajás project in the Brazilian Amazon would result in the deforestation of 72,000 hectares of forest per year over the 250-

year life of the project (Fearnside, 1989: 142). The effects of mining on specific ecosystems are described in article 1 and table 1.

The most noticeable impact to biodiversity as a result of mining is the removal of plants, trees and vegetation, resulting in loss of the availability of food and shelter for wildlife ultimately leading to damage to the ecosystem. Exotic species (e.g., weedy plants and insect pests) may thrive while native species decline (Ripley, 1997: 94). Some wildlife species benefit from the modified habitat provided by mines, such as bighorn sheep that use coal mine walls as shelter (MacCallum, 1989).

Article 1: Sensitivity of Select Ecosystems to Mining

Mining and oil development may pose risks to some environments due to the sensitivity and/or rarity of these ecosystems. These include the following:

Forests

Forests are the most biologically diverse terrestrial ecosystems. Tropical forests are particularly diverse and provide the greatest source of endemic plant species in the world.

The key direct impact of mining on forest ecosystems is the removal of vegetation and canopy cover. Indirect impacts include road-building and pipeline development, which may result in habitat fragmentation and increased access to remote areas. While larger intact forest ecosystems may withstand the impacts of mining and oil development, smaller fragments are likely to be particularly sensitive to clearing.

Wetlands and Mangroves

Wetlands (including estuaries, mangroves, and floodplains) act as natural pollution filters, as well as provide unique habitat for aquatic species. Mangroves act as an important interface between terrestrial and marine ecosystems, often providing food and refugia for marine organisms. Wetlands may be destroyed through direct habitat elimination or by pollution from heavy metals and oil spills upstream. Mining and oil development can also contribute to the destruction of mangroves and wetlands through altering upstream watersheds and increased sedimentation. The United States has lost at least 54 percent of its wetlands and European countries have lost up to 90 percent of their wetland ecosystems.

Mountain and Arctic Environments

Extreme northern ecosystems are characterized by cold temperatures and short growing seasons. Arctic ecosystems exhibit far fewer plant and animal species than in the tropics, but they are often highly sensitive to disturbance and the loss of one or two species has a far greater impact. Lichens and mosses are often among the first species to disappear due to pollution and human disturbance. Permafrost degradation associated with mining and oil development may extend far beyond the initial area of disturbance, due to melting of ice, soil degradation, and impoundment of water. The arctic environment often takes longer to recover from pollution due to the slow speed of biological processes. In addition, the lack of sunlight throughout the winter months makes management of some mining wastes (e.g., cyanide-laced tailings) more difficult.

Arid Environments

Water scarcity is the primary constraint in arid environments. Vegetation is limited, but biodiversity is high among insects, rodents, and other invertebrates, especially in semiarid regions. The main impact of mining and oil development on these ecosystems is the alteration of the water regime, especially lowering of the water table and depletion of groundwater. These

impacts may result in increased salinization of the soil and erosion, which eventually lead to a decline in vegetation and wildlife species. In densely populated areas, the competition for scarce water resources makes these ecosystems especially fragile.

Coral Reefs

Coral reefs harbor the most biodiversity of any marine ecosystem. Located primarily in the Indo-Western Pacific and Caribbean regions, coral reefs are important links in maintaining healthy fisheries. Reef systems are highly sensitive to human disturbance. Sedimentation from upstream land-uses and pollution are among the greatest threats to coral reefs. Mining directly impacts coral reefs through increased sedimentation, especially in cases where wastes are dumped directly in rivers and oceans, as well as through increased pollution of heavy metals.

Sources: H.A. Mooney et al., "Biodiversity and Ecosystem Functioning: Ecosystem Analyses," In V.H. Heywood and R.T. Watson *Global Biodiversity Assessment* (London: Cambridge University Press/ UNEP, 1995); J.A. McNeely et al., "Human influences on Biodiversity," in V.H. Heywood and R.T. Watson, *Global Biodiversity Assessment*; World Resources Institute, *World Resources Report 2000-2001* (Washington, DC: World Resources Institute, 2001).

TABEL 2: UNESCO World Heritage Sites Impacted by Extractive Industries

<i>SITE NAME</i>	<i>COUNTRY</i>	<i>ACTIVITY</i>	<i>DATE</i>
<i>World heritage in danger</i>			
Mt. Nimba Strict Nature Reserve	Guinea and Côte d'Ivoire	Iron ore	1992
Okapi Wildlife Reserve	Democratic Republic of Congo	Gold mining	1996
<i>World heritage sites</i>			
Peninsula Valdes	Argentina	Oil tanker traffic	1999
Kakadu National Park	Australia	Uranium mining	1981
Tasmanian Wilderness	Australia	Small-scale mining	1982
Wet Tropics of Queensland	Australia	Tin mining	1988
Blue Mountains National Park	Australia	Coal mining	2000
The Sundarbans	Bangladesh/ India	Oil transport	1997
Southeast Atlantic Forest Reserves	Brazil	Calcareous, gold, and lead mining	1999
Pantanal Conservation Complex	Brazil	Small-scale gold mining	2000
Dja Faunal Reserve	Cameroon	Calcareous mining	1987
Dinosaur Provincial Park	Canada	Gas wells	1979
Canadian Rocky Mountain Parks	Canada	Oil/gas/coal	1984
Kluane National Park/ Wrangell- St. Elias National Park and Preserve	Canada/ U.S.	Oil pipeline/ unsettled mine	1979
Waterton Lakes National Park	Canada	Gas wells	1995
Talamanca Range	Costa Rica/ Panama	Copper mining	1983
Tai National Park	Côte d'Ivoire	Illegal gold mining	1982
Sangay National Park	Ecuador	Gold mining	1983
Ujong Kulon National Park	Indonesia	Oil transport	1991
Lorentz National Park	Indonesia	Gold/copper mining	1999

Kinabalu National Park	Malaysia	Copper mining	2000
Whale Sanctuary El Vizcaino	Mexico	Oil drilling	1993
Huascarán National Park	Peru	Gold mining	1985
Manu National Park	Peru	Oil drilling/ gold mining	1987
Volcanoes of Kamatchka	Russia	Gold mining	1996
Greater St Lucia Wetland Park	South Africa	Oil transport	1998
Donana National Park	Spain	Mining	1994
Sinharaja Forest Reserve	Sri Lanka	Illegal gem mining	1988
Central Suriname Nature Reserve	Suriname	Gold mining	2000
Bwindi Impenetrable National Park	Uganda	Gold mining	1994
St. Kilda National Nature Reserve	Scotland	Oil transport	1986
Selous Game Reserve	Tanzania	Oil exploration	1982
Grand Canyon National Park	United States	Mining	1979
Redwoods National Park	United States	Offshore oil/gas development	1980
Mammoth Cave National Park	United States	Oil/gas wells	1981
Olympic National Park	United States	Oil transport	1981
Kahuzi-Biega National Park	Democratic Republic of Congo	Gold mining	1981
Canaima National Park	Venezuela	Gold mining	1994
Mana Pools National Park	Zimbabwe	Oil exploration	1984

Source: World Conservation Monitoring Centre, “World Heritage Sites” List available online at: http://www.wcmc.org.uk/protected_areas/data/wh/. Last accessed May 14, 2003.

Note: Reflects sites threatened by proposed, current or past extractive activity. Sites listed under “World Heritage in Danger” are categorized as such by UNESCO. Degree of threat to each site from extractive activities varies.

Table 2 illustrates how mining has the power to influence heritage sites around the world over a number of years. It is also illustrated that mining activities are in very close or in some cases even in the proximity to the heritage sites. These mines have the potential to destroy the heritage sites.

4.4 INFORMAL SETTLEMENTS

‘Our beautiful land is being spoiled by large ugly developments’-Mike Vincent, Nov 06 2005

What about the sight of ugly informal settlements? Houses in informal settlements destroy the land in a big radius around the settlement, there is a lot of pollution and rivers, dams, etc. are also polluted creating problems for the environment further downstream affecting the environment. How can golf estates be seen as ugly developments? When with good management, technology and other techniques, new ecosystems, and environmental improvements can be created and rescued.

4.4.1 PROBLEMS CAUSED BY INFORMAL SETTLEMENT

The surrounding soil is being destroyed in 3 ways:

- deforestation
- overgrazing
- soil erosion

This destroys the natural vegetation and plant life, thus creating a chain effect that impacts the animal life. A big problem as a result of this is that the topsoil cannot be held together under heavy rainfall. If the rainwater is not absorbed by soil, the topsoil can be flushed away as well as rivers and dams can be destroyed.

Informal settlements create problems through:

- The construction of roads, buildings and channels. This destroys the natural vegetation, and increases the draining effect.
- Houses are built on less appropriate or even dangerous terrain where floods can occur.

An example of a flood in South Africa.

On September 30th, 1987, a violent tropical storm broke out over Natal. At least 180 people died. Thousands of shacks collapsed under the heavy rain. Roofs were ripped off and houses were seriously damaged. Seven thousand families were left cold and hungry with no roof over their heads, in a single day. Most of the bridges and roads were washed away and emergency personnel could not reach victims by truck. The electricity failed and there was no sewerage or tap water. All the pipelines were destroyed by the floodwaters. Businesses came to a standstill and severe financial losses were felt in the economic field. Farmers lost their harvests and their cattle. All the rich topsoil was washed away and would take years to recover. The walls of farm dams broke and fences were swept away. These alone would bring about serious financial implications if they were to be fixed.

The bodies of people and animals were strewn about, which caused a health risk. This caused the water to become polluted, and another health risk reared its ugly head: cholera.

4.5 AGRICULTURE

(Information quoted from Ekurhuleni SoER 2003, Land and Soil, Chapter 7)

Industrial and agricultural activities, together with expansion of human settlements, have generated large amounts of substances, which are harmful to humans and ecosystems. Some pollutants have very long-term effects, and continue to damage ecosystems even after the

amount of pollutant being released is reduced or stopped altogether. Soil degradation due to these abovementioned activities encompasses physical degradation (compaction, crusting, structural deterioration, erosion and desertification), chemical degradation (acidification, salinisation, sodicity, alkali nation, nutrient depletion, pollution and toxicity) and biological degradation (decline in soil organic matter, loss of biodiversity and soil sterility). The principle effects of land degradation are impoverishment of the soil, causing greater susceptibility to droughts and making agricultural production more difficult and expensive; silting of water storage reservoirs such that they become uneconomic to operate; silting of rivers and estuaries; and the modification of both land- and water based ecosystems. Reduction of vegetation and biomass production through land degradation will lead to a reduction in soil structure, water infiltration, lower aggregate stability, nutrient cycling and storage and energy capture. The erosion hazard of bare soil with no protective cover and litter on the soil surface will also be much greater than soil covered with perennial vegetation. Soil erosion has an effect on the physical and chemical properties of the soil. Sediment movement by erosion contributes significantly to shifts in soil fertility.

The types of damage caused by accelerated erosion are:

- Loss of agricultural potential when soil mineral particles, soil organic matter and nutrients are removed that provide water and nutrient supplies for plant growth.
- Deterioration of water and air quality due to increased turbidity, dust and pollution of adsorbed chemicals on the sediment.
- Deposition of sediment that buries productive land and infrastructure and the silting of dams and rivers.

Impacts due to agriculture as a driver and the related pressures such as the increasing demand for agricultural products are summarised below:

- excessive use of fertilizers cause soil salinasation;
- overstocking, overgrazing, inappropriate crop rotations and site characteristics cause soil loss;
- inappropriate soil conservation planning cause soil erosion;
- heavy machinery cause soil compaction;
- pesticides and fertilizers cause soil contamination;
- excessive burning causing deposition of atmospheric deposition and related soil acidification;
- all the above cause loss of nutrients and soil fertility.

4.6 SUMMARY

The reason people have problems with golf estates are because we need more houses and agricultural land in South Africa, which will reduce poverty. This is a valid reason, but golf estates can be planned to include housing for low-income housing in a gated community and

thus the land where the informal settlement once was can be rescued and reused as agricultural land.

In the Western Cape government has placed demanding guidelines, consisting of a 72 page document, for developments to include low-income housing on the land.

The guidelines take into account the protection of the ecosystem, economic development and social justice. The documents state that estates “shall provide service land and top structures” for low-income housing.

Stronger guidelines should be put in place regarding the effects of pollution caused by mining and agricultural chemicals and fertilizers. In the articles 1, table 1, and the information provided on agriculture it can clearly be seen that a big part of the destruction of the natural land and heritage is caused by mining and agriculture.

The most direct human contribution to land degradation is land use practice. Decades of inequitable land and development policies have shaped current land use patterns in SA and have resulted in severe land degradation. As a result of these policies, large numbers of people were forced into subsistence lifestyles and many of these people are still highly dependent on natural resources to meet their nutritional, medicinal, housing and energy needs (Ballance, 2001), (Ekurhuleni SoER 2003, Land and Soil, Chapter 7).

4.7 CONCLUSION

There has been a perception created that golf estate developments causes the destruction of land natural heritage and the environment, but new strict guidelines and rules have made developments more environmentally friendly and contributors to the ecosystem if managed accordingly. People must just open their eyes and see that developments can contribute more to the environment than mining and informal settlements. Developments together with agriculture can create a better living environment that is also aesthetic.

CHAPTER 5:

Are Golf Estate Developments such a big success because they feed of people's fear of crime and violence and the money of the rich?

5.1 INTRODUCTION

Former President Thabo Mbeki described golf estates as the "new form of apartheid" (John Yield, Sept, 2005).

Gated communities provide secure living environments that may take on the form of golf estates. Almost all of these developments is only affordable by the rich and provides no housing or facilities for the workers of the golf courses whose daily labour is needed for the smooth operation of the golf course. In a country with a high crime rate gated communities provide much needed security and because of the crime gated communities like golf estates are a big success.

In South Africa crime has increased dramatically since 1985, with rates stabilizing since 1994 (White Paper on Safety and Security, 1998). A recent report on fatal injuries in South Africa showed homicide to be the leading cause of non-natural death (accounting for 46% of all non-natural deaths). Firearms were the leading cause of nonnatural death in the age group 15-65 years (Butchart, 1999).

A survey showed that 70% of South Africans believed that criminals have "too many rights", and 31% of respondents felt that the police have the right to use force to extract information from suspects (Pigou et al in Hamber 1999).

Gated communities are becoming a worldwide phenomenon, because of an increasing crime rate and the fact that the rich are getting richer and the poor becomes poorer. This chapter is an article from Wikipedia that summarizes and explains gated communities from around the world.

5.2 SUB-PROBLEM

Golf Estate Developments are such a big success because they feed of people's fear of crime and violence and the money of the rich?

5.3 GATED COMMUNITIES (See Bibliography: References for the article about gated communities for 5.3-5.3.6)

Gated communities consist of housing estates in an enclosed perimeter of walls and fencing with strictly controlled entrances for pedestrians, bicycles and automobiles. Some gated communities, depending on their size, have their own infrastructures in place with all the necessary amenities. In small communities this can be for example: parks. In the larger communities the residence can do their daily activities and chores without leaving the walls of the community. Probably the most important aspect of gated communities is that they provide security and protection as well as a good investment for the upper class and expatriates.

Given that gated communities are spatially a type of enclave, Setha M. Low, among other anthropologists, has argued that they have a negative effect on the overall social capital of the broader community outside the gated community.

Some gated communities, usually called guard-gated communities, are staffed by private security guards and are often home to high-value properties, and/or are set up as retirement villages. Some gated communities are secure enough to resemble fortresses and are intended as such.

5.3.1 AMENITIES

Amenities available in a gated community depend on a number of factors including geographical location, demographic composition, community structure, and community fees collected. When there are sub-associations that belong to master associations, the master association may provide many of the amenities. In general, the larger the association the more amenities that can be provided. Amenities also depend on the type of housing. For example, single-family-home communities may not have a common-area pool, since individual homeowners have the ability to construct their own private pools. A condominium, on the other hand, may offer a community pool, since the individual units do not have the option of a private pool installation.

Typical amenities offered can include one or more:

- Swimming pools
- Tennis courts
- Community centres or clubhouses
- Golf courses

- Marina
- On-site dining
- Playgrounds
- Exercise rooms including workout machines
- Spa

5.3.2 HIGH SECURITY RESTRICTED ACCESS

To enter some gated communities, the person must be a registered resident with photo ID or the person must have a friend in the gated community who gives specific permission (via phone or internet) to the security guards at the gate to this effect "my friend Joe Smith will visit me in the next hour or so, his drivers licence number is XXXXXX, let him in".

5.3.3 AS A WORLD WIDE PHENOMENON

In Brazil, the most widespread form of gated community is called "condomínio fechado" (closed housing estate) and is the object of desire of the upper classes. Such a place is a small town with its own infrastructure (backup power supply, sanitation, and security guards). The purpose of such a community is to protect its residents from outside violence. The same philosophy is seen on closed buildings and most shopping centers (many of them can only be accessed from inside the parking lot or the garage).

Protective 'spikes' help ensure the safety of residents living in 'security-zone' communities

In Panama, people buy houses inside of them because of the increased security, mainly in big cities. The majority of these gated communities are built for the middle and upper middle classes. They are preferred over condos and apartments because of lower community payment, higher feelings of privacy, and lower house prices.

In Argentina, they are called "barrios privados" (literal translation "private neighborhoods") or just "countries" and are often seen as a symbol of wealth. However, gated communities enjoy dubious social prestige (many members of the middle and middle upper class regard gated community dwellers as nouveaux riches or snobs). While most gated communities have only houses, some bigger ones, such as Nordelta, have their own hospital, school, shopping mall, and more. In recent years, this influx of people going from the big cities to the gated communities has experienced a backlash in Argentina. Visiting Buenos Aires, the renowned geographer and urbanist Jordi Borja from Spain who teaches urban planning at the University of Barcelona criticized gated communities calling them "the negation of cities". Architect and university professor Marcela Cambor, who heads the Urban Design Dept in Florida, USA told

the La Nacion newspaper that "the gated communities experiment has failed", calling them "unsustainable from the economic, social, and now even energetic point of view".

In post-apartheid South Africa, gated communities have mushroomed in response to high levels of violent crime. South African gated communities are broadly classified as "security villages" (large-scale privately developed areas) or "enclosed neighborhoods. Some of the newest neighborhoods being developed are almost entirely composed of security villages, with a few isolated malls and other essential services (such as hospitals). A common mode of development of the security villages involves staking out a large land claim, building a high wall surrounding the entire zone, then gradually adding roads and other infrastructure. In part, property developers have adopted this response to counter squatting, which local residents fear due to associated crime, and which often results in a protracted eviction process. Crime syndicates have been known to acquire property in some of these security villages to be used as a base for their operations within them.

They are popular in southern China, namely the Pearl River Delta Region. These communities are often purchased by overseas Chinese, Hong Kong Chinese, and new-rich local Chinese. Most famous one is Clifford Estates.

In Saudi Arabia, gated communities have existed since the discovery of oil, mainly to accommodate Westerners and their families. After threat levels raised since the late 1990s against Westerners in general and Americans in particular, gates have become armed, sometimes heavily, and all vehicles have been inspected. Marksmen and SANG armored vehicles appeared in certain times, markedly after recent terrorist attacks in areas nearby, targeting Westerners.

Gated communities are very rare in Europe.

5.3.4 CRITICISM

Proponents of gated communities (and to a lesser degree, of culs-de-sac) maintain that the reduction or exclusion of people that would just be passing through, or more generally, of all non-locals, makes any "stranger" much more recognisable in the closed local environment, and thus reduces crime danger. This view has been attacked as unrealistic - since only a very small proportion of all non-locals passing through the area are potential criminals, increased traffic should increase rather than decrease safety by having more people around whose presence could deter criminal behaviour or who could provide assistance during an incident.

Another criticism is that gated communities offer a false sense of security. Some studies indicate that safety in gated communities may be more illusion than reality, showing that gated communities have no less crime than non-gated neighborhoods.

5.3.5 COMMON ECONOMIC MODEL TYPES

- Lifestyle — country clubs, retirement developments.
- Prestige — gates for status appeal
- Security zone communities — gates for crime and traffic.
- Purpose-designed communities — catering to foreigners (e.g. worker compounds in the Middle East, built largely for the oil industry)

5.3.6 EXAMPLPES

A limited number of gated communities have long been established for foreigners in various regions of the world:

The worker compounds in the Middle East, built largely for the oil industry.

The closed cities of Russia are also an example of purpose-designed gated communities.

The Arbor Oaks subdivision located in El Monte, California, which appears in the film *Back to the Future Part II* as Hilldale, is now gated because of the fans coming to see it in person. Residents are sometimes angry at fans who come by the development.

Argentina

There are many gated communities in Argentina, especially in Greater Buenos Aires, in the county of Pilar, 60 km N of Buenos Aires city, as well as in other suburban areas, such as Nordelta.

Even though Tortugas Country Club was the first gated community developed in Argentina—dating from the 1930s/1940's—most of them date from the 1990s, when liberal reforms were consolidated.

Since Buenos Aires has been traditionally regarded as a socially integrated city, gated communities have been the object of research by sociologists. Gated communities are an important way through which people - particularly middle and upper classes - cope with the high levels of violent criminal activity in Greater Buenos Aires.

Australia

Although gated communities have been relatively rare in Australia, since the 1980s a few have been built. The most well-known are those at Hope Island, in particular Sanctuary Cove, on the Gold Coast of Queensland. Other similar projects are being built in the area. In Victoria, the first such development is Sanctuary Lakes, in the local government area of Wyndham, about 16 km

south west of Melbourne city. In NSW there is Macquarie Links gated community. Many Australian gated communities are built within private golf courses.

Brazil

Alphaville, one of the gated communities on the suburbs of São Paulo, Brazil. It is also a business center of the city.

Brazil also has many gated communities, particularly in the metropolitan regions Rio de Janeiro and São Paulo. For example, one of São Paulo's suburbs, Tamboré, has at least 6 such compounds known as Tamboré 1, 2, 3, and so on. Each consists of generously spaced detached houses with very little to separate front gardens.

One of the first big-scale gated community projects in São Paulo city region was Barueri's Alphaville, planned and constructed during the 1970s military dictatorship when the big cities of Brazil faced steep increases of car ownership by the middle and higher-classes, rural exodus, poverty, crime, urban sprawl and downtown decay.

Canada

Planning laws in some Canadian provinces ban locked gates on "public" roads as a public health issue (they deny emergency vehicles quick access). In any event "physical or explicit gating is relatively rare. More common is an implicit or symbolic gating, which effectively partitions the private infrastructure and amenities of these communities from their surrounding neighbourhoods". Nevertheless, many newer suburban subdivisions employ decorative gates to give the impression of exclusivity and seclusion.

China

China, and Beijing in particular, has experienced a surge in gated communities. These compounds, like most other gated communities around the world, target the rich. Also many foreigners live in gated communities in Beijing . Often foreign companies choose the locations where their foreign employees will live, and in most cases they pay the rent and associated costs (e.g. management fees and garden work etc.).

Mexico

The Bosques de Interlomas area of Mexico City is home to over 250 large gated communities.

Gated communities in Mexico are a result of the huge income gap existing in the country. They are usually found in major cities, such as Monterrey, Mexico City or Guadalajara. The Motecuhzoma Xocoyotzin gated community outside of Mexico City is the largest gated

community in the world, stretching over 54 square miles. It is estimated that there are 56.8 million Mexicans living in gated communities as of 2008.

Philippines

The Philippines has a sizable number of gated communities or "subdivisions" as they are locally called.

Forbes Park in Makati City, Metro Manila - An upper-class subdivision in close-proximity to the Makati Central Business District. It is where the richest personalities in The Philippines live.

Dasmariñas Village in Makati City

Valle Verde in Pasig City, Metro Manila - A series of six separate complexes of homes, all surrounded by walls and guarded by private security guards.

Russia

Gated communities (other than closed cities) usually are made from the secret objects where level of Classifiedency was lowered but communities kept or residents are still in force to preserve its status. The new are not popular because in practice first "point building" were guarded and in spite crime level was higher and prefer single-door checkpoints instead.

Barvikha: it used as elite land even if many houses are guarded separately

Moscow, Gateway-10 island: pass allowed to residence and staff only, two bridges are not shown on the map.

Moscow, Blue bird complex: Checkpoints disabled to pedestrians

Thailand

Nichada Thani is a gated community based around International School Bangkok.

United Kingdom

In the United Kingdom, gated communities can usually be found in London, especially in the Docklands, such as New Caledonian Wharf, Kings and Queen Wharf and Pan Peninsula and east London, for example Bow Quarter in Bow, London, although there is an increasing number across the whole of the country. There are an estimated 1000 gated communities in England.

United States

Most gated communities in the U.S. are unincorporated—some, like Indiana's Briar Ridge, may even span more than one incorporated municipality—but uniquely, there are several

incorporated gated cities in Southern California, namely Bradbury, Canyon Lake, Hidden Hills, Laguna Woods, and Rolling Hills. To meet legal requirements, the city halls and municipal facilities are public, and private corporations own parks and other facilities within the gates. By 1997, an estimated 20,000 gated communities had been built across the country. Approximately 40% of new homes in California are behind walls. In 1997, estimates of the number of people in gated communities ranged from 4 million in 30,000 communities up to around 8 million, with .5 million in California alone.

The village of Rosemont, Illinois, just outside Chicago, maintains a security checkpoint at the entrance of its main residential section.

There are other incorporated gated communities outside California including Sea Ranch Lakes, Florida and North Oaks, Minnesota.

Hot Springs Village, Arkansas is the largest gated community in the United States with over 26,000 heavily-wooded acres. HSV is governed by the HSV Property Owners' Association (POA), a private, tax-exempt home owners association.

Turkey

Turkey has several gated communities, especially in Istanbul and Ankara. They are mostly located around the edge of the city.

Other countries

Aerial view of the Santiago de Surco middle class gated community of Lima, Peru.

Lima, Peru has several gated communities, especially in the wealthy districts of La Molina and Santiago de Surco. They are home to many prominent Peruvians.

Guayaquil and Quito, Ecuador have many gated communities. In the coastal city of Guayaquil they are mostly located in Samborondón and in Quito in the Valleys surrounding the city. They are home mostly for the wealthiest people, but there's a trend, specially in Guayaquil, of houses in gated communities with moderate prices as well.

Pokrovsky Hills and Rosinka are gated communities in Moscow.

In Saudi Arabia, expatriate workers are required to live in Saudi Aramco-controlled gated communities. The largest such community is Dhahran. Gated communities are also popular with well-to-do Saudis. The largest communities include, in addition to Dhahran, Ras Tanura, Abqaiq, and Udhailiyah.

In the United Arab Emirates, gated communities have exploded in popularity, particularly in Dubai, where the 2002 decision to allow foreigners to own freehold properties has resulted in the construction of numerous such communities built along various themes. Examples include The Lakes, Springs, Meadows, and Arabian Ranches.

South Africa has an increasing number of gated communities.

In Indonesia, a gated community is preferred by most people. Some gated communities are luxurious (with lots of up to 740 square metres (8000 sq ft)), and some are very affordable (with lots ranging from 700 to 1300 sq ft). Some examples are houses in Pondok Indah and Kemang.

5.4 SUMMARY

More recent international research tends to highlight a few identifiable risk factors that contribute to high levels of crime. These include:

- Poverty and unemployment deriving from social exclusion particularly from the youth.
- Dysfunctional families with uncaring and incoherent parental attitudes, violence and parental conflicts
- Social valuation of a culture of violence
- Presence of facilitators such as firearms and drugs
- Discrimination and exclusion deriving from sexist, racist or other forms of oppression
- Degradation of urban environments and social bonds
- Inadequate surveillance of places and availability of goods that is easy to transport or sell (ICPC, 1997, pp. 20-21).

These above mentioned factors are the reasons why we build gated communities with big walls and fences. The gated communities are in place so that people that have the financial means can isolate themselves and their loved ones from crime. If anyone had the finances they would without thinking twice live in a gated community. Former Pres. Mbeki and other heads of state all live in highly secure gated communities, yet it is called the new form of apartheid. By addressing the above mentioned factors will help to reduce crime and reduce the need for gated communities.

5.5 CONCLUSION

In the hypotheses it was stated that golf estates are not a big success because of crime, but the research has shown that one of the biggest factors contributing to golf estate sales is the crime rates of a country.

Yes, crime is a major issue and it is not just in South Africa but around the world. Chapter 5 shows that gated communities are a worldwide trend, and it is because of crime. The only way to get rid of the walls and fencing is to stop crime, and that is going to take some doing, by providing an education for all, reduce poverty and do not just make gated communities for the rich, include flats and low income housing into the development. This will ensure that everyone in the community, rich and poor, have access to all the same amenities. Ultimately leading to better living conditions, less crime, the reduction of poverty and even a cleaner environment.

CHAPTER 6:

Conclusion

6.1 BACKGROUND

Many people see Golf Estate Developments as negative projects that have a negative effect on the environment, community and infrastructure, just to make money? Why do we need more golf estates if they have a bad influence on the environment, community, etc?

6.2 SUMMARY

New Golf estates are supposed to be “environmentally friendly”, but they use 1-2 million litres of water per day. Water supply and demand for golf courses are huge. There is not enough water for more golf estate developments and golf courses to exist?

Water is the biggest life source on the planet, we cannot survive without water. One of the biggest problems regarding golf courses is the amount of water needed to sustain the high demand of water golf courses require. The technology is available to solve the water problems and help golf courses with water management, two examples discussed in chapter 2 are; firstly by applying the technology used in submarines to turn salt water into fresh water, a process called reverse osmosis and secondly another technique discussed is the recycling of used water for example; the use of irrigation and other purposes on the golf course.

Golf courses located near the ocean can take a big advantage because both methods can be applied to them, but golf courses located inland can only use the recycling method to optimise a better water usage.

These systems must provide a water purification system that can operate for a long time before cleaning or replacements of membranes, it must also be efficient in energy consumed per unit volume of purified water produced, and environmentally friendly.

Systems and techniques are in place to stop and reduce water waste that will allow the use of golf courses, etc., without unnecessary waste of water. This can also create new job opportunities within the community, as well as save money, and most importantly water, without damage to our precious environment.

Golf Estate Developments damage the environment through destruction of ecosystems, introduction of alien vegetation and pollution through pesticides and fertilisers?

The biggest problem man suffers today is the destruction of our planet. Pollution and deforestation are the two major contributors to global warming. Plants and trees are needed to reduce the carbon footprint we leave behind. Golf courses can provide a solution to some of these problems, they can be used as bio filters, green spaces, and oxygen banks if correctly developed and managed. With the correct management, regulations and application of the different techniques the estates can be reduced of alien vegetation, the use of pesticides and fertilizers can also be brought down and with the introduction of turf grass systems will help with water usage, fertilisers, pesticides, etc.

The care of golf courses has become a professional occupation involving and integrating science, and technologies to provide organic fertilizers with a longer lasting effect and reduces the use of pesticides and fungicides. Specific pests can be targeted and only treated when they reach plague proportions. Microbes can be introduced to combat pests and specific areas can be targeted to reduce overspray. Some golf courses come with their own weather stations to see when rain is forecasted. Probes and tensiometers can be installed to provide water directly to the rooting structure of the plants reducing water runoff and waste.

Golf courses cause the destruction of land and natural heritage? The land can be used for agriculture and informal settlements?

Mining and informal settlements (squatter camps) have been around much longer than golf estates, they cause more destruction of natural land and heritage than golf estates do. Mining causes pollution, destruction of the environment and pollution of waterways, etc. while informal settlements contribute to pollution, unsanitary living conditions, pollution of water and destruction of the environment, etc.

Golf estates or any estate and development can be used in a way to develop the environment, promote recycling and provide a clean living area for people, and contributing to preserve our natural heritage and land. Golf estates can provide more positive aspects to the environment than mining and informal settlements.

There has been a perception created that golf estate developments causes the destruction of land natural heritage and the environment, but new strict guidelines and rules have made developments more environmentally friendly and contributors to the ecosystem if managed

accordingly. People must just open their eyes and see that developments can contribute more to the environment than mining and informal settlements. Developments together with agriculture can create a better living environment that is also aesthetic.

The reason people have problems with golf estates are because we need more houses and agricultural land in South Africa, which will reduce poverty. This is a valid reason, but golf estates can be planned to include housing for low-income housing in a gated community and thus the land where the informal settlement once was can be rescued and reused as agricultural land.

In the Western Cape government has placed demanding guidelines, consisting of a 72 page document, for developments to include low-income housing on the land.

The guidelines take into account the protection of the ecosystem, economic development and social justice. The documents state that estates “shall provide service land and top structures” for low-income housing.

Stronger guidelines should be put in place regarding the effects of pollution caused by mining and agricultural chemicals and fertilizers. In the articles 1, table 1, and the information provided on agriculture it can clearly be seen that a big part of the destruction of the natural land and heritage is caused by mining and agriculture.

Golf Estate Developments are such a big success because they feed of people’s fear of crime and violence and the money of the rich?

South Africa is known all around the world as a country with one of the highest crime rates in the world. Gated communities like golf estates have become very successful because of the fact that people want a safe living environment.

Crime is a major issue and it is not just in South Africa but around the world. This article in chapter 4 show that gated communities are a worldwide trend, and one of the main reasons for this is because of crime. The only way to get rid of the walls and fencing is to stop crime, and that is going to take some doing, by providing an education for all, reduce poverty and do not just make gated communities for the rich, include flats and low income housing into the development. This will ensure that everyone in the community, rich and poor, have access to all the same amenities. Ultimately leading to better living conditions, lesser crime, the reduction of poverty, and even a cleaner environment.

The gated communities are in place so that people that have the financial means can isolate themselves and their loved ones from crime. If anyone had the finances they would without thinking twice live in a gated community. Former Pres. Mbeki and other heads of state all live in highly secure gated communities, yet it is called the new form of apartheid. By addressing some

of the factors mentioned in chapter 4 the above mentioned factors will help to reduce crime and reduce the need for gated communities.

6.3 CONCLUSION

This theses shows that golf estate development can be used in society to develop and promote better living conditions, save and preserve the environment and reduce pollution, but this can only be successful if the right rules, regulations, plans, management, procedures, etc. are in place.

New legislations must be put in place in regards with the topics discussed in this thesis that has to do with golf estate developments and even normal residential developments. This will help change golf estates into eco living spaces that are sustainable in the environment.

Golf courses use a lot of water whether it is for irrigation or household use, the solutions provided in chapter 2 regarding this problem clearly shows that the two techniques discussed can provide a way to reduce the amount of water required to sustain a golf course on a day to day basis, ultimately reducing the amount of water required by golf courses if the golf course did not have these techniques in place.

Golf estates can be used to build new eco systems required for the environment to carry on as a living organism. With correct rules and regulations in place the amount of alien vegetation within some of these estates can be eradicated, because of the destructive nature that alien vegetation have on a foreign environment it remains one of the main problems golf estate developments bring with them. With the correct natural fauna and flora in place the need for fertilizers and pesticides will also be reduced and if a pest, or similar problems occur the pesticides, etc. are available to target the specific insects, diseases causing damage to the plants without destroying or having any negative effect on the other organisms in the environment.

In chapter 4 golf courses are viewed as developments that destroys land that could have been used for other purposes like informal settlements or agriculture, but the fact of the matter is that informal settlement are more destructive than golf courses when regarding the environment, this could be solved with introducing low income housing within the golf estate developments, providing a safe and carefree living environment for everyone. Part of the land of the projects can also set aside for agricultural purposes. Another alternative mentioned in the chapter discusses an agricultural development program; this can also be combined together with golf estates.

Golf estates only cater for the rich, because a developer would like to turn a positive profit at the end of the project, and safety is used as a leverage to attract potential buyers.

The techniques and technologies are available to solve the main problem. The research only discussed some of the problems regarding golf estate developments; there is still room for more in dept research and other sub-problems to be resolved, especially in the field of the environment and the impacts on the environment, regarding golf estate developments. The research in this thesis only describes the details in short in regards to the sub-problem in chapters 2-4. The information provided is efficient enough to reach the conclusion that the main problem can be solved.

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