

# **TOWARDS ZERO-WASTE TO LANDFILL: THE CASE OF CSIR'S FRAMEWORK**

by  
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## **DECLARATION**

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## ABSTRACT

Organisations are beginning to take responsibility for the impacts made by their operations/activities on the environment. The sustainability of organisations can not only be measured by their economic performance, but also by their social and environmental performance. Good governance as recommended in the King III report (Institute of directors in South Africa, 2009) requires reporting to be integrated with the organisation's social and environmental performance. Organisations inevitably use natural resources and generate waste. Agenda 21 states that organisations should use natural resources efficiently (UNCED, 1992). The challenge according to UNDP (1998:1) is not to stop growth, but to *“change the patterns of consumption and production, using new technologies to achieve greater efficiency and reduce waste and pollution”*.

Waste management is not only an internal concern for the Council for Scientific and Industrial Research (CSIR), but also for the national and international institutions. In South Africa, waste management previously only involved the disposal of waste aspects of it; leaving out important components of waste management such as its treatment and the principles of waste reduction, re-use and recycling. South Africa has in the past ten years changed and has instead developed sustainability plans. For example, The Polokwane Declaration on waste management outlines what the government, civil society and the business community will do to ensure the reduction of waste generation and disposal (South Africa, 2001). The National Environmental Management: Waste Act (Act 59 of 2008) states that waste must be reduced, reused, recycled and treated before it is disposed. To this effect, South African municipalities are trying to identify ways to ensure that residents and industry adhere to these requirements.

The CSIR is a scientific and technological research, development and implementation organisation which has a long-standing commitment to environmental protection. It has been accredited for adherence with ISO14001 Environmental Management System requirements for over ten years. Development of the Zero-Waste to Landfill Framework builds on the strengths of the organisation's Environmental Management System and enhances sustainable practices throughout the organisation; and also responds to national imperatives such as the Polokwane Declaration. Typical waste streams generated at the CSIR sites include general business waste (paper, cans, plastics, glass etc), general industrial waste (oils, greases, metals, plastics etc), and hazardous waste (chemical, laboratory, bio hazardous). The Zero-Waste to Landfill Framework assists, and gives guidance to the organisation in order to achieve Zero-Waste to Landfill. It informs the CSIR in planning for initiatives and systems that need to be in place in order to achieve the Zero-Waste to Landfill goal. The framework is developed to provide sustainable solutions for waste management which result in economic, social and environmental benefits for an organisation such as the CSIR.

This research was done to look into the factors that ensure that an effective waste minimisation process and programme is implemented at the CSIR, and the recommendations are that;

- a) The CSIR participates in sustainability reporting.
- b) The CSIR implements green procurement.
- c) The CSIR explores different innovative methods, technologies and materials that can be used to minimise waste.
- d) The CSIR runs intensive awareness raising campaigns.

## OPSOMMING

Dit blyk dat sekere Suid-Afrikaanse organisasies uiteindelik besig is om verantwoordelikheid te neem ten opsigte van die impak wat hul produksieprosesse op die omgewing het. Die volhoubaarheid van organisasies word nie net deur ekonomies uitsette gemeet nie, maar sluit ook die monitoring van organisatories-ekonomiese in. Effektiewe bestuur soos aanbeveel deur die King III verslag (Institute of directors in South Africa, 2009) vereis dat organisatoriese rapportering sosiale en omgewingsuitsette insluit. Dit is onafwendbaar dat organisasies natuurlike bronne sal gebruik en afval daardeur genereer. Agenda 21 (UNCED, 1992) vereis egter dat organisasies natuurlike hulpbronne op 'n effektiewe en verantwoordelike manier sal gebruik. Volgens die UNDP (1998:1) is die uitdaging aan organisasies nie om vooruitgang te stuit nie, maar *“to change the patterns of consumption and production, using new technologies to achieve greater efficiency and reduce waste and pollution”*.

Effektiewe afvalbestuur is nie net van toepassing op die “Council of Scientific and Industrial Research (CSIR) nie, maar geld ook vir ander nasionale organisasies. In die verlede was afvalbestuurmetodes in Suid-Afrika hoofsaaklik gemik op die wegdoening van afval, terwyl metodes soos hergebruik, afvalvermindering en herwinning nie eers oorweeg is nie. Suid-Afrika het gedurende die afgelope tien jaar vooruitgang gemaak op hierdie terrein deur planne te ontwikkel wat volhoubaarheid sal bewerkstellig, byvoorbeeld the Polokwane Verklaring insake Afvalbestuur wat bepaal watter metodes die regering, gemeenskap en besigheidsgemeenskap sal implementeer om die vermindering en wegdoening van vaste afval te verseker. Die “National Environmental Management Waste Act” van 2008 vereis dat metodes vir die vermindering, hergebruik en herwinning oorweeg moet word alvorens blote wegdoening plaasvind. Die munisipaliteite in Suid-Afrika is tans besig om maniere te identifiseer wat sal verseker dat inwoners en industrieë hierdie vereistes nakom.

The CSIR is gemik op tegnologiese navorsing, ontwikkeling en implementering en het 'n langtermyn verbintenis om die omgewing te beskerm. Dit het die afgelope tien jaar die ISO 14 001 akkrediasie bekom en behou. Die ontwikkeling van die “Zero-waste to landfill”-Beleid bou op die positiewe aspek van die Organisasie se omgewingsbestuursisteen en bevorder volhoubare praktyke regdeur die Organisasie. Die Beleid spreek ook tot nasionale imperatiewe soos die Polokwane Verklaring. Die CSIR genereer afvalstrome ten opsigte van algemene kantoorafval (papier, blikkies, plastiek, glas, ens.), industriële afval (olie, ghries, metale, plastiek, ens.), sowel as gevaarlike afvalstowwe afkomstig van laboratoriums wat chemikalieë en biologies-gevaarlike materiaal insluit. Die “Zero-waste to Landfill”-Beleid fasiliteer en gee gestalte aan die Organisasie om hierdie doelwitte in die praktyk te bereik deur die ontwikkeling van inisiatiewe en sisteme. Die

Beleid is ontwikkel met die doel om volhoubare oplossings te verskaf aan 'n Organisasie soos die CSIR wat uiteindelik ekonomiese, sosiale en omgewingsvoordele sal inhou. Hierdie navorsing is gedoen om faktore wat die suksesvolle implementering van effektiewe afvalvermindering prosesse en programme by die CSIR beïnvloed te ondersoek.

Die aanbevelings sluit die volgende in:

- a) Die CSIR moet betrokke wees by volhoubare rapporteringsmetodes.
- b) Die CSIR moet aankoopmetodes implementeer wat volhoubaarheid ondersteun.
- c) Die CSIR moet verskeie innoverende metodes, tegnologie en materiale ondersoek wat gebruik kan word om die generering van afval te minimaliseer.
- d) Die CSIR moet intensiewe bewusmakingsveldtogte van stapel stuur.

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## Table of Contents

DECLARATION .....	i
ABSTRACT .....	ii
OPSOMMING .....	iv
ACKNOWLEDGEMENTS .....	vi
LIST OF FIGURES .....	x
LIST OF TABLES .....	x
LIST OF BOXES .....	x
LIST OF ACCRONYMS AND ABBREVIATIONS .....	xi
1 BACKGROUND .....	1
1.1 INTRODUCTION .....	1
1.2 WASTE MANAGEMENT WITHIN THE CSIR .....	3
1.3 RATIONALE OF THE STUDY .....	6
1.4 RESEARCH PROBLEM .....	7
1.5 RESEARCH GOAL .....	8
1.6 RESEARCH OBJECTIVES .....	8
1.6.1 General Objective .....	8
1.6.2 Specific Objective .....	8
1.7 KEY CONCEPTS .....	9
1.7.1 Waste management .....	9
1.7.2 Waste minimisation .....	9
1.7.3 Zero-Waste to Landfill .....	9
1.8 STRUCTURE OF THE THESIS .....	9
2 LITERATURE REVIEW .....	11
2.1 INTRODUCTION .....	11
2.2 WASTE MANAGEMENT .....	12
2.2.1 Waste Management challenges in South Africa .....	12
2.2.2 South African policies and legislation on waste management .....	14
2.2.3 Requirements for waste generators .....	18
2.2.4 City of Tshwane integrated environmental policy .....	20
2.2.5 City of Tshwane solid waste by-laws .....	21
2.2.6 The City of Johannesburg (CoJ) Integrated Waste Management Policy .....	22
2.2.7 Zero-Waste to Landfill .....	22
2.2.8 The Waste Management Hierarchy .....	22
2.2.9 Minimising waste in organisations .....	24
2.3 SUSTAINABLE DEVELOPMENT .....	26
2.3.1 Waste management and sustainable development .....	28
2.3.2 International obligations .....	29
2.3.3 The National Framework for Sustainable Development (NFSD) .....	29
2.3.4 Sustainable development in organisations .....	30
2.3.5 Advantages of sustainable development in organisations .....	35
2.3.6 Indicators of sustainable development .....	36
2.4 ASSESSING PROGRESS TOWARDS SUSTAINABLE DEVELOPMENT .....	37
2.4.1 A guiding vision and goals .....	40
2.4.2 Essential elements .....	41
2.4.3 Practical focus .....	41



2.4.4 Adequate scope .....	42
2.4.5 A holistic perspective .....	42
2.4.6 Openness .....	44
2.4.7 Effective communication .....	46
2.4.8 Broad participation .....	47
2.4.9 Ongoing assessment .....	48
2.4.10 Institutional capacity.....	49
2.5 CONCLUSION .....	50
3 RESEARCH DESIGN AND METHODOLOGY .....	52
3.1 INTRODUCTION .....	52
3.2 RESEARCH DESIGN.....	52
3.3 RESEARCH METHODOLOGY.....	53
3.3.1 The case study.....	54
3.3.2 Interviews with experts.....	57
3.4 RESEARCH INSTRUMENTS .....	58
3.5 DATA.....	59
3.6 ANALYSIS.....	61
3.7 LIMITATIONS AND ASSUMPTIONS.....	61
3.8 ETHICAL CONSIDERATIONS .....	61
3.9 CONCLUSION .....	62
4. RESULTS .....	63
4.1 INTRODUCTION .....	63
4.2 CASE STUDY RESULTS .....	63
4.2.1 Organisation principles and culture .....	63
4.2.2 Setting of waste indicators .....	66
4.2.3 Environmental Management System (EMS).....	67
4.2.4 Waste management roles and responsibilities .....	70
4.2.5 Waste management planning.....	71
4.2.6 Knowledge management .....	74
4.2.7 Training, awareness and communication .....	75
4.3 RESULTS FROM INTERVIEW WITH EXPERTS .....	77
4.3.1 Organisation principles and culture .....	77
4.3.2 Setting of waste indicators .....	77
4.3.3 Environmental Management System (EMS).....	78
4.3.4 Waste management roles and responsibilities .....	78
4.3.5 Waste management planning.....	78
4.3.6 Knowledge management .....	79
4.3.7 Training, awareness and communication .....	79
4.4 DISCUSSION OF THE RESULTS .....	80
4.4.1 Organisation principles and culture .....	81
4.4.2 Setting waste indicators .....	81
4.4.3 Environmental Management System (EMS).....	82
4.4.4 Waste management roles and responsibilities .....	83
4.4.5 Waste management planning.....	83
4.4.6 Knowledge management .....	84
4.4.7 Training awareness and communication .....	84

4.5 CONCLUSION .....	85
5 CSIR ZERO-WASTE TO LANDFILL FRAMEWORK .....	86
5.1 INTRODUCTION .....	86
5.2 DEFINITIONS.....	86
5.3 ACRONYMS AND ABBREVIATIONS.....	87
5.4 OBJECTIVE .....	87
5.5 SCOPE.....	87
5.6 RESPONSIBILITIES.....	87
5.7 BACKGROUND.....	88
5.8 ORGANISATIONAL GOALS .....	91
5.9 INDICATORS AND TARGETS .....	91
5.10 WASTE INFORMATION.....	92
5.11 WASTE MANAGEMENT HIERARCHY .....	92
5.12 WASTE MINIMISATION INITIATIVES.....	93
5.13 ENVIRONMENTAL MANAGEMENT SYSTEM (EMS).....	94
5.14 CONCLUSION .....	96
6 IMPLEMENTATION OF THE FRAMEWORK.....	98
6.1 INTRODUCTION .....	98
6.2 GOAL SETTING.....	98
6.3 PLANNING AND WASTE MINIMISATION TARGETS.....	99
6.4 INTEGRATION.....	100
6.5 CHECKING .....	101
6.6 CONCLUSION .....	102
7 CONCLUSIONS AND RECOMMENDATIONS.....	103
7.1 INTRODUCTION.....	103
7.2 JUSTIFICATION OF THE ACHIEVEMENT OF THE STUDY .....	103
7.2.1 Research problem.....	103
7.2.2 Goals and objectives.....	103
7.2.3 Research design .....	104
7.3 EVALUATION OF THE STUDY.....	104
7.4 RECOMMENDATIONS .....	105
7.5 CLOSING REMARKS.....	106
REFERENCES .....	107
LIST OF INTERVIEWEES .....	117
APPENDICES.....	121
APPENDIX 1: PROPOSITIONS FROM THE LITERATURE REVIEW .....	121
APPENDIX 2: CASE STUDY PROTOCOL.....	123
APPENDIX 3: CASE STUDY FOLLOWUP INTERVIEW QUESTIONS .....	132
APPENDIX 4: LOCATION AND USAGE OF INFORMATION.....	134
APPENDIX 5: EXPERT INTERVIEW QUESTIONS.....	135
APPENDIX 6: CSIRO DRAFT INTEGRATED WASTE MANAGEMENT PLAN.....	137
APPENDIX 7: CSIR DRAFT ENVIRONMENTAL STRATEGY (EXTRACT).....	138
APPENDIX 8: PLANNED STAKEHOLDER ENGAGEMENT .....	166
APPENDIX 9: CSIR INTEGRATED WASTE MANAGEMENT PLAN DEVELOPEMENT (IWMP) PROCESS.....	167
APPENDIX 10: WASTE MANAGEMENT PROJECT PROPOSAL.....	168

APPENDIX 11: ENVIRONMENTAL MANAGEMENT COMMITTEE TERMS OF REFERENCE	174
APPENDIX 12: INTERNAL ISO14001:2004 AUDITS CONDUCTED IN 2010 – 11 .....	179

## LIST OF FIGURES

Figure 1: CSIR representation in South Africa.....	1
Figure 2: SSHERM relationship to the CSIR .....	2
Figure 3: SSHERM Structure .....	4
Figure 4: Framework on how the literature review is presented.....	11
Figure 5: The waste management hierarchy .....	23
Figure 6: The spheres of sustainability.....	27
Figure 7: The Interdependence model of sustainability .....	27
Figure 8: ISO14001 Plan-Do-Check-Act (PDCA) Methodology .....	32
Figure 9: Research Design .....	53
Figure 10: CSIRO's Environmental Management Framework .....	65
Figure 11: South African National Waste Management Hierarchy.....	93
Figure 12: CSIR waste minimisation initiatives .....	94
Figure 13: Integration of ISO14001 EMS with CSIR waste minimisation process .....	95

## LIST OF TABLES

Table 1: IEM Tools.....	33
Table 2: Strategies for the selection of Samples and Cases .....	55
Table 3: Case study Tactics for four Design Tests .....	56

## LIST OF BOXES

Box 1: Bellagio's principles.....	37
Box 2: HSE's five essential strategic initiatives.....	67

## LIST OF ACCRONYMS AND ABBREVIATIONS

CEO: Chief Executive Officer  
COGTA: Cooperative governance and traditional affairs  
CoJ: City of Johannesburg  
CSE: CSIRO Sustainability Ecosystems  
CSIR: Council for Scientific and Industrial Research  
CSIRO: Commonwealth Scientific and Industrial Research Organisation  
CSR: Corporate Social Responsibility  
DEAT: Department of Environmental Affairs and Tourism  
DWAF: Department of Water Affairs and Forestry  
EHS: Environment, Health and Safety  
EMPR: Environmental Management Programme Report  
EMC: Energy management committee  
EMS: Environmental Management System  
EMSC: Environmental Management Systems Committee  
ESS: Environmental Sustainability Strategy  
FM: Facilities Management  
GRI: Global Reporting Initiative  
HBA: Human Biological Agents  
HCS: Hazardous Chemical Substances  
H&S: Health and Safety  
HSE: Health, Safety and Environment  
HSEC: Health, Safety, Environment Committee  
IDP: Integrated Development Plan  
IEM: Integrated Environmental Management  
IndWMP: Industry Waste Management Plan  
ISO: International Organisation for Standardization  
IWMP: Integrated Waste Management Plan  
IWMS: Integrated Waste Management Strategy  
JPOI: Johannesburg Plan of Implementation  
JSE SRI: Johannesburg Stock Exchange Socially Responsible Investment  
KPI: Key Performance Indicator  
NEMA: National Environmental Management Act  
NFSD: National Framework for Sustainable Development  
NRE: Natural Resources and the Environment  
NWMS: National Waste Management Strategy

OHS&E: Occupational Health Safety and Environment

PSC: Project Planning Committee

RA: Risk Assurance

RA&A: Risk Assessment and Audit

SABS: South African Bureau of Standards

SADC: Southern African Development Community

SAWIC: South Africa Waste Information Centre

SHE: Safety, Health and Environment

SHES: Safety, Health, Environment and Security

SHEQ: Safety, Health, Environment and Quality

SSHERM: Security, Safety, Health, Environment and Risk Management

UN: United Nations

UNCED: United Nations Conference on Environment and Development

UNDP: United Nations Development Program

UNGC: United Nations Global Council

UNISA: University of South Africa

USEPA: United States Environmental Protection Agency

VC: Video conference

WCED: World Commission on Environment and Development

WSSD: World Summit for Sustainable Development

## 1 BACKGROUND

### 1.1 INTRODUCTION

The Council for Scientific and Industrial Research (CSIR) is one of the leading scientific and technology research, development and implementation organisations in Africa (CSIR, 2007). The main campus of the CSIR is in Pretoria, and it is represented in several regional sites in South Africa (see Figure 1 for CSIR representation in South Africa). The CSIR's mandate is to improve the quality of life of the people of South Africa through research and technological innovation (CSIR, 2008a): *"The objects are that through directed and particularly multi-disciplinary research and technological innovation, should in the national interest and in fields which in its opinion should receive preference, foster industrial and scientific development, either by itself or in co-operation with principals from the private or public sectors. In doing so, the CSIR contributes to the improvement of the quality of life of the people of the Republic of South Africa. The CSIR also performs any other functions that may be assigned to the CSIR by or under this Act"* (CSIR, 2008a).



Figure 1: CSIR representation in South Africa

The CSIR Safety, Health and Environment (SHE) policy states that the CSIR is committed to ensuring the environmental integrity of its activities, products and services. This will be achieved by protecting the natural environment and minimising adverse impacts on the environment caused by the organisation's activities, products and services (CSIR, 2008b). The core activities of the CSIR are research and development, and these activities may impact on the environment in different ways. The Security, Safety, Health, Environment and Security (SSHERM) department has identified ways in which this can happen, and has documented these in separate SHE Risk assessments for the organisation (See Figure 2 below for how SSHERM relates to the organisation). Land, soil and water pollution have been identified in the risk assessments as possible risks that can be caused by waste generation from the organisation's activities (CSIR, 2008c). These impacts can be minimised by reducing waste generation, reducing waste to landfill and implementing proper and safe waste disposal methods. It is through the commitment as stated in the SHE policy that the CSIR endeavours to continue to improve its environmental performance; and the impacts of its generated waste streams.

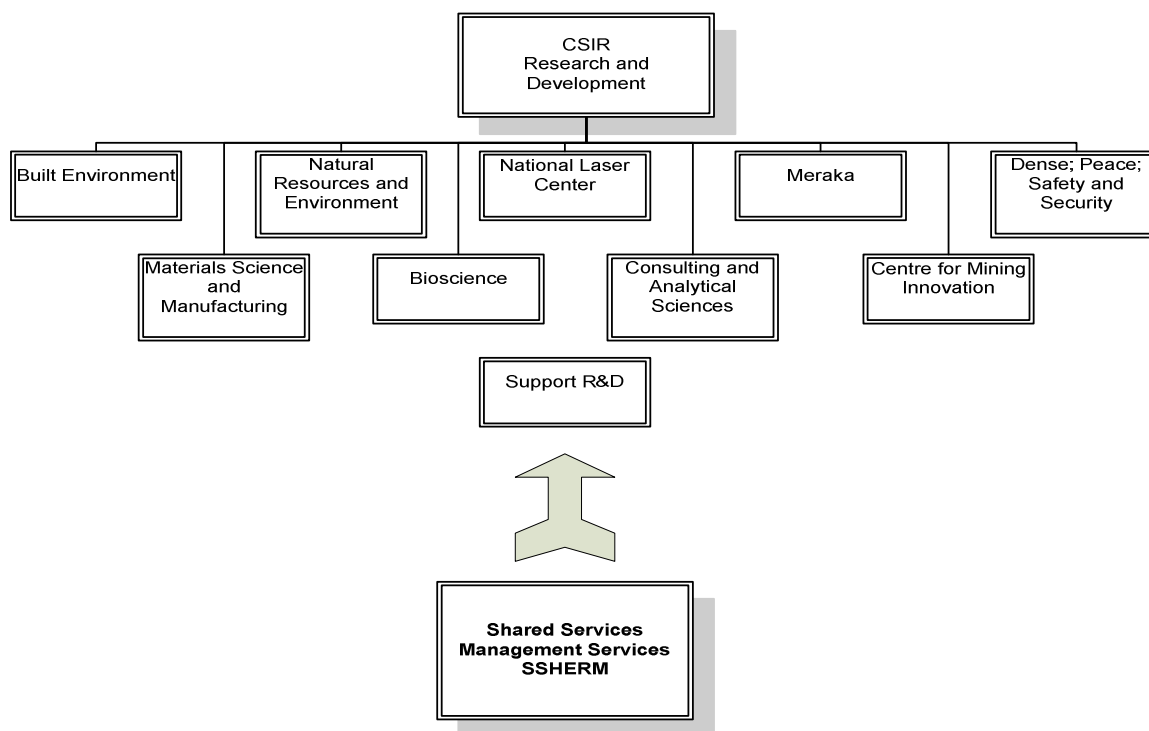


Figure 2: SSHERM relationship to the CSIR

This study has subsequently focused on the factors that ensure that an effective waste minimisation process and programme is operational within an organisation. The factors may include decision makers, engineering systems, standards, requirements, and employees. It is therefore necessary to conduct a study that will take into account the complexity of the

organisation as stated by Max-Neef: *“our relation with a complex world and a complex nature requires complex thought”* (Max-Neef, 2004:27).

MacDonald (2003:631-643), in his study on strategic sustainable development using the ISO 14001 standard, suggests broad big picture planning for organisations that want to implement programmes such as waste management. He suggests that organisations should plan for sustainability and apply ISO14001 from a more strategic perspective. This planning requires a clear understanding of energy and material flows in the organisation and how they relate to products, processes and services. MacDonald (2003:631) believes that tools such as ISO14001, while a useful start, do not in themselves assist an organisation in strategic planning with true sustainability in mind. A Zero-Waste to Landfill Framework that takes the complexity of the organisation into account, plans for sustainability and applies ISO14001 from a more strategic perspective can therefore assist the organisation to achieve its Zero-Waste to Landfill goal.

## **1.2 WASTE MANAGEMENT WITHIN THE CSIR**

The CSIR either owns or rents space at its various different sites. At some spaces of its sites, there are tenants who rent space. Waste management at all the sites is entirely the responsibility of the CSIR and waste collection is either done by the local municipality or outsourced to a private service provider. Almost all the sites have more than one building. Typical waste streams generated at the sites include general business waste (paper, cans, plastics, glass etc), general industrial waste (oils, greases, metals, plastics etc), and hazardous waste (chemical, laboratory, bio hazardous).

The CSIR SSHERM Manager has the overall responsibility for environmental compliance and improvement within the organisation. Previously the SSHERM Manager had appointed the Occupation Hygienist as the responsible person for waste management. This had an adverse effect of knowledge gap on waste management. The new SSHERM structure which came into effect in April 2010 is presented in Figure 3. The Environmental Manager was appointed in September 2010 to report to the SSHERM Manager with the responsibility of environmental management. The Environmental Manager gives strategic guidance on environmental issues and ensures that the organisation complies with legal and other environmental requirements. Until April 2011 there were Safety, Health, Environment and Quality (SHEQ) Managers responsible for the implementation of environmental policies in the different operating units, departments and research sites. The SHEQ Managers from Shared Services were appointment as Safety, Health and Environment (SHE) Management Representatives within the operating units and centres. They



served as the link between top management and employees regarding SHEQ operational issues. Currently the units are in the process of appointing unit-based SHE Management Representatives.

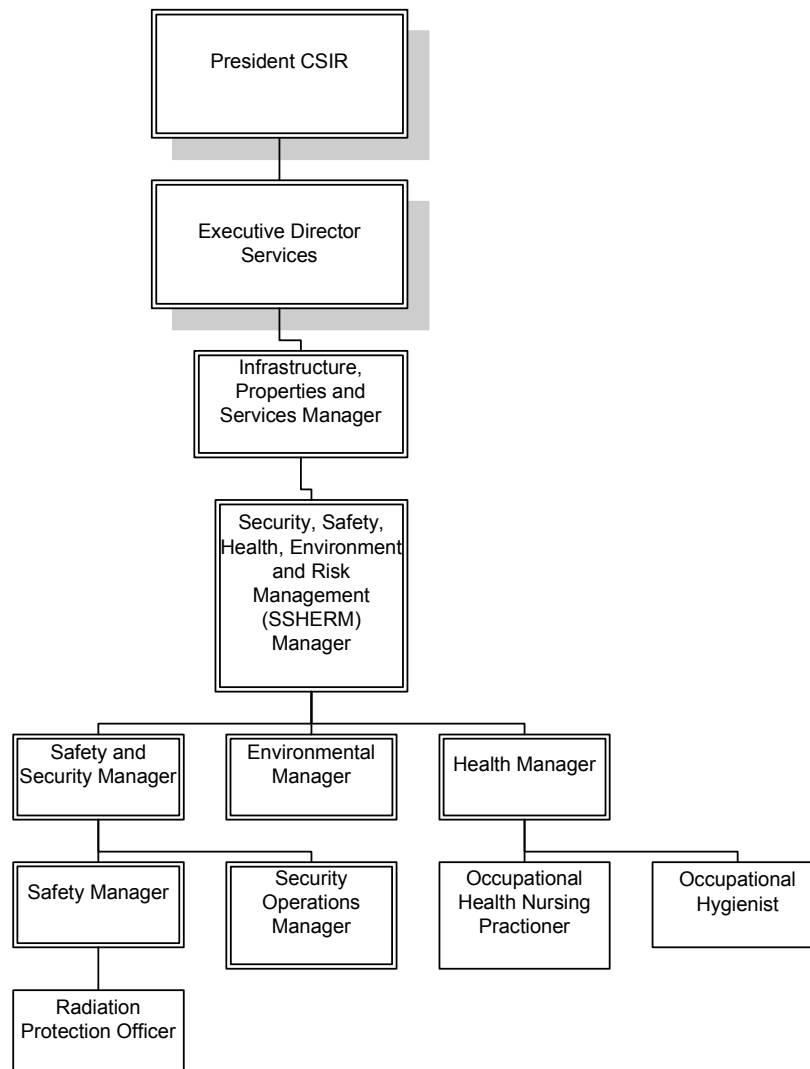


Figure 3: SSHERM Structure

ISO14001:2004 requires that the units' appoint a member of top management as Management Representative with specific responsibility for health, safety and the environment, irrespective of other responsibilities, and with defined roles and authority for:

- Ensuring that an SHE system is established, implemented and maintained in accordance with the ISO standards
- Ensuring that reports on the performance of the SHE management system are presented to top management for review and used as a basis for improvement of the SHE management system.

The SSHERM department is responsible for ensuring that the organisation adheres to its Safety, Health and Environment policies, as well as legal and other requirements that are related to their

mandate. The implementation and maintenance of the ISO 14001:2004 Environmental Management System (EMS) has been used in the organisation to facilitate and ensure adherence to these policies and requirements. SHE management within SSHERM has put measures that ensure that the organisation mitigates the impact of waste on the environment. Waste streams have been identified, hazardous waste is collected and disposed of by approved hazardous waste service providers and some waste is being recycled. Although this is acceptable and compliant with the requirements of ISO 14001:2004, it is not sufficient to enable the organisation to achieve Zero-Waste to Landfill.

The SSHERM 2010-2011 draft business plan states that the SSHERM Department's objective is to improve and enforce proper waste management within the organisation (SSHERM, 2010). One of the department's concerns is that there is currently no information available on the volumes of waste re-used, reduced and recycled. This makes it difficult to identify the trends within the organisation. The development of the Zero-Waste to Landfill Framework in this project, serves to address these plans and concerns.

Waste management procedures that state how waste generated at the sites will be managed from generation production to disposal have been drafted for the different CSIR sites (CSIR, 2008d; CSIR, 2000; CSIR, 1994). Some sites do not have these procedures, but they have systems for managing waste. The different responsibilities of authorities in waste management processes are generally listed as follows in procedures:

- Facilities Manager: Responsible for ensuring implementation of waste management procedures and ensuring compliance with waste management requirements.
- Maintenance Officer (Estates) and Facilities Management: Responsible for monitoring and checking all general, garden and waste oil removal.
- The general waste contractor: Responsible for the removal and recycling of all domestic and office waste according to the Refuse Removal and Recycling Contract.
- SHEQ Managers, Hazardous Biological Agents (HBA) and Hazardous Chemical Substances (HCS) Coordinators (if appointed) and SHE Representatives: Responsible for the handling, containment and disposal of all hazardous waste in their areas.
- All employees: Responsible for the handling and containment of waste, and reporting any incidents of irresponsible handling and containment of waste.

The CSIR procurement policies and procedures do not encourage green procurement. The procurement policy is put in place to encourage transparency, fairness, equity, uniformity, cost-effectiveness and efficiency. The CSIR Weighting Matrix (CSIR, 2007; CSIR, 2007a) is used to

evaluate and rate suppliers. This matrix leaves it up to the person procuring the goods to consider greening requirements under other factors when evaluating the supplier. The main factors that are evaluated are cost, technical competence and BEE status. Suppliers providing goods and services equal or more R500 000 per annum are also evaluated at least every twenty four months or at an ad hoc review requested by procurement. The evaluation dimensions used here also do not include any greening requirements, what is looked at is;

- Price performance,
- quality of product/service,
- quality of support,
- objectives set and met and
- contractibility and responsiveness.

### 1.3 RATIONALE OF THE STUDY

Industry as a major contributor of waste generation plays a major role in waste management (DEAT, 2007:1). Lack of proper waste management may have a number of potential negative impacts on the environment and human health. Terry (2008:145) states that: *“whilst companies contribute to the economy, they also draw on it. They consume scarce resources, they generate waste and they use the infrastructure of their countries.”* One way in which waste generation impacts negatively on the environment and human health is through inefficient usage of natural resources. Many products (e.g. paper) that are used and disposed of at the CSIR are produced from natural resources. Waste generation also impacts negatively on the environment and human health is through environmental pollution. If hazardous substances are disposed of incorrectly, they will pollute the environment. Responsible organisations must prevent and minimise negative impacts of waste generation on the environment.

The National Environmental Management: Waste Act (Act 59 of 2008) and Polokwane Declaration aim to promote proper waste management. The Act requires that hazardous waste is treated before it is disposed and that all waste is disposed of in an appropriate manner. In addition to this, it requires that waste reduction, reuse, recycling and recovery is adopted if its use of natural resources is more efficient than disposal and if it is less harmful to the environment. As a South African organisation which is ISO14001:2004 accredited, the CSIR needs to comply with this requirement.

The need to improve waste management has been identified by the organisation. In 2002, an assessment of waste management was conducted at the CSIR Pretoria site (CSIR, 2003). The report identified issues and gaps, and recommended solutions to address them. Short, medium

and long-term integrated waste management objectives and implementation strategies were also proposed for the organisation as a result of this audit. Although nine years have passed since the report was published, the organisation still faces some of the waste management challenges identified in 2002.

The issues and gaps that were identified in the 2002 waste management assessment and which remain unresolved are the following:

- Build-up of spent, chemical hazardous samples in laboratories and workshops;
- Poor source separation of recyclables;
- Staff unsure of safe disposal methods of various wastes;
- Need for reliable waste information from the Pretoria site;
- Need for alternatives to waste disposal;
- Not all staff are aware of CSIR procedures;
- Staff are reticent to implement waste minimization, re-use and recycle initiatives; and
- There is no cost structure in place to promote disposal of wastes generated on site.

The following objectives were identified in this assessment but have not yet been fully addressed as per the proposed implementation plan:

- Waste volume/tonnage and type must be captured electronically by Environment, Health and Safety department to allow for the establishment of trends over time;
- The principles of sustainable waste management, namely waste reduction, re-use, recycling, and disposal are to be implemented on site;
- Waste produced by tenants should be recorded; and
- Tenants need to be managed.

#### **1.4 RESEARCH PROBLEM**

Although the CSIR has been ensuring that negative impacts on the environment caused by waste generated at the organisation are minimised, efficient use of natural resources has not been prioritised. Waste generation and disposal trends have not been monitored at the CSIR, and there have been no formal organisational initiatives to ensure that waste generation is reduced. CSIR procurement processes allow for any type of material to be procured without considering ways of reducing waste. Although recycling and reuse is done in some areas, there is still a lot of recyclable and reusable waste that is being disposed to landfill. This is an environmental sustainability problem as natural resources are currently being used inefficiently and that there is dwindling of landfill space in South Africa.

As already indicated in Section 1.2 of this Thesis above, the CSIR currently has a SSHERM department that is responsible for environmental management in the organisation. One of the responsibilities of this department is to ensure that the organisation complies with applicable waste regulations and to set improvement targets on the generation and disposal of waste. The SSHERM 2010-2011 draft business plan states that the SSHERM department has plans to improve and enforce proper waste management within the organisation (SSHERM, 2010). However, there is no framework to guide the department and organisation on how to achieve this. This framework needs to be developed. The core task for this research is to develop the CSIR Zero-waste to Landfill framework. This framework will contribute to the improvement and enforcement of waste management as required by the SSHERM department.

## **1.5 RESEARCH GOAL**

The goal of this research is to develop a detailed framework that the CSIR can use to achieve the objective of Zero-Waste to Landfill according to national imperatives such as: the Polokwane Declaration; Waste Act (Act 59 Of 2008); the National Waste Management Strategy (DEAT,2009) and the National Domestic Waste Management Standards (DEAT, 2009). To this effect, objectives were drawn in order to meet the above goal, and these are outlined below.

## **1.6 RESEARCH OBJECTIVES**

### **1.6.1 General Objective**

The general objective of the research is to investigate the ways in which Zero-Waste to landfill can be achieved in the entire CSIR operations.

### **1.6.2 Specific Objective**

Specific objectives were set in this study in order to ensure that the research goal and its general objective are achieved. These objectives were as follows:

- Gathering information and assessing from literature what is required for organisations to achieve Zero-Waste to Landfill.
- Using information from the literature to develop propositions to be used to produce case study and interviews questions.
- Selecting a specific case where waste management and waste minimisation goals have been set and conducting a study on the case.
- Interviewing experts in order to gain their opinions on issues pertaining to what has been assessed from literature.

- Analysing data and information from the literature review, case study and interviews with experts in order to develop principles to use to develop the CSIR Zero-Waste to Landfill Framework.

## **1.7 KEY CONCEPTS**

The key concepts that are repeatedly used in this study are:

### **1.7.1 Waste management**

Waste management refers to the necessary measures that are taken to prevent, or where prevention is not possible, to minimise the amount of waste that is produced and the risk posed by waste to health and the environment (Government of South Africa, 2007).

### **1.7.2 Waste minimisation**

Waste minimisation refers to all the methods used to reduce material utility at source and improve process efficiency (Government of South Africa, 2005).

### **1.7.3 Zero-Waste to Landfill**

The term Zero-Waste to Landfill is used in this study; this may also be referred to as Zero-Waste in other literature. For the purpose of this study Zero-Waste to Landfill refers to a state where waste generation is minimised as far as is technologically and economically feasible. Waste minimisation is therefore required in order to achieve Zero-Waste to Landfill. Although the term “Zero-Waste” implies “No-Waste”, it does not necessarily take this meaning literally in this study.

## **1.8 STRUCTURE OF THE THESIS**

The report is divided into seven chapters namely;

- Chapter 1: Background
- Chapter 2: Literature review
- Chapter 3: Research design and methodology
- Chapter 4: Results
- Chapter 5: Zero-Waste to Landfill Framework
- Chapter 6: Implementation of the Zero-Waste to Landfill Framework
- Chapter 7: Conclusions and recommendations

The full encapsulation of all the chapters is given below.

The background of this study is given in the first chapter. The second chapter covers the literature review. The literature review provides an insight into what is required in order to achieve Zero-

Waste to Landfill. There are certain international, national and organisational expectations and obligations that must be met in terms of waste management. It is also important to understand what Zero-Waste to Landfill means and how this can be achieved in organisations. In this study it is assumed that Zero-Waste to Landfill promotes sustainable development, therefore the literature covers ways in which progress towards sustainable development can be assessed. From this chapter, propositions are developed. These propositions cover the important aspects gathered from the literature review.

The third chapter describes the overall strategy that was followed when conducting the study. The research design ensured that the goal of the study was achieved. Two data collection methods were used; the case study and interviews with experts. The propositions from the literature review were used to develop case study and interview questions. A single case, Commonwealth Scientific and Industrial Research Organisation (CSIRO) was selected for this study. Four experts in the areas of EMS, Sustainability or Waste Management were interviewed in order to obtain their opinions pertaining to implementation of a Zero-Waste to Landfill initiative in an organisation such as the CSIR.

Results of the case study and interviews with experts are presented and analysed in the fourth chapter. The analysis of the results leads to the development of the Zero-Waste to Landfill Framework in chapter five. Chapter six is a follow up on the study, explaining how the Zero-Waste to Landfill Framework has been implemented at the CSIR. Finally, the last chapter presents conclusions and recommendations drawn from this study.

## 2 LITERATURE REVIEW

### 2.1 INTRODUCTION

According to Hofstee (2006:91), a literature review provides a theoretical base, a survey of published works pertaining to the investigation, and an analysis of that work. Hofstee (2006:91) adds that the literature review shows that there is a theory base for the work that has been proposed. In this case, the theory provides an insight into what is required to achieve Zero-Waste to Landfill in terms of expectations from an international, national and organisational point of view. Figure 4 below shows the outline of the literature review as it is presented in this section.

Section	Topics covered
2.2 Waste Management	Waste management challenges in South Africa
	South African policies and legislation on waste management
	Requirements for waste generators
	City of Tshwane integrated environmental policy
	City of Tshwane solid waste by-laws
	City of Johannesburg Waste Management Policy
	Zero-Waste to Landfill
	The Waste Management Hierarchy
	Minimising waste in organisations
2.3 Sustainable Development	Waste management and sustainable development
	International obligations
	The National Framework for Sustainable Development (NFSD)
	Sustainable development in organisations
	Indicators for sustainable development
2.4 Assessing progress towards sustainable development	A guiding vision and goal
	Essential elements
	Practical focus
	Adequate scope
	A holistic perspective
	Openness
	Effective communication
	Broad participation
	On-going assessment
	Institutional capacity

Figure 4: Framework on how the literature review is presented



Because the goal of the study is to develop a Zero-Waste to Landfill Framework for an organisation, the structures and tools that can be used in an organisation are discussed. The literature review starts with waste management requirements. There are legal and other requirements that waste generators are expected to comply with. Some of the requirements that affect the CSIR are covered in this section. It is important to understand what the term Zero-Waste to Landfill means, and what is required in order to achieve this. The literature then covers the types of techniques that can be used to achieve Zero-Waste to landfill. It is understood in this study that Zero-Waste to Landfill contributes to sustainable development. With this understanding, the theory therefore looks at what the South African Government and organisations in the country are doing to achieve sustainable development. The last section of the literature review details how progress towards Sustainable Development can be assessed. The Bellagio principles supported by other literature sources are used to review this assessment. The information that is gathered in this chapter enables the researcher to draw propositions which are used later in this study.

## **2.2 WASTE MANAGEMENT**

### **2.2.1 Waste Management challenges in South Africa**

South Africa faces a number of waste management challenges. These challenges are mainly due to a lack of adequate resources and inappropriate infrastructure for waste disposal. There are also challenges with disposal of hazardous and harmful waste resulting in pollution, especially in cases where illegal dumping of waste takes place. For a long time the focus in South Africa was on waste disposal and impact control. This resulted in the lack of waste avoidance, minimisation and cleaner production technology initiatives and regulatory initiatives to manage waste minimisation (Government of South Africa, 2000b). Industry also has challenges in implementing waste minimisation initiatives. The following were said to be problems affecting the implementation of waste prevention, minimisation and recycling in industry:

- *“Insufficient commitment to waste minimisation by management. The amount of information targeted at management level should be increased and information on the techniques and benefits associated with waste minimisation, recycling and cleaner production should be made available.*
- *The prevalent perception that waste minimisation and recycling is a cost factor rather than an opportunity for savings, should be rectified.*
- *The lack of knowledge about the availability of waste minimisation and recycling technology and existing case studies must be addressed.*

- *Better training and appropriate courses in waste minimisation and recycling should be instituted.”*

(Government of South Africa, 2000)

Most of the waste in South Africa is disposed of at landfills. However, in some instances there is lack of land for additional landfills (DEAT, 2009). Industrial and domestic general wastes are both disposed of at general waste landfill sites (Government of South Africa, 2000). As the amount of waste generated increases, there is an increase in the number of landfill sites that are required. This has put pressure on municipalities to supply waste disposal facilities (Government of South Africa, 2010). The lack of adequate waste disposal facilities has led to dumping of waste on inappropriate areas resulting in land and ground water pollution.

It was also reported in Government of South Africa (2010) that waste is frequently burned in the streets by impatient communities awaiting service delivery. This can result in the release of harmful substances such as dioxins and furans as an Unintentional Persistent Organic Pollutants (UPOPs). *“Many illegal waste disposal sites have developed for reasons including delayed collection services, long transport distances to formal disposal sites, the refusal by the public or industry to pay landfill fees, an indifference to the environmental consequence of poor waste handling and disposal and the lack of waste education and awareness”* (Government of South Africa, 2010). DEAT (2009) also states that illegal dumping and littering is a challenge in South Africa. Medical waste is sometimes disposed of at informal dumping sites. This creates the risk for informal salvagers, as well as the general public (especially young children), to contract diseases. Ball (2006) points out that unacceptable waste management practices are said to be common in developing countries.

Municipalities face the challenge of a lack of resources that will enable them to obtain the right technological solutions needed to solve some of the problems they are faced with. Municipalities still rely on revenue that is generated from waste disposal and this can be small, especially where there are large numbers of poor households. Lack of resources in the waste management context refers to staff know-how, infrastructure and finances dedicated to developing and executing waste management services (Ball, 2006). Financing and charges for waste management have been found to be challenges in South Africa (DEAT, 2009). The 2000 White Paper on Integrated Pollution and Waste Management states that insufficient funds and human resources are allocated to waste management because it is not prioritized. According to Ball (2006), this is common in developing countries as waste management is given lower priority over water, food, shelter, roads, electricity and sanitation.

Nhamo, et al. (2008) categorise the challenges faced by municipalities as both technical and governance challenges. The main technical challenges are related to *“reliability of equipment, provision of required infrastructure and vandalism of equipment.”* The governance challenges include political issues, financial management, planning, capacity, administrative arrangements, procurement and legislation. Due to the fact that municipal management appointments are political appointments, a political agenda will be dictated when decisions are made. This compromises the implementation of environmental initiatives. The challenge will always be the low priority afforded to waste management. Financial management is affected by the lack of accounting; this in turn impacts on the generation of income and profit. Proper planning is limited by the lack of accurate data. In addition to this, waste management by-laws are not available in most municipalities, and those municipalities that have by-laws in place, enforcement is lacking. Lack of by-laws results in illegal dumping and non-compliance to landfill permits Nhamo, et al. (2008).

The management of hazardous waste is a further challenge in South Africa. Inadequate management of waste disposal sites that contain hazardous substances can result in land pollution (Government of South Africa, 2000a). There is an increase of electronic waste as electronic goods are sold or donated to South Africa when they near their expiry date. The South African Government reported in the 2000 that there was lack of hazardous waste landfills within South Africa and large quantities of potentially hazardous industrial waste were thought to be illegally disposed of at general waste landfills (Government of South Africa, 2000). In addition to this, it is highlighted in The White Paper on Integrated Pollution and Waste Management that there is insufficient involvement and empowerment of people (Government of South Africa, 2000b). Workers, especially contract and temporary workers who are exposed to hazardous substances and waste in the workplace are not properly educated about handling these substances.

The South African government cannot solve these challenges on its own. Organisations that generate waste must play a greater role. The implementation of proper waste management systems and managing waste within organisations will contribute towards addressing these national challenges.

### **2.2.2 South African policies and legislation on waste management**

According to the South African Waste Information Centre (SAWIC, 2009) waste in South Africa is currently governed by means the following legislation:

- The South African Constitution (Act 108 of 1996)
- Hazardous Substances Act (Act 5 of 1973)
- Health Act (Act 63 of 1977)

- Environment Conservation Act (Act 73 of 1989)
- Occupational Health and Safety Act (Act 85 of 1993)
- National Water Act (Act 36 of 1998)
- The National Environmental Management Act (Act 107 of 1998)
- Municipal Structures Act (Act 117 of 1998)
- Municipal Systems Act (Act 32 of 2000)
- Mineral and Petroleum Resources Development Act (Act 28 of 2002)
- Air Quality Act (Act 39 of 2004)
- National Environmental Management: Waste Act, 2008 (Act 59 of 2008)

In this section, it is discussed below what is stated in some of the legislation listed above and other legislation related to waste management.

#### **2.2.2.1 The South Africa Constitution (Act 108 of 1996)**

In relation to the environment, the South African Constitution (Act 108 of 1996) stipulates that everyone has the right to have an environment that is not harmful to his or her health and to have the environment protected, for the benefit of present and future generations, through reasonable legislature and other measures that:

- Prevent pollution and ecological degradation;
- Promote conservation;
- Secure ecologically sustainable development and use natural resources while promoting justifiable economic and social development.

(Government of South Africa, 1996)

#### **2.2.2.2 The National Environmental Management Act (Act 107 of 1998)**

In relation to waste management, the National Environmental Management Act (Act 107 of 1998) (NEMA) establishes the principle of a stronger statement of the waste management hierarchy that establishes avoidance of waste as the most basic objective of waste management (Government of South Africa, 1998).

#### **2.2.2.3 Polokwane Declaration on waste management**

The Polokwane declaration recognises that waste management is a priority for all South Africans. It further emphasises the need for urgent action to reduce, reuse, and recycle waste in order to protect the environment. The goals that were set by government in the declaration were;

- I. to stabilise waste generation and reduce the waste disposal by 50% by 2012 and

- II. to develop a plan for Zero Waste by 2022.

The declarations call for government, business and civil society to join in common efforts toward the accomplishment of this goal. In addition to this, some of the expectations on business are listed as follows;

- cleaner production technologies and methods of production must be used,
- compliance with legislation, regulations and standards is required,
- waste reduction targets must be met, in addition to this, voluntary commitments to exceed the targets must be made and
- recycling opportunities must be promoted (Government of South Africa, 2001).

#### **2.2.2.4 The National Environmental Management: Waste Act (Act 59 of 2008)**

The National Environmental Management: Waste Act (Act 59 of 2008) aims to address fragmentation in South Africa's waste legislation and provide a framework for meeting the World Summit for sustainable development goals (Government of South Africa, 2010). The objectives of the Act are:

- “(a) to protect health, well-being and the environment by providing reasonable measures for:*
- (i) minimising the consumption of natural resources;*
  - (ii) avoiding and minimising the generation of waste;*
  - (iii) reducing, re-using, recycling and recovering waste;*
  - (iv) treating and safely disposing of waste as a last resort;*
  - (v) preventing pollution and ecological degradation;*
  - (vi) securing ecologically sustainable development while promoting justifiable economic and social development;*
  - (vii) promoting and ensuring the effective delivery of waste services;*
  - (viii) remediating land where contamination presents, or may present, a significant risk of harm to health or the environment; and*
  - (ix) achieving integrated waste management reporting and planning;*
- (b) to ensure that people are aware of the impact of waste on their health, well-being and the environment;*
- (c) to provide for compliance with the measures set out in paragraph (a) and*
- (d) generally, to give effect to section 24 of the Constitution in order to secure an environment that is not harmful to health and well-being.”*

It is also a requirement of the Act that *“Any person who sells a product that may be used by the public and that is likely to result in generation of hazardous waste must inform the public of the impacts of that waste on health and the environment.”* The Act further states that an industrial waste management plan may be required from an organisation, depending on the types of waste that is generated and the impacts that the waste may have on the environment. Where a waste management licence is required, the Act stipulates that it should be obtained before commencing with that waste management activity. Also covered in the Act are the requirements for holding, storing and collecting waste. Minimisation of the generation of waste is encouraged, where this is not possible during the holding and storage of waste, there should be no pollution of the environment or harm to health. Each municipality is expected to include in its Integrated Development Plan (IDP) as contemplated in chapter 5 of the Municipal Systems Act and Integrated Waste Management Plan (Government of South Africa, 2008).

#### **2.2.2.5 National Waste Management Strategy (NWMS)**

The NWMS is a legislative requirement of the National Environmental Management: Waste Act, 2008 (Act No.59 of 2008). The purpose of the NWMS is to help achieve the objectives of the Waste Act and help address the numerous South African waste management challenges. The NWMS follows the waste management hierarchy approach. All stakeholders are expected to apply this approach when making decisions on how to manage waste. Eight goals are set in the NWMS in order to ensure that the objectives of the Act are met. Each NWMS goal must be met by 2016. These goals are listed in the NWMS as follows;

1. *“Promote waste minimisation, re-use, recycling and recovery of waste.*
2. *Ensure the effective and efficient delivery of waste services.*
3. *Grow the contribution of the waste sector to the green economy.*
4. *Ensure that people are aware of the impact of waste on their health, wellbeing and the environment.*
5. *Achieve integrated waste management planning.*
6. *Ensure sound budgeting and financial management of waste services.*
7. *Provide measures to remediate contaminated land.*
8. *Establish effective compliance with and enforcement of the Waste Act.”*

Stakeholders, including industry play an important role in ensuring the implementation of this strategy by improving waste management. The different roles and responsibilities that need to be taken up by each stakeholder are listed in the strategy. Industry is responsible for educating, providing bins at source, collecting and disposal of hazardous waste. Industry is expected to prepare industry waste management plans (IndWMP). These plans will identify how specific waste

streams will be managed. Industry is expected to proactively take responsibility for developing these plans. Recycling, recovery or re-use targets must be included in the IndWMP. In addition to this, industry will be required to report on agreed targets in order to track progress. (Government of South Africa, 2011).

#### **2.2.2.6 National Domestic Waste Collection Standards**

The National Domestic Waste Collection Standards are minimum standards that municipalities must meet for waste services in domestic urban, peri-urban and rural areas. The standard attempts to redress past imbalances in the provision of waste collection services by providing affordable and sustainable waste collection throughout the country. According to the standard, all domestic waste is to be separated at source. The municipality is expected to provide an enabling and accessible environment for households to recycle domestic waste. The standard recommends the type of containers that should be used for collecting waste. The frequency at which waste must be collected, including vehicles that can be used for collecting waste are also recommended. The standard stipulates that health hazards must be prevented at all times during the waste collection process. To ensure that these health hazards are prevented, regular medical check-ups, personal protective equipment and ongoing training must be provided for all waste collection workers. (Government of South Africa, 2011a).

#### **2.2.3 Requirements for waste generators**

In South Africa the role of the state with regard to waste management is to put measures in place that *“seek to reduce the amount of waste that is generated and, where waste is generated, to ensure that waste is re-used, recycled and recovered in an environmentally sound manner before being safely treated and disposed of”*. By fulfilling this role, the state will be ensuring the prevention of pollution and ecological degradation, and securing ecologically sustainable development (Government of South Africa, 2007).

The Paper on the Programme for the implementation of the National Waste Management Strategy recognises that waste generators come from *“all sectors, including mining, metallurgy, power generation, agriculture, industry, commerce, residential and the public. Local authorities are also considered as waste generators, because residential, commercial and industrial waste is generated in their area of jurisdiction.”*

According to the South African government, the generic roles, functions and responsibilities of waste generators include the following:



- Familiarising and complying with applicable legislation and regulations.
- Keep records of the quantities and types of general and hazardous waste generated.
- Manage waste such that there is no threat to the environment and public health.
- Explore clean technology, resource recovery and recycling in order to minimise waste generation.
- Hazardous waste generators must register with DEAT when the waste information system database for the registration of waste generators is in place.
- Provide the best qualitative and quantitative baseline information when required to local authorities, consultants and planners.
- Ensure that waste storage areas meet appropriate regulations and by-laws and make adequate provision for projected waste generation.
- Compile plans to ensure that adequate and appropriate provision is made for the management of current and projected waste streams. (Government of South Africa, 2000).

Organisations that generate waste need to have systems in place to manage their waste. The Government of South Africa (2007) states that waste management *“includes the measures, including the avoidance of the generation of waste, that are necessary to prevent, or where prevention is not possible, to minimise the amount of waste that is produced and the risk posed by waste to health and the environment”*. Sushil (1990) defines waste management *“as a multidisciplinary activity involving engineering principles, urban and regional planning, management techniques and social sciences to economically minimise the overall wastivity of the system under consideration”*. An Integrated Waste Management System (IWMS) ensures that waste is dealt with optimally, keeping all costs and the resulting environmental impacts as low as possible (CSIR boutek, 2002:1). Reducing the impacts of waste on the environment helps to achieve sustainable development. Waste needs to be managed, in order to reduce the impacts that it has on the environment. Sushil (1990) believes that prevention of environmental pollution depends on the effective management of waste.

Care needs to be taken with the handling of waste that has been put aside for disposal in order to reduce its impact on human health and the environment. This means that proper storage and collection principles should be adopted for these processes to be managed adequately. Sushil (1990) states that by developing infrastructure that will allow for segregation and meticulous collection of waste, there will be reduced disposal of waste and an increase in resource recovery. According to him, this is an important component of waste management. While waste is being stored, its integrity should be kept such that waste is not mixed if separated and it should always



be kept dry and free of contaminants (USEPA, 1989). The containers in which waste is stored must be intact and fit for safe waste storage, prevent accidental spillage or leakage, kept clean and free from odours and breeding of vectors (Government of South Africa, 2008). Waste, especially hazardous waste, must be treated before disposal (Government of South Africa, 2008).

Before designing an appropriate system for collection, the mode of segregation must be chosen (Sushil, 1990). The waste collection system should be convenient for the waste collection crews to use. The frequency and mode of collection is an important aspect to be considered because of their impact on the way waste is handled. According to the (Government of South Africa, 2008) only authorised personnel, municipality or municipality service providers are allowed to collect waste.

#### **2.2.4 City of Tshwane integrated environmental policy**

As part of the city's Integrated Development Plan, the city of Tshwane has an integrated environmental policy. This policy was developed in response to Agenda 21, the South African Constitution and the NEMA all of which affirm that the fundamental right of every South African citizen is to have a healthy environment. The vision of the city, according to this policy is to be "*An internationally acclaimed African capital city of excellence caring for its environment, demonstrating commitment and responsibility through innovation and collaboration.*" The city plans to improve the management systems of Tshwane by making those responsible for environmental degradation legally liable. One of the objectives of the city is to improve the quality of the environment and human health by minimising the amount of waste produced by human activities in Tshwane. This will be achieved by:

- "i) initiating projects that encourage communities to reduce waste streams through waste minimisation, recycling and re-use;*
- ii) setting targets to minimise the amount of waste generated at the source;*
- iii) encouraging industry to reduce waste streams by reducing waste at the source, recycling, re-use and the redesign of processes and products where possible;*
- iv) investigating the promotion of incentives for waste minimisation initiatives implemented by communities and/or industry;*
- v) continuing with existing waste management and minimisation initiatives and cleaning campaigns in Tshwane (such as the national Cleanest City competition, the Inner City Clean Zone Initiative, city cleansing and waste management education strategies to create community awareness and consciousness about sustainable waste management and the Tshwane Glass Recycling project) and developing and implementing new initiatives where required.*

- vi) *providing support for establishing economically efficient waste re-use and recycling initiatives throughout the city to service domestic, commercial and industrial producers of waste; and*
- vii) *supporting the implementation of initiatives for waste reduction, recycling and reuse at source, including the use of cleaner technologies and the provision of controlled access to landfill sites for salvagers*" (Tshwane, 2006).

### **2.2.5 City of Tshwane solid waste by-laws**

The city of Tshwane has solid waste by-laws that provide guidance on how the municipality and residents of the city should manage solid waste. These by-laws state that the municipality provides and ensures that there is a service for the collection and removal of business waste at the applicable tariff. Businesses must only allow authorised service providers to collect waste from their premises. The municipality provides containers for the storage and collection of waste. These containers should be kept in a clean and hygienic condition and only be used for the purpose of storing waste. According to the by-laws, care should be taken with regard to the type of waste that is disposed of in the containers. This waste should not cause any injury to municipality workers. It is also proposed that an adequate area must be provided for the storage of waste. This area must be kept neat and free of waste and obstruction at all times. Garden waste and building waste must be separated and treated separately as this is disposed of at designated areas at the landfill site.

The municipality has requirements for handling hazardous and harmful waste. It is a requirement that the municipality should be notified of the composition of waste, quantity, method of storage, duration of storage and method of disposal before any special industrial waste, hazardous waste or medical waste are generated. When changes are introduced in waste management, the municipality should be notified. The municipality can at any time audit sites for special industrial waste, hazardous or medical waste. These wastes should be kept in appropriate containers so that they do not cause contamination when stored. Only persons approved and registered by the municipality are allowed to remove special industrial waste, hazardous waste and medical waste. The By-laws further state that the generation, storage, removal and disposal of special industrial waste, hazardous waste or medical waste "*are subject to the provisions of the Hazardous Substances Act, 1973, the Occupational Health and Safety Act, 1993 (Act 85 of 1993), the National Road Traffic Act, 1996, the Health Act (Act 63 of 1977), and the Fire Brigade Services Act, 1987 (Act 99 of 1987), and any regulations promulgated under these Acts*" (Tshwane, 2005).

### **2.2.6 The City of Johannesburg (CoJ) Integrated Waste Management Policy**

The purpose of the policy is to “*create a strategic framework for achieving integrated waste management*” within the CoJ and “*articulate approaches towards meeting the targets and objectives set by the Polokwane Declaration in 2001.*” Waste generators within the CoJ are expected to minimise and reuse waste. The policy applies to both general and hazardous waste, and includes all stakeholders that are involved in waste management activities within the boundaries of the CoJ. It promotes waste management through the adoption of the waste management hierarchy principles. It also encourages the separation at source practice. According to the policy, garden, building, demolition, health care, and hazardous domestic waste must be separated and disposed of safely. The policy sets a number of goals and objectives which have to be achieved by the CoJ.

The Polokwane Declaration will be met by the CoJ through a number of initiatives. Waste minimisation clubs and cleaner technology initiatives are encouraged in industry and business. “*The CoJ will ensure accurate waste data capturing at all waste treatment and disposal facilities for inclusion into a waste management system aligned with the provincial and national waste information requirements*”. According to the policy, the CoJ will ensure that adequate and effective communication, education and awareness programmes are given to the public.

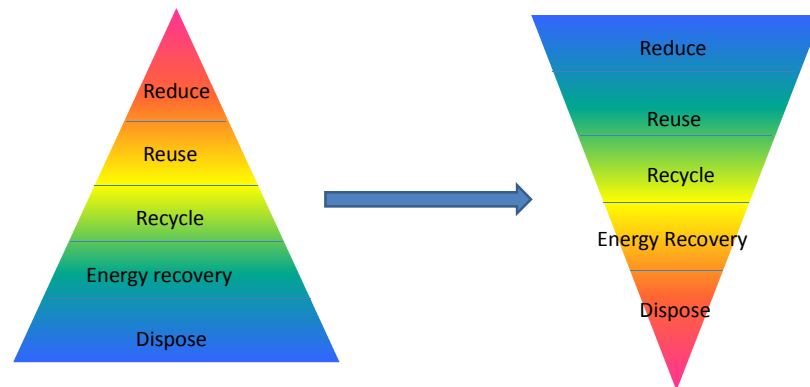
### **2.2.7 Zero-Waste to Landfill**

Zero-Waste to Landfill is a long-term goal attainable through a systematic and incremental approach. It requires continuous improvement, innovation and creativity French, et al. (2010). Zero-Waste, also described as 100% efficiency in Government of South Africa (2005), ensures avoidance of the generation of waste and minimisation of waste. Sushil (1990) warns that Zero-Waste should not be interpreted as no waste generated, the aims of this philosophy according to him are “*to minimise waste generated as far as is technologically and economically feasible, and whatever little waste is generated should be put to some effective use.*” (Government of South Africa, 2005) identifies sustainable technologies, for example the recycling of paper, as environmental technologies that will help achieve Zero-Waste.

### **2.2.8 The Waste Management Hierarchy**

The waste management hierarchy provides various possible methods of waste management from most to least preferred and this will be used for purposes of this research. It remains the most appropriate extrapolation of waste management services in South Africa. However, it should be

noted that the Waste Act has challenged the approach to focus more on waste minimisation. Figure 5 below emphasizes the importance of waste minimisation, through inverting the hierarchy to minimise actual disposal of waste (Mvuma and Afrika, 2010).



The Waste Management Hierarchy

Figure 5: The waste management hierarchy

Source: Fermanagh District Council website, UK ([www.fermanagh.gov.uk](http://www.fermanagh.gov.uk))

The Zero-Waste South Australia Waste Management Hierarchy prioritises the methods of dealing with waste from most preferred to least preferred as Avoid, Reduce, Reuse, Recycle, Recover and Disposal (Government of South Australia, 2008). The South African Waste Management Hierarchy follows the same order in prioritising methods for handling waste. Agenda 21 stipulates that governments are expected to formulate policies for reuse and recycle an integral component of national and local waste management programmes and to also improve reuse and recycling programmes, giving incentives where necessary. According to (Government of South Africa, 2008), although Reduce, Reuse, Recycle and Recover are preferred over disposal, there are requirements that have to be met before adopting these methods. Reduction, reuse, recycling or recovery can only be adopted if they use fewer natural resources than disposal and if they are less harmful to the environment.

The options of the Waste Management Hierarchy are prioritised according to the amount of resources used and the amount of waste generated for disposal. Preference is given to the options that requires less resource usage and generate less waste for disposal. Waste is defined as “any unnecessary input to or any undesirable output from any system, encompassing all types of

*resources*” (Sushil, 1990). Sammaddar and Heiko (1993) define waste as anything that does not add value. Waste minimisation is defined as *“the avoidance of the amount and toxicity of waste that is generated and in the event where waste is generated, the reduction of the amount and toxicity of waste that is disposed of”* (Government of South Africa, 2008).

The Waste Management Hierarchy therefore gives the options that can be taken to minimise waste. Avoiding the generation of waste is the highest on the priority list, because no waste is generated in this case. Reduce, which comes second implies *“reduced wastivity and increased productivity”* (Sushil, 1990). Reuse according to Palmer (2008) is putting back product into use for the same or different purpose without remediation. Recycling is different from reuse in that material is reprocessed or remanufactured before it is reused as a new resource (USEPA, 1989; Government of South Africa, 2008). Recovery is the controlled extraction or retrieval of energy from waste (Government of South Africa, 2008). Waste disposal which is the last and least preferred option on the Waste Management Hierarchy, according to Government of South Africa (2008) is *“the burial, deposit, discharge, abandoning, dumping, placing or release of any waste into, or onto, any air, land or water.”* Treatment of waste, which is on the South African Waste Management Hierarchy, involves reducing the toxicity of waste in order to minimise its impact on the environment (Government of South Africa, 2008).

### **2.2.9 Minimising waste in organisations**

Different ways in which organisations can minimise waste have been identified. Cleaner production, industrial ecology, industrial waste exchange and lean manufacturing are some initiatives that have been used in business and industry to ensure efficient use of resources and less production of waste. Cleaner production involves the *“continuous application of integrated preventative environmental strategies to processes, products and services to increase overall efficiency and to reduce the impact of these processes, products and services on health and environment”* (Government of South Africa, 2008). *Agenda 21* states that this *“concept implies striving for optimal efficiencies at every stage of the product life cycle.”* In an industrial ecology, materials are exchanged between different industrial sectors. The waste output of one industrial sector is used as a resource to another industrial sector. In industrial waste exchange, waste generators are not only linked to companies that can use waste as a raw material input to their products, but also to waste recyclers (Government of South Africa, 2005). Lean manufacturing has been adopted by the best companies e.g. Henry Ford and Toyota Production System. In lean manufacturing, waste refers to *“identifying and removing unnecessary steps in organisational systems and processes that naturally evolve to become needlessly intricate”* (Leaner & Fitter, 2008).

Source reduction and waste minimisation are methods that ensure minimisation of waste. USEPA (1989) describes source reduction as *“the design, manufacture, and use of products so as to reduce the quantity and toxicity of waste produced when the products reach the end of their useful lives”*. The ultimate destiny of the product is considered when the product is made. Waste minimisation according to (Government of South Africa, 2005): *“involves investigating all methods of reducing material utility use at source and improving process efficiency, thereby reducing emissions to the environment and saving money.”* Agenda 21 states that *“environmentally sound waste management must go beyond the mere safe disposal or recovery of wastes that are generated and seek to address the root cause of the problem by attempting to change unsustainable patterns of production and consumption”*.

According to USEPA (1989) source reduction activities fall into the following categories:

- **“Product reuse** – Reusable shopping bag. This reduces the amount of materials that might be managed as waste.
- **Reduced material volume** – Larger food containers can reduce the amount of packaging used e.g. buying in bulk.
- **Reduced toxicity** – Reducing the amount of toxic constituents in products entering the waste stream.
- **Increased product lifetime** – products with longer lifetimes can be used over short-lived alternatives that are designed to be discarded at the end of their useful lives.
- **Decreased consumption** – consumers can be educated on what materials are difficult to dispose of or are harmful to the environment.”

Greening of corporations is regarded as contributing towards the efficient use of resources. Lehner (2007) says greening of corporations can be generally thought of in three different ways. The first is in greening the company's operations; in this way, companies ensure efficient use of resources in their operations. The second way of greening corporations is to green the company's supply chain. This may involve, for example, buying recycled paper. The third way is to change entire markets: *“to change the ground rules within which companies are operating so that the right incentives are sent throughout the company's operations.”* According to Khoo, et al. (2001), a new approach to performing business will be required, one which does not merely aim at achieving economic profit but also developing ecologically sensitive strategic management policies.

Green buildings are buildings which from design, construction and operational practices use resources efficiently. According to the Green Building Council of South Africa, these buildings are

environmentally responsible GBCSA (2010). They are designed to change and encourage practices that will allow reduction, reuse, recycling and recovery of materials within the building.

There are other innovative measures that organisations have taken to minimise waste such as participating in waste minimisation clubs and waste and material exchange markets. Waste minimisation clubs involve a small number of companies working together to exchange ideas and information on waste minimisation and to encourage each other to improve process efficiency, save money and reduce environmental impacts (Government of South Africa, 2005). Waste and materials exchange markets sell and buy reusable and recyclable commodities. The City of Cape Town has a free internet based waste system that facilitates the swapping of waste materials on behalf of interested parties. Materials are advertised on the website and anyone who is interested in them contacts the person or organisation that has advertised to arrange the exchange of these materials (Cape Town, 2008).

## 2.3 SUSTAINABLE DEVELOPMENT

According to Mvuma in his paper (Mvuma, 2001) he states that in the late 1980s, the concept “sustainable development” was introduced into the environmental debate as an expression of the interdependence between economic development, the natural environment and people. The most widely accepted definition of sustainable development is presented in the report, “*Our Common Future*” (WCED, 1987), where it is described as “*development that meets the needs of current generations without compromising the ability of future generations to meet their needs and aspirations*”. This means improving the quality of life of humans whilst living within the carrying capacity of supporting ecosystems. Unfortunately, to date a lack of common understanding of the term “sustainable development” and its relevance to society exists. Clearly, this could create problems when it is central to the goal and purpose of an organization or a nation or a region. The developmental goals for sustainable development in the Southern African region are underpinned by the sustainable development concept. These goals are to:

- Accelerate economic growth with greater equity and self-reliance.
- Improve the health, income and living conditions of the poor majority.
- Ensure equitable and sustainable use of the environment and natural resources for the benefit of present and future generations (SADC, 2008).

Figures 6 and 7 below provide a pictorial representation of the spheres of sustainable development. Figure 6 shows a model based on the acceptance that the social, economic and natural systems operate independently. This model is frequently used to show the links between the economy, the environment and society, as articulated in the SADC goals above. This model



can be useful in showing what and where the interrelationships exist, for example within the biophysical and socio-economic domain.

A better picture of sustainability is given in the Interdependence model (Figure 7). As the model illustrates, the economy exists entirely within society, because all parts of the human economy require interaction among people. However, society is much more than just the economy and is not based entirely on exchanging goods and services. Society, in turn, exists entirely within the environment. Finally, the environment surrounds society. Although human activity is re-shaping the environment at an ever-increasing rate, society can never be larger than the environment. The ultimate objective of sustainable development is complete integration of social, economic and biophysical systems, as illustrated in Figure 6.

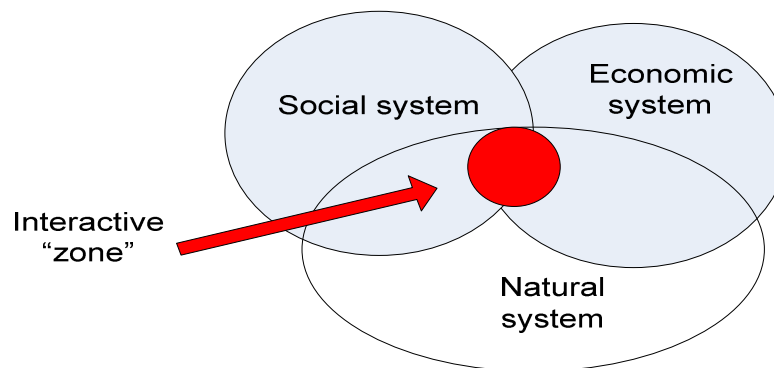


Figure 6: The spheres of sustainability

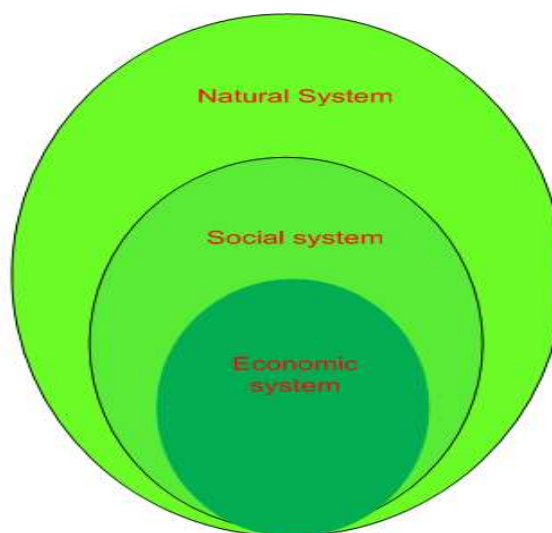


Figure 7: The Interdependence model of sustainability



### 2.3.1 Waste management and sustainable development

The management of waste and the environment are not only internal CSIR concerns; they are also external and global concerns that require urgent attention. As indicated above, sustainable development is a global concept that deals with current and future economic, social and environmental challenges. Environmental challenges such as natural resource use, resource degradation, pollution and waste management require urgent attention. The most widely accepted definition is as given in the above section 2.3. The South African definition of sustainable development states that social, economic and environmental factors should be taken into consideration at all stages of the development, planning, implementation and decision making process (Government of South Africa, 1998).

An important pathway towards sustainability for business and industry, according to Agenda 21, is the improvement of production systems through technologies and processes that utilise resources more efficiently and at the same time produce less waste. Meeting the needs of present generations without compromising the ability of future generations to meet their needs and aspirations requires efficient utilisation of resources and producing less waste. By doing so there is equity of distribution between present and future generations. Zero-Waste to Landfill is a measure that can help utilise resources more efficiently and produce less waste. This also leads to sustainable development. There is consensus in Government of South Africa (2007) that *“sustainable development requires that the generation of waste is avoided or where it cannot be avoided, that it is minimised, reused, recycled or recovered and only treated and safely disposed of as a last resort”*. According to Government of South Africa (1999) the successful management of waste is fundamental to the sustainability of any society.

Meadows (1999:368) argues that one of the ways in which sustainable development can be measured is through *“the efficiency with which ultimate means are translated into ultimate ends”*. He describes ultimate means as natural capital in which all life and all economic transactions are built and sustained. These include solar energy, the biosphere, earth materials and the biogeochemical cycles. Ultimate ends are described as wellbeing which can be regarded as happiness or fulfilment. Although ultimate ends are emotional and philosophical concepts and differ between individuals, they are dependent on tangible substance such as consumer goods, health, wealth and knowledge. Meadows (1999:366) believes that theology and ethics play a role in translating these tangible substances to ultimate ends. If ultimate means are used efficiently, future generations will be able to meet their own needs as they also need these resources to fulfil their needs.

### 2.3.2 International obligations

One of the outcomes of the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro in June 1992 was Agenda 21. Agenda 21 was instrumental in guiding countries to achieve sustainable development through clear principles and guidelines on how to achieve this. Agenda 21 aims to improve the decision making process, so that socio-economic and environmental issues are fully integrated in a participatory manner at all levels of decision making (UNCED, 1992). Ten years after the UNCED, an implementation plan was reviewed at the World Summit for Sustainable Development (WSSD) in Johannesburg. The purpose was to evaluate the progress made towards implementing Agenda 21 and to negotiate an implementation plan. At this conference, countries committed themselves to *“undertaking immediate steps to make progress in the formulation and elaboration of national strategies for sustainable development and begin their implementation by 2005”* UNCED (2002). As a party, South Africa it is obliged to fulfil requirements and expectations resulting from these initiatives.

Agenda 21 highlighted a number of concerns regarding the management of waste. *“Sound management of wastes was among the environmental issues of major concern in maintaining the quality of the earth’s environment and especially in achieving environmentally sound and sustainable development in all countries”*. Major concerns are the increasing quantities of production and consumption in different countries. Governments are urged in Agenda 21 to process and monitor waste trend information and implement waste minimisation policies. Another important aspect regarding waste in Agenda 21 is sound management, including prevention of illegal international traffic of toxic, radioactive and hazardous waste.

### 2.3.3 The National Framework for Sustainable Development (NFSD)

In accordance with Agenda 21, South Africa has developed a National Strategy on Sustainable Development (South Africa, 2009). Chapter 8 of Agenda 21 states that countries should adopt national strategies for sustainable development that should build upon and harmonise the various sectoral, social and environmental policies and plans that are operating in the country. Emphasis on the protection of the resource base and the environment for the benefit of future generations is placed in this section of Agenda 21. South Africa should also develop indicators for sustainability as stated in Chapter 40 of Agenda 21.

The National Framework on Sustainable Development (NFSD) reflects South Africa’s national vision for sustainable development and specifies strategic interventions that will be adopted during the development process in order to ensure sustainable development. It proposes a national

vision, principles and areas for strategic intervention and will act as a guideline for the development of the national strategy and action plan. The proposed vision states that as an aspiring sustainable country, South Africa should manage its limited ecological resources responsibly for current and future generations. The guidelines for the development of the national strategy and action plan are based on principles of integration and innovation, consultation and participation, and implementation in a phased manner. According to the NFSD some of the ways in which sustainable development will be achieved should be through sustaining the ecosystem and using natural resources efficiently and responding appropriately to emerging human development, economic and environmental challenges. The NFSD further confirms the need to develop a comprehensive set of indicators that can be used to monitor gradual progress towards the vision of sustainable development in South Africa. These indicators will indicate whether South Africa is making progress or not with respect to the key trends identified as critical driving forces for South Africa's choice to sustainable development Government of South Africa (2008a).

#### **2.3.4 Sustainable development in organisations**

According to Agenda 21, *"business and industry should recognise environmental management as among the highest corporate priorities and as a key determinant to sustainable development."* For business and industry to progress towards sustainability, they will have to improve their production systems so that they utilise resources more efficiently and at the same time produce less waste UNCED (1992). Business and industry have contributed to the consumption of scarce resources, the generation of waste, pollution and deforestation (Terry, 2008:193; UNDP, 1998:1). They have designed manufactured and packaged products without considering how these products will be disposed of in the end. UNDP (1998:1) argues that the challenge is not to stop growth, but it is to *"change the patterns of consumption and production, using new technologies to achieve greater efficiency and reduce waste and pollution"*. This will require examining patterns that show what is being consumed and the efficiency of production processes.

Business and industry have had to change and take a more responsible role over the years in order to ensure sustainable development (Terry, 2008:153). They are also becoming increasingly concerned with demonstrating and achieving environmental performance and controlling environmental impacts SABS (2005). This is seen through corporate citizenship which is linked to the sustainable development agenda. Corporate citizenship is one of the ways in which business has introduced a culture of responsibility. Corporate citizenship according to (Hamann, 2006:176-177) *"refers to the expectation that if companies enhance their engagement with stakeholders, if they assess and manage their social, environmental and economic impacts and if they channel some of their capacities for value creation and innovation towards development objectives, then*

*these efforts will make a decent contribution to a better society.*" Pressure on organisations from stakeholders has forced them to be more transparent and acknowledge their responsibilities. This has been evident through initiatives such as the Ceres Principles, International Organisation for Standardisation (ISO), United Nations Global Compact, and World Business Council for Sustainable Development and the King Report on Corporate Governance (Terry, 2008:150-170).

Corporate Social Responsibility (CSR) similar to corporate citizenship is another way that business and industry have shown their increasing willingness to demonstrate responsibility for their actions. CSR "encompasses the economic, legal, ethical and philanthropic expectations placed on organisations by society at a given point in time." Each of these expectations differs in terms of what is expected from organisations. Economic expectations are those placed by shareholders who expect a reasonable return on investment, employees who expect fair salaries and customers who expect good quality products. Legal expectations imply that organisations should abide by the law. Ethical expectations imply that organisations are expected to "*do what is right, just and fair even when they are not compelled to do so by the legal framework*". Philanthropic expectations depend on the organisation's discretion to improve the quality of life of the society in general (Andrew & Matten, 2004:43-44).

CSR reporting has further formalised CSR in organisations since it provides stakeholders with a broader perspective on the sustainability of the organisation. Different reporting bodies have different requirements for reporting. The Global Reporting Initiative (GRI) expects organisations to report on social, economic and environmental issues (GRI, 2007). This, also known as triple bottom line reporting, is common and endorsed by many for organisations' sustainability reporting (Vanclay, 2004:267). To improve the quality of reporting, the GRI provides guidelines for reporting. The United Nations Global Compact (UNGC) asks companies to embrace, support and enact, within their sphere of influence, a set of core values in the areas of human rights, labour standards, the environment and anti-corruption (UNGC). These reports are made available and accessible to the public and stakeholders by the bodies that govern these processes. This form of reporting gained popularity since the JSE Limited incorporated King II recommendations into its listing requirements (Terry, 2008:190). In South Africa, there are a number of organisations that take part in GRI and UNGC reporting. These organisations include mining and banking industries such as Sasol, Nedbank and Standard bank (GRI, 2007). The University of South Africa (UNISA) reports to the UNGC. The Council for Scientific and Industrial Research (CSIR) currently does not take part in this kind of reporting. A sustainability status quo assessment and gap analysis is being conducted to determine sustainability reporting gaps at the CSIR.

According to Jorg and McIntosh (2001:13) relevant issues are being addressed through new standards, initiatives and institutions in organisations. These standards and initiatives assist organisations to improve their environmental performance. The type of initiatives that an organisation will undertake will depend on type of organisation, its size, its processes, and objectives. Environmental Management Systems (EMS) are the totality of all things that an organisation undertakes to monitor its effects on the environment and manage its environmental affairs (Ibbotson, 1996; Darnall, et al. 2000). EMS enable organisations to put emphasis on the environment identify and manage all applicable aspects and impacts of their activities, products and services on the environment. ISO was given the mandate to develop tools that will help organisations measure environmental performance and develop powerful environmental management techniques SABS (2005). *"In 1996, the ISO 14000 series was published with the intension of crossing all trade and political borders, as well as being applicable to any kind of organisation"* (Elefsiniotis & Wareham, 2005). The ISO14001 standard is based on the methodology known as Plan-Do-Check-Act (PDCA) as shown in Figure 8.

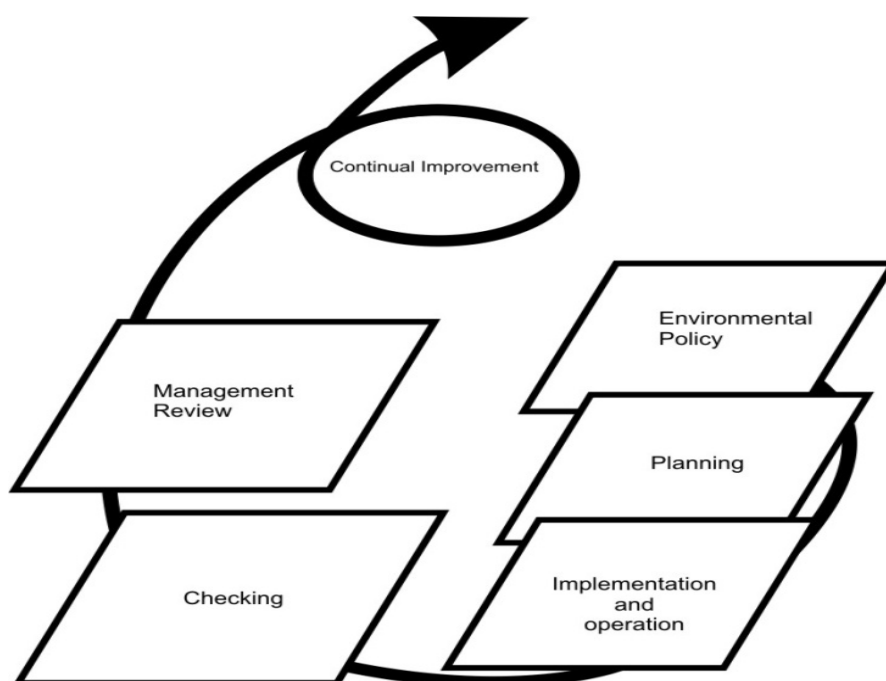


Figure 8: ISO14001 Plan-Do-Check-Act (PDCA) Methodology

Source: ISO (2004)

PDCA can be briefly described as follows:

**Plan:** establish the objectives and processes necessary to deliver results in accordance with the organisation's environmental policy.

**Do:** Implement the processes.

**Check:** Monitor and measure processes against environmental policy, objectives, targets, legal and other requirements, and report the results.

**Act:** take actions to continuously improve performance of the EMS (ISO, 2004).

Integrated Environmental Management (IEM) provides a holistic framework that can be used for the assessment and management of environmental impacts and aspects associated with an activity for each stage of the activity life cycle. Environmental considerations are taken at different stages of a project or process using different sets of tools to address relevant issues. IEM allows for the integration of these tools, thereby promoting sustainable development DEAT (2004:8). Table 1 shows some the tools that can be used when implementing a zero-waste programme in an organisation. The choice of tools depends on the needs of the organisation.

Table 1: IEM Tools

Source: DEAT (2004)

IEM TOOL	DESCRIPTION	REFERENCE FOR INFORMATION
Environmental auditing	<p>Environmental auditing is the process of testing an organisation's environmental performance against numerous requirements for example clearly defined policies, legislated requirements and key performance indicators. The approach includes interviews: review of relevant documentation: and visual observations.</p> <p>The international chamber of commerce (ICC, 1991) defines environmental auditing as "a management tool comprising a systematic, documented, periodic and objective evaluation of how well environmental organisation management and equipment are performing with the aim of contributing to the safeguarding of the environment by (i) facilitating management control of environmental practices; and (ii) assessing compliance with company policies, which include meeting regulatory requirements."</p> <p>Differing types of environmental audits exist, such as: Environmental management audits; Environmental compliance audits; waste audits, environmental due diligence; and supplier audits.</p>	<p>DEAT 2004, Environmental Auditing information series 14 International Chamber of Commerce (ICC) 1991, An ICC guide to effective environmental auditing.</p> <p>Environmental Management Tools <a href="http://www.uneptie.org/pc/pc/tools/ISO1401:1996.Environmental%20management%20systems">http://www.uneptie.org/pc/pc/tools/ISO1401:1996.Environmental management systems</a></p>

Table 1 continued: IEM Tools

IEM TOOL	DESCRIPTION	REFERENCE FOR INFORMATION
Life Cycle Assessment (LCA)	A tool for systematic analysis and evaluation of the environmental aspects of a product or service through all the stages of its life cycle. LCA considers all inputs (e.g. energy, raw materials and water) and all outputs (e.g. products, by-products, services and various forms of waste). It could be done for a specific company/organisation (e.g. aluminium smelter) or an industry (e.g. aluminium sector). LCA approaches are generally guided by standards. A professional code of practice has been developed by the Society of Environmental Toxicology and Chemistry (SETAC) which provides more detail.	
Ecological and environmental foot printing	Ecological foot printing provides a measure of how much bio productive area (i.e. land, water or air) a population would require to sustainably produce all the resources it consumes and to absorb the waste it generates, using available technology. Environmental foot printing is a similar concept that focuses on calculating the geographical extent of the activities, products or services of a business or organisation in the surrounding environment. For example, foot printing can be done for an individual, an organisation or a city.	<p>Best foot forward  <a href="http://www.bestfootforward.com">www.bestfootforward.com</a></p> <p>Barret et al 2002, A material flow analysis and ecological Footprint of york  <a href="http://www.york.ac.uk/inst/sel/ecofootprint/york/technicalreport.pdf">www.york.ac.uk/inst/sel/ecofootprint/york/technicalreport.pdf</a></p> <p>Wackernagel 1997, Ecological Footprints of nations /English/footprint/  <a href="http://www.ecouncil.ac.cr/rio/focus/report/english/footprint/introduction.htm">www.ecouncil.ac.cr/rio/focus/report/english/footprint/introduction.htm</a></p>
Risk Assessment	<p>Risk assessment includes, as a minimum, the definition of the probability and severity of a desired effect, expressed in the context of associated uncertainties. The risk assessment procedure can be integrated with the generic Environmental Impact Assessment procedure, as well as applied at a policy level. Other key components of risk assessment include risk management and risk communication.</p> <p>Specific applications include human health risk assessment and ecological risk assessment. Ecological risk assessment evaluates the likelihood that adverse ecological effects may occur or are occurring as a result of one or more stressors.</p>	DEAT 2002, Ecological Risk Assessment, information series 6



Table 1 continued: IEM Tools

IEM TOOL	DESCRIPTION	REFERENCE FOR INFORMATION
Indicators	Indicators evaluate and monitor the amount and direction of change occurring in the environment and whether developments or actions are operating at a sustainable level. They are used to assess and understand the interaction between development and the environment. Most indicators are designed to provide early warning information about instability or unsustainable change in the environment. They can therefore be used in proactive planning and risk management, and are important in assessing whether goals and targets set are being met.	DEAT <a href="http://www.environment.gov.za">http://www.environment.gov.za</a>  Mpumalanga DACE 2003, Mpumalanga state of the environment Report <a href="Http://www.mpu.agric.za">Http://www.mpu.agric.za</a>
Sustainability Analysis	Sustainability analysis is an emerging tool. It aims to evaluate the extent to which activity/business is aligned with the principles of sustainable development and contributes to sustainable development. An example of a methodology developed for this purpose is the natural step. This methodology consists of three parts: ecological sustainability analysis; economic sustainability analysis and social sustainability analysis.	Educating a nation: The Natural Step. <a href="http://www.context.org/ICLIB/IC28/Robert.htm">http://www.context.org/ICLIB/IC28/Robert.htm</a>
Eco labelling	A term used to describe an officially sanctioned scheme in which a product may be awarded an ecological label based on an acceptable level of environmental impact and responsible management.	Facts and figures: <a href="http://www.mineralresourcesforum.org/workshops/Berlin/docs/append_4.pdf">www.mineralresourcesforum.org/workshops/Berlin/docs/append_4.pdf</a>
Sustainability reporting	Sustainability reporting is an organisation's public accounting of economic, environmental and social performance in relation to its operations, products and services – i.e. the triple bottom line.	Global Reporting initiative : <a href="http://www.gri.com">http://www.gri.com</a>
Environmental policy	Within an EMS, the environmental policy details an organisation's aims and principles of action with respect to the environment including compliance with all relevant regulatory requirements. This may form the basis for an organisation's public environmental commitment.	Facts and Figures: <a href="http://www.mineralresourcesforum.org/workshops/berlin/docs/append_4.pdf">www.mineralresourcesforum.org/workshops/berlin/docs/append_4.pdf</a>

### 2.3.5 Advantages of sustainable development in organisations

Organisations that demonstrate environmental performance have experienced a number of advantages and in some instances gained a competitive edge. The advantages identified by (Terry, 2008:197; SABS, 2005; Dladla, 2007; Tsai and Chou, 2009; Andrew and Matten, 2004:41) are:



- a) Customer's satisfaction and trust because of the good organisational image and reputation.
- b) Attraction and retention of new customers and employees.
- c) Discounts on insurance premiums.
- d) Gaining a competitive advantage.
- e) Improved environmental performance.
- f) Cost savings through efficient use of material, energy and waste reductions.
- g) Better cooperation and relationship with regulators.
- h) Acceptance by external environmentally concerned stakeholders.
- i) Access to loans from banks.
- j) Increased investor and stakeholder confidence in the organisation.
- k) Gaining market access.
- l) Lowering of organisation environmental risks.
- m) Learning and innovation.
- n) Operational efficiency.

### **2.3.6 Indicators of sustainable development**

Indicators of sustainable development can be used to assess whether sustainable development goals are being achieved or not. They are chosen for their relevance to the broader goal of sustainable development (Chiras & Corson, 1997). According to Innes et al. 2000:178, they will also *"help cities and regions to become adaptive and learning systems"*. Indicators provide comprehensive information about the systems shaping sustainable development. They are used to guide policies, decisions and actions to be taken. *"Indicators are quantitative or qualitative measurements of the state of something that is important to us. They are important because they provide information about the state of our health"* Bossel (1999:25). Indicators must represent all important concerns, be comprehensive and compact, covering all relevant aspects. Agenda 21 states that *"indicators of sustainable development need to be developed to provide solid bases for decision making at all levels and to contribute to a self-regulatory sustainability of integrated environmental and development systems"*.

The process of finding an indicator must be participatory and incorporate the vision, values, interests and views of stakeholders and communities for whom they are being developed. Above this, they must be clearly defined, reproducible, unambiguous, understandable and practical (Bossel, 1999:7). All stakeholders need to understand and own these indicators after they have been established and future generations should be able to understand and make use of information given by these indicators (Innes & Booher, 2000:175-176,184). Vanclay (2004:284)

recommends that the focus should rather be on issues that can be quantified. It is important to develop an approach for identifying indicators of sustainability and further consider how information will be used when indicators are identified (DEAT, 2004:14). It is not unusual for information from sustainable development indicators to be misunderstood (Innes & Booher, 2000:177); that is why there is a need to guard against this.

## 2.4 ASSESSING PROGRESS TOWARDS SUSTAINABLE DEVELOPMENT

Achieving sustainable development requires much thought and effort. Sustainable development is not a fixed state of harmony, but rather a process of change in which the exploitation of resources, the orientation of the technological development and institutional change are made consistent with future as well as present needs (Wackernagle & Rees, 1996:39). This requires constant review of the state of sustainable development. Although indicators of sustainable development are designed to indicate the state of progress towards the achievement of sustainability goals, Bossel (1999:14) observes that indicators themselves are not perfect. This is so because indicators cannot provide all essential information about the viability of a system and its rate of change, and indicate the contribution to the overall objective. Bossel (1999:14) further states that by realising these inadequacies, *"we must analyse the entire complex of problems and tasks more carefully. This requires a reasonably detailed (mental or formal) model of the total system and its components"*.

The Bellagio Principles (Box 1) for practical assessment of progress towards sustainable development were formulated in response to the deficiency highlighted by Bossel (1999:14). (Senge, 1992:69) and (Max-Neef, 2004:29) suggest the need for a different approach when dealing with complex systems; this change in approach must take into consideration the nature of a complex system and assist society to act responsibly when faced with complexity.

Box 1: Bellagio's principles  
Source: Bossel (1999:15-16)

**Bellagio Principles - Guidelines for practical Assessment of Progress Towards Sustainable Development (from Hardi, P and T Zdan, 1997, *Assessing Sustainable Development: principles in practise* Winnipeg: IISD)**

### 1. GUIDING VISION AND GOALS

Assessment of progress toward sustainable development should:

Be guided by a clear vision of sustainable development and goals that define the vision.

Box 1 continued: Bellagio's principles

## **2. HOLISTIC PERSPECTIVE**

Assessment of progress towards sustainable development should:

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

## **3. ESSENTIAL ELEMENTS**

Assessment of progress towards sustainable development should:

- Consider equity and disparity within the current population and between present and future generations, dealing with such concerns as research use, overconsumption and poverty, human rights and access to services, as appropriate;
- Consider the ecological conditions on which life depends;
- Consider economic development and other non-market activities that contribute to human and social wellbeing.

## **4. ADEQUATE SCOPE**

Assessment of progress towards sustainable development should:

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

## **5. PRACTICAL FOCUS**

Assessment of progress towards sustainable development should have:

- An explicit set of categories or an organising framework that links vision and goals to indicators and assessment criteria;
- A limited number of key issues for analysis;
- A limited number of indicators or indicator combinations to provide a clearer signal of progress;
- Standardising measurement wherever possible to permit comparison;
- Comparing indicator values to targets, reference values, ranges, thresholds or direction of trends, as appropriate.

Box 1 continued: Bellagio's principles

#### **6. OPENNESS**

Assessment of progress towards sustainable development should:

- Make the methods and data that are used accessible to all;
- Make explicit all judgements, assumptions and uncertainties in data and interpretations.

#### **7. EFFECTIVE COMMUNICATION**

Assessment of progress towards sustainable development should:

- Be designed to address the needs of the audience and set of users;
- Draw from indicators and other tools that are simulating and serve to engage decision-makers;
- Aim, from the onset, for simplicity in structure and use of clear and plain language.

#### **8. BROAD PARTICIPATION**

Assessment of progress towards sustainable development should:

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

#### **9. ONGOING ASSESSMENT**

Assessment of progress towards sustainable development should:

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

#### **10. INSTITUTIONAL CAPACITY**

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

- Clearly assigning responsibility and providing ongoing support in decision-making process
- Providing institutional capacity for data collection, maintenance and documentation
- Supporting development of local assessment capacity

When initiatives to reduce resource use and waste production are implemented, a contribution is made to sustainable development as discussed in section 2.3.1 of this literature review. Indicators of sustainability are discussed in section 2.3.6 of this literature review; these indicate performance towards achieving the set goals. The approach that is taken in this study is to use the Bellagio's Principles and theory from other scholars as a guide to investigate how progress towards achieving the goal of Zero-Waste to Landfill will be assessed. This assessment will also help to identify what

needs to be put in place in order to achieve this goal. The Bellagio's Principles provide guidance on how this can be achieved in complex organisations.

The Bellagio Principles state that practical assessment of progress towards sustainable development should be guided by the following principles:

#### **2.4.1 A guiding vision and goals**

According to the Bellagio Principles, assessment of progress towards sustainable development should be guided by a clear vision of sustainable development and goals that define the vision. Vision is described as the 'what?' – "*the picture of the future we seek to create*" (Senge, 1992:223). It provides a common guide in achieving and encouraging long-term commitment. Vision becomes a living force only when people truly believe they can shape their future. According to Senge (1992:206) "*when people truly share a vision they are connected and bound together by a common aspiration*". Goals are specific items that an organisation plans to achieve at a certain time and stage. The vision and goals are important because they give direction. A vision has internal and external effects that may allow emerging properties and thereby create a space for creativity and innovation. Senge (1992:9) states that when there is genuine vision, people excel and learn, not because they are told to but because they want to.

Senge (1992:211) believes that a shared vision results from personal visions of people throughout the organisation. Lack personal vision results in compliance and lack of commitment. According to (Senge, 1992:211) the results of a top-down vision are often disappointing for three reasons:

- 1) It is a one-shot vision, it is a single effort of providing a vision for the whole organisation;
- 2) It does not build on every one's vision within the organisation and therefore it fails to motivate everyone within the organisation;
- 3) Vision is not a "solution to a problem". If seen in that light, when the problem goes away, then the vision will also go away.

However, this does not mean vision cannot come from the top; it can also come from the top (Senge, 1992:211).

Goals and objectives are set so that it is clear what needs to be achieved. According to Government of South Africa (2005) goal setting is not a once-off activity. Programmes should be continuously monitored and targets reassessed and reset at regular intervals. The ISO14001:2004 EMS requires that organisations set environmental goals that deal with their impacts on the environment. These goals, according to ISO (2004) should aim to reduce the organisation's impact on the environment. It is important to also plan how the goals will be achieved. Harris and Sims

(2004:29-30) believe that planning follows the goal setting process. It helps select strategies and allocates resources in the diversified corporation. According to the USEPA (1989) successful waste minimisation programmes hinge on careful planning and organising.

A business strategy helps to provide a high level plan of how the business goals will be achieved. There is management buy-in as the strategy is set by the business management team. Many believe management buy-in and commitment are required to achieve business goals (Sushil, 1990; ISO, 2008; USEPA, 1989; Leaner & Fitter, 2008). A strategy provides a platform for management to provide resources that will be needed to achieve goals. Terry, (2008:120-121) believes that the CEO of an organisation has the crucial role of planning and implementing sustainability strategies. He also believes that the responsibility of a sustainability strategy should not be placed in the hands of a department as these are core business issues that should be driven by the CEO. The benefits of a strategy according to Harris and Sims (2004:9) are to:

1. Ensure consideration of long-term goals within the organisation;
2. Identification of strategic issues;
3. Better coordination of business units, programmes and goals;
4. Improved corporate image;
5. More strategic control as there are clear policies, targets and defined responsibilities; and
6. Business continuity.

#### **2.4.2 Essential elements**

According to the Bellagio Principles, the assessment of progress towards sustainable development should deal with such concerns as resource use and overconsumption in addition to considering the ecological conditions on which life depends as well as activities that contribute to human and social well-being. Section 2.3.1 of this literature review states why it is important to use resources efficiently and minimise waste. The ways in which this can be carried out in organisations is discussed in section 2.2.8.

#### **2.4.3 Practical focus**

The Bellagio Principles also recommend that the assessment of progress towards sustainable development should be based on a limited number of key issues for analysis and indicators for analysis and provide a clearer signal of progress. Integration can be used to reduce or limit key issues. According to Sushil (1990), a lack of integration in production and operations results in a form of waste. If integration is done properly, it will enhance flexibility, quality and productivity of manufacturing or service in organisations. Sushil (1990) suggests that these improvements should

be made continuously if an organisation wants to stay ahead of its competitors. Total quality management can be integrated into an organisation's process to ensure quality of products. According to SABS (2005), waste minimisation programmes can be integrated into an organisation's EMS. Integration is not limited to operational processes and programmes; goals can also be integrated. Harris and Sims (2004:29-30) state that before goals are translated from senior management to the rest of the organisation, they should be coordinated and integrated.

#### **2.4.4 Adequate scope**

According to the Bellagio principles, assessment of progress towards sustainable development should adopt a time horizon long enough to capture human and ecosystem time scales, thus responding to current short-term decision-making needs as well as those of future generations. Harris and Sims (2004:29) state that SMART objectives should be set. This is a common way of setting objectives in organisations. SMART objectives according to Harris and Sims (2004:29) are:

- Specific – unambiguous in what is to be achieved.
- Measurable – specified as a quantity.
- Attainable – within reach.
- Relevant – appropriate to the group or individual to whom it is applied.
- Time bound – with a completion date.

It is also a requirement of the Bellagio principles that assessment of progress towards sustainable development should build on historic and current conditions to anticipate future conditions. This is appropriate since complex systems have history (Cilliers, 1998:122). This history is important to the systems behaviour (Cilliers, 2000:24). Audouin and Hattingh (2008:234) believe that to address the constraints of modernism in environmental assessment and management, you should “*gain an understanding of how the system has evolved, its history and the influence of its past on its current trajectory of change*”. According to the USEPA (1989), some of the key steps to conducting a waste assessment are to examine company records and to take a facility walkthrough. This gives a background to what has been going on in the organisation.

#### **2.4.5 A holistic perspective**

According to the Bellagio principles, assessment of progress towards sustainable development should include a review of the whole system as well as its parts. When working with a complex system, the system, the systems environment and the systems components should not be considered as separate parts. The components of the system, the system and its environment are equally important and dependant on each other. Whole systems and parts are not competing with

each other but are complementing each other (Morin, 1992:375). Businesses are systems that are bound by invisible fabrics of intertwined actions which often take years to fully play out their effects on each other (Senge, 1992:7). Lehner (2007) argues that corporations have legal, institutional and financial arrangements within which they function; therefore to really change corporate behaviour, the world in which they operate needs to be addressed.

Some systems are complex in their behaviour. *“Complex behaviour arises because of the interaction between the components of a system. One can therefore not only focus on individual components, but also on their relationships. The properties of the system emerge as a result of these interactions; they are not contained within individual components”* Cilliers (2008:44). Systems are termed complex if they have an internal structure of many qualitatively different processes, subsystems, interconnections and interactions (Bossel, 1999:21). *“Interrelationships rather than linear cause-effect chains”* and *“processes of change rather than snapshots”* must be seen. In complex systems *“there is no outside, you and the cause of your problems are part of a single system”* (Senge, 1992:72).

Cilliers (1998:122; 2008:45) believes that complex systems show the following characteristics:

- *“They consist of a large number of elements.*
- *Individual elements of a complex system are ignorant of the behaviour of the whole in which they are embedded.*
- *Other elements mediate in a complex system.*
- *There are no direct links necessary for distant elements to interact.*
- *They operate under conditions far from equilibrium.*
- *The elements in a complex system interact dynamically.*
- *The level of interaction of the elements of a complex system is fairly rich.*
- *The interactions of the elements of a complex system are non-linear.*
- *They display emergent properties.*
- *They are incompressible.*
- *They are open systems.*
- *They have boundaries.”*

Viability is determined both by the system and its environment (Bossel, 1999:24). Cilliers (2000:26) further states that a complex system self organises, forming a new structure internally as a result of external changes in its environment. This according to Bossel (1999:24) is so because for the system to be viable, its environment also needs to be viable. According to Bossel (1999:24)



indicators of sustainable development must reliably capture important aspects of the system's interaction with its environment.

A complex system cannot be compressed or reduced. Everything that is excluded in order to simplify or reduce it has to be taken into consideration (Morin, 1992:381). Those things that are left out as minor or insignificant in the system should not be ignored, but rather considered as recognised (Morin, 1992:378). Sushil (1990) states that for effective and orderly management of waste, the fundamental aspects and relationships must be identified and clearly understood. Reyers, et al. (2008:147) believe that the constraints of modernism in environmental management can be addressed through *"understanding the social-ecological system as a system that has both exterior (e.g. ecological and institutional structures) and interior (worldview, values, and power relations) dimensions, which both need to be understood and considered in making recommendations for action."* These characters and properties make all complex systems different. This is a precondition (Cilliers, n.d.:2) for the existence of complex systems.

Senge (1992:299) calls on a new role for central management. This entails *"understanding the organisation as a system and understanding the internal and external forces driving change"*, and to *"design the learning processes whereby managers throughout the organisation come to understand these trends and forces."* It is stated in Audouin and Hattingh (2008:232) that this type of understanding can help address the constraints of modernism in environmental assessment and management. Audouin and Hattingh (2008:232) believe that for this to happen, holders of specialist knowledge and stakeholders involved in environmental assessment and management processes must have a shared understanding of the boundaries of the social-ecological system, its components that might be defined for pragmatic reasons and the relationship between these components". Cilliers (1998:139) says that to deal with complexity, as much information on the issues as possible should be gathered, notwithstanding the fact that it is impossible to gather all information.

#### **2.4.6 Openness**

According to the Bellagio principles, the assessment of progress towards sustainable development should make explicit all judgements, assumptions and uncertainties in data and interpretations. Senge (1992:12) believes that systems thinking requires the discipline of building mental models. Mental models, according to him: *"focus on the openness needed to unearth shortcomings in our present ways of seeing the world."* They are deeply ingrained assumptions, generalisations, or even pictures or images that influence how the world is understood and how actions are taken. This requires awareness and openness about all judgements, assumptions and uncertainties in

data and interpretations made. To be able to challenge one's world views, assumptions made need to be viewed as sets of assumptions rather than facts (Senge, 1992:174). This openness gives allowance for new insights to be put into practice. According to (Senge, 1992:282), there is no right answer when dealing with a complex system. The state of being open is realising that any available answer is at best an approximation, always subject to improvement and never final. But this does not however imply that all problems are unsolvable.

Senge (1992:277) states that there are two different aspects of openness, namely participative openness and reflective openness. Participative openness includes the freedom of participants to speak their mind. Similarly, managing in a participative manner allows people to get involved in the decision making process. The advantage of this is that everybody has the opportunity to express their views; however this does not necessarily produce quality decisions (Senge, 1992:277). On the other hand, reflective openness results in people looking inward and willing to change their thinking. Senge (1992:277) believes that organisations that are serious about openness support their members in developing these skills.

Full control is impossible as the components of a complex system are open to interact with components or systems in different ways. However, Cilliers (1998:139) believes in trying as much as possible to control the system, but at the same time bearing in mind that not everything can be controlled. One can only be confident of assumptions when one has full control of the system. A theory of complexity cannot provide a method to predict the effects of decisions. Nor can it provide a way to predict the future behaviour of the system under consideration. *"Our decisions are guided by some notion of what we think the organisation should be and it is in this 'should' that the ethical dimension is contained."* Therefore when decisions are made, an ethical position must be taken. This is as a result of the inability of the theory of complexity to provide a complete description of the system (Cilliers, 2000:28). Audouin and Hattingh (2008:234) believe that to accommodate the unpredictability of systems, the use of an adaptive approach in which the recommendations for actions to be implemented are seen as a 'hypothesis' or experiments to be monitored, managed and adjusted in an adaptive way. Cilliers (1998:139) believes that to deal with complexity there must be a way to revise judgements when it becomes clear that they have flaws.

The Bellagio principles continue to state that assessment of progress towards sustainable development should make the methods and data that are used accessible to all. Through training and awareness methods and data are made accessible to all. Staff is also made aware of what is going on in the organisation through training and awareness. It is stated in USEPA (1989) that education and training of employees are the key steps to selecting, implementing, and monitoring waste reduction options. In a survey conducted to find out why Small and Medium Enterprises

implement ISO14001, Dladla (2007) learnt that training and awareness for staff was considered as the most important action for successful implementation of an EMS.

Training is considered to be a key factor for successful implementation of EMS in industry. Sammalisto and Brorson (2006) state that including the majority of employees in training changes environmental behaviour. The training process can also be a useful tool to help employees accept and take ownership of the system (Tack, 1999). Training sessions are also a good platform for staff to raise concerns and propose ideas for future enhancement of environmental systems and environmental performance. According to Tack (1999) *“training sessions have shown that employees are the most valuable resource for identifying problems, proposing solutions and implementing the entire system once adequate means are mobilised.”*

#### **2.4.7 Effective communication**

According to the Bellagio principles, the assessment of progress towards sustainable development should *“aim, from the outset, for simplicity in structure and use of clear and plain language”*. Cilliers (1998:122) states that individual elements of the complex system are ignorant of the behaviour of the whole system in which they are embedded. Although components may belong to one system, it does not necessarily mean that they are aware of what goes in the whole system. This is why communication in clear and plain language is important. Communication even between the same disciplines is becoming more difficult, even impossible (Nicolescu, 2002:34). It is even more challenging in different disciplines where the language used is different. Reyers, et al. (2008:147) believe that the constraints of modernism in environmental management can be addressed through explicitly placing environmental assessment and management procedures within a clear, normative framework. Harris and Sims (2004:430) assert that an important aspect of the effective performance of projects is communication. According to Tack (1999) many industries are now aware that communication on environmental issues is essential for facilitation and enhancing their relationship with neighbours, local authorities and technical administrators. This communication makes the activities of an organisation transparent to its stakeholders and encourages good relations between the organisation and its stakeholders.

Clayton and Radcliffe (1996:18) describe communication as *“the transmission of information in some form to effect regulation and feedback”*. This can take many forms, for example, face-to-face discussions, electronic mail, reports, tele-conferencing, telephone or internal memoranda. It is important to check for understanding and encourage feedback in oral communication. The ISO14001:2004 manual states that internal communication is important to ensure the effective implementation of the EMS. It is a requirement that an organisation has internal procedures for

communication among the various levels and functions of the organisation. According to CSIR Boutek (2002) and USEPA (1989) when implementing a waste minimisation programme in an organisation, there needs to be communication with employees including *“cleaning staff, staff in participating departments, the board of directors, new employees, others involved, purchasing suppliers, customers and contract workers”*. Possible communication channels include: *“bulletins/newsletters, workshops on a regular basis, and meetings with the members of the project team on a regular basis”*.

#### **2.4.8 Broad participation**

According to the Bellagio principles, the assessment of progress towards sustainable development should *“obtain broad representation of key grassroots, professional, technical and social groups, including youth, women and indigenous people to ensure recognition of diverse and changing values”*. Audouin and Hattingh (2008:232) believe that *“including key stakeholders in environmental assessment and management processes, from the stage of designing the process and identifying the concerns to be addressed, with a particular emphasis on the inclusion of marginalised groups”* will address the constraints of modernism in environmental assessment and management. Andrew and Matten (2004:41) find that organisations rely on the contribution of the wider society around them, rather than just stakeholders and this makes it necessary for them to take into account the interests and goals of the society. It is stated in Agenda 21 that in sustainable development, everyone is a user and provider of information. According to USEPA (1989), one of the key steps to start a successful waste minimisation programme is to get the whole organisation on board by announcing the programme and its goals to all employees.

Andrew and Matten (2004:50) describe a stakeholder of a corporate as: *“an individual or group which is harmed by, or benefits from the corporation or whose rights can be violated, or have to be respected by the corporation”*. Stakeholders are described in Harris and Sims (2004:23) as having legitimate interest in the activities of an organisation. These include investors, management, staff and organised labour, customers, suppliers, local community and national government. Hall (2001) describes environmental stakeholder groups as:

- 1) Regulatory stakeholders, which either set regulations or have the ability to convince governments to set standards;
- 2) Organisational stakeholders that are directly related to an organisation and that can have a direct financial impact on the company;
- 3) Community groups, environmental organisations and other potential lobbies who can mobilise public opinion in favour of or against a firm's environmental policies;
- 4) The media, which has the ability to influence society's perception of a firm.

Present strategic thinking encourages managers to consider stakeholders when setting the mission and goals of the organisation. This is because stakeholders can affect the success of a strategy, depending on whether they support it or not. Organisations are also *“expected to be good citizens because they are only permitted to exist by society on the sufferance of not abusing their power”* (Harris & Sims, 2004:23). Different stakeholders will hold different knowledge, and how to deal with this knowledge is important. Reyers, et al. (2008:147) believe that the constraints of modernism in environmental management can be addressed through:

- *“Acknowledging the importance of all forms of knowledge (i.e. scientific, indigenous, experiential, and value-based) without prioritising one over another.*
- *Placing an emphasis on contextualised knowledge that reflects the particular characteristics of the social-ecological system being considered”.*

Participation of decision makers and those who influence processes is important in an organisation. The participation of the operations management is important in an organisation as the operations role has an important role in the organisation. The three important roles for the operations function according to Pycraft, et al. (1997:43) are supporting business strategy, implementing business strategy and driving business strategy. Furthermore the contribution of the operations strategy is to help other functions within an organisation to contribute to the business strategy. The way in which the operations function operates will be affected by the organisations goals and values. Pycraft, et al. (1997:22) gives an example of how the green operations at the Body Shop affect its operations management policies. The Body Shop *“has led the field in green operations by using only minimal and simple packaging, encouraging the recycling and refilling of containers, by not testing products on animals, by using natural materials whenever possible, and by having strong and explicit social policies. This philosophy affects its operations management policies in the following ways: socially responsible purchasing, using renewable sources, social location, re-using and recycling waste.”*

#### **2.4.9 Ongoing assessment**

According to the Bellagio principles, the assessment of progress towards sustainable development should promote development of collective learning and feedback to decision makers. According to Senge (1992:236), the process of aligning and developing the capacity of a team to create the results its members truly desire is known as team learning. Team learning enables the different views of team members to be used efficiently for the team. In a team, different views are inevitable. Audouin and Hattingh (2008:232) believe that *“recognising and conceptualising the boundaries and components of a complex system is a subjective exercise which can be adjusted based on learning, requiring the participation of holders of specialist knowledge and stakeholders”*. The

discipline of team learning, according to Senge (1992:236) involves mastering the practices of dialogue and discussion, *“the two distinct ways that teams converse”*. *“In dialogue, there is the free and creative exploration of complex and subtle issues, a deep ‘listening’ to one another and suspending of one’s own views. By contrast, in discussion different views are presented and defended and there is a search for the best view to support decisions that must be made at this time.”* Senge (1992:236) believes that team learning is required now more than ever because almost all important decisions are made in teams.

Roux, et al. (2008:618) state that *“it is ultimately through connecting with other people that an individual’s learning experience is shaped. Connectivity that enables free flow of knowledge and associated learning is largely a function of the quality of interpersonal relationships. Given the multi stakeholders and transdisciplinary nature of challenges associated with natural resources management, it is imperative for the organisations of concern to learn how to effectively participate in extended group learning.”* Senge (1992:207) believes that shared vision is vital for the learning organisation because it provides the focus and energy of learning.

According to the Bellagio principles, assessment of progress towards sustainable development should be iterative, adaptive and responsive to change and uncertainty because systems are complex and change frequently. The phrase *‘learning organisation refers to the aims and aspirations of a growing number of companies that were seeking to transform the nature of their organisation. To cope with change it was realised that experimentation and adaptation were necessary and that new ways of operating would be required.’* Organisation members learn together and gradually begin to change how things are done when individual learning has an impact on and interrelates with others (Harris and Sims, 2004:100). Organisations learn only through individuals that learn. Individual learning is possible in organisations where it is safe for people to create visions, where inquiry and commitment to the truth are the norm, and where challenging the status quo is expected (Senge, 1992:139).

#### **2.4.10 Institutional capacity**

According to the Bellagio principles, the assessment of progress towards sustainable development should be assured by clearly assigning responsibility and providing ongoing support in the decision-making process. Bossel (1999:22) believes that hierarchy and subsidiarity are characteristics of a complex system. The quality hierarchy in a complex system enables each subsystem to be able to perform specific actions, and responsible for performing certain tasks contributing to the viability of the total system. The quality of subsidiarity in a complex system enables each subsystem to keep its own house in order within the range of its own abilities and

potential (Bossel, 1999:22). Cilliers (2008:50) believes that the hierarchies are a result of the non homogenous asymmetrical structure of the system. Hierarchies are not rigid, but there are relationships which cut across different hierarchies such that it cannot be said that one hierarchy is more important than the other. Bossel (1999:22) believes that hierarchy facilitates efficient operation. According to Harris and Sims (2004:29-30), after setting strategic goals in an organisation, roles and responsibilities must be given.

According to the Bellagio principles, assessment of progress towards sustainable development should be assured by *“providing institutional capacity for data collection, maintenance and documentation.”* Knowledge management places emphasis on the management and sharing of knowledge and information. It focuses on the use of databases and the use of intelligent search engines. Knowledge management is not just the use of information technology to manage information. It also involves all other ways of collating, analysing, storing, distributing, sharing and using information. Sushil (1990) believes that *“development of waste management information systems in the organisation is crucial to the success of waste recycling systems”*. *“Although operating procedures are important for organisational stability and contribute to efficiency they can also result in complacency, inertia and disproportional reliance on prior knowledge”* (Roux et al., 2008: 610).

Waste management information systems encompass the measurement, monitoring, as well as control of waste. Waste monitoring assists management to determine where losses and waste are occurring. It also identifies the causes of losses so that immediate action may be taken resulting in lower wastivity or higher efficiency of the system (Sushil, 1990). According to Sushil (1990) accurate information on waste generation rates and composition is necessary for the sound planning and management of functional elements associated with the management of wastes. It provides a basis for the design and operation of various waste control programmes, recycling and processing plants, waste disposal projects and the choice of the most effective alternative.

## 2.5 CONCLUSION

There is a global call for governments and organisations to minimise waste. This is due to the need to conserve resources and reduce waste disposal. Sustainable development requires that resources are used efficiently and that waste is reduced. Governments and organisations have strategies, goals, programmes and tools that can guide them to achieve this. The literature review has highlighted ways in which this can be implemented in organisations. Propositions have been developed from the literature review as listed in Appendix 1. These propositions state what should be in place for an organisation to achieve Zero-Waste to Landfill. It is important that the



organisation prioritises sustainable development and demonstrates this by the goals that it has set. A sound EMS that can be integrated with waste management goals is of utmost importance. In addition to this, waste management roles and responsibilities, planning, knowledge management and training, awareness and communication must be in place for the success of any waste minimisation initiative.



### 3 RESEARCH DESIGN AND METHODOLOGY

#### 3.1 INTRODUCTION

The goal of this research is to develop a framework that the Council for Scientific and Industrial Research (CSIR) can use to achieve the objective of Zero-Waste to Landfill. The first section of this chapter presents the research design that is used to address the problem under investigation. Mouton (2001:56) states that the research design “*focuses on the end product: What kind of study is being planned and what kind of results is aimed at?*” The research design used in this study ensures that the study undertaken provides relevant and appropriate data that can be used to develop the required Zero-Waste to Landfill Framework for the CSIR. The second section of this chapter describes the methodology that was used to conduct the study. The strengths and weaknesses of the methodologies were taken into consideration during the selection of the research design, methods, tools and procedures used in this research. Mouton (2001:56) states that the research methodology “*focuses on the research process and the kind of tools and procedures to be used.*” The methodology that is used in this study ensures that the right tools and procedures are used to collect and analyse data that will be used to develop the zero-waste to landfill framework.

#### 3.2 RESEARCH DESIGN

The research design mainly consisted of a case study approach with interviews to solicit information on waste minimisation initiatives. In order to understand how organisations minimise their waste, it is better to investigate and find out more from those organisations that are practicing waste minimisation. Conducting a case study on these organisations is one way of gaining this understanding as case studies are capable of providing in-depth insights into phenomena (Mouton, 2001:150). Interviews are targeted and allow one to focus directly on study topics and direct answers for the information which they seek. Theory from the literature review is tested in both the case study and interviews. Figure 9 outlines the research design for this project.

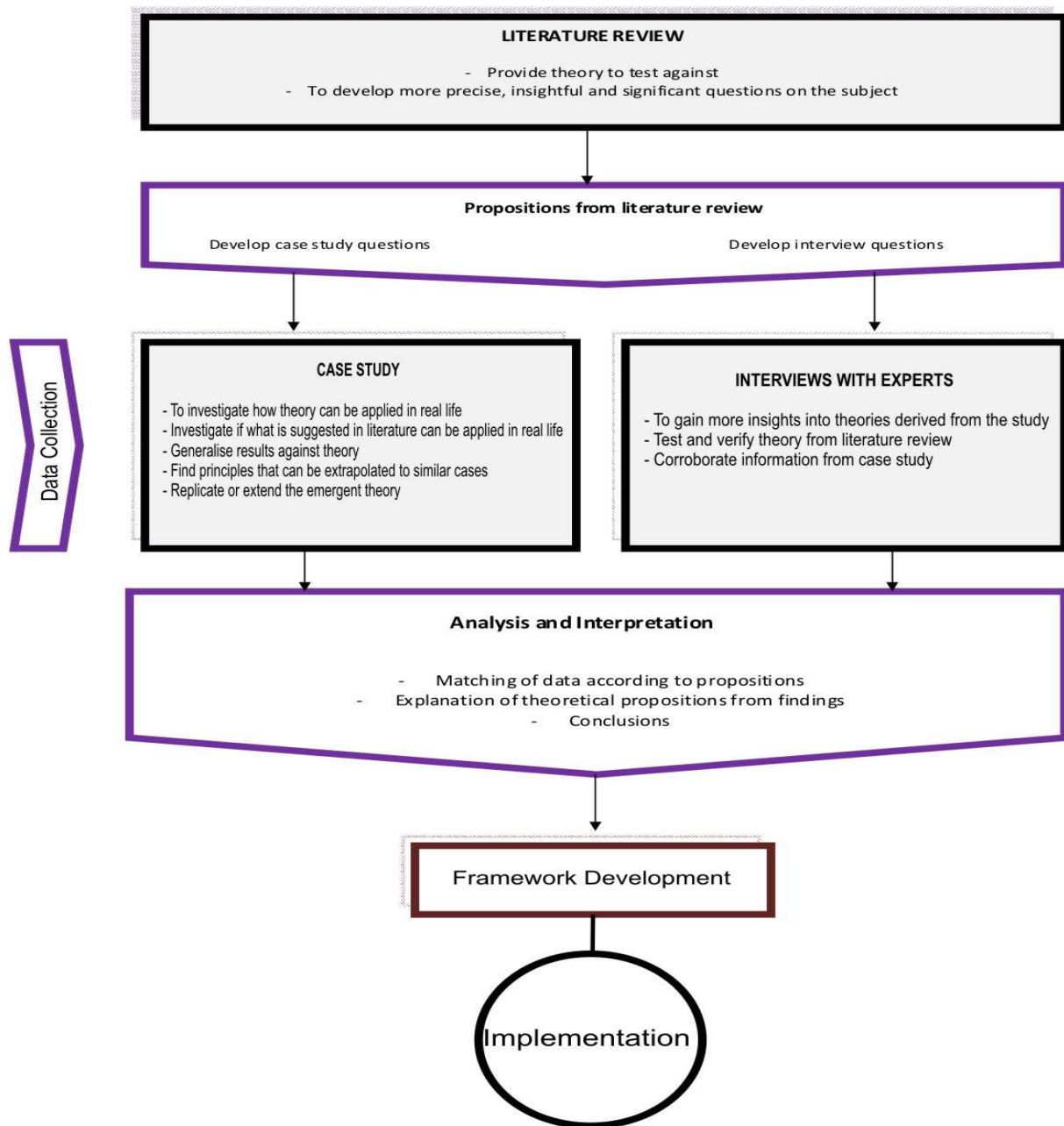


Figure 9: Research Design

### 3.3 RESEARCH METHODOLOGY

According to Hofstee (2006:108) the word method refers to the general technique/s that are employed to examine a thesis statement. Different methodologies are used in this study. This section covers the different types of methodologies used, reasons for selecting them and how they were used in this study.

### 3.3.1 The case study

The case study methodology was selected for this research because the researcher decided that it would be of benefit to learn how organisations minimise their waste. Yin (2009:10) states that “how” and “why” questions in research are likely to favour the use of case studies. In addition to this, according to Yin (2009:11), the case study method is preferred in examining contemporary events and when the relevant behaviours cannot be manipulated. The case study methodology was also selected to examine the literature in order to prove if what was suggested in literature can be applied in real life and if so, how it can be applied. According to Hofstee (2006:123) the case study will probably be used to test a hypothesis that the researcher has about the case itself, and also in the hope that the researcher will find principles that can be extrapolated to similar cases. Well designed case studies can play a role in testing certain types of hypotheses (Levy, 2008). Flyvbjerg (2006) believes that the case study is useful for both generating and testing of hypotheses.

For case studies, it is important to identify the unit of analysis, which Yin (2009:29) describes as defining what the “case” is. In this case study, the case selected for the study was the Commonwealth Scientific and Industrial Research Organisation (CSIRO). CSIRO is the only case that was selected for this study; making this research approach a single case study. Ragin (1992) believes that *“it is misguided to see the single case study as being inferior to multiple case studies, because even single case studies are multiple in most research efforts because ideas and evidence may be linked in many different ways”*. The case study was conducted in order to find out how CSIRO sets, implements and achieves its waste minimisation goals.

CSIRO is an Australian organisation, which like the CSIR conducts scientific and industrial research. It is one of the largest and most diverse research agencies in the world. As a similar organisation, CSIRO has similar waste streams as the CSIR. CSIRO has developed a Sustainability Strategy; one of the goals of the organisation according to this strategy is to halve waste generation by 2015. Since the development of the strategy in 2008, the organisation has put in place some plans to ensure that this goal is achieved. CSIRO has an established department (the Health, Safety and Environmental department) that is responsible for the management of its environmental goals. There is a historical relationship between this department and the CSIR Security, Safety, Health, Environment and Risk Management (SSHERM). Because of this relationship, obtaining the required information from CSIRO is easy. Because CSIRO is a similar organisation to the CSIR, the researcher expected the information gathered from CSIRO to be relevant to the CSIR. These are the main reasons why CSIRO was selected as a case that can provide information that could be used for the development of the CSIR Zero-Waste to Landfill

Framework. In Eisenhardt (1989) this method of selecting cases is called theoretical sampling, the goal of theoretical sampling is to choose cases which are likely to replicate or extend the emergent theory. Reproducing from the case means considering CSIRO principles for the CSIR and learning from and improving on their failures.

Table 2 illustrates strategies for the selection of samples and cases. CSIRO has been selected because of expectations about its information content. This type of selection for is **information oriented selection**. According to Van der Merwe (1996:288) a topic is sometimes investigated for its importance as a representative example of a larger population of a similar phenomenon or event, in which case it is research of universal importance.

Table 2: Strategies for the selection of Samples and Cases

Source: Flyvbjerg (2006)

Type of Selection	Purpose
<b>A. Random Selection</b>	To avoid systematic biases in the sample. The sample's size is decisive for generalisation
1. Random Sample	To achieve a representative sample that allows for generalisation for the entire population
2. Stratified sample	To generalise for specially selected subgroups within the population
<b>B. Information oriented selection</b>	<b>To maximize the utility of information from small samples and single cases. Cases are selected on the basis of expectations about their information content.</b>
1. Extreme/deviant cases	To obtain information on unusual cases, which can be especially problematic or especially good in a more closely defined sense.
2. Maximum variation cases	To obtain information about the significance of various circumstances for case process and outcome (e.g. three to four cases that are very different on one dimension: size, form of organisation, location, and budget).
3. Critical cases	To achieve information that permits logical deductions of the type, "if this is (not) valid for this case, then it applies to all (no) cases".
4. Paradigmatic cases	To develop a metaphor or establish a school for the domain that the case concerns.

The quality of this case study was ensured by the use of the four logical tests listed in Table 3. Yin (2009:41) states that the quality of any given research design can be judged according to certain logical tests. Table 3 lists four tests, their recommended case study tactics and the phase of research in which the tactic occurs in case studies. According to Yin (2009:40) these tests have been summarised in numerous textbooks as follows:

- *"Construct validity: identifying correct operational measures for the concepts being studied.*
- *Internal validity (for explanatory or casual studies only and not for descriptive or exploratory studies): seeking to establish a casual relationship, whereby certain conditions are believed to lead to other conditions, as distinguished from spurious relationships.*

- *External validity: defining the domain to which a study's findings can be generalised.*
- *Reliability: demonstrating that the operations of a study - such as the data collection procedures – can be repeated, with the same results."*

Table 3: Case study Tactics for four Design Tests

Source: Yin (2009:41)

Tests	Case Study Tactic	Phase of Research in which tactic occurs
Construct validity	<ul style="list-style-type: none"> <li>- use multiple sources of evidence</li> <li>- establish chain of evidence</li> <li>- have key informants review draft case study report</li> </ul>	<ul style="list-style-type: none"> <li>- data collection</li> <li>- data collection</li> <li>- composition</li> </ul>
Internal validity	<ul style="list-style-type: none"> <li>- do pattern matching</li> <li>- do explanation building</li> <li>- address rival explanations</li> <li>- use logic models</li> </ul>	<ul style="list-style-type: none"> <li>- data analysis</li> <li>- data analysis</li> <li>- data analysis</li> <li>- data analysis</li> </ul>
External validity	<ul style="list-style-type: none"> <li>- use theory in single-case studies</li> <li>- use replication logic in multiple-case studies</li> </ul>	<ul style="list-style-type: none"> <li>- research design</li> <li>- research design</li> </ul>
Reliability	<ul style="list-style-type: none"> <li>- use case study protocol</li> <li>- develop case study database</li> </ul>	<ul style="list-style-type: none"> <li>- data collection</li> <li>- data collection</li> </ul>

### 3.3.1.1 Weakness of case studies

It was necessary for the researcher to understand the weaknesses of the case study in order to put measures in place to deal with these weaknesses. Mouton (2001:150) cautions that in case studies, there is lack of generalisation of results. However, according to Flyvbjerg (2006) it is incorrect to conclude that one cannot generalise from a single case. It is also not true that the case study cannot provide reliable information about the broader class. Flyvbjerg (2006) believes that it depends on the specific case and how it is chosen. The choice of method should be relevant as a research method and should depend on the problem under study and its circumstances. Yin (2009:15) believes that *"case studies, like experiments, are generalisable to theoretical propositions and not to populations or universes. Therefore in doing a case study, your goal should be to expand and generalise theories and not enumerate frequencies"*.

A frequent complaint about case studies is that they *"take too long, and they result in massive, unreadable documents"* (Yin, 2009:15). It is highlighted in Mouton (2001:150) that data collection and analysis can be very time-consuming when conducting a case study. According to Flyvbjerg (2006), narratives from the case study may be difficult or impossible to summarise into neat scientific formulae, general propositions, and theories. However, Flyvbjerg (2006) believes that *"the*

*case story is itself the result, something essential may be lost by summarising*". There are also a number of concerns about the lack of rigor of case study research ((Mouton (2001:150), Yin (2009:14) and Flyvbjerg (2006)). Flyvbjerg (2006) believes that the case study has its own rigor which is different from and not less than the rigor of quantitative methods.

The main source of error in case studies, according to Mouton (2001:150), is the potential bias of the researcher. The case study is seen as a method that can give too much scope for the researcher's own interpretations and thus affect the validity of the case study. Flyvbjerg (2006) however believes that this is a misunderstanding of case-study research. *"Contrary to belief, case studies contain a greater bias toward falsification of preconceived notions than toward verification"*. Yin (2009:69) advises that a case study investigator must be *"unbiased by preconceived notions, including those derived from theory"*. According to Hosftee (2006:123) the case study is often combined with other techniques to help keep it focused and produce unbiased results that can be generalised.

### **3.3.1.2 Strengths of case studies**

The case study method was selected in this study because of the advantages that it offers over other methods. Case studies generally offer different types of evidence from other methods. (Cook & Payne, 2002) believe that case studies can offer important evidence that can complement experiments and therefore they should be viewed as "adjuncts to experiments rather than as alternatives to them". According to Flyvbjerg (2006), the case study is well suited for identifying "black swans" because of its in-depth approach: What appears to be "white" often turns out on closer examination to be "black".

The advantage of the case study is that it can "close in" on real-life situations and test views directly in relation to phenomena as they unfold in practice Flyvbjerg (2006). Mouton (2001:150) also agrees that case studies give in-depth insights. *"It has high construct validity; establishing rapport with research subjects."*

### **3.3.2 Interviews with experts**

This study involved conducting interviews with experts in order to gain more insight into theories derived from the literature review. The experts were selected based on their knowledge and experience in the areas of waste management, environmental management or sustainable development. According to Yin (2009:102) interviews focus directly on the case study topic and provide insightful information. The interviews were used as a source of information and also to

verify and test theory from the literature review. Two sets of interviews were prepared, case study interviews and interviews with experts. All the people that were interviewed are experts, including those interviewed in the case study. The expertise is based on the interviewees' experience and knowledge in the Environment Management, Sustainable Development and Waste Management disciplines. The section after the reference section contains a list and details of all the people that were interviewed as well as their experience and knowledge.

Interviews with different people were arranged by first calling or emailing the person to give them a background of the interview, and then setting up a meeting to conduct the interview. Different sets of questions were prepared for the interviewees. The interviews were either face to face, video conference or telephonic interviews depending on the availability and location of the interviewee. The interviews were conducted at different stages of this project; either before, during or after conducting the case study.

#### **3.3.2.1 Weakness of interviews**

According to Yin (2009:102) interview questions and answers can be biased. This bias may be a result of poor articulation of questions asked by the interviewer. Yin (2009:102) suggests that questions must be carefully worded, so that the interviewer appears genuinely naïve about the topic. By doing so the interviewee is able to provide fresh commentary about the question. Bias may also result from poor recall, and poor or inaccurate articulation of the responses from the interviewee. Yin (2009:109) suggests that in case study interviews, a *“reasonable approach is to corroborate interview data with information from other sources.”*

#### **3.3.2.2 Strength of interviews**

Interviews focus directly on the case topics and are insightful Yin (2009:102). From the prepared interview questions, precise information was sort from interviewees.

### **3.4 RESEARCH INSTRUMENTS**

A case study protocol, as shown in Appendix 2 was developed and used by the researcher as a guide and plan to conduct the case study. *“The protocol increases the reliability of the case study”* (Yin, 2009:80). The protocol consisted of case study questions and the sources from which case study data would be collected. The sources of data were identified as documentation and interviews. Most of the data collected in this case study was from the CSIRO website. The Global Reporting Initiative (GRI) website was also used to collect some information. A follow up interview



was conducted during the case study to clarify information that was found in documents. The questions asked in this interview are in Appendix 3.

A case study database was developed while conducting the case study. According to Yin (2009:41) the case study database increases the reliability of the case study. Appendix 4 shows the location and usage of information collected during the case study. The case study database consists of everything that is listed in this appendix. This case study database can be used in future by other investigators to review the evidence directly, and not be limited to the written case study as suggested in Yin (2009:119).

The researcher's colleague was invited to some meetings to assist with taking notes. Notes and minutes of the meetings were taken during the interviews to capture responses from the interviewees'. The following guide, suggested by Bless, et al. (2006:111-137) was used to structure interview questions and conduct the interviews:

- Interviews commenced with open-ended questions to put the interviewee at ease and to enable them to state personal views and elaborate.
- These were followed by specific structured questions that allowed the interviewee no room to reformulate or get sidetracked, or to give his or her personal subjective opinion.
- Leading questions were avoided.
- Some questions were stated indirectly and others directly.
- Conflicting data was rechecked by posing specific detailed questions and by asking a second time at a later stage.
- The general approach for the interview was to start with the "*known/general/macro*" issues regarding waste management and conclude with "*unknown/specific/micro*" issues."

Although the interview questions were structured as shown in Appendix 2, 3 and 5, the structure was not necessarily followed because in some instances while answering one question, the interviewee would also give an answer which is related to another question. In addition to this, the transitions from one topic to another also determined the sequence and phrase of the questions. This required flexibility of the researcher and prior knowledge of the questions that were going to be asked.

### 3.5 DATA

The three principles for collecting data suggested by Yin (2009:114) were used when collecting data for the case study. The first principle is to use multiple sources of evidence, the second one is to create a case study database, and the third is to maintain a chain of evidence. Yin (2009:114)



believes that these principles give the case study investigator formal procedures to ensure quality control during the data collection process.

The CSIRO website has a Health, Safety, and Environment link that contains all environmental information which the organisation wishes to communicate to its stakeholders. This includes information concerning what has happened, what is happening and the organisation's future plans. The GRI website has links to the sustainability reports of different organisations, including CSIRO. Information that is available on both these websites is controlled by the organisation that hosts the website and cannot be manipulated by other users of the website. CSIRO's annual reports and policies were approved by Top Management before they were published. The Group Executive Environment gives forward of the CSIRO Sustainability Report. The CSIRO Occupational Health, Safety and Environment (OHS&E) Annual Reports are prepared by the CSIRO OHS&E Managers network. Work procedures such as waste management procedures could not be found on this website and were requested from the interviewees.

The listed reports on the GRI website are the CSIRO 2006/2007 and 2007/2008 Sustainability Reports. Annual Occupational Health, Safety and Environment Reports were from the year 2004 to 2008. In both these reports, CSIRO is supposed to report on the organisation's environmental performance. Waste minimisation, which is an organisational goal, is also reported on these reports. These reports were sufficient to track how the organisation had evolved and progressed in environmental performance throughout the years.

Waste management procedures detail how waste is managed in an organisation. The CSIRO Integrated Waste Management Plan was requested from CSIRO as it was not available on the CSIRO website. Company records form a good source of evidence when conducting an audit or other investigation. The company records are used to prove if the information on the reports is correct. In this research, company records were not reviewed. The researcher however relied on the information which was on the reports and information given during the case study interview. The follow up case study interview was used to verify the information from the documents.

During the interviews, notes and minutes were taken. The interviewees' were notified at the beginning of the interview that this would be done. Interviewees' were asked to explain or repeat an answer when the answer given was not clearly understood by the interviewer. The notes taken were written in the same way as the interviewee explained them and not interpreted by the researcher or her assistant. The notes and minutes taken during the interview were sent to the interviewees for them to check if what was captured was a true reflection of what they had said during the interview.

### 3.6 ANALYSIS

*“The aim of analysis is to understand the various constitutive elements of one’s data through an inspection of the relationships between concepts, constructs or variables, and to see whether there are any patterns or trends that can be identified or isolated, or to establish themes in the data”* (Mouton, 2001:108).

Propositions as shown in Appendix 1 were formulated from the literature review which was conducted at the beginning of this study. The propositions were then used to develop case study and interview questions. The questions helped to focus attention to certain data and to ignore other data during the data collection process. Yin (2009:128) suggests starting with questions to analyse your case study, then identify the evidence that addresses the question. Thereafter, draw a tentative conclusion based on the weight of the evidence. Analysis of data followed themes which are the questions that were developed from the propositions. Sets of results found in the case study and interviews were matched with the questions that were developed from the propositions. *“Pattern matching compares empirically based pattern with a predicted one (or with several alternative predictions)”* (Yin, 2009:136). In some instances sets of results found in the case study and interviews were used to explain how the theoretical propositions can be applied in practice.

### 3.7 LIMITATIONS AND ASSUMPTIONS

The assumption that was made in this study was that CSIRO has an established waste management and minimisation system from which the CSIR can learn. The research design and methodology selected for this study were capable of providing the results that were expected by the researcher. However, observation through site visit could have been another method used to investigate the case in addition to the methods used in this study. Through observations, records would have been reviewed in order to get more detail and insight into processes. According to the researcher, observations would have identified some aspects, especially odd aspects that interviews and documents might not have covered or overlooked.

Waste minimisation includes minimising the use of other natural resources such as energy and water; these however were not considered for this study.

### 3.8 ETHICAL CONSIDERATIONS

Data that was collected for this project was considered company confidential information and treated as such. Before collecting data, the researcher explained to the interviewees the purpose of the interview and how and where the information that was collected would be used.

Interviewees' were asked to review answers that they gave during the interviews to ensure that they had been accurately recorded.

### **3.9 CONCLUSION**

It has been discussed in this chapter how and why the research design and methodology for this research has been selected to address the problem under investigation. The purpose of selecting the tools and procedures which were used in this project was to improve the quality of the research and better manage weaknesses of the methods, while at the same time taking advantage of the strengths of the methods. Tools such as the case study protocol were used to plan and give guidance to the researcher while conducting the case study and interviews. Using the protocol improved the traceability, accuracy and time management of the case study. A case study database which contains all the documents, notes and minutes taken during the case study and interviews was developed. A chain of evidence was maintained, making it possible to track the sources of data to the results that are given in this study.

## 4. RESULTS

### 4.1 INTRODUCTION

This chapter is divided into three sections. The results from the case study and interviews with experts are discussed in the first two sections. All of the results in this section are presented as they were obtained. The results are based on data collected from the case study internally produced documents, case study interviews and interviews with experts. The last section presents a discussion and analysis of the results of this study. Using the results, and information from the literature review, it will be discussed what is required to achieve Zero-Waste to Landfill in an organisation. The current practice at the CSIR was investigated, and is highlighted in order to identify gaps to be included in the framework. The CSIR Zero-Waste to Landfill Framework is developed using this information.

### 4.2 CASE STUDY RESULTS

#### 4.2.1 Organisation principles and culture

The Commonwealth Scientific and Industrial Research Organisation's (CSIRO) environmental vision, goals and plans are documented in the organisation's policies, reports and relevant strategies. The Health, Safety and Environment (HSE) vision is to improve environmental performance through identification, management and prevention of issues<sup>1</sup>. CSIRO's environmental policy states that CSIRO is committed to ensuring that environmental management of its operations remains a high priority and a key to sustainable development for the organisation. The 2007-2011 HSE strategy states that the goals for HSE are zero environmental harm. CSIRO Sustainable Ecosystems (CSE) Sustainability Charter states that its values and beliefs are to minimise CSIRO's footprint<sup>2</sup>. The Waste Reduction Project Manager explained in an interview that their goal is to minimise their environmental footprint. Improved understanding of the environmental footprint of the organisation and reducing resource use, according to her, is an on-going process.

According to CSIRO's Environment Group Manager, Dr Andrew Johnson, a systems understanding is required for a positive response to the challenges faced by Australia<sup>3</sup>. The Core Values and beliefs according to the CSE Sustainability Charter are stated as "*Systems thinking – balancing risk with benefit and integrating multiple disciplinary and cultural perspectives and forms*

<sup>1</sup> CSIRO Environmental Policy taken from OHS&E Annual Report 2005

<sup>2</sup> CSE Sustainability Charter taken from CSIRO Sustainability Report 2006/7 and 2007/8

<sup>3</sup> Taken from CSIRO Sustainability Report 2006/7

*of knowledge into our work*<sup>4</sup>.” The CSE division further seeks to be a place where multidisciplinary and trans-disciplinary science capacity can be seeded and grown.

The CSIRO 2008-2015 Environmental Sustainability Strategy (ESS) aims to protect the natural and built environment by minimising adverse environmental impacts. CSIRO’s Environmental Sustainability Strategy aims to integrate environmental sustainability considerations into CSIRO strategy and decision-making. This will ensure that environmental sustainability is seen as part of CSIRO’s normal business. According to CSE Chief of division “*At CSIRO CSE, sustainability matters not just to our research but to how we plan, implement and evaluate our operations and research activities.*”<sup>5</sup> The organisation’s Environmental Sustainability Strategy sets a bold vision for the environmental sustainability of a public research agency.

CSIRO believes that it has an important leadership role to play with respect of environmental stewardship. As Australia’s leading scientific organisation, CSIRO believes that it will be looked upon in order to take a leadership role in environmental sustainability<sup>6</sup>. The organisation acknowledges that it has both a direct and indirect impact on the environment and communities in which it operates and that it also has an obligation to consider and manage these impacts in a responsible way<sup>7</sup>. Public and transparent reporting on CSIRO’s own activities is one way in which CSIRO believes that it is demonstrating its commitment to understanding the impact of its operations on the environment and communities in which it works. This also allows the organisation to take measures to limit any negative impacts<sup>8</sup>. CSIRO uses the Global Reporting Initiative (GRI) G3 Guidelines for external environmental reporting. Annually the HSE division publishes a report on the organisation’s HSE performance. This report is available on the CSIRO website for stakeholders to access<sup>9</sup>.

The Environmental policy states that CSIRO will use scientific processes, practices, material or products that avoid, reduce or control pollution. According to the HSE EMS framework (see Figure 10) in order to achieve improved environmental performance, CSIRO needs to reduce the impact of its operations on the environment. CSIRO uses a risk management process which requires all project groups to identify potential environmental impacts, assess the risk and implement control strategies<sup>10</sup> prior to work or projects commencing. The Waste Reduction Project Manager stated in

<sup>4</sup> Taken from CSIRO Sustainability Report 2006/7 and 2007/8

<sup>5</sup> Taken from CSIRO Sustainability Report 2006/7

<sup>6</sup> Taken from HSE Annual Report 2008

<sup>7</sup> Taken from CSIRO Sustainability Report 2006/7 and 2007/8

<sup>8</sup> Taken from CSIRO Sustainability Report 2006/7

<sup>9</sup> <http://www.csiro.au/resources/HSEReport.html>

<sup>10</sup> Taken from OHS&E Annual Report 2004

the interview that a risk management team led by the Environmental Sustainability Manager looks at risk management in the organisation.



Figure 10: CSIRO's Environmental Management Framework

Source: OHS&E 2005 Annual Report

The Environmental Sustainability Strategy covers all the organisation's operations. It includes support structures such as procurement, property services and other divisions. Environmental sustainability considerations are an essential component of procurement of goods and property services policy and initiatives in the design and construction of new and refurbished buildings<sup>11</sup>. Environmental assessment on CSIRO properties is undertaken as part of due diligence and where there is a potential need for environmental remediation it is put in place<sup>12</sup>. Through implementation of a variety of programmes developed as part of the Environmental Sustainability Strategy, the

<sup>11</sup> Taken from HSE Annual Report 2006

<sup>12</sup> Taken from HSE Annual Report 2006

whole organisation will be involved in decreasing the consumption of natural resources and taking whole life cycle principles into account. In the interview with the CSIRO Waste Reduction Project Manager, it was confirmed that procurement and property policies are currently being developed to achieve waste minimisation goals.

#### **4.2.2 Setting of waste indicators**

Three goals that are set in the Environmental Sustainability Strategy define the vision. These goals are:

1. CSIRO to become carbon neutral by 2015.
2. CSIRO to half mains water by 2015 and
3. CSIRO to half waste generation by 2015.

It is clear to the organisation and its stakeholders what CSIRO wants to achieve in terms of environmental sustainability, and when and how the organisation is going to achieve this. One of the Environmental Sustainability Strategy high-level goals stated above is to half waste generation by 2015. According to the annual reports and interviews, the strategy was developed under the leadership of Executive Team member Dr Andrew Johnson (Group Executive Environment) working with a broad cross-section of CSIRO staff. When setting the Environmental Sustainability Strategy goals, senior managers met to identify what they thought the organisation should achieve. External consultants were used to investigate usage of resources and recommend goals. It is stated in the CSIRO Sustainability Report 2006/07<sup>13</sup> that *“Stakeholder feedback was used to define the key sustainability issues for the division and identify a subset of GRI indicators that would best reflect the most critical functions of our operations and our performance.”*

According to the Environmental Sustainability Manager, focus groups were formed to work on the different goals. Each focus group consisted of property services, finance, the Environmental Sustainability Manager, a consultant and CSIRO experts. CSIRO experts were engaged and consulted in order to gain agreement on actions and goals, and buy-in for delivery. The waste focus group consisted of researchers who had interest in waste management, the CSIRO Ecosystems division and the Environmental Sustainability Manager. The objectives of the focus groups were to identify initiatives that would ensure that the organisation achieves its goals, and thereafter draft a costing structure. CSIRO's performance and future aspirations were benchmarked with national and international best practice.

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<sup>13</sup> Taken from CSIRO Sustainability Report 2006/7



### 4.2.3 Environmental Management System (EMS)

In December 1998, the CSIRO Executive Committee approved an EMS based on AS/NZS ISO 14001 EMS Principles. At CSIRO, each division and site has a unique set of environmental issues and risks. Because of this, divisional and site management is responsible for managing them. Each division and site therefore is responsible for implementing its own customised EMS based on the ISO14001 standard. A corporate EMS manual and procedure templates are provided to guide and assist EMS implementation across the diverse and geographically dispersed sites. A project to streamline the EMS into an organisational-wide approach was initiated in 2007 to reduce the bureaucratic nature of the EMS. According to the Environmental Sustainability Manager this process is still in progress. This was done in accordance with CSIRO's environmental policy, which states that *"the EMS will be reviewed regularly to ensure its appropriateness and effectiveness in fulfilling CSIRO's environmental responsibilities."* HSE's plan has been to implement an EMS that supports sustainable development.

The AS/NZS ISO 14001 EMS requires that the organisation should identify its activities and effects that it could have on the environment and develop goals to reduce these impacts on the environment. There are five essential strategies in which the HSE 2007-2011 strategic plan seeks to achieve zero environmental harm as shown in Box 2. Two of these are listed as *"risk based prioritisation"* and *"measurement, review, audit and closure"*. These two essential strategies are in line with the requirements of the AS/NZS ISO 14001 EMS<sup>14</sup>.

Box 2: HSE's five essential strategic initiatives

Source: CSIRO HSE Annual Report 2007

CSIRO's commitment to HSE is reflected in the CSIRO HSE Strategic Plan 2007-2011 with the challenges that requires us to drive *a step - change improvement in HSE culture and performance* over the coming four years. CSIRO has also embraced the aspirational goal of *Striving for Zero Harm*:

- Zero injuries
- Zero illnesses
- Zero environmental harm
- Zero tolerance of unsafe behaviours

Achieving this vision will require significant organisational, behavioural and operational change in HSE management. The HSE Strategic Plan for 2007-2011 seeks to deliver this step-change by focusing on five essential strategic initiatives:

1. Leadership commitment and competency
2. Clear expectations and accountabilities of all staff
3. Effective HSE management system and tools
4. Risk-based prioritisation
5. Measurement, review, audit and closure

<sup>14</sup> Taken from HSE Annual Report 2007



CSIRO environmental risk review and audits have been used to identify risks and environmental deficiencies. Action plans are then developed to address the environmental deficiencies that were identified by the risk assessments and audits. A review of the organisation's environmental impact (risk) exposure was conducted by the Risk Assessment & Audit (RA&A) group and completed at the end of 2004<sup>15</sup>. The key objective of the risk assessment was to establish an environmental risk profile for CSIRO to complement the Occupational Health and Safety (OH&S) risk review providing the organisation with an understanding of the risk exposures for Occupational Health, Safety and Environment (OHS&E). The environmental risk review also aimed to:

- identify areas where management systems were not adequate, or more efficient and effective environmental management practices could be implemented; and to
- monitor activity by identifying high-risk areas where management systems were already mitigating the risk to an acceptable level.

Environmental performance was included as part of the review by the RA&A division. Resource use and incident reports were collated and analysed to develop a risk profile for CSIRO that included potential and actual risk. The diverse nature of CSIRO's activities contributes to high levels of inherent environmental risk exposure across a broad range of possible risk categories. An evaluation of existing controls to prevent and manage environmental impacts indicated that 68% potential aspects were being managed effectively. This was indicative of the modest size use of hazardous substances and small amounts of waste. The shortcomings in management controls were identified as waste and pollution. These areas presented opportunities for management to revise or implement further environmental risk reduction strategies<sup>16</sup>.

The CSIRO Environmental Risk Review highlighted the potential significant environmental impact CSIRO has due to pollution and environmental damage arising from improper management of trade waste. Activities that potentially contribute to this impact included accidental spill, release or intentional disposal of the following:

- laboratory chemical wastes,
- liquid radioactive wastes,
- cleaning products,
- coolants and fluids from plant and equipment,
- irrigation waters from glasshouses,
- canteen and kitchen wastes and
- other liquid effluents or solids.

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<sup>15</sup> Taken from HSE Annual Report 2006 and confirmed in the interview with the Waste Reduction Project Manager

<sup>16</sup> Taken from OHS&E Annual Report 2004

It was suggested that mismanagement of these activities could firstly cause contamination of surface and ground water. Secondly it could cause permit limits to be exceeded. Third, it could affect flora and fauna and damage the food chain or human health. Last, it could result in soil contamination and incur fines and violations. In response to these findings, CSIRO conducted an audit of trade waste management in early 2005. Following the completion of the trade waste audit, an action plan was developed in 2006 for completion by business units and individual sites to address a number of deficiencies identified by these audits<sup>17</sup>.

RA&A also completed a general waste management audit, 'CSIROWaste', in a few selected business units in 2006. The general waste audit targeted management of general waste, domestic, medical, biological, laboratory and radioactive waste. The initial feedback indicated that waste management was not consistent across all business units. However, during the time of this audit CSIRO was developing an Environmental Sustainability Strategy to address numerous issues including waste. Many of the recommendations required organisational waste targets and these were built into the CSIRO Environmental Sustainability Strategy. Business units then undertook CSIROWaste audits on their sites to assist them to develop and implement appropriate waste management practices<sup>18</sup>.

The Australian National Audit Office (ANAO) conducted a Green Office Procurement Audit for Government agencies in late 2005. Five elements were audited namely: sustainable policies and initiatives, waste, water, procurement practices and motor vehicles. The report highlighted some positive activities by CSIRO and identified recommendations for all Australian Government agencies. Eighteen of the recommendations affected on CSIRO. These recommendations were addressed as part of the development of an organisational Environmental Sustainability Strategy<sup>19</sup>. Some of the improvements made to enable CSIRO to meet its environmental objectives and address issues identified in the risk assessments and audits included full implementation of ISO14001 based EMS in each division and annual reporting on environmental performance. Several procedures were updated and new ones were developed, including the waste management procedure. The waste management procedure prescribed a consistent approach to waste management at CSIRO, including the development and implementation of management plans relating to water, energy and waste in general. It provides business units with guidelines to avoid waste production. Where this is not practical, guidance on the minimisation and management of waste streams is given. All business units were required to produce annual environmental improvement plans. These plans are approved by the managers of business units for

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<sup>17</sup> Taken from HSE Annual Report 2006 and confirmed in the case study interview

<sup>18</sup> Taken from HSE Annual Report 2006

<sup>19</sup> Taken from HSE Annual Report 2006 and confirmed in case study interview

implementation. They typically include information on training needs, risk reduction actions, water and energy conservation plans and waste management plans. As a result of these plans, many business units are reported to have been able to demonstrate some excellent sustainability outcomes<sup>20</sup>.

#### **4.2.4 Waste management roles and responsibilities**

Clear expectations and accountabilities of all staff are some of the five essential strategic initiatives listed in the HSE 2007-2011 Strategic Plan which will enable HSE to achieve its zero environmental harm goals as shown in Box 2. Health, Safety and Environment (HSE) division is responsible for environmental management in the organisation. HSE is required to demonstrate leadership by setting direction and motivating the staff to be environmentally responsible. The division is responsible for ensuring that all employees are allocated environmental responsibility for all jobs and activities. Everyone at CSIRO is accountable for the environmental impacts of their operations. According to the HSE division, clarification of roles and responsibilities is required so that they can deliver an organisation of HSE aware and accountable staff that takes care of the natural and built environment.

Previously, the CSIRO Environmental Management Systems Committee (EMSC) was responsible for the development and implementation of environment policy and an EMS. The EMSC merged with the H&S Committee in early 2006 to form a combined Health, Safety and Environment Committee (HSEC). The Committee met every three months and was responsible for the development and implementation of Environment Policy and an EMS<sup>21</sup>.

The CSIRO Sustainability Ecosystems division was responsible for developing the Environmental Sustainability Strategy. The HSE division led by the General Manager is responsible for the direct management of the Environmental Sustainability Strategy. The Environmental Sustainability Manager is responsible for implementing the seven-year Environmental Sustainability Strategy. The Waste Reduction Project Manager is responsible for ensuring the achievement of the waste reduction goals. Business unit HSE officers are responsible for HSE in the business units. Corporate Property is responsible for the management of all CSIRO properties. Part of Corporate Property's responsibilities is overseeing the environmental management impacts of sites and the remediation of any environmental issues that affect the land<sup>22</sup>.

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<sup>20</sup> Taken from HSE Annual Report 2006 and confirmed in the case study interview

<sup>21</sup> Taken from HSE Annual Report 2006 and confirmed in the case study interview

<sup>22</sup> HSE structure taken from OHS&E Annual Report 2004 and confirmed in interview

#### 4.2.5 Waste management planning

According to the 2008 HSE annual report, it was planned that the first twelve months of the Environmental Sustainability Strategy will be focussed predominantly on energy, water and waste audits across a number of CSIRO sites, with the aim to improve CSIRO's understanding of energy and water consumption and waste generation. Outcomes and recommendations from the audits will identify areas for improved sub-metering and opportunities to reduce energy, water and waste. The 2008 HSE annual report further states that the Environmental Sustainability Strategy will have a variety of programmes for implementation across CSIRO which will focus on decreasing consumption of natural resources.

The CSIRO Environmental Sustainability Strategy was also developed to achieve continual improvement and it is expected to further guide the evolution of CSE's future practice. According to the Executive Director Human Resources, Safety and Sustainability, it was found that the EMS had not yet yielded the sustainability improvements that CSIRO was seeking<sup>23</sup>. To ensure that CSIRO continued to improve its environmental performance, an Environmental Sustainability Strategy was developed in 2008.<sup>24</sup> It was believed that this would help to insulate CSIRO from future risks involved in energy, waste and water prices. The Environmental Sustainability Strategy outlines paths to ensure that CSIRO reaches its environmental sustainability goals. In the long term CSIRO's path towards a more sustainable organisation will not only benefit the environment, but waste reduction will save resources that can be invested in other areas. Where appropriate, CSIRO expertise and research and development solutions will be deployed directly to achieve the strategic goals.

According to the Environmental Sustainability Strategy, CSIRO's activities in the waste reduction domain include more strategic procurement and strategies to reduce, reuse and recycle. Under Strategic Procurement, the activities that CSIRO will undertake in order to encourage more strategic procurement include:

- **Direct Procurement:** CSIRO will link waste management objectives to strategic procurement to identify opportunities to reduce waste inputs such as through reduced packaging materials or packaging covenants which return waste to the supplier. This approach will not just relocate waste responsibilities to suppliers, but seek active waste minimisation approaches.

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<sup>23</sup> Taken from HSE Annual Report 2008

<sup>24</sup> Taken from HSE Annual Report 2008

- **Centralised waste contracts:** Opportunities will be explored to centralise waste management contracts to better quantify waste streams and to find reuse and recycling opportunities in conjunction with contractors.
- **Supply Chain Procurement:** CSIRO procurement will be further refined based on cost, performance and life cycle assessment, adopting best practice approaches (such as US EPA EPP or Australian Green Procurement)

Strategies to Reduce, Reuse and Recycle CSIRO will also undertake a number of initiatives to directly reduce both consumption and waste to landfill:

- **Site Audits:** CSIRO will undertake audits to quantify the organisation's waste footprint, and to identify waste reduction opportunities at 30 sites. Waste management plans will be required for all sites to promote minimisation, reuse and recycling and identify alternative uses for wastes.
- **Waste reuse and recycling:** The organisation will promote and reduce barriers to improve recycling and reuse. Increased re-use and recycling waste streams will reduce the volume of waste directed to landfills and implementation of acceptable collection systems.
- **Scientific waste:** CSIRO will investigate means to reduce the amount of scientific waste through better purchasing practices and better inventory management. It will also identify key input materials for the organisation and reducing input consumption along with the current output focussed measures.
- **Spring Fling:** The "Spring Fling" will be introduced across CSIRO annually during National Recycling Week in November.
- **Education and Awareness:** A programme will be developed to change the behaviour of staff to promote better use of the waste hierarchy using a multi-faceted approach.

According to the Environmental Sustainability Strategy, the key elements to CSIRO's Environmental Sustainability Strategy are:

- **The Carbon & Energy, Waste and Water goals**
- **Measurement and Evaluation:** Strategies in improving data capture and management, as well as verification and audit of information
- **Integration:** Strategies to integrate the four other elements in the areas of project management and delivery, change management and staff engagement and internal and external reporting

The Environmental Sustainability Strategy is still in its early development stage. Currently CSIRO is developing procurement policies. Site audits have been conducted, education and awareness is

on-going in different forms. According to the Waste Reduction Project Manager conducting the audits has been a great achievement. Stakeholders are being engaged to get them to buy into the vision. The goals that were set in 2008 have not changed but there have been some changes in the plan of action. Lifecycle analysis which were planned to start in 2012 have been moved forward because it was found that the decisions that needed to be taken now will require information from the lifecycle analysis.

There is learning and sharing of experiences between the stakeholders, auditors and the HSE division. According the Waste Reduction Project Manager the following are the main lessons and achievement to date:

- When planning for audits enough time should be allocated to accumulate and analyse information from the audits.
- Think carefully about the waste streams that should be audited and ensure that specifications and wording of tender documents are clear and specific.
- Make sure that the auditors understand expectations and requirements from the audits. An initial site walkthrough is also helpful to induct auditors on the organisation's processes.
- Allocate a full-time person who will accompany auditors when they audit so there is understanding between the auditors and the site people.
- Never assume that everyone in the organisation understands waste management and the waste management industry.
- Every site in the organisation is different. The culture and processes of each site are different; therefore working and communicating with each site should be unique and individualised.

According to the Waste Reduction Project Manager, although the waste goal is to half waste by 2015, the aim is not to stop at 50 percent reduction. This goal was set as a result of a lack of available resources externally that will enable the organisation to reach Zero-Waste to Landfill. In future this goal will be stretched. The Waste Reduction Project Manager further stated that even if the goal was Zero-Waste to Landfill, the same process and plans would still be followed.

CSIRO also has a documented draft Integrated Waste Management Plan (IWMP) as shown in appendix 6. This IWMP includes the requirement to meet the CSIRO Strategic Plan, the Australian Federal and State Policies and Legislature and International obligations. It shows how the Environmental Sustainability Strategy, organisational and national requirements link with each other. The AS/NZS ISO 14001 EMS requires that the organisation must meet legal and other requirements associated with its activities. CSIRO's environmental policy states that CSIRO is

committed to regular assessments of legal requirements. According to CSIRO's Waste Reduction Project Manager, government policies and guidelines give guidance on where the nation is going and the direction that the organisation should take. It is important for CSIR to adhere to the government policies and requirements. Membership in waste forums and associations has helped to keep abreast with the latest developments in waste management.

CSIRO is in line with the Australian waste legislation as the Environmental Sustainability Strategy goals address what the nation demands. The Australian National Waste Policy states that Australia has a responsibility to meet international obligations. Australia intends to avoid the generation of waste, produce less waste and pursue sustainability. Waste treatment, disposal, recovery and re-use are expected to be undertaken in a safe, scientific and environmentally sound manner. According to the National Waste Policy, one of the strategies to achieve the policy plans is to improve waste generation and re-use of materials in the commercial and industrial waste streams (Government of Australia, 2009). The Policy Implementation plan details government milestones that will be achieved from 2010 to 2015 to ensure that the policy goals are met. One of the milestones is to pursue the sustainability direction (Government of Australia, 2010). Implementing CSIRO's Environmental Sustainability Strategy will support the Australian government in achieving this milestone.

#### **4.2.6 Knowledge management**

The HSE division aims to analyse current and future trends in environment performance<sup>25</sup>. It is believed that accurate measurement and monitoring of environmental performance is an important part of effective science, management and business<sup>26</sup>. In the CSIRO EMS Framework it was identified that improving environmental performance requires improving measurement and reporting on environmental performance. This is also identified as one of the key elements of the Environmental Sustainability Strategy. According to the HSE division, improving environmental performance requires improving environmental measurement systems. If these systems are not efficient, current and future organisational environmental trends cannot be monitored and analysed. An electronic system for collecting, sorting and analysing all environmental data is used at CSIRO. This system is reliable and easy to use. Waste, energy and water data for the whole organisation are collected and analysed on this system. Reports can be extrapolated and distributed from the data which is put on the system.

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<sup>25</sup> Taken from OHS&E Annual Report 2004, 2005 and 2006

<sup>26</sup> Taken from 2008 Annual Report 2008



The CSIRO Waste Reduction Project Manager stated in the interview that currently carbonsystems<sup>27</sup> is used for collecting, analysing and managing waste information. This system streamlines the capturing and reporting of all quantitative and qualitative source data across the organisation's waste management portfolios. The Waste Reduction Project Manager described this system as "brilliant", because it enables tracking and analysis of all waste information throughout the organisation. Waste information is captured by different people in different departments, as well as by suppliers.

CSIRO still needs to improve its waste management processes to ensure that all data is collected accurately. Uniform waste collection systems will need to be developed. In addition to this, waste contractors will be required to provide summary data outlining waste sorting and disposal statistics across sites.

#### **4.2.7 Training, awareness and communication**

One of the principles through which CSIRO believes it will meet its vision of improving environmental performance, as stated in the environmental management framework is through participation (see figure 10). This means the encouragement of employee, contractor and community involvement in the management of environmental issues, for example employee and contractor awareness, training, communication and stakeholder involvement.

CSIRO's policies and strategies describe how communication of environmental affairs will be conducted in the organisation. The CSIRO environmental policy states that CSIRO will communicate openly and honestly with staff, stakeholders and community on environmental issues. According to the CSIRO Sustainable Ecosystems Charter, the organisation's values and beliefs are "facilitating open and honest communication and meaningful engagement with our staff and stakeholders". Each aspect of the Environmental Sustainability Strategy has a provision for an awareness and participation initiative to engage staff and promote behavioural change.

After completion of the CSIRO Environmental Sustainability Strategy, there was a launch to communicate it to the organisation in order to make employees aware of the organisation's intentions to minimise waste. The communications department assisted with how to best communicate the Environmental Sustainability Strategy goals. Interviews on video cast and announcements were made by the Environmental Sustainability Manager on the Environmental Sustainability Strategy goals. Internal newsletters, emails, posters, the intranet, share points and annual external sustainability reports are still being used to communicate this information. After the

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<sup>27</sup> <http://www.globalcarbonsystems.com>



Environmental Sustainability Strategy goals were communicated, audits were conducted. The outcomes from the audits were communicated using the same channels that were used to communicate the goals<sup>28</sup>. Some sites were also visited to share information from the audit findings.

The CSIRO Waste Reduction Project Manager confirmed that she found that while interacting with different people on the ground during audits, *“you are able to learn from them and have a first-hand experience of what they go through”*. This also helped to build relationships and get buy-in from the stakeholders. Through communication and participation, trust has been gained from employees and an increasing number of employees want to be involved in the waste minimisation project. As a result of this, a Sustainability Coordinator has been appointed to engage with all employees on sustainability projects at CSIRO. This person coordinate all sustainability projects, communicate with employees on planned projects and get input from employees on these projects. The Sustainability Coordinator will also observe behavioural change during this process<sup>29</sup>.

Another way in which stakeholders are engaged at CSIRO is through external reporting. An annual sustainability report is developed using GRI guidelines published on the CSIRO website. The HSE division publishes a report on HSE performance annually on the organisations website. Both these reports can be accessed by internal and external stakeholders. This shows the openness and willingness of the organisation to allow stakeholders to see how it is performing. The reports do not only report on positive outcomes, but also on negative outcomes and action plans for these.

According to CSIRO's environmental policy, the organisation will provide training to ensure that staff, business partners and service providers are aware of the organisation's environmental policy and that they are able to fulfil their responsibilities. According to the CSIRO Waste Reduction Project Manager, all new employees at CSIRO undergo HSE induction training on their first day of employment. They are provided with information on corporate policies and procedures, employee requirements including information on environmental management. Environmental officers, supervisors and staff are taken through an EMS awareness course. HSE conferences and workshops are used to provide opportunities for learning, growing and sharing of experiences for HSE employees<sup>30</sup>. External bodies such as waste associations are used to obtain information on the current trends and available training, and depending on the need, employees are trained. Training for cleaners is currently being explored as they play an important role in the management of waste streams.

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<sup>28</sup> Taken from Interview with CSIRO Waste Reduction Project Manager

<sup>29</sup> Taken from interview with CSIRO Waste Project Reduction Manager

<sup>30</sup> Taken from interview with CSIRO Waste Reduction Project Manager

## 4.3 RESULTS FROM INTERVIEW WITH EXPERTS

### 4.3.1 Organisation principles and culture

Four experts were asked for opinions pertaining to what should be in place for an organisation such as the Council for Scientific and Industrial Research (CSIR) to implement a Zero-Waste to Landfill strategy. The experts interviewed are listed below;

- i) James Modiba: Security, Safety, Health, Environment and Risk Management Manager (SSHERM) - CSIR; Management Services Department.
- ii) Linda Godfrey: Pollution and Waste Competency Area Manager – CSIR; Natural Resources and the Environment Unit.
- iii) Nana Agyepong: Project Researcher - University of South Africa (UNISA), UNISA/United Nations Global Compact (UNGC).
- iv) Pieter Haasbroek: Environmental Management Systems Manager – South African Bureau of Standards.

The Environmental Management Systems Manager of the South African Bureau of Standards (SABS) said that a policy statement that includes the waste minimisation objective must be signed by top management and waste minimisation must form part of management's objectives. The Environmental Management Systems Manager of the SABS believes that the environmental policy which is signed by the Chief Executive Officer (CEO) shows commitment from top management. There should be buy-in from employees on this policy.

When asked what the CSIR was doing to show corporate social responsibility, the Security, Safety, Health, Environment and Risk Management (SSHERM) Manager of the CSIR said that *“the CSIR Safety, Health and Environment (SHE) policy states that the CSIR will take care of the environment. The organisation's CEO has signed this policy, to show the organisation's commitment to the policy. The organisation is also certified with ISO14001 which enables CSIRO to identify risks that it poses on the environment and mitigate these risks. “Currently the organisation is looking at sustainability reporting as we believe that we need to start reporting on our environmental performance to our stakeholders.”*

### 4.3.2 Setting of waste indicators

Four experts were asked how they think Zero-Waste to Landfill goals should be set. All four suggested that top management involvement and buy-in is necessary for the success of such an initiative. The SSHERM Manager of the CSIR said setting realistic goals would be required. The

Pollution and Waste Competency Area Manager of the CSIR said that when setting goals, realistic goals need to be set, this means that achieving the goal should be within the people's control. This also requires having infrastructure and systems that can support achievement of the goal.

The Project Researcher from the University of South Africa/United Nations Global Council (UNISA/UNGC) Office said the formation of focus groups where all stakeholders are represented was important when setting goals. The objective of the focus groups would be to find out how the stakeholders view the organisation and its environment, and to find out what the stakeholders want to achieve with regard to waste management.

#### **4.3.3 Environmental Management System (EMS)**

Concerning the possibility of integrating the Zero-Waste to Landfill goal into an organisation's EMS, The SSHERM Manager of the CSIR said that this was possible. According to him, waste goals need to be integrated with the EMS because they are also environmental goals. The Environmental Management Systems Manager of the SABS said it is definitely possible to integrate Zero-Waste to Landfill with an EMS. This can be integrated into the impacts and aspects of the organisation. He suggested that the waste minimisation initiative needs to be run with a management programme such as ISO9001 and ISO14001. The Environmental Management Systems Manager of the SABS added that ISO14001, 14004 and 14005 can be used as guidelines to implement a waste minimisation project.

#### **4.3.4 Waste management roles and responsibilities**

When asked what the CSIR is doing to show corporate social responsibility, the Security, Safety, Health, Environment and Risk Management (SSHERM) Manager of the CSIR said that there are CSIR employees who have responsibilities to ensure that the CSIR takes care of the environment as stated in the Safety, Health and Environmental policy.

#### **4.3.5 Waste management planning**

Three experts were asked what they think should be in place for an organisation such as the Council for Scientific and Industrial Research (CSIR) to implement a Zero-Waste to Landfill strategy. They all suggested that an investigation of the organisation's waste streams and baseline study must be conducted as a starting point. This would need to be done for all sites and all units. The SSHERM Manager of the CSIR said when setting targets to minimise waste, it would be important to be aware of the quantities and types of waste that will be generated in current and

future projects. This information should be taken from the business units annually. This must be done by involving the business units. He added that the systems that are needed to achieve the goals would then need to be determined. The Pollution and Waste Competency Area Manager of the CSIR said that when setting goals, waste streams must be prioritised by deciding which streams require more attention and suggested that addressing the more difficult areas should be undertaken initially. A good start, according to her would be to focus on paper. The Environmental Management Systems Manager of the SABS said that all the tools and resources required for the initiative to succeed must be identified. He added that consideration of the Waste Act was required for such an initiative. The Project Researcher from the UNISA/UNGC Office said that an environmental sustainability practice survey as an initial desktop investigation would also be of benefit in order to find out the current practice and behaviour of employees. Recommendations from the survey would then need to be considered for implementation.

#### **4.3.6 Knowledge management**

The SSHERM Manager of the CSIR said that system gatekeepers are needed to manage knowledge. These are systems where information is kept and retrieved when needed. According to the Pollution and Waste Competency Area Manager of the CSIR, a system for capturing waste information is required in an organisation as data is needed to monitor performance. However, how information is shown can vary. A complicated or advanced system is not required; a spreadsheet can be developed in-house to capture data. The Pollution and Waste Competency Area Manager of the CSIR concluded by saying that the CSIR needs to position itself so that it is able to give information on the types and quantities of waste generated by the organisation.

According to the Project Researcher of the UNISA/UNGC Office, all information needs to be stored properly. Organisation websites and intranet can be used to store and share information. Hard copies can be stored in the organisation's library. The Project Researcher of the UNISA/UNGC Office added that everybody in the organisation should have access to the documents, both soft and hard copies.

#### **4.3.7 Training, awareness and communication**

The experts interviewed believe that communication of the waste goals would be important in the organisation. The Pollution and Waste Competency Area Manager of the CSIR said that management needs to communicate the waste goals. The Environmental Management Systems Manager of the SABS said that the environmental policy must be communicated so that the whole organisation knows what the CSIR wants to achieve. The Pollution and Waste Competency Area

Manager suggested that there would be a need to develop a communication strategy that covers the following three important aspects:

1. The CSIR and CSIR Directors think waste minimisation is important,
2. The consequences of not minimising waste, and
3. State how the Zero-Waste to Landfill goal will be achieved.

She added communicating and raising awareness on the current waste management system in the CSIR would be a good start.

The Environmental Management Systems Manager of the SABS said the training needs for stakeholders must be identified. He added that stakeholders must be trained and equipped to perform their responsibilities. In a separate interview the Pollution and Waste Competency Area Manager of the CSIR suggested that there is a need for on-going awareness and communication programmes made for cleaners.

The SSHERM Manager of the CSIR was asked who the stakeholders for a waste minimisation project at the CSIR are. He said that environmental management is everyone's responsibility. The scientists are stakeholders because they are the highest generators of hazardous waste. Management is a stakeholder as it needs to enforce waste management. SSHERM department is a stakeholder as it needs to manage the waste management system. Facilities Management as the landlords is a stakeholder, and SHE representatives uphold the EMS in the units. He added that there are other stakeholders who are interested parties; these are indirectly affected by the CSIR's activities. According to the Project Researcher of the UNISA/UNGC office, stakeholders are any group of people or person who may affect or be affected by the organisation's activities, decisions, changes and improvements. She believes that there are different roles for different stakeholders.

#### **4.4 DISCUSSION OF THE RESULTS**

What has come out from the case study results is that CSIRO has documentation which states the organisation's environmental goals and plans. The resources and systems which will be required to achieve their goals are mentioned in the documentation. There also exist formal implementation plans which will ensure achievement of their environmental goals. The people involved in the development and implementation of these goals have been interviewed and other experts outside the case study. This discussion will form part of the responses from the case study and all interviews that were conducted in this study. This discussion will form the foundation of what will be included in the CSIR Zero-Waste to landfill Framework.

#### **4.4.1 Organisation principles and culture**

From the results, it is clear that CSIRO is an organisation that wants to reduce its environmental footprint and minimise its impact on the environment. CSIRO does not only recognise environmental management of its operations as a high priority, but the organisation considers itself as a leader in environmental management. As a scientific organisation, it believes that it will be looked upon in order to take a leadership role in environmental sustainability and therefore it intends to be more sustainable in its operations. The culture that has been built in the organisation is that of caring and putting the environment first. The organisation makes this known in several documents such as the organisation's environmental policy, the HSE Strategy and the Environmental Sustainability Strategy.

CSIRO has developed an Environmental Sustainability Strategy which focuses on three environmental sustainability goals. The Environmental Sustainability Strategy gives the steps that will be taken to minimise waste in the organisation. The resources needed to achieve this goal are allocated to ensure achievement of the goal. In this strategy, the aim is to ensure that organisational processes incorporate environmental sustainability principles and practice. There is open communication with stakeholders on the organisation's goals and performance. The public and stakeholders have access to the environmental policy and annual reports.

The environmental policy gives direction and shows the organisation's vision to both employees and stakeholders. It also provides a framework for action and for the setting of environmental goals. The CSIRO environmental policy details CSIRO's commitments to manage the environment appropriately. The Environmental Sustainability Strategy confirms what is in the policy. In an organisation that is certified with ISO14001, the environmental policy must contain the vision and goals of the organisation. (ISO, 2004) describes the environmental policy as the overall intentions and direction of an organisation related to its environmental performance.

#### **4.4.2 Setting waste indicators**

The goal for waste minimisation is clear at CSIRO; the indicator for achievement of the goal will be to half waste generation by 2015. This goal can be understood by all in the organisation, and with proper systems in place, it can be easily measured. By measuring this goal, CSIRO will be able to see how it is progressing towards the sustainability goal. According to Bossel (1999:25) indicators are important because they provide information about the state of our health.

It is important to also see how these indicators have been set as well as how stakeholders have been involved in the process of setting the indicators. One of the experts interviewed in this study said that involving stakeholders in this process is important. According to (CSIR Boutek, 2002), *“The first step is getting management commitment since the co-operation of management makes it easier to reach your waste-reduction targets.”* Sushil (1990); ISO (2008); USEPA (1989); Leaner and Fitter (2008) all agree that management buy in and commitment are required to achieve business goals. The results also show that the leadership in the organisation have bought into the vision and goals set in the CSIRO Environmental Sustainability Strategy. The Environmental Sustainability Strategy was developed under the leadership of Executive Team member working with a broad cross-section of CSIRO staff.

#### **4.4.3 Environmental Management System (EMS)**

The CSIRO EMS has been integrated with waste minimisation goals and initiatives. The ISO14001 EMS requires that an organisation's environmental policy should include a commitment to continual improvement and prevention of pollution. The results gathered track improvements made at CSIRO since 2002. Continuous improvement allows the organisation to grow and improve. All CSIRO audits have been used to identify improvement opportunities. Indicators for environmental performance have been used to guide decision making at CSIRO. Negative and positive indicators are highlighted in audits or risk assessments. According to DEAT (2004:14), it is important to develop an approach for identifying indicators of sustainability and further consider how information will be used when indicators are identified.

Experts interviewed in this project suggested that a survey and initial investigation of the organisation's waste streams and baseline study must be conducted as a starting point of a waste minimisation project. This would assist in highlighting the status of the organisation and gaps that need to be closed. It is explained in (CSIR Boutek, 2002) that this initial investigation will help identify and choose the most feasible and cost-effective waste minimisation actions for the organisation.

The CSIRO Sustainable Ecosystem's Sustainability Charter states that the organisation's values and beliefs are to *“minimise our environmental footprint”*. Improvement of the understanding of the environmental footprint of the organisation and reducing resource use is an on-going process. One of the vehicles that CSIRO used to do this was environmental risk assessments and audits that gave an indication of the organisation's status. Setting targets and conducting regular monitoring are identified as key processes in the CSIRO Sustainable Ecosystem's Sustainability Charter and environmental policy.



Looking at the history of the HSE division since 2002, the organisation's environmental risk assessment was conducted. The findings from this risk assessment required that a trade waste audit be conducted so that management of trade wastes could be improved. Following this risk assessment, between 2005 and 2006 a general waste audit which targeted management of general waste, domestic, medical, biological, laboratory and radioactive waste was conducted. There were also some audits that were conducted by external bodies on other business processes in 2005. The recommendations were addressed as part of the development of an organisational Environmental Sustainability Strategy. It is clear that the HSE division is living its vision of improving environmental performance through identification, management and prevention of environmental impacts.

#### **4.4.4 Waste management roles and responsibilities**

Harris and Sims (2004:29-30) state that after setting strategic goals in an organisation, roles and responsibilities must be given. In the ISO14001 EMS, organisations are advised to define, document and communicate roles, responsibilities and authorities in order to facilitate effective environmental management. At CSIRO the HSE division is responsible for demonstrating leadership by setting direction and motivating staff to be environmentally responsible. This is necessary so that HSE can deliver an organisation of HSE responsible staff that take care of the natural and built environment and ensure the achievement of environmental goals.

Clear roles and responsibilities have been given to a number of individuals in the organisation for the achievement of the waste minimisation goals. Some of these employees were specifically appointed to fulfil the roles that would ensure that the Environmental Sustainability Strategy goals are met. The Environmental Sustainability Manager is responsible for implementation of the seven-year Environmental Sustainability Strategy. The Waste Reduction Project Manager is responsible for ensuring the achievement of the waste minimisation goal. There are also HSE staff members that are responsible for development and implementation of the environmental policy and EMS. By identifying specific people for specific roles it has been possible to start the implementation of the Environmental Sustainability Strategy and waste management plans.

#### **4.4.5 Waste management planning**

A plan to achieve the waste minimisation goals must be developed in order to ensure success of the goal. A business strategy helps to provide a high level plan of how the business goals will be achieved. A strategy provides a platform for management to provide resources that will be needed



to achieve goals. The Environmental Sustainability Strategy details the plan of action and strategies to support CSIRO's waste minimisation goal of halving the amount of waste generated by 2015. As Harris and Sims (2004:29-30) suggest, planning follows the goal setting process and helps to select strategies and allocate resources in the diversified organisation. According to the USEPA (1989), successful waste minimisation programmes depend on careful planning and organising.

#### **4.4.6 Knowledge management**

Knowledge management includes all methods by which information is collected, analysed, stored, distributed, shared and used. The ISO14001 EMS has requirements for management of environmental documents. It requires that there must be a formal documented system for developing, managing and disposing environmental related documents. The South African Waste Act also requires that waste generators know the quantities and types of waste that they generate. CSIRO has a system for collecting, analysing and managing waste information. The organisation is able to track the trends and progress made in its waste management system. This is done for different sites and different business units. The advantage of this system is that the organisation is able to know the types and quantities of waste that it generates at all times. This information is important, especially when goals have been set, progress towards achieving the goal can be measured. Improvements and changes can be made on time depending on the information that is gathered after analysing the waste information. The information that is gathered can also be used regularly for reporting purposes.

#### **4.4.7 Training awareness and communication**

In order to develop and successfully implement waste minimisation goals, all stakeholders need to be identified and involved throughout the process. (Audouin and Hattingh, 2008:232) state that *"including key stakeholders in environmental assessment and management processes, from the stage of designing the process and identifying the concerns to be addressed, with a particular emphasis on the inclusion of marginalised groups"* will address the constraints of modernism in environmental assessment and management. The Environmental Sustainability Strategy has been communicated to all stakeholders. *"The envisaged goals and targets should be published to all involved with the waste-minimisation assessment in the company"* (CSIR Boutek, 2002). The ongoing process of implementing waste goals involves communication and participation of stakeholders at all stages. CSIRO has enabled this by appointing an Environmental Sustainability Coordinator who is responsible for stakeholder engagement. Engaging with stakeholders has brought benefits of learning and sharing ideas with the stakeholders.

It is stated in (CSIR Boutek, 2002) that establishing an effective training programme increases awareness of environmental issues and encourages commitment and enthusiasm to waste reduction goals. According to (Tack, 1999) the training process can also be a useful tool to help the employees accept and take ownership of the EMS. The Environmental Management Systems Manager of the SABS interviewed in this study indicated that stakeholders must be trained and equipped to perform their responsibilities. The requirements of the ISO14001 EMS are strict and clear on what organisations should do with regards to training and development. ISO (2004) insists that organisations should identify training needs associated with their environmental aspects and EMS. Thereafter, the organisation should provide training or take other action to meet the training needs. CSIRO hosts an environmental induction session for new employees. Training for employees and contractors is also done to ensure that environmental goals are met.

#### **4.5 CONCLUSION**

Taking into consideration the literature review and results from the case study and interviews with experts, it is apparent that for an organisation to minimise waste it needs to be serious and committed to ensuring environmental sustainability. Environmental sustainability must be integrated into the organisations strategy, decision making and form part of the normal business operations. Zero-Waste to Landfill cannot be achieved by a single department in an organisation. The whole organisation must be involved. All policies, including procurement policies must support environmental sustainability.

A vision and goals that provide direction must be clear and communicated to all stakeholders. CSIRO uses public reporting to make stakeholders aware of what they are doing. It is also important that top management supports this vision and goals. The resources, including training and awareness required to achieve the goals must be provided.

The results highlight how the CSIRO's EMS has evolved through the years and the plans that CSIRO has for the future. CSIRO has also shown the steps and measures that have been taken to get where it is today. There has been learning and improvement throughout the years at CSIRO. Theory supports these steps and measures that have been taken. A plan which constitutes realistic targets has been turned into action. Clear roles and responsibilities are given to ensure that targets are met. The information gathered in this chapter will be used to develop a Zero-Waste to Landfill Framework for the CSIR.

## 5 CSIR ZERO-WASTE TO LANDFILL FRAMEWORK

### 5.1 INTRODUCTION

The goal of this study was to develop a Zero-Waste to Landfill Framework for the CSIR. This chapter presents the framework. A literature review was conducted, and propositions from the literature review were used to develop case study and interview questions. Data collected from the case study and interviews with experts has been analysed and conclusions drawn from the analysis in chapter four. In this chapter, the Zero-Waste to Landfill Framework is presented using the information gathered in chapter four.

### 5.2 DEFINITIONS

**Environment:** Surroundings in which an organisation operates, including air, water, land, natural resources, flora, fauna, humans, and their interrelation (ISO, 2004)

**Environmental stakeholder groups:**

- 1) Regulatory stakeholders, which either set regulations or lobby governments to set standards;
- 2) organisational stakeholders that are directly related to an organisation and that can have a direct financial impact on the company;
- 3) community groups, environmental organisations and other potential lobbies who can mobilise public opinion in favour of or against a firm's environmental policies; and
- 4) the media, which have the ability to influence society's perception of a firm. Hall (2001)

**Hazardous waste:** Any waste that contains organic or inorganic elements or compounds that may, owing to the inherent physical, chemical or toxicological characteristics of that waste, have a detrimental impact on health and the environment<sup>31</sup>.

**Sustainable development:** Development that meets the needs of the present without compromising the ability of future generations to meet their needs and aspirations (WCED, 1987).

**Waste:** Any unnecessary input to or any undesirable output from any system, encompassing all types of resources" (Sushil, 1990)

**Waste minimisation:** Involves investigating all methods of reducing material utility use at source and improving process efficiency, thereby reducing emissions to the environment and saving money.<sup>32</sup>

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<sup>31</sup> National Environmental Management: Waste Act, 2008 (Act 59 of 2008)

**Zero-Waste to Landfill:** To minimise waste generated as far as is technologically and economically feasible Sushil (1990)<sup>33</sup>

### 5.3 ACRONYMS AND ABBREVIATIONS

CSIR: Council for Scientific and Industrial Research

CSIRO: Commonwealth Scientific and Industrial Research Organisation

EMS: Environmental Management System

IEM: Integrated Environmental Management

ISO: International Organisation for Standardization

SAWIC: South Africa Waste Information Centre

SHE: Safety, Health and Environment

SSHERM: Safety, Security, Environment and Risk Management

UNCED: United Nations Conference on Environment and Development

### 5.4 OBJECTIVE

This document provides a framework that the CSIR can use to achieve the Zero-Waste to Landfill goal. The framework will enable the Security, Safety, Health, Environment and Risk Management (SSHERM) department to improve and enforce proper waste management within the organisation.

### 5.5 SCOPE

This framework is applicable to all the CSIR sites, units, centres and departments that generate waste. It covers only the minimisation of general solid waste and treatment of hazardous waste. Minimisation of waste water and gaseous waste are not covered in this framework.

### 5.6 RESPONSIBILITIES

- The CSIR Environmental Manager is responsible for implementation of this framework.
- The SSHERM department is responsible for updating and approving changes made on this framework.
- Other waste management roles and responsibilities are listed in waste management procedures and plans.

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<sup>32</sup> Government of South Africa, 2005

<sup>33</sup> Sushil (1990) also describes this as 100% efficiency. (Government of South Africa, 2005) states that zero-waste ensures avoidance of the generation of waste and minimisation of waste

## 5.7 BACKGROUND

Due to increasing global demand on finite natural resources, business is required to use natural resources efficiently. According to Khoo et al. (2001), a new approach to performing business will be the one which does not merely aim at achieving economic profit but also developing ecologically sensitive strategic management policies. The King III Code calls for sustainability reporting and disclosure to be integrated with the financial reporting of the organisation. Sustainability reporting ensures that reporting on environmental performance is as important as reporting on financial performance. An important path way towards sustainability for business and industry, according to Agenda 21 is the improvement of production systems through technologies and processes that utilise resources more efficiently and at the same time produce less waste. Zero-waste to landfill is a measure that can help organisations utilise resources more efficiently and produce less waste.

The CSIR quality policy states that the CSIR strives to act as a responsible steward of the environment in its activities. This framework is developed as part of continuous improvement of the CSIR waste management process. It builds on existing CSIR Safety, Health and Environment (SHE) procedures and waste management programmes and aims to set the framework for achieving the Zero-Waste to Landfill goal. Zero-waste to Landfill is a long term goal that requires continuous improvement and innovation.

By implementing this framework, the CSIR could experience the following benefits:

- Customer satisfaction and trust because of the good organisation image and reputation.
- Advantage over competitors.
- Improved environmental performance.
- Cost savings through efficient use of material and waste reductions.
- Better cooperation and relationship with regulators.
- Acceptance by external environmentally concerned stakeholders.
- Lowering of organisation environmental risks.
- Learning and innovation.
- Operational efficiency.<sup>34</sup>
- Fostering the health and well-being of its workers.

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<sup>34</sup> (Terry, 2008:197), SABS, 2005; Diadla, 2007, Tsai and Chou, 2009, Andrew and Matten, 2004:41 list these as benefits in organisations for environmental performance

### **5.7.1 International obligations and commitments**

Agenda 21 is an outcome of the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro in June 1992. It was instrumental in guiding countries, including South Africa to achieve sustainable development in that it has clear principles and guidelines on how to achieve sustainable development. Agenda 21 aims to improve the decision making process, so that consideration of socio-economic and environmental issues are participatory and fully integrated at all levels of decision making UNCED (1992). In Agenda 21 there are a number of concerns that are highlighted regarding the management of waste. *“Sound management of wastes was among the environmental issues of major concern in maintaining the quality of the earth’s environment and especially in achieving environmentally sound and sustainable development in all countries”*. Major concerns are on the increasing quantities of production and consumption made in different countries. Governments are urged in Agenda 21 to process and monitor waste trend information and implement waste minimization policies.

### **5.7.2 National policy obligations and legal requirements**

South Africa is currently governed by means of a number of pieces of legislation regarding waste management.

#### **5.7.2.1 The Constitution of South Africa**

The constitution of South Africa (Act 108 of 1996) forms the foundation of the evolutionary process for all the legislative framework regimes in the country. To this effect:

- Section 152 (1) of the Constitution states that one of the responsibilities of local government is to ensure that the provision of services to communities is done in a sustainable manner.
- Schedule 5B of the Constitution stipulates that waste management service delivery, including refuse storage, refuse removal, refuse dumps and solid waste disposal, is a local government function.

In summary, in relation to the environment, the South African Constitution (Act 108 of 1996) stipulates that everyone has the right to have an environment that is not harmful to his or her health and to have the environment protected, for the benefit of present and future generations, through reasonable legislature and other measures that:

- Prevent pollution and ecological degradation;

- Promote conservation; and
- Secure ecologically sustainable development and use natural resources while promoting justifiable economic and social development (Government of South Africa, 1996).

#### **5.7.2.2 The main new development in the national legislative regimes**

These include;

- National Environmental Management: Waste Act, 2008 (Act 59 of 2008)
- Hazardous Substances Act (Act 5 of 1973)
- Health Act (Act 63 of 1977)
- Environment Conservation Act (Act 73 of 1989)
- Occupational Health and Safety Act (Act 85 of 1993)
- National Water Act (Act 36 of 1998)
- The National Environmental Management Act (Act 107 of 1998)
- Municipal Structures Act (Act 117 of 1998)
- Municipal Systems Act (Act 32 of 2000)
- Mineral and Petroleum Resources Development Act (Act 28 of 2002)
- Air Quality Act (Act 39 of 2004)

In relation to waste management, the National Environmental Management Act (Act 107 of 1998) (NEMA) establishes the principle of a stronger statement of the waste management hierarchy that establishes avoidance of waste as the most basic objective of waste management (Government of South Africa, 1998).

The National Environmental Management: Waste Act, (Act 59 of 2008) aims to address fragmentation in South Africa's waste legislation and it provides a framework for meeting the World Summit for Sustainable Development goals (Government of South Africa, 2010). The objectives of the Act are:

*“(a) to protect health, well-being and the environment by providing reasonable measures for*

- (i) minimising the consumption of natural resources;*
- (ii) avoiding and minimising the generation of waste;*
- (iii) reducing, re-using, recycling and recovering waste;*
- (iv) treating and safely disposing of waste as a last resort;*
- (v) preventing pollution and ecological degradation;*
- (vi) securing ecologically sustainable development while promoting justifiable economic and social development;*
- (vii) promoting and ensuring the effective delivery of waste services;*

- (viii) remediating land where contamination presents, or may present, a significant risk of harm to health or the environment: and*
- (ix) achieving integrated waste management reporting and planning;*
- (b) to ensure that people are aware of the impact of waste on their health, well-being and the environment;*
- (c) to provide for compliance with the measures set out in paragraph (a) and*
- (d) generally, to give effect to section 24 of the Constitution in order to secure an environment that is not harmful to health and well-being.”*

### **5.7.2.3 Relevant National and Provincial governments’ policies and strategies**

In line with new relevant National and Provincial governments’ policies and Strategies are the pronouncements made in the following:

- Polokwane Declaration by DEAT;
- Local Government Turnaround strategy by COGTA;
- Draft Municipal Waste Sector Plan by DEAT;
- Draft National Waste Management Strategy (NWMS) by DEAT;
- Draft National Policy on Free Basic Refuse Removal by DEAT;
- National Treasury: Environmental Fiscal Reform Policy by Treasury.

In conclusion, there are benefits and national and international requirements for waste minimisation as discussed above. The sections that follow below provide details of what needs to be in place in the organisation in order to achieve Zero-Waste to Landfill.

## **5.8 ORGANISATIONAL GOALS**

Setting the goal and targets to achieve the goal is a good starting point for organisations that are committed to Zero-Waste to Landfill. The next step is make goal known to the organisation and stakeholders.

## **5.9 INDICATORS AND TARGETS**

Once the goal has been set, it is important to know if there is progress towards this goal or not. This requires developing a comprehensive set of monitoring indicators and targets. The targets must be clearly defined, reproducible, unambiguous, understandable and practical. Agenda 21 states that “*indicators of sustainable development need to be developed to provide solid bases for decision making at all levels and to contribute to a self regulatory sustainability of integrated*



*environmental and development systems*". Indicators evaluate and monitor the amount and direction of change occurring in the environment and whether developments or actions are operating at a sustainable level. They are used to assess and understand the interaction between development and the environment. Most indicators are designed to provide early warning information about instability or unsustainable change in the environment.

The CSIR can use similar waste indicators as those set by DEAT. These indicators are described as follows;

- Waste recycling: The quantity of material recycled and
- Generation of hazardous waste: The quantity of hazardous waste managed in the organisation<sup>35</sup>.

## **5.10 WASTE INFORMATION**

Accurate information on waste generation rates and composition is necessary for planning and management of functional elements associated with the management of wastes. Appropriate ways for collecting, analysing, storing and distributing information must be used.

## **5.11 WASTE MANAGEMENT HIERARCHY**

The Waste Management Hierarchy gives guidance on the waste management options. It provides the options from the most preferred to least preferred option of dealing with waste as shown in figure 11 below. Although Reduce, Reuse, Recycle and Recover are preferred over disposal, there are requirements that have to be met before adopting these options. Reduction, reuse, recycling or recovery can only be adopted if it uses fewer natural resources than disposal and if it is less harmful to the environment (Government of South Africa, 2008). This hierarchy must be considered when implementing waste minimisation initiatives from the initial procurement stages to the final stages of waste disposal.

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<sup>35</sup> <http://enviroindicator.deat.gov.za/cocoon/rsadb/docs/index>

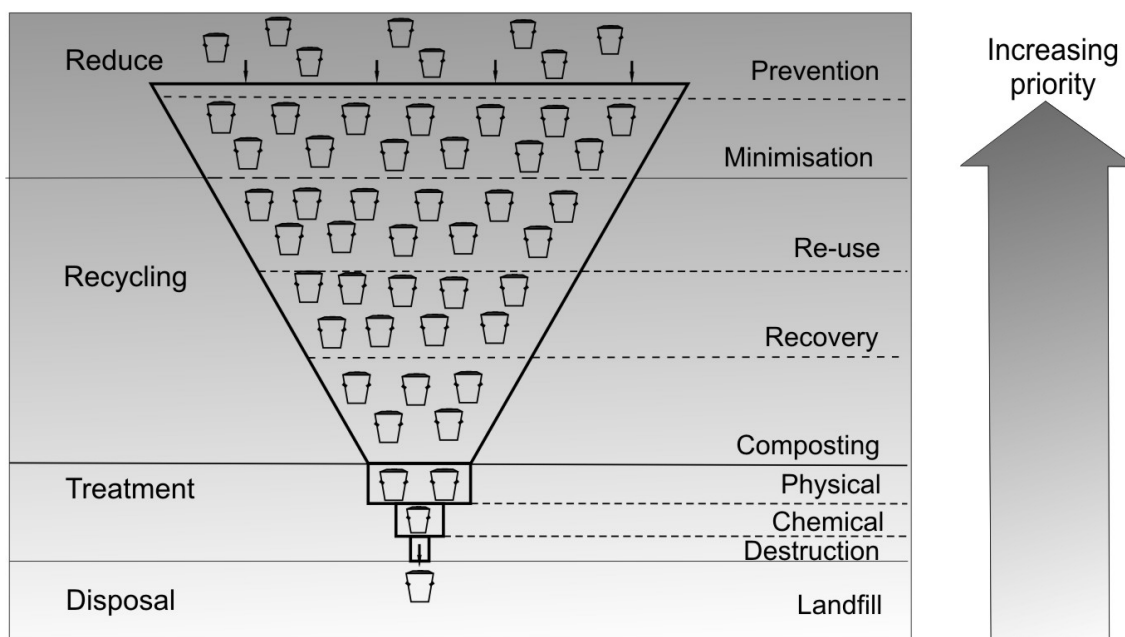


Figure 11: South African National Waste Management Hierarchy

Source: CSIR Boutek (2002)

The meaning of the Waste Management Hierarchy options can be defined as follows:

- Reduce includes the prevention and minimisation of waste. This helps to create less waste at source.
- Reuse according to Palmer (2008) is putting back product into use for the same or different purpose without remediation.
- Recycling is different from reuse in that material is reprocessed or remanufactured before it is reused as a new resource (South Africa, 2008).
- Recovery is the controlled extraction of a material or retrieval of energy from waste to produce a product (South Africa, 2008).
- Treatment of waste involves reducing the toxicity of waste in order to minimise its impact on the environment (South Africa, 2008).
- Waste disposal which is the last and least preferred option on the Waste Management Hierarchy is the burial, deposit, discharge, abandoning, dumping, placing or release of any waste into, or onto, any air, land or water (South Africa, 2008).

## 5.12 WASTE MINIMISATION INITIATIVES

After the Zero-Waste to Landfill goal has been set, materials entering and taken out of the organisation need to be managed. The whole supply chain, from suppliers to waste services service providers including the organisation's operations must be involved in implementation of the waste minimisation initiatives. Figure 12 shows waste minimisation initiatives that will be

implemented at the CSIR in order to reduce waste to landfill and achieve Zero-Waste to Landfill throughout the supply chain. These initiatives are further discussed in the CSIR Environmental Sustainability Strategy.

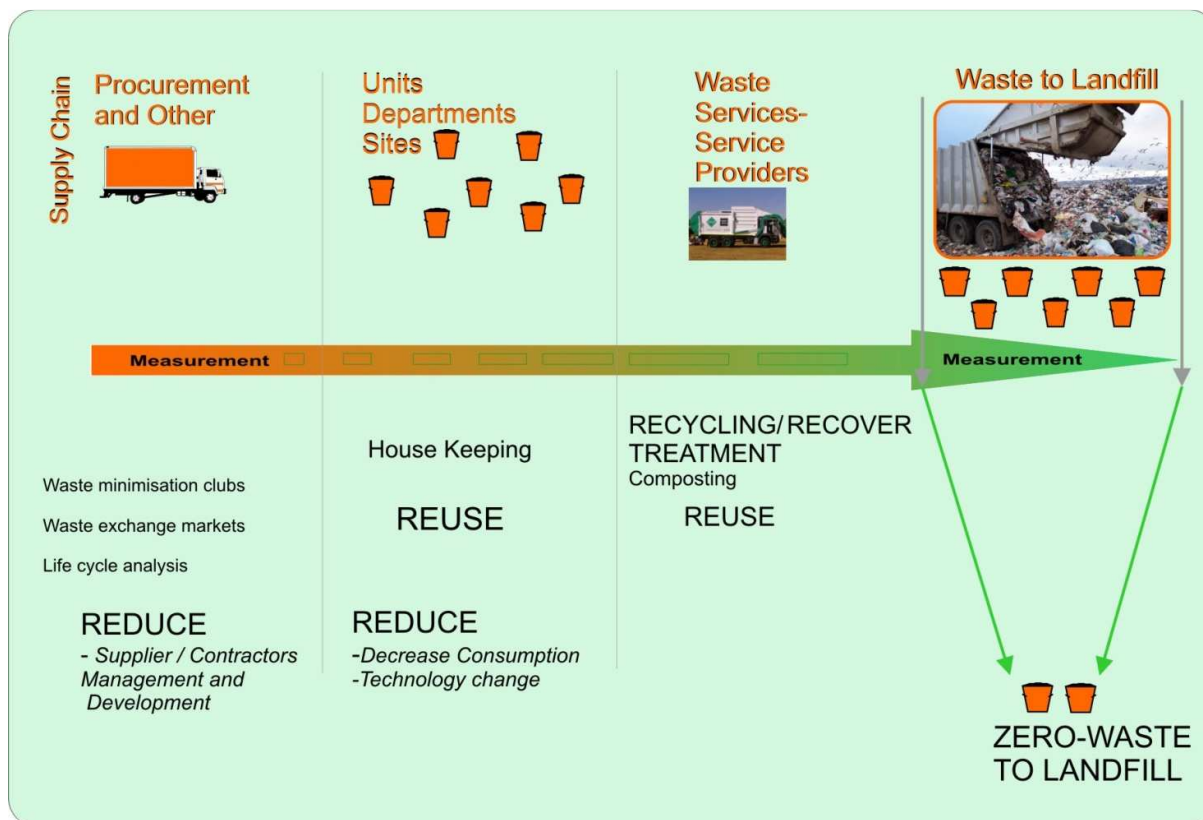


Figure 12: CSIR waste minimisation initiatives

### 5.13 ENVIRONMENTAL MANAGEMENT SYSTEM (EMS)

The waste minimisation project must be integrated with the ISO14001 EMS. Figure 13 shows how these two will be integrated.

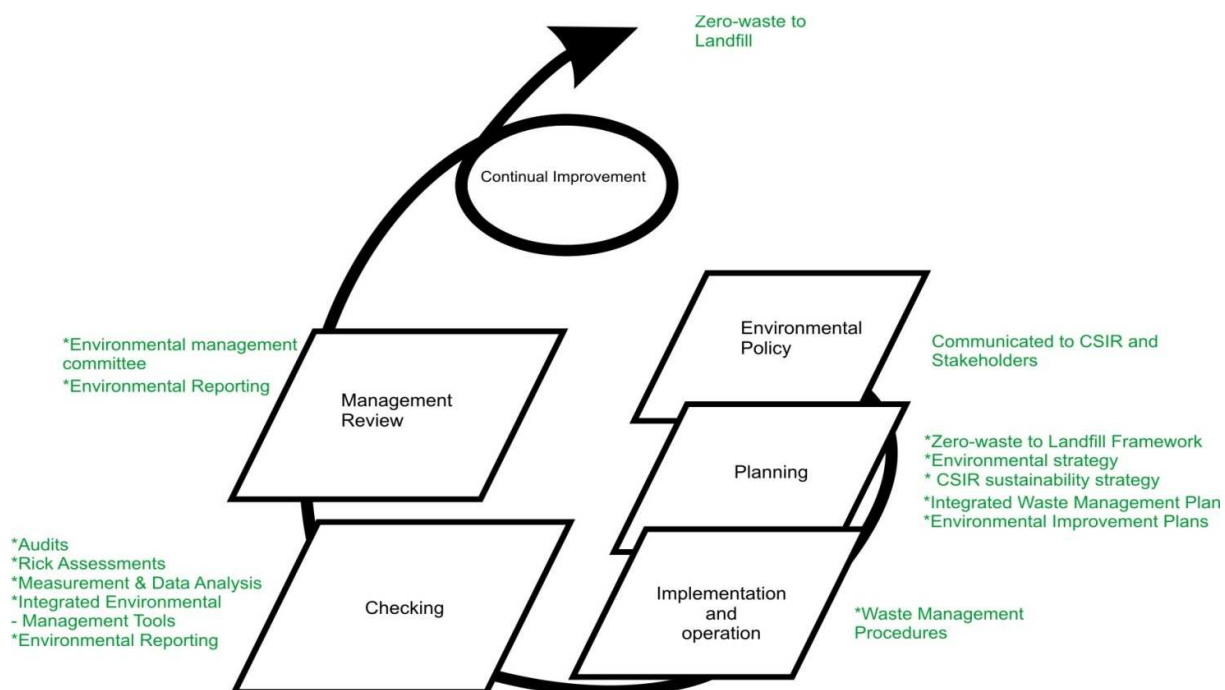


Figure 13: Integration of ISO14001 EMS with CSIR waste minimisation process

The **policy** governing environmental management states that the organisation strives for the highest quality of acting as responsible stewards of the environment, through sustainable environmental management in line with international standards. This policy therefore promotes Zero-Waste to Landfill as it achieves the highest quality in waste management. This message and practices required to achieve environmental goals must be communicated to the CSIR and stakeholders.

The Zero-Waste to Landfill Framework, Environmental Sustainability Strategy and Integrated Waste Management Plan must detail all the **plans** to manage current and projected waste streams. These plans include how the Zero-Waste to Landfill goal will be achieved. Environmental improvement plans can be developed by units and sites. In cases where these are developed, they must be approved by the business unit or centre managers. Waste management plans should take into consideration and not be limited to the following:

- Strategies that will ensure that waste is minimised.
- Meeting legal and other applicable requirements.
- New projects and future projects which may result in different waste streams.
- Resources and systems required to achieve waste minimisation goals.
- Infrastructure that will allow for segregation and collection of waste
- Efficiency, keeping all costs and environmental impacts as low as possible.
- Measurement, data collection and management.

- Auditing, and monitoring and evaluation of progress towards waste minimisation goals.
- Integrated environmental management (IEM) tools.
- Communication, training and awareness programs.
- Stakeholder engagement.
- The green procurement aspects.

Waste management standard operating procedures must detail specific **implementation and operational** guidelines for the different sites. Roles and responsibilities must be clearly detailed in the operating procedures. All stakeholders' training needs must be identified in the procedures in order to ensure that they are able to perform their responsibilities.

There needs to be continuous **checking** of the effectiveness of the EMS, waste minimisation programme and progress towards achieving the waste minimisation goals. Different Integrated Environmental management (IEM) tools, audits and risk assessments can be used check this. Measurement and data collection systems will enable quantification and tracking of progress towards achieving the waste minimisation goals.

**Management reviews** must be conducted according to the requirements of ISO14001:2004 EMS and include tracking progress towards the waste minimisation goals. The management reviews must happen at unit, department, and organisational level.

Zero-Waste to Landfill requires innovation, creativity and **continuous improvement**. Continuous improvement may result from or be initiated by policies, environmental goals and targets, audit results, analysis of data, corrective and preventive actions and management reviews. Audits and risk assessments are used as tools for identifying gaps and improvement opportunities. Audits are to be conducted with the aim of improving the understanding of waste generation.

## 5.14 CONCLUSION

If the CSIR is to achieve Zero-Waste to Landfill needs, the first step is to set this goal at organisational level. This goal ensures sustainable development and is in line with both international and national legal requirements. Systems, plans and procedures that will enable waste minimisation need to be developed and implemented. Planning for Zero-Waste to Landfill involves selecting alternatives and using materials efficiently across the value chain. The Waste Management Hierarchy gives guidance various waste management options. The CSIR has already established an EMS based of ISO14001:2004 principles. The Zero-Waste to Landfill goal must be

integrated with this system. It is important that stakeholders are involved at all levels in order to ensure the success of this waste minimisation project.

## **6 IMPLEMENTATION OF THE FRAMEWORK**

### **6.1 INTRODUCTION**

It is important that the Zero-Waste to Landfill Framework is implemented at the CSIR. Since the beginning of this project in February 2010 to its completion in September 2011, some aspects of the framework have been implemented at the CSIR, following the CSIR internal planning processes. This chapter explains how this implementation has been done. The framework is a broad guideline on what the CSIR needs to do in order to achieve the Zero-Waste to Landfill goal. It has played a major role in informing the CSIR Security, Safety, Health, Environment and Risk Management (SSHERM) Environmental Sustainability Strategy waste management plans. The CSIR Environmental Sustainability Strategy is a five year high level plan detailing environmental goals and targets and how these will be achieved. The CSIR Integrated Waste Management Plan (IWMP) will be developed following guidelines from the Zero-Waste to Landfill Framework. It will be a more detailed plan focussing on how the waste management and minimisation goals will be achieved. Waste minimisation project plans which follow internal Project Management Office procedures will be developed to ensure delivery of projects.

### **6.2 GOAL SETTING**

A draft CSIR Environmental Sustainability Strategy has been developed. The first draft was presented to the Environmental Management Committee (EMC) at a workshop in April 2011. Appendix 7 shows extracts from the draft Environmental Sustainability Strategy. The extract details the waste management sections covered in the Environment Sustainability Strategy. The sections covering energy, carbon and water initiatives have been excluded. It is recommended in the strategy that the Zero-Waste to Landfill goal should be set by the organisation by 2013. Appendix 8 shows the stakeholder engagement process that will be followed before the strategy is approved by the CSIR board. The planned process aims to ensure buy-in from the stakeholders. These stakeholders are mainly Department, Group and Unit Managers and experts in the areas of waste management.

At the beginning of 2010 a project steering committee (PSC) requested the Sustainable Social Ecological Systems Research Group from the CSIR Natural Resources and the Environment (NRE) unit to conduct a CSIR sustainability status quo assessment and gap analysis. The PSC comprised the Executive Director Services, the Security, Safety, Health, Environment and Risk Management (SSHERM) Manager and an administrator. The CSIR sustainability status quo assessment and gap analysis forms the component of the overall objective of developing a

sustainability strategy that will help to integrate sustainability principles and reporting into the operational activities of the CSIR.

The findings of the CSIR sustainability status quo assessment and gap analysis identified significant gaps and weaknesses as per the Global Reporting Initiative (GRI), United Nations (UN) Compact, King Reports (I, II and III) and the Johannesburg Stock Exchange Socially Responsible Investment (JSE SRI) international and national practices, codes and standards. The following are some recommendations which were made in the first draft report:

- Environmental commitment should be reflected in the organisation's strategic priorities.
- Key performance indicators must be developed to demonstrate environmental commitment.
- Integrated reporting must be considered in order to embrace and respond to the King III report.
- A Sustainability Strategy which outlines and communicates the vision and direction of the organisation must be developed. (CSIR, 2010a).

These findings from the CSIR Sustainability status quo and gap analysis have been presented to the CSIR Operational Committee (OpCo) meeting and largely accepted. This is a positive step towards ensuring that the organisation makes a commitment to meet sustainability goals.

Phase II of this project is to develop a Sustainability Strategy Framework that addresses the sustainability objectives of the CSIR and its key stakeholders. In order to successfully complete this project a Project Management Team will be established. The project team will be responsible for the overall management of the project and the compilation of the deliverables. The CSIR Environmental Manager is part of the project management team. The Environmental Manager is also expected to assist in providing the memory required to support onward leadership, implementation and monitoring of the project within the CSIR Executive. The Environmental Sustainability Strategy will inform the environmental goals that will be set in the CSIR Sustainability Strategy. The Zero-Waste to Landfill goal is one of the environmental goals that will be addressed in this phase.

### **6.3 PLANNING AND WASTE MINIMISATION TARGETS**

Plans to achieve Zero-Waste to Landfill at the CSIR are detailed in the CSIR SSHERM Environmental Sustainability Strategy. These plans include implementing initiatives to reduce and reuse waste by changing procurement and unit processes. Together with key suppliers, procurement will identify opportunities to reduce waste inputs in products. Procurement will also be



refined based on cost, performance and life cycle assessments. Units and departments will investigate ways to reduce waste materials in their processes where possible. Recycling, recovery and treatment initiatives will also be implemented across the value chain. The CSIR will undertake audits to quantify the organisations footprint and identify waste minimisation opportunities. Increased recycling and recovering waste streams will be introduced to reduce the volume of waste directed to landfill through implementation of acceptable collection systems. Stakeholders will be engaged in order to come up with innovative programmes and methods that will assist in reducing waste to landfill.

## **6.4 INTEGRATION**

The CSIR has implemented and established an EMS based on the principles of ISO14001:2004 for over twelve years. A number of established operating procedures, guidelines and plans form part of the ISO14001:2004 EMS. Integration of the Zero-Waste to Landfill goal with the EMS will require updating these procedures to reflect and support implementation of the waste minimisation goals. In some instances new procedures and guidelines will need to be developed. The Environmental Sustainability Strategy and IWMP are new documents that will form part of the EMS documents. The CSIR IWMP will be developed after completing a number of assessments within the organisation. Appendix 9 shows the process that will be followed in developing the CSIR IWMP. Stakeholder engagement forms part of this process. It is organisational practice to change and update procedures when processes change. After developing the IWMP, site waste management procedures will be updated. The operating procedures will list all waste management roles and responsibilities and training needed.

A project proposal for measurement, recycling and treatment of waste has been developed and approved by the CSIR SSHERM Manager and Project Management Office. The objectives of the project are to:

- measure all waste generated at the CSIR;
- develop systems to optimise the recycling and recovery of all waste generated within the CSIR;
- provide information required for developing the CSIR Integrated Waste Management Plan;
- ensure environmentally safe disposal of all waste generated within the CSIR and
- minimise costs associated with waste disposal at the CSIR.

Appendix 10 shows the details of the project proposal.

Communication of the waste minimisation goals and processes is important for achieving the Zero-Waste to Landfill goal. A Safety, Health and Environment (SHE) Communication Plan was developed in December 2010 as per the ISO14001:2004 requirements. One of the activities that was planned for 2011 was a waste minimisation awareness campaign in September 2011 during the world clean up week. This campaign raised awareness of staff about the importance of waste minimisation and paper recycling at the Pretoria campus. Responses from employees suggested ways in which waste minimisation can be improved at the CSIR.

A new Environmental Management Committee (EMC) was established in February 2011 (see Appendix 11 for EMC terms of reference). EMC meetings are held quarterly and are regarded as management reviews. There is an executive member in the committee who ensures that environmental concerns are referred to the Executive Committee (ExCo). Strategic Procurement Unit (SPU), Facilities Management (FM), Risk Assurance (RA) Management and ICT are represented in this forum. SPU, FM and RA play an important role of implementing waste minimisation initiatives in their areas.

## **6.5 CHECKING**

ISO14001:2004 EMS audits have been conducted at the CSIR. Appendix 12 shows the ISO14001:2004 internal audits that were conducted in 2010 and 2011. The Environmental Sustainability Strategy shows the analysis of audit findings, how audit findings have been addressed, and the improvements that need to be made at the CSIR. As part of implementation and operation, a service provider who can recycle paper, plastic, glass and cardboard will be identified as proposed in the project proposal in Appendix 10. Improvement audits will be conducted to get baseline information and current practice. The Environmental Sustainability Strategy proposes that in the financial year 2012/13 life cycle analysis, a waste audit and feasibility study should be conducted to identify all waste streams and determine a baseline and possible recycling, recovery and treatment initiatives in the organisation.

Information that is available currently on waste volumes is collected and analysed by the Environmental Manager using Microsoft excel programme. This is stored on the CSIR's I drive and forms part of environmental monthly reports. In 2013/14, as per the Environmental Sustainability Strategy, a request will be put in the budget for an environmental data capturing and analysis system.

## **6.6 CONCLUSION**

The Zero-Waste to Landfill Framework has assisted in setting waste management goals and plans in the CSIR Environmental Sustainability Strategy. It provides direction and suggests waste management improvements. The Environmental Sustainability Strategy still needs to be approved by the CSIR board after a process of stakeholder engagement. The CSIR IWMP still needs to be developed. From all the work that has been done and the future plans, the CSIR SSHERM department is confident that the CSIR will be successful in achieving the Zero-Waste to Landfill goal.

## **7 CONCLUSIONS AND RECOMMENDATIONS**

### **7.1 INTRODUCTION**

In this chapter, the results of the study are summarised according to the research objectives in order to demonstrate how the objectives have been fulfilled by the study.

Section 7.2 will demonstrate how the objectives of this study have been fulfilled.

Section 7.3 will give an evaluation of this study.

Section 7.4 will present recommendations which can be made from the study.

And finally, section 7.5 will give some concluding remarks on the study.

### **7.2 JUSTIFICATION OF THE ACHIEVEMENT OF THE STUDY**

#### **7.2.1 Research problem**

It has been pointed out in the research problem that the Council for Scientific and Industrial Research (CSIR) generates waste, and from the waste generated, a lot of reusable and recyclable waste area disposed to landfill. Waste generation and disposal trends have not been monitored at the CSIR. There have been no formal organisational initiatives to ensure that waste generation is reduced. CSIR procurement processes allow for any type of material to be procured without prior consideration of ways to ensure waste minimisation. Although the Security, Safety, Health, Environment and Risk Management (SSHERM) Department plans to improve and enforce waste management within the organisation, there is no framework to guide the department and organisation on how to achieve this.

#### **7.2.2 Goals and objectives**

The goal of this study is to develop a Zero-Waste to Landfill Framework for the CSIR. The framework will give the CSIR direction on how to achieve Zero-Waste to Landfill. Five objectives have been identified in order to achieve this goal.

The first objective requires assessment of literature and collection of information on what is required for an organisation to achieve Zero-Waste to Landfill. This information was collected from

the literature review. It was clear from information collected that Zero-Waste to Landfill requires efficient use of natural resources and minimisation of waste. It also requires investigating different methods and technologies to minimise waste. The literature describes how these methods and technologies can be employed to ensure efficient use of resources. The Bellagio Principles were used to assess progress towards sustainable development. It was evident from the requirements, principles, methods and tools illustrated in the literature what interventions would be required for an organisation to achieve Zero-Waste to Landfill.

A summary and analysis was made from the information gathered in the literature review to develop propositions. Using the propositions, precise and insightful questions were asked in the case study and interviews with experts. This helped to achieve the second objective which required developing propositions from the literature review which would be used to produce case study and interview questions. In order to meet the third and fourth objectives of this study, the Commonwealth Scientific and Industrial Organisation (CSIRO) was selected for the studies. Protocols were prepared for conducting a case study on CSIRO and interviews with experts were conducted at CSIRO, CSIR, SABS and UNISA. Data and information was collected from the case study and interviews with experts.

The fifth objective required the analysis of data and information gathered from the literature review, case study and interviews with experts in order to develop principles that would be used to develop the CSIR Zero-Waste to Landfill Framework. The literature review confirmed the theories through the case study and interviews. These theories were utilised for the development of the Zero-Waste to Landfill Framework.

### **7.2.3 Research design**

Data was collected through case studies and interviews in this study. Questions for the case study and interviews were developed from the literature review. After analysing the data, the Zero-Waste to Landfill Framework was developed.

## **7.3 EVALUATION OF THE STUDY**

### **7.3.1 Practical application of the study**

The framework suggests ways in which the CSIR can achieve Zero-Waste to Landfill. The CSIR Environmental Sustainability Strategy and Integrated Waste Management Plan will be used to plan and ensure that the framework is implemented at the CSIR.

### **7.3.2 Relevance of the study**

This study is relevant for the CSIR since it has been conducted at a time when the organisation is looking for practical solutions for the waste it is generating. Simultaneously the law and stakeholders have started to require waste minimisation and efficient use of resources.

### **7.3.3 Positive aspects of the study**

The Zero-Waste to Landfill Framework which was developed in this study provides a practical solution for any research organisation which can be easily implemented and monitored. There are also cost saving benefits that will be realised by the organisation and other organisations that implement Zero-Waste to Landfill. In addition to this, by implementing this initiative, the organisation contributes to national and international requirements and obligations.

### **7.3.4 Limitations of the study**

The focus of this study was on developing a Zero-Waste to Landfill Framework for the CSIR. The possibility of applying this framework in other types of organisations has not been investigated.

## **7.4 RECOMMENDATIONS**

The Zero-Waste to Landfill Framework that has been developed in this study recommends ways in which the CSIR can achieve Zero-Waste to Landfill. The recommendations that are covered in this section are listed as possible research opportunities that will benefit not only the CSIR, but also other organisations that want to minimise their waste. In summary, it is recommended that:

- e) The CSIR participates in sustainability reporting.
- f) The CSIR implements green procurement.
- g) The CSIR explores different innovative methods, technologies and materials that can be used to minimise waste.
- h) The CSIR runs intensive awareness raising campaigns.

It is recommended that the CSIR does annual sustainability reporting. The sustainability reports must be available to stakeholders and the public. This will show the organisations commitment to sustainability and improve its image as stakeholders will be aware of what is happening in the organisation. This report will include waste management initiatives that are being carried out in the organisation.

The CSIR needs to move up to speed with implementing the Zero-Waste to Landfill Framework and developing its integrated waste management plan. Carbon footprint studies can also be conducted after developing these plans. External experts in waste management can be involved with the CSIR officials to prepare these plans.

Considering that Zero-Waste to Landfill requires implementation of initiatives that will ensure that waste to landfill is reduced, it is necessary to explore in depth the different innovative methods, technologies and materials that can be used at the CSIR. This information can be shared with other universities, research organisations and other companies to promote waste minimisation and good environmental practice. Packaging produces and becomes waste once the product is used. It is necessary to conduct studies that will ensure reuse and recycling of packaging.

If the CSIR is to achieve Zero-waste to Landfill, these procurement procedures must be reviewed and ensure the adaptation of green procurement practices within the organisation. A full life cycle costing policy must be put in place. Currently it is not easy to source or supply materials and products that have been reused or recycled due to accessibility of information or markets. Although there are active waste exchange markets in some parts of the country, awareness needs to be raised in organisations on the availability and purpose of these markets. Organisations such as the CSIR use a lot of products and materials that has been packaged. A database of suppliers of recycled products would assist the procurement office in the selection of materials and products.

## **7.5 CLOSING REMARKS**

Waste is a significant issue in any organisation. According to Khoo et al. (2001), a new approach to performing business will be required, one which does not merely aim to achieve economic profit but also develop ecologically sensitive strategic policies. The CSIR has to find new solutions for its waste. The Zero-Waste to Landfill Framework suggests ways to minimise waste and improve environmental performance. The journey of environmental improvement has begun; it will be up to the organisation to demonstrate leadership in this area.

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## **LIST OF INTERVIEWEES**

### **1. Case study interviews**

1.1 Elaine Osborn: Waste Reduction Project Manager – CSIRO, CSIRO Corporate Health, Safety and Environment Office. Tel: +61 408 914707 Email: [Elaine.Osborn@csiro.au](mailto:Elaine.Osborn@csiro.au) Interviewed 12 August 2010 and 22 October 2010.

1.2 Dr Tony Hudson: Environmental Sustainability Manager – Commonwealth Scientific and Industrial Research Organisation (CSIRO); CSIRO Corporate Health, Safety and Environment Office. Tel: (02) 627 66173 Email: [Tony.Hudson@csiro.au](mailto:Tony.Hudson@csiro.au) Interviewed 12 August 2010.

## **2. Interviews with experts**

2.1 James Modiba: Security, Safety, Health, Environment and Risk Management Manager (SSHERM) - Council for Scientific and Industrial Research; Management Services Department (CSIR) Tel: 012 841 4170 Email: [JMModiba@csir.co.za](mailto:JMModiba@csir.co.za) Interviewed 4 August 2010.

**Current position:** Security, Safety, Health, Environment and Risk Management Manager

### **Current activities:**

- Develops strategies to ensure compliance with laws, agreements and practices applicable to the CSIR' businesses in relation to Safety, Health and Environmental Management (SHE).
- Ensure that all CSIR sites perform in line with organisational policies, procedures and practices in areas of Security, Safety, Health and Environment.
- Determine KPI's in the portfolios and ensure CSIR meets performance targets approved by the CSIR Executive.

### **Experience**

Modiba has over five years experience in creating and managing corporate-wide risks relating to security, safety, health, environment, quality, compliance, assurance programmes as well as having implemented these initiatives across the organisation employed in.

2.2 Linda Godfrey: Pollution and Waste Competency Area Manager – CSIR; Natural Resources and the Environment Unit (Position held at the time of interview). Tel: 012 841 3675 Email: [LGodfrey@csir.co.za](mailto:LGodfrey@csir.co.za) Interviewed 4 August 2010.

**Current position:** Environmental scientist, specialising in integrated waste management.

### **Current activities and research interests:**

- Waste and society - understanding the social, economic and governance requirements for creating an enabling environment for effective and sustainable integrated waste management.
- Waste information - the role of data and information in improving the management of waste in a developing-country context.

## **Experience**

Godfrey's experience include governance, institutional and social opportunities and constraints of integrated waste management; design, development and implementation of waste decision support/information systems; waste information and indicator development and assessment; input to development of waste policy and legislation; assessment of the environmental impacts of waste on receiving environments; validation of non-burn hazardous waste treatment facilities; waste site selection and environmental suitability assessment; and integrated waste management planning.

Godfrey is chairperson of the Central Branch of the Institute of Waste Management of Southern Africa (IWMSA), and registered with the South African Council for Natural Scientific Professions as a Natural Scientist (400101/99).

## **Formal education**

BSc (geology, chemistry) - Rhodes University, 1991

BSc Hons (geology) - Rhodes University, 1992

MSc (geohydrology) - University of the Free State, 1993

PhD (chemical engineering), University of KwaZulu-Natal, current

2.3 Nana Agyepong: Project Researcher - University of South Africa (UNISA), UNISA/United Nations Global Compact (UNGC) Project (Position held at the time of interview). Tel: (012) 429 8948 Email: [agyepao@unisa.co.za](mailto:agyepao@unisa.co.za) Interviewed 3 August 2010.

**Current position:** Environmental scientist, specialising in integrated waste management.

### **Current activities:**

- To plan, implement and evaluate UNGC related projects.
- To liaise with relevant stakeholders on UNGC activities (Unisa staff, public institutions, universities and the private sector).
- To facilitate meetings and interviews with Unisa staff, students and relevant stakeholders to gather necessary information to coordinate the programme effectively.
- To create an information structure for easy access to staff, students and other stakeholders as well as for research.

## **Experience**

Nana has spent more than two years researching and implementing the UNGC principles at Unisa.

### **Formal education**

Masters in Human Ecology – Unisa, 2009

B Consumer Science – Unisa, 2004

Registered for PhD in Environmental Management: Unisa, 2011

2.4 Pieter Haasbroek: Environmental Management Systems Manager – South African Bureau of Standards (Position held at the time of interview). (SABS) Tel: 012 428 7664 Email: [HAASBRPD@SABS.CO.ZA](mailto:HAASBRPD@SABS.CO.ZA) Interviewed 3 August 2010.

### **Experience**

Pieter currently manages Environmental Management Systems. He has over ten years experience in auditing and certification of SHE Management Systems. His responsibilities at the SABS included managing the certification process of organisations. He was also a member of the certification approval body which is responsible for ensuring that all submissions comply with relevant requirements.

## **APPENDICES**

### **APPENDIX 1: PROPOSITIONS FROM THE LITERATURE REVIEW**

Zero-Waste to Landfill requires the minimisation of waste generated as far as technologically and economically feasible, and whatever little waste is generated should be put to some effective use. The risk posed by waste to health and the environment must always be minimised. This explains why reducing, reusing, recycle and recovery can only be carried out if they are less harmful to the environment than disposal. The following propositions are developed from the literature review; they illustrate all the important aspects that need to be in place in organisations in order for them to achieve Zero-Waste to Landfill.

#### **2.1.1 The organisation's principles and culture**

Environmental management should be recognised as being among the highest corporate priorities and as a key determinant to sustainable development within the organisation. Environmental stakeholders must be involved in the implementation and management of environmental initiatives. It is normal for an organisation that prioritises environmental management to adhere to the principles of corporate citizenship or corporate social responsibility (CSR). These organisations have a system of reporting environmental performance to stakeholders and they continuously try to improve their environmental performance. Leadership and management within the organisation show commitment to the achievement of the waste minimisation goals. There is a clear vision for Zero-Waste to Landfill and goals that define the vision. This is reflected in the organisation's strategy and plans.

#### **2.1.2 Setting of the Zero-Waste to Landfill indicators**

Zero-Waste to Landfill indicators are those indicators that show how an organisation is progressing towards its goal of achieving Zero-Waste to Landfill. The organisation should develop an approach for identifying these indicators. The approach should be participatory, as it incorporates the vision, values, interests and views of stakeholders and community for which the indicators are being developed. The importance of all forms of knowledge (i.e. scientific, indigenous, experiential, and value-based) must be acknowledged without prioritising one over another. Zero-Waste to Landfill indicators must be continuously monitored, reviewed and improved at regular intervals.

### **2.1.3 Environmental Management System (EMS)**

The Zero-Waste to Landfill goal and initiatives must be integrated into the organisation's EMS.

### **2.1.4 Waste management roles and responsibilities**

All stakeholders should know their roles and responsibilities within the EMS.

### **2.1.5 Waste management planning**

Comprehensive plans on the management of current and projected waste streams must form part of the EMS. The supply chain and organisation's operations must be included in implementing initiatives that will ensure achievement of the Zero-Waste to Landfill goal. Avoidance of waste in all the organisation's processes must be prioritised. Reduce, reuse, recycle and recover as listed on the Waste Management Hierarchy, are the options that must be taken where avoidance is not possible. There must be an understanding of what is required to reduce, reuse, recycle and recover, including technologies, methods and tools that can be used in the organisation to achieve this. Production systems must be improved through technologies and processes that utilise resources more efficiently and at the same time produce less waste. Disposal of waste must be the last option that is taken during disposal the risks on health and the environment must be reduced. There should also be sound procedures on hazardous waste management, waste storage and waste collection.

### **2.1.6 Knowledge management**

Systems for knowledge management must be in place. The knowledge management system will be used to collect, analyse, share, distribute and store information. Waste information systems for data collection, analysis, storage and distribution must be available. These Information systems must be capable of giving accurate information on waste generation rates and composition.

### **2.1.7 Training, awareness and communication**

Communication is important in environmental management; this communication must be of clear and plain language. Waste minimisation goals must be communicated to stakeholders. All stakeholders must be aware of the environmental activities and performance of the organisation.

## **APPENDIX 2: CASE STUDY PROTOCOL**

### **1. INTRODUCTION**

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) has been selected as a case for this study. It will be investigated how CSIRO sets, implements and achieves its waste minimisation goals. The case study is used in this research project as a method to get information on how waste minimisation can be achieved in an organisation. It will be investigated if what is suggested in literature can be applied in real life, and if so, how it can be applied. It is expected that the case study will contain principles that can be extrapolated and replicated from it to the Council for Scientific and Industrial Research (CSIR).

This protocol is developed in order to increase the reliability of this case study research. It will ensure reliability by giving the researcher guidance when conducting the case study. Planning for the case study is detailed in this protocol. Planning enables the researcher to select adequate tools and procedures for data collection, analysis and reporting. This protocol will be used and followed during the entire case study process.

### **2. DATA COLLECTION PROCEDURES**

#### **2.1 DATA COLLECTION PLANS**

CSIRO is based in Australia. Due to financial and time constraints, the site will not be visited for the purposes of conducting observations. The person responsible for Environmental Sustainability at CSIRO is DR Tony Hudson. Reporting to Dr Tony on waste management projects is Ms Elaine Osborn. Dr Tony Hudson, the Environmental Sustainability Manager and Ms Elaine Osborn the Waste Reduction Project Manager are the contact people to be used in this case study to access information from CSIRO. The main medium of communication with the CSIRO will be by email. This is an efficient and cost effective method of communication for this study. Video conferencing will also be used to conduct the main interview. If the need arises, the telephone will be used. Telephone and video conferencing are not only more expensive than email, but can also be affected by the time differences between Australia and South Africa. With video conferencing, there may also be technology problems.

Organisation websites are a good starting point for getting general information on the organisation. Websites of other organisations such as the Global Reporting Initiative (GRI) also have information about other organisations. Permission will first be requested from CSIRO to use their information for this study. It will be explained that this information is required for the purpose of this study, and



confidential information will be treated as such. Answers to the case study questions will be searched on CSIRO's website and others will come from interviews. The data required and sources to search data must be identified. A case study database needs to be developed in order to track all data that has been collected for this case study.

## 2.2 SOURCES OF EVIDENCE

The sources of evidence that will be used in the case study are documentation, archival records and interviews. Table 1 lists the sources of evidence that will be used in this case study and the strengths and weaknesses of these sources. These strengths and weakness must be taken into consideration when conducting the case study, especially in the case of the weaknesses in order to minimise or reduce their effect on the case study. Yin (2009:101) believes that the various sources of evidence are highly complementary, and a good case study will want to use as many sources as possible.

Table 1: Sources of evidence: Strengths and Weaknesses Source  
Source: Yin (2009:102)

Source of evidence	Strength	Weakness
Documentation	<ul style="list-style-type: none"> <li>• Stable – can be reviewed repeatedly</li> <li>• Unobtrusive – not created as a result of the case study</li> <li>• Exact – contains exact names, references, and details of an event</li> <li>• Broad coverage – long span of time, many events, and many settings</li> </ul>	<ul style="list-style-type: none"> <li>• Retrieval – can be difficult to find</li> <li>• Biased selectivity, if collection is incomplete</li> <li>• Reporting bias – reflects (unknown) bias of author</li> <li>• Access – may be deliberately withheld</li> </ul>
Interviews	<ul style="list-style-type: none"> <li>• Targeted – focuses directly on case study topics</li> <li>• Insightful – provides perceived casual inferences and explanations</li> </ul>	<ul style="list-style-type: none"> <li>• Bias due to poorly articulated questions</li> <li>• Response bias</li> <li>• Inaccuracies due to poor recall</li> <li>• Reflexivity – interviewee gives what interviewer wants to hear</li> </ul>

### 2.2.1 Documentation

An internet search on CSIRO will be conducted. The organisation's website will be looked at to review its policies, procedures and reports. The GRI website will be looked at to check CSIRO's sustainability reports. Email correspondence will also be used to get other documents. Documents that are not found from the sources identified will be requested from CSIRO by email. The case study questions will determine which documents will be looked at. Yin (2009:105) warns that documents should not be taken as containing all truth as they are written for some specific purpose and some specific audience other than those of the case study being done.

### 2.2.2 Interviews

Interviews are an essential source of case study evidence because most case studies are about human affairs or behavioural events (Yin, 2009:108). The case study interviews will be focused by using case study questions derived from propositions from the literature review. If required a follow up interview will be conducted to clarify and corroborate findings from documentation used to gather data from the case study.

## 2.3 CASE STUDY QUESTIONS

A literature review was conducted in order to investigate what is required for organisations to minimise their waste and achieve Zero-Waste to Landfill. A number of propositions were developed from the literature review. These propositions suggest important aspects that should be in place for an organisation to achieve Zero-Waste to Landfill. The following questions are developed from the propositions. The questions must be used when conducting the case study. Table 2 below is a summary of where to search for answers for these questions.

### 2.3.1 Organisation principles and culture

- i. What evidence is there to show that environmental management is a high priority in the organisation and is a key determinant to sustainable development within the organisation?
  - Check organisation's website
  - Check GRI website
  - Check organisation's policies
  - Check organisation's business, Environmental Sustainability Strategy or annual reports
  - Compare organisation's strategies or annual reports over a period of 5 years to see any improvements or plans to improve environmental performance
  - Check organisation's organogram to see if there are people responsible for environmental management

Table 2: Summary of sources from which to search data

Question Number	SOURCE FROM WHICH TO SEARCH DATA				
	Procedures	Policies	Business Plan/ Environmental Strategy/ Environmental Annual Report	Website	Other
2.3.1 i		X	X	CSIRO & GRI	Organisation and EMS organogram
2.3.1 ii		X	X	CSIRO & GRI	
2.3.1 iii		X	X	CSIRO & GRI	-Email correspondence
2.3.1 iv	X	X	X	CSIRO & GRI	
2.3.2 i	X		X	CSIRO & GRI	Meeting minutes
2.3.2 ii	X	X	X	CSIRO & GRI	- Organograms -Job descriptions
2.3.3 i			X	CSIRO & GRI	Australia ISO
2.3.4 i	X		X	CSIRO	
2.3.5 i	X		X	CSIRO & GRI	-Email correspondence
2.3.5 ii	X	X	X	CSIRO	
2.3.6 i	X		X	CSIRO	
2.3.6 ii	X		X	CSIRO	
2.3.7 i	X	X	X	CSIRO	
2.3.7 ii	X	X	X	CSIRO	

ii. Is there leadership and management commitment to the achievement of waste minimisation goals?

- Check organisation's website
- Check Global Reporting Initiative (GRI) website
- Check organisation's policies
- Check organisation's business plan
- Check Environmental Sustainability Strategy

iii. How does the organisation demonstrate corporate social responsibility?

- Check organisation website
- Check GRI website
- Check email correspondence
- Check Environmental Sustainability Strategy

- iv. Is the organisation a learning organisation and is it seen and treated as a complex system? From procedures, policies, business plans, organograms and job descriptions check evidence of the follow:

- A guiding vision and goals
- Essential elements
- Practical focus
- Adequate scope
- A holistic perspective
- Openness
- Effective communication
- Broad participation
- Ongoing assessment and Institutional capacity

### **2.3.2 Setting of Zero-Waste to Landfill indicators**

- i. Is there a process for setting and management waste indicators
- Check organisation website
  - Check GRI report
  - Check email correspondence
  - Check waste management procedures
  - Check Environmental Sustainability Strategy Plan
- ii. What evidence is there to show that stakeholders are involved in the implementation and management of environmental initiatives?
- Check organisation website
  - Check GRI report
  - Check waste management implementation and management procedures
  - Check waste management goal setting minutes if available
  - Check CSIRO Environmental Sustainability Report
  - Check EMS implementation and management procedures

### **2.3.3 Environmental Management System (EMS)**

- i. Is there a formal EMS?
- Check organisation website
  - GRI website

- Check Australia ISO for EMS accredited organisations
  - Check Safety, Health and environment (SHE) Reports
- ii. Is waste minimisation integrated into the EMS?
- Check organisation website
  - GRI website
  - Check waste management procedures to see if waste management is integrated into the EMS

#### **2.3.4 Waste management roles and responsibilities**

- i. Are roles and responsibilities given to all stakeholders?
- Check organisation website
  - Check email correspondence
  - Check waste management procedures
  - Check EMS job descriptions

#### **2.3.5 Waste Management planning**

- i. Do environmental plans comprehensively cover the management of current and projected waste streams?
- Check organisation website
  - Check GRI report
  - Check email correspondence
  - Check Environmental Sustainability Strategy
  - Check environmental reports
- ii. Does the supply chain play a role in achieving the waste management goals
- Check waste management procedures
  - Check research process procedures
  - Check procurement process procedures
  - Check policies
  - Check Environmental Sustainability Strategy

### **2.3.6 Knowledge Management**

- i. How is waste information collected, analysed, stored, distributed, shared and used?
  - Check organisation website
  - Check EMS procedures on how knowledge is managed
  - Check environmental reports
- ii. Is there a waste information system?
  - Check organisation website
  - Check procedures for waste information
  - Check SHE reports

### **2.3.7 Training, awareness and communication**

- i. Is communication clear and in plain language?
  - Check organisation website
  - Check EMS communication procedures
  - Check EMS implementation and management procedures
  - Check waste management procedures
  - Check environmental reports
  - Check policies
- ii. Is training and awareness on waste goals and initiatives conducted
  - Check organisation website
  - Check EMS communication procedures
  - Check EMS implementation and management procedures
  - Check waste management procedures
  - Check environmental reports
  - Check policies

## **2.4 CASE STUDY INTERVIEW QUESTIONS**

The following will be observed during the interview to determine if the organisation is a learning organisation and it is seen and treated as a complex system. From the conversation with the interviewee observe answers that demonstrate the following:

- A guiding vision and goals
- Essential elements
- Practical focus
- Adequate scope
- A holistic perspective
- Openness
- Effective communication
- Broad participation
- Ongoing assessment and Institutional capacity

The following questions will be asked to determine if environmental management is a high priority in the organisation.

2.4.1 What is the role of the Environmental Sustainability Manager within the organisation?

2.4.2 Why is this role critical to the organisation?

The following question will be asked to determine if the organisation has an EMS

2.4.3 Does the organisation have a formal EMS?

The following questions will be asked to determine how EMS planning is conducted within the organisation.

2.4.4 How are environmental goals set, implemented and managed in the organisation?

2.4.5 How are the waste goals set?

The following will be asked to determine if waste management is integrated into the EMS.

2.4.6 Is waste management integrated into the EMS?

The following questions will be asked to determine if stakeholders are involved in the implementation and management of environmental goals.

2.4.7 Who are your stakeholders?

2.4.8 How are environmental goals communicated to stakeholders?

2.4.9 To what extent are stakeholders involved in the EMS?

The following question will be asked to determine how the organisation demonstrates corporate social responsibility (CSR).

2.4.10 What does CSR mean to CSIRO?

The following question will be asked to determine how knowledge is managed within the organisation.

2.4.11 How is knowledge managed within the organisation and EMS?

2.4.12 How is knowledge from different stakeholders managed?

The following question is asked to determine if there is a waste management information system.

2.4.13 Is there a waste information system?

2.4.14 How does the waste information system work?

2.4.15 How long has the waste information system been in use?

2.4.16 What are the benefits of having the waste information system?

### **3. OUTLINE OF THE RESULTS SECTION**

3.1 Organisation principles and culture

3.2 Setting of waste indicators

3.3 Environmental Management System (EMS)

3.4 Waste management roles and responsibilities

3.5 Waste management planning

3.6 Knowledge management

3.7 Training, awareness, communication and participation



### **APPENDIX 3: CASE STUDY FOLLOWUP INTERVIEW QUESTIONS**

**INTERVIEWEE:** CSIRO Waste Reduction Project Manager Ms Elaine Osborn

The following questions are asked so that we can get a better understanding of your organisational structure and responsibilities and authorities of divisions with respect to your Environmental Sustainability Strategy (ESS) performance.

1. What is the relationship between CSE and Health, Safety and Environment (HSE)?
2. What is the role of CSIRO Sustainable Ecosystems (CSE) with respect to the CSIRO ESS?
3. Why was ESS developed by Group Executive Environment and not under DCE Science Strategy & people?
4. What is the HSE structure and responsibilities?
5. Do you still have CSIRO HSE committee (HSEC)? If yes, does this committee report to the board? What is the responsibility of this committee?

The following questions are asked to determine the plans that you have to achieve your waste reduction goal and your progress to date.

6. What plans did you have to reduce waste during the development of your ESS in 2008?
7. Have any of these plans changed to date?
8. Between 2008 to date what have been your main achievements and learning's?
9. How have you communicated waste goals and requirements in the organisation?
10. How have you identified and planned training that is needed to achieve your goals?
11. How do you ensure that you meet legal and other requirements?

The following questions are asked to determine the roles that audits and risk assessment play in the achievement of your goals.

12. How have you planned and priorities your audits (for example which site to audit first and which waste streams will be audited)?
13. How do you ensure that site environmental improvement plans and waste management plans are implemented?

Other questions related to environmental management and waste reduction

14. How do you get researchers to do risk assessments for projects?
15. Is waste reduction integrated with your Environmental Management System?
16. How do you collect, analyse, store, distribute and share waste information?

17. Is there anything you would be doing differently from what you are doing now if your organisational goal was to achieve Zero-Waste to Landfill by 2015?
18. What does an environmental emergency plan entail?

#### APPENDIX 4: LOCATION AND USAGE OF INFORMATION

Component	Type	Source	Title	Where stored	Where used
Narratives	Answers from the case study question	Case study interview	Case study interview answers	Note book in researchers office	Interviews
Meeting Minutes	Minutes taken during the case study interview	Case study interview	CSIRO Interviews	Folder on CSIR I Drive: I/SS/SHES/Waste Management/Zero-Waste to landfill/Case study	Interviews
Record	Contact details of Interviewees	N/A	Contact details of interviewees		Interviews
Document	Sustainability Report	<a href="http://www.csiro.au/files/files/pjka.pdf">http://www.csiro.au/files/files/pjka.pdf</a>	CSIRO Sustainability Report 2006/07		Case study questions
Document	Sustainability Report	<a href="http://www.csiro.au/files/files/ppbm.pdf">http://www.csiro.au/files/files/ppbm.pdf</a>	CSIRO Sustainability Report 2007/08		
Document	Occupational Health, Safety and Environment (OHS&E) Annual Report 2004	<a href="http://www.csiro.au/resources/HSE/Report.html">http://www.csiro.au/resources/HSE/Report.html</a>	Occupational Health, Safety and Environment (OHS&E) Annual Report 2004		
Document	Occupational Health, Safety and Environment (HSE) Annual Report 2005	<a href="http://www.csiro.au/resources/HSE/Report.html">http://www.csiro.au/resources/HSE/Report.html</a>	Occupational Health, Safety and Environment Annual Report 2005		
Document	Health, Safety and Environment (HSE) Annual Report 2006	<a href="http://www.csiro.au/resources/HSE/Report.html">http://www.csiro.au/resources/HSE/Report.html</a>	Health, Safety and Environment (HSE) Annual Report 2006		
Document	Health, Safety and Environment (HSE) Annual Report 2007	<a href="http://www.csiro.au/resources/HSE/Report.html">http://www.csiro.au/resources/HSE/Report.html</a>	Health, Safety and Environment Annual Report 2007		
Document	Health, Safety and Environment (HSE) Annual Report 2008	<a href="http://www.csiro.au/resources/HSE/Report.html">http://www.csiro.au/resources/HSE/Report.html</a>	Health, Safety and Environment Annual Report 2008		
Document	Procedure	CSIRO	CSIRO Draft IWMP		
Document	Sustainability Strategy	CSIRO	CSIRO Sustainability Strategy		

## **APPENDIX 5: EXPERT INTERVIEW QUESTIONS**

### **CSIR Security, Safety, Health, Environment and Risk Management (SSHERM)**

**Manager:** James Modiba

1. If an organisation such as the CSIR was to embark on a Zero-Waste to Landfill initiative, what structures would need to be in place within the organisation?
2. How would you recommend setting of Zero-Waste to Landfill goals in an organisation such as the CSIR?
3. How possible is it for organisations to integrate a Zero-Waste to Landfill strategy into the organisation's Environmental Management System?
4. Who do you consider as environmental stakeholders?
5. What role in your view should stakeholders play in waste management?
6. How do you manage environmental knowledge?
7. How is the organisation showing corporate social responsibility?

### **CSIR Waste Pollution and Waste Competency Area Manager:** Linda Godfrey

1. If an organisation such as the CSIR was to embark on a Zero-Waste to Landfill initiative, what structures would need to be in place within the organisation?
2. How would you recommend setting of Zero-Waste to Landfill goals in an organisation such as the CSIR?
3. What are the benefits of having a waste information system?
4. Would you recommend that organisations have such a system?

### **UNISA/UNGC Project Researcher:** Nana Agyepong

1. How are you setting your waste management goals and why are you setting them in this manner?
2. What role in your view should stakeholders play in an organisation's waste management system?
3. How do you manage environmental knowledge?

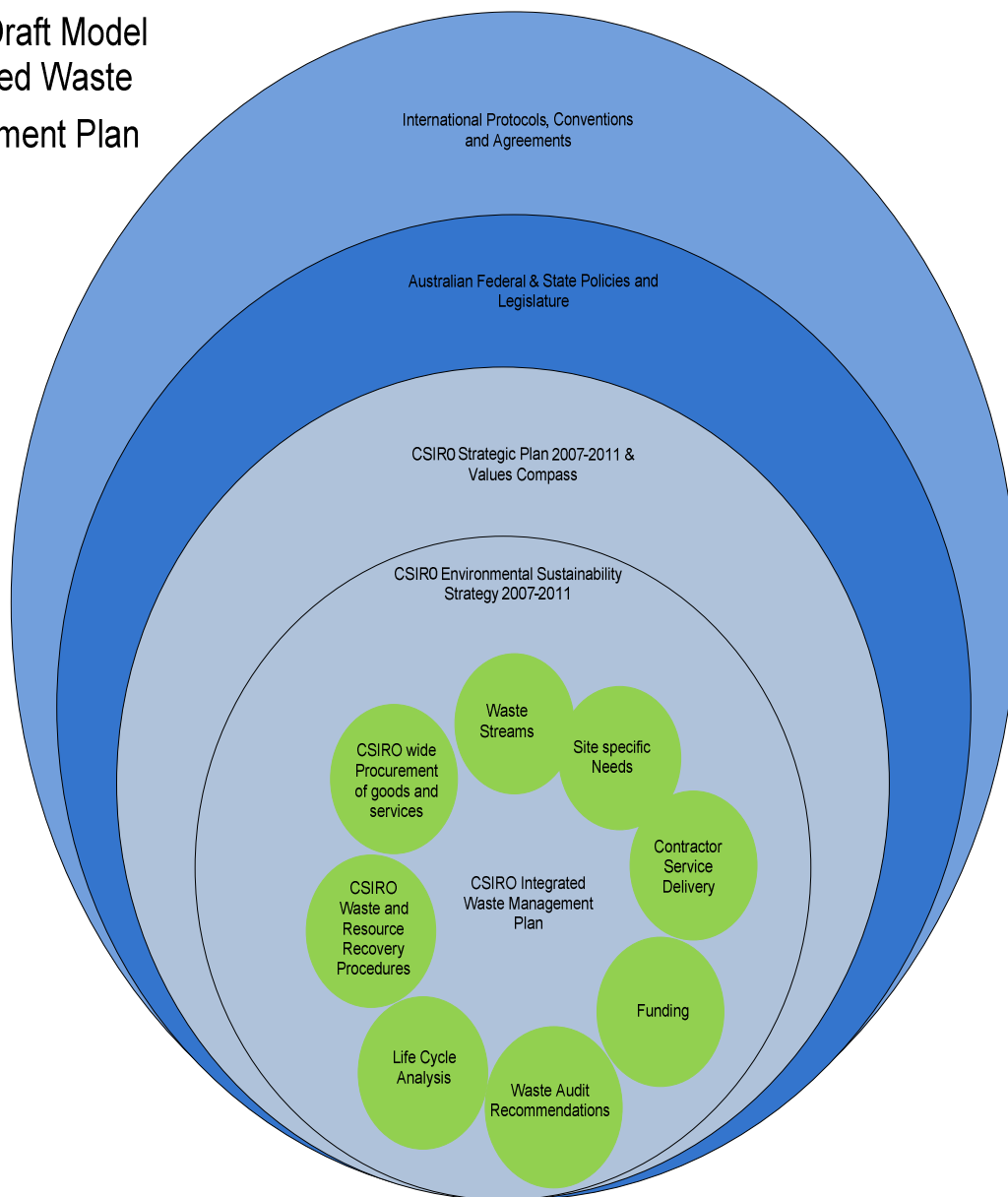
### **SABS Environmental Management Systems Manager:** Pieter Haasbroek

1. If an organisation such as the CSIR was to embark on a Zero-Waste to Landfill initiative, what structures would need to be in place within the organisation?

2. What role in your view should stakeholders play in an organisation's waste management system?
3. How possible is it for organisations to integrate Zero-Waste to Landfill strategy into organisation's Environmental Management System?

## APPENDIX 6: CSIRO DRAFT INTEGRATED WASTE MANAGEMENT PLAN

### CSIRO Draft Model Integrated Waste Management Plan



**APPENDIX 7: CSIR DRAFT ENVIRONMENTAL STRATEGY (EXTRACT)**

**ENVIRONMENTAL SUSTAINABILITY STRATEGY  
FOR  
THE CSIR ENVIRONMENTAL MANAGEMENT  
PROGRAMME**

**Compiled by**

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**Approved by**

**CSIR Board**

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## Executive Summary

As a Scientific Research organisation, the CSIR is looked upon to lead in environmental management, and as a responsible organisation, at all times the organisation minimises the impacts of its activities on the environment. ISO14001:2004 Environmental Management System certification has been retained at the CSIR for over ten years. This has helped the organisation to prevent environmental pollution, minimise its impacts on the environment in its activities and comply with legal requirements. While the organisation is proud of this achievement, there are still a number of opportunities that need to be explored. In order to explore these opportunities, this strategy has the following five objectives:

- CSIR to achieve Zero-Waste to Landfill by 2013
- CSIR to establish water reduction targets by 2013
- CSIR to establish carbon reduction targets by 2014
- CSIR will reduce energy usage by 12% by 2015
- CSIR to cause zero environmental incidents

This Environmental Sustainability Strategy details the plan of action that will be taken to achieve the set objectives. In the first year, focus will be on data collection and developing and implementing environmental management procedures and guidelines. This will ensure that the organisation's processes and projects incorporate environmental requirements. Implementation of the procedures will contribute to the achievement of the objectives. Water, waste and carbon baselines will be developed from data collected and from these improvements will be tracked and reported on a regular basis. Environmental improvement audits will be conducted in the following two years, and suggestions for improvement from these audits will be implemented. Information coming from the development of baselines and audits will be used to set targets. Renewable energy initiatives and alternatives to mains water supply, materials and energy will also be a focus area in the next five years. It will be important to develop a robust Environmental Management System that will effectively manage the objectives of this strategy and ensure environmental sustainability. A more integrated and strategic approach is required.



## Table of Contents

1.0 ABBREVIATIONS AND ACRONYMS.....	141
2.0 VISION.....	141
3.0 MISSION.....	141
4.0 VALUE PROPOSITION.....	141
5.0 SITUATIONAL ANALYSIS.....	142
6.0 CHALLENGES.....	146
7.0 GOALS AND OBJECTIVES.....	147
8.0 KEY PRINCIPLES FOR THE SUCCESS OF THIS STRATEGY.....	147
9.0 STRATEGY.....	148
10.0 REQUIRED RESOURCES.....	151
11.0 RECOMMENDATIONS.....	153
12.0 CONCLUSION.....	153
13.0 APPENDICES.....	155

## LIST OF DIAGRAMS

Diagram 1: 2007 Benchmark waste footprint.....	146
Diagram 2: Framework for achieving environmental goals.....	148

## LIST OF TABLES

Table 1: Waste management initiatives.....	149
Table 2: Other environmental management initiatives.....	150
Table 3: Required resources.....	151

## **1.0 ABBREVIATIONS AND ACRONYMS**

BSM: Business Support Manager

CSIR: Council for Scientific and Industrial Research

CSIRO: Commonwealth Scientific and Industrial Research Organisation

EMC: Environmental Management Committee

EMS: Environmental Management System

ISO: International Organisation for Standardization

SHE: Safety, Health and Environment

SHES: Safety, Health, Environment and Security

SHEQ: Safety, Health, Environment and Quality

SSHERM: Security, Safety, Health, Environment and Risk Management

SWOT: Strength, Weakness, Opportunities, Threats

## **2.0 VISION**

Our vision is to creating a zero-environmental harm organisation and to be among the leading research institutes in environmental management.

## **3.0 MISSION**

The CSIR's mission is to lead in environmental management ensure zero-environmental harm on the environment by promoting and encouraging the adoption of ecologically sustainable work practices and operations.

## **4.0 VALUE PROPOSITION**

The CSIR has a long-standing commitment to environmental protection. It builds on the strengths its Environmental Management System to enhance sustainable practices throughout the organisation. The CSIR believes that all the people of this nation have the right to a safe and healthy environment, inside and outside the workplace. As a socially and environmentally responsible organisation, the organisation has a role to play in safeguarding, upholding and promoting this right. Environmental sustainability is core to our values. Our aim is to address environmental concerns throughout the value chain. The CSIR will work together with staff, customers, authorities and other affected parties to resolve environmental issues and improve our environmental performance. In addition to this, at all

times protect the natural environment, minimise adverse impacts and prevent pollution in the course of our activities, products and services.

## **5.0 SITUATIONAL ANALYSIS**

### **5.1 External Context**

There is a much tougher and constantly evolving regulatory regime targeting waste, energy, carbon and climate change in particular. Non-compliance with regulatory regime increases the organisation's risks to prosecution. South African legislation requires that the organisation prevents environmental pollution. The National Air Quality Act 39 of 2004 requires pollution prevention plans for substances contributing to air pollution. The National Water Act 36 of 1998 states that a land owner, a person in control of land or a person who occupies or uses the land must take all reasonable measures to prevent pollution from occurring, continuing or recurring. The National Environmental Management: Waste Act (2008) requires industry to prepare plans that include measures to prevent pollution or ecological degradation. This Act requires organisations to develop to minimise waste to landfill. Since 2008 municipal bylaws have been changing to accommodate the requirements of this Act.

### **5.2 Internal Context**

#### **5.2.1 Social trends**

The CSIR has very highly qualified researchers in environmental sustainability. Partners, customers, suppliers and other stakeholders of the CSIR are becoming more environmentally aware. This puts a lot of pressure on the organisation to improve its environmental performance because employees and stakeholders want to know how the organisation is performing environmentally. As government funding decreases annually, this makes the CSIR to expand its funding model and source more private sector funding. As the private sector becomes more sensitive to environmental sustainability, this forces the CSIR to improve its environmental performance. Five years ago, CSIRO was performing at the same level as the CSIR but has now improved and developed environmental sustainability strategies. Customers such as Vodacom want to know the CSIR's environmental targets and performance before starting work with the organisation. Some tender processes have also followed this route. Organisations that openly communicate to their stakeholders on their

environmental performance and have set goals to reduce their carbon footprint are perceived as good responsible organisations and this improves their image and reputation.

### **5.2.2 Technological trends**

Methods for collecting and analysing environmental data still need to be developed and improved at the CSIR. Although there are procedures and standards at the CSIR, there are no integrated environmental data management systems. Currently monthly environmental performance statistics (Energy demand, energy usage, travel, waste and water usage) are compiled manually drawing information from other departments and units internally and externally from service providers. Considering that some technologies such as water testing and carbon foot printing are developed at the CSIR, the organisation should be using these technologies.

### **5.2.3 Economic trends**

Many of the initiatives which will need to be implemented at the CSIR to improve the organisation's Environmental Management System and performance will require financial investment. Information, both quantitative and qualitative, that is currently not collected and analysed might need to be collected and analysed in future. Good carbon data management systems cost money to install and maintain.

### **5.2.4 Ecological trends**

Growing global demand for finite natural resources and degradation of the environment is forcing organisations to reconsider how they do business and to change their environmental practices. Several assessments conducted during 2010 and early 2011 identified shortcomings in the CSIR environmental management programme which need to be addressed. The assessments include the Sustainability assessment: status quo and gap analysis conducted by the CSIR Sustainable Social Ecological Systems Research Group, the Strength, Weaknesses, Opportunities and Threats (SWOT) analysis (Appendix A) undertaken during the strategic business planning process, environmental audits and an environmental risk assessment. The following issues were identified from these assessments:

#### **5.2.4.1 Findings from Sustainability assessment: status quo and gap analysis and SWOT analysis**

Waste management at almost all sites is entirely the responsibility of the CSIR and waste collection is either done by the local municipality or outsourced to a private service provider. Typical wastes generated at the sites include general business waste (paper, cans, plastics, glass etc), general industrial waste (oils, greases, metals, plastics etc), and hazardous waste (chemical, laboratory, bio hazardous), see Appendix B for CSIR Waste Streams.

Waste management procedures have been documented for the different CSIR sites stating how waste generated at the sites will be managed from production to disposal. Some sites do not have these procedures, but they have systems for managing waste. In some instances these procedures are not adequate. There is a need to develop a CSIR integrated waste management plan that will help reduce waste generation and disposal.

Environmental sustainability aspects have not been integrated into the strategic and operational plan of the CSIR. There are no initiatives and strategies to reduce waste. Current waste recycling processes at the CSIR are not monitored and controlled. In addition to this, waste services service providers are not monitored to confirm what and how they dispose waste. It is suggested in the Sustainability status quo and gap analysis that there must be implementation of research projects within the CSIR that showcase sustainability initiatives and a review and economic analysis of various waste recycling savings measures.

#### **5.2.4.2 Findings from environmental risk assessment**

The environmental risk register helped to identify threats to attaining environmental objectives as shown in Appendix C. There are still some activities and processes that need to be improved to reduce the threats posed by the risks. Organisational environmental targets have not been set, only energy and ISO14001:2004 targets are set. As a result of this, environmental sustainability requirements are not enforceable. The Safety, Health and Environment (SHE) risk management process needs to be improved to ensure that activities and services are assessed correctly. Currently, there is no formal process to ensure that environmental considerations are made during the development of projects. This increases the risk to environmental pollution and inefficient use of natural resources. Environmental procedures and guidelines need to be developed taking into consideration the organisation's vision.

#### **5.2.4.3 Findings from SHE internal audits**

A cycle of annual SHE internal audits has been conducted at the CSIR sites and units from 2010 to 2011 as required by the ISO14001:2004 Environmental Management System (EMS) requirements. One of the reasons for conducting these audits is to ensure continuous improvement within the organisation. The main issues that were identified at most sites and units were with respect to SHE planning, risk management, training and the internal audit process.

It is required that units and sites set environmental targets, develop plans to meet the targets and monitor and review progress towards meeting these targets. Targets are set to reduce environmental risks and to improve environmental performance. All the employees who are involved in environmental management need to be trained so that can perform their duties. It was found during the audits that there were still some areas where environment targets were not set, procedures for planning were not followed. In some instances there was no evidence of planning to meet targets. According to ISO14001:2004, top management must review progress against set targets. It was found during the audits that in some areas these reviews were not conducted according to the CSIR procedures and ISO14001:2004 requirements. Training needs analysis was not done in a number of areas, logistics officers are not trained on ISO14001:2004 and there is lack of environmental awareness in some areas.

According to ISO14001:2004, the organisation needs to identify all environmental risks of all its activities and ensure that plans to minimise them are made. It was also identified in a number of places in the organisation that there were flaws assessing these risks. Not all activities were assessed and the rating of the risks was questionable. According to the auditors, risk management for contractors was not in place. No environmental incidents had been recorded, nor had environmental emergency drills been conducted. Emergency drills are necessary to ensure preparedness in case of a real emergency. The auditors also found that SHE legal audits had not been conducted in a number of areas.

### **5.3 BENCHMARKING CSIR**

#### **5.3.1 Waste – Current footprint benchmarking**

The benchmarking outcomes for the CSIR in the waste domain are shown below in diagram 1. This position has not changed since 2007. CSIR has been positioned in with the “Laggers” because currently it does not have any data on its waste performance. The “Chasing Pack”

organisations present their waste management performance and also have targets set, whereas those in the current “Leadership” position have stated commitments to send Zero Waste to Landfill.

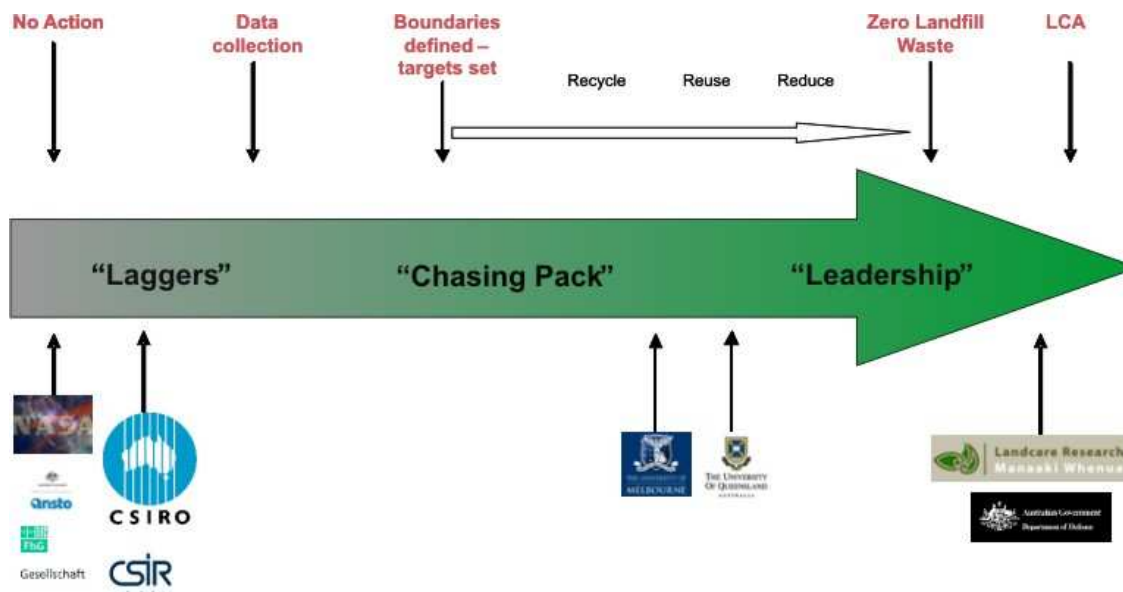


Diagram 1: 2007 Benchmark waste Footprint  
Source: CSIRO Draft ESS

## 6.0 CHALLENGES

Environmental objectives are not department objectives, they are organisational goals. The current culture in the organisation shifts these goals to the SSHERM department. Systematic and strategic attention to environmental sustainability has to be demonstrated in the whole organisation. The only organisational environmental targets that have been set are the energy and ISO14001:2004 targets. Water, waste and carbon emission reduction targets have not been set.

The current economic climate poses a challenge to implementing environmental initiatives at the CSIR. Environmental management, improvement and initiatives require investment in infrastructure, systems, technologies, training and awareness programmes, human resources and financial resources. The only audits that are budgeted for currently are ISO14001 audits. Audits need to be performed to determine baselines, footprints, opportunities for improvement and full life cycle analysis.

Some SHE procedures are not followed according to CSIR and ISO14001:2004 requirements. These are mainly the risk assessment, planning and review processes. In addition to this some environmental procedures and guidelines that support environmental objectives need to be developed and reviewed.

The organisational changes from nine Safety, Health, Environment and Quality (SHEQ) Managers based at the units to five Business Support Managers (BSM's) is going to have operational impact in that Safety, Health and Environment (SHE) knowledge is going to be spread thinly on the ground. People undertaking incident investigations and risk assessments require environmental training and currently the unit is not trained on this. It has already been confirmed in the internal SHE audits that environmental training and induction lacks in some areas.

## **7.0 GOALS AND OBJECTIVES**

The five environmental sustainability objectives set by this strategy are:

- CSIR to achieve Zero-Waste to Landfill by 2013
- CSIR to establish water reduction targets by 2013
- CSIR to establish carbon reduction targets by 2014
- CSIR will reduce energy usage by 12% by 2015
- CSIR to cause zero environmental incidents

## **8.0 KEY PRINCIPLES FOR THE SUCCESS OF THIS STRATEGY**

### **8.1 LEADERSHIP ACCEPTANCE**

Leadership buy-in is crucial for any successful environmental management programme. The old Safety, Health, Environment and Security (SHES) committee was dissolved in 1 April 2011. The members of the committee need to be revised and should include S16 appointees or at least S8 appointees. This will increase their visibility in the environmental management drive.

### **8.2 STAKEHOLDER ENGAGEMENT**

Stakeholder engagement is required from development to implementation of any environmental management plan. The success of this strategy depends on the support and



collaboration with stakeholders. Guidelines will be developed in collaboration with internal stakeholders to ensure that internal processes align with the environmental objectives. The CSIR will form partnerships with external organisations such as Eskom to strengthen its capabilities to meet environmental objectives.

### 8.3 COMMUNICATION

A combined SHE communications strategy has been designed to prevent communication fatigue. Communication events will be targeted and well planned. Regular articles and fact sheets will be published on the intraweb on relevant topics. Communicating with stakeholders will be important for the success of this strategy.

### 8.4 ROLES AND RESPONSIBILITIES

Clear roles and responsibilities must be stated and communicated to all those affected. All SHE procedures and appointment letters state roles and responsibilities. All persons responsible for carrying out environmental procedures must be trained and provided with the resources that are needed to carry out their responsibilities.

### 9.0 STRATEGY

The framework for achieving our objectives is summarised diagram 2 below.

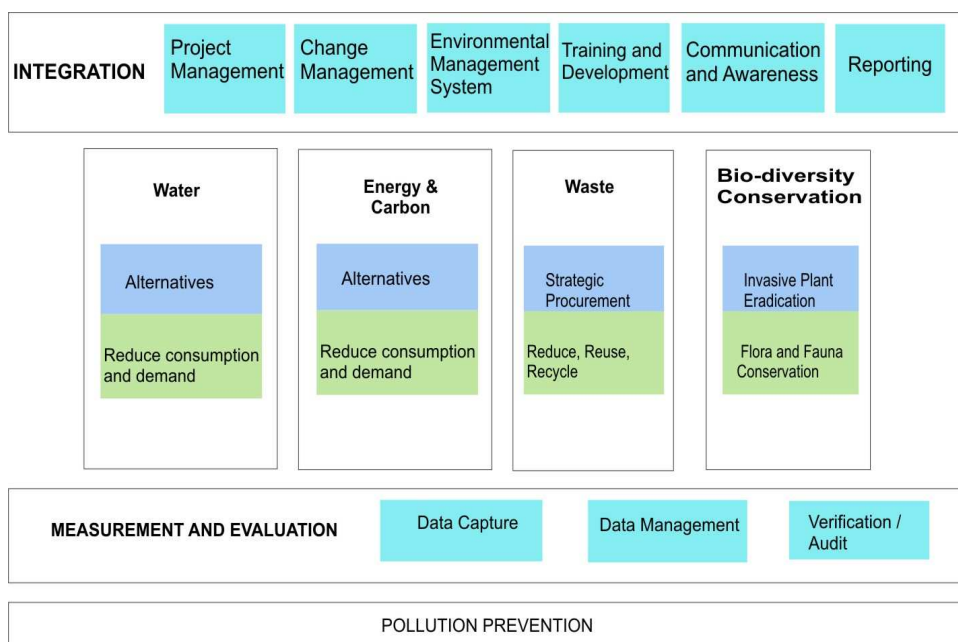


Diagram 2: Framework for achieving environmental goals

## 9.1 WASTE MANAGEMENT INITIATIVES

Table 1: Waste management initiatives

Focus area		Initiative
Reduce/Reuse	Strategic procurement	CSIR will link waste management objectives to strategic procurement. This will include working with key suppliers to identify opportunities to reduce waste inputs such as through packaging agreements which return waste to the supplier.
		Procurement will be refined based on cost, performance and life cycle assessments.
		Opportunities will be explored to centralise waste management contracts to better quantify waste streams and to work with contractors to find reuse and recycling opportunities.
		CSIR will investigate means to reduce the amount of scientific waste through better purchasing practices and better inventory management.
		Waste minimisation clubs and waste exchange markets will be explored to improve reuse of materials at the CSIR.
	Units and departments	Units and departments will investigate ways to reduce waste and reuse materials where possible.
Reduce/Reuse/Recycle/Recover Treat	Site based audits	CSIR will undertake audits to quantify the organisation's footprint and to identify waste minimisation opportunities.
Recycle/Recover Treat	Waste management plans and procedures	Waste management plans and procedures will be required for all sites to promote environmental pollution prevention, prevention of harm to human health and waste minimisation.
	Waste services service providers	CSIR will source waste service providers that are competent and experienced in recycling, recovery, treatment and disposal of waste.
	Sustainable facilities management	Increased recycling and recovering waste streams will be introduced to reduce the volume of waste directed to landfill through implementation of acceptable collection systems. Garden waste will also be used for making compost.

## 9.2 OTHER ENVIRONMENTAL MANAGEMENT INITIATIVES

Table 2: Other environmental management initiatives

Focus area	Initiative
Bio-diversity conservation	Plans to eradicate invasive plants on site will be put in place. Infrastructure development projects within the CSIR will take into consideration bio-diversity conservation.
Communication and awareness	One of the ways in which stakeholders will be engaged is through communication. Environmental communication promotes behavioural change. The environmental policy must be communicated to all CSIR employees and stakeholders. A SHE communication plan has been developed and SHE communication procedure updated to ensure that this communication and communication on environmental objectives occurs throughout the organisation. The plan also includes environmental awareness campaigns that will be run annually across the CSIR.
Training and development	An effective training programme that will increase awareness of environmental issues and encourage commitment and enthusiasm towards the achievement of environmental objectives must be entrenched. The training needs associated with the organisation's aspects and Environmental Management System (EMS) have been identified in Appendix D. Additional environmental training may be identified, depending on the specific job and project requirements.
Reporting	The CSIR will report regularly on its performance against set environmental targets. As a responsible organisation, the CSIR believes that employees and stakeholders have the right to know about how the organisation is performing environmentally.
SHE Systems	The ISO14001:2004 EMS has been implemented at the CSIR. This EMS requires continuous improvement. Environmental improvement plans will be used to drive continuous improvement. Annual management reviews will be conducted in order to improve and review the effectiveness of this system.
Measuring and monitoring	Effective environmental measurement and monitoring systems must be used to measure and monitor environmental targets. The CSIR is accountable for its environmental impacts, therefore it is important that these are measured and monitored accurately. The CSIR Environmental Management Committee is responsible for monitoring progress against the set environmental goals. Refer to terms of reference of the Environmental Management Committee for responsibilities.
Pollution prevention	The CSIR goal is zero-environmental harm. Environmental risks assessments are conducted for all new and changes in jobs, projects and processes in order to ensure prevention and minimisation of impacts on the environment.

## 10.0 REQUIRED RESOURCES

This strategy is dependent on the performance of other units and departments outside the SSHERM department. Table 3 below shows the resources required from SSHERM and other units and departments for this strategy to succeed.

Table 3: Required resources

Area of work	2011/12	2012/13	2013/14	2014/15
Risk Assurance: Energy audits		Energy auditors		
Risk Assurance: Water audits			Water auditors	
Risk Assurance: Carbon and green house gas audits			Carbon auditors	
Risk Assurance: Environmental risk audits		Environmental auditor		
SSHERM: Waste audits	1 Intern			
General services: Video conference facilities		Video conferencing facilities		
FM: Energy sub metering	Energy sub meters	Energy sub meters		
FM: Water sub metering			Water sub meters	
FM: Waste service provider			Waste service provider	
FM: Eradication of invasive plants		Contractor		
SSHERM: Communication, awareness and training	Awareness campaign	Awareness campaign	Awareness campaign	Awareness campaign
SSHERM: Environmental legal register	Legal register	Legal register	Legal register	Legal register
SSHERM: Carbon management data system			Data management system	
SSHERM: ISO14001 certification		TBC	TBC	TBC
SSHERM: Life cycle analysis		Environmental auditor		

Table 3 continued: Required resources

<b>Area of work</b>	<b>2011/12</b>	<b>2012/13</b>	<b>2013/14</b>	<b>2014/15</b>
SSHHERM: Renewable energy initiative			TBA	
SSHHERM: Human Resources		1 Intern	1 Environmental Officer	2 Environmental Officers
SSHHERM: Professional registration, Conferences, Seminars		TBA	TBA	TBA
SSHHERM: Regional visits		TBA	TBA	TBA

## **11.0 RECOMMENDATIONS**

Environmental objectives must be set at organisational level. In this strategy, waste minimisation and incident reduction targets are set. Water and carbon targets still need to be determined. A reliable environmental data management system will be required to collect all CSIR environmental data and measure the organisation's carbon footprint.

Procedures and guidelines that will ensure practices that support the objectives need to be developed. Guidelines to address the use of water within the organisation and a CSIR Integrated Waste Management Plan need to be developed. Green building guidelines and fauna and flora management guidelines need to be reviewed and updated. These must be communicated to employees and stakeholders, where training and awareness is required, it must be given. All training needs must be identified, and training given to the people that require training.

The organisation also needs to consider investing in developing projects and initiatives that will help achieve the environmental objectives. Subsequent to this, a funding model needs to be developed so that savings generated by environmental initiatives are returned to the fund and enable support for further environmental initiatives. Assessments and feasibility studies will need to be conducted to determine which projects and initiatives, including systems and infrastructure to support these are required. In order to improve environmental performance, other environmental audits and assessments need to be budgeted for in future.

It will be required in most instances that internal resources are used to develop, design or implement the initiatives coming from this strategy. Stakeholder engagement and buy-in is therefore important in the development and implementation of this strategy.

## **12.0 CONCLUSION**

The goal of this strategy is to set long term environmental objectives and provide a plan and actions needed to achieve these objectives. The plans and actions of this strategy address findings from a number of assessments including the SWOT analysis and environmental risk assessment. Appendix E details the environmental operational plan for the next five years. There is also an operational dashboard that is updated monthly to track performance against the objectives.

By implementing this strategy, the CSIR will be living up to its values and adhering to the King III code as showing organisational good governance and sound corporate sustainability. The King Report on Governance for South Africa (King I, II and III) encourages business in South Africa to integrate responsible financial, social, ethical and environmental behaviour into core business practices. This strategy will be instrumental in informing the CSIR as to what goals, initiatives and resources are required to meet the strategic environmental objectives when the CSIR Sustainability Strategy is developed.

## 13.0 APPENDICES

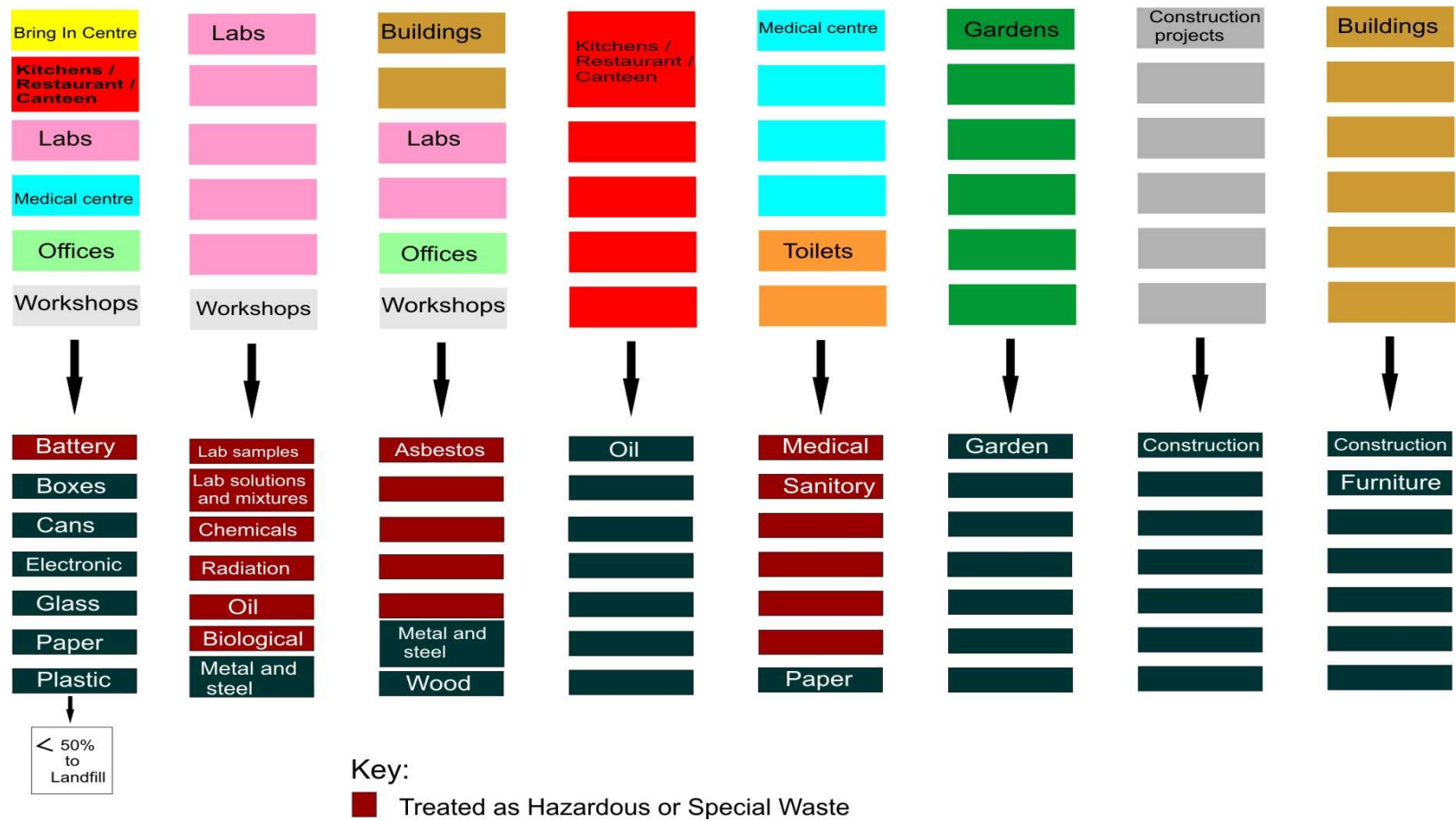
### APPENDIX A: ABSTRACT FROM ENVIRONMENTAL SWOT ANALYSIS

INTERNAL		
POSITIVE	<b>STRENGTHS</b> <b>(Attributes that are helpful in achieving the objectives)</b> <ul style="list-style-type: none"> <li>• ISO14001 Certification</li> <li>• Environmental management procedures available in some areas</li> <li>• Established contracts with waste removal and recycling companies</li> <li>• Environmental, including waste, water and energy experts within the organisation</li> </ul>	<b>Weaknesses</b> <b>(Attributes that are harmful to achieving the objectives):</b> <ul style="list-style-type: none"> <li>• Waste types and quantities are not identified, i.e. there is no formal system of measuring waste types and quantities</li> <li>• Measuring and reporting on waste and water is not adequate</li> <li>• Waste minimisation, segregation, substitution and disposal concept is not well understood or simply neglected</li> <li>• There are no regular audits of waste service providers to check compliance to duty of care principle</li> <li>• Inadequate communication on environmental management</li> <li>• Lack of structured coordination of environmental goals across units and centres</li> <li>• There are no initiatives or strategy in place to reduce waste and water usage, or increase efficiency of water usage</li> <li>• Environmental procedures are not adequate</li> </ul>
	<b>Opportunities</b> <b>(External conditions that are helpful to achieving the objectives):</b> <ul style="list-style-type: none"> <li>• Improved environmental performance</li> <li>• Improved corporate image</li> <li>• Review of procurement policy and management practices to incorporate energy management and environmental stewardship</li> <li>• Set up environmental procedures, manuals, specifications and guidelines</li> <li>• Development and use of a comprehensive Integrated Waste Management Plan</li> <li>• Reduced operation costs through waste, energy, carbon and water management and initiatives</li> <li>• Reduction in landfill, air, ground and water pollution</li> <li>• Development and use of efficient systems for measuring energy, carbon, water and waste generated</li> </ul>	<b>Threats</b> <b>(External conditions which could do damage to the objectives):</b> <ul style="list-style-type: none"> <li>• Damage to reputation</li> <li>• Prosecution by law</li> <li>• Impacts on the next generation</li> <li>• Landfill, air, ground and water pollution</li> <li>• Unnecessary costs due to poor waste, water and energy usage</li> <li>• Climate Change and environmental compliance changes in future</li> <li>• Competing OU's and Centres Objectives and priorities</li> <li>• Resistance to change by employees</li> </ul>
EXTERNAL		



## APPENDIX B: CSIR WASTE STREAMS

### CSIR Waste Streams



## APPENDIX C: ABSTRACT FROM ENVIRONMENTAL RISK REGISTER

CSIR-MS-SSHerm-ERR-003 2011 REV 00

	Risk Definition		Risk Analysis	
Risk No.	Risk/Threats in attaining objectives	Impact of the risk (description)	Residual Risk Rating	Additional action required to mitigate risk(s)
1	Emergency preparedness not in place	1. Death and injuries to fauna on site 2. Fatality and injuries of employees 3. Damage to the organisation's reputation	H	Development of emergency plan and addressing actions from the emergency plan
2	Environmental considerations not taken into consideration during projects	1. Inefficient use of natural resources 2. Increased costs due to usage of natural resources 3. Ground, water and air pollution 4. Damage to the organisation's reputation	H	The process of evaluating environmental risks before a project begins needs to be developed and formalised across the organisation.
3	Environmental sustainability requirements not enforceable	1. Inefficient use of natural resources 2. Increased costs due to usage of natural resources 3. Increased carbon emissions 4. Ground, water and air pollution 5. Damage to the organisation's reputation	H	Waste, water and energy requirements and guidelines need to be updated and some still need to be developed. These guidelines will include improvement of data capturing systems within the CSIR, baseline and gap analysis audits and setting of targets.
4	Inefficient usage of natural resource i.e. energy, water, gas and fuels	1. Increased costs due to usage of natural resources 2. Wastage and depletion of natural resources 3. Negative impacts on the ecosystem 4. Damage to the organisation's reputation	C	Waste, water and energy requirements and guidelines need to be updated and some still need to be developed. These guidelines will include improvement of data capturing systems within the CSIR, baseline and gap analysis audits and setting of targets.
5	Contractors not well managed and coordinated	1. Inefficient use of natural resources 2. Increased costs due to usage of natural resources 3. Generation of waste 4. Ground, water and air pollution 5. Damage to the organisation's reputation	H	Contractor management process needs to be improved. The procedure for contractor management should include how the organisation will ensure that contractors' impacts on the environment are mitigated.

## APPENDIX C: ABSTRACT FROM ENVIRONMENTAL RISK REGISTER CONTINUED

CSIR-MS-SSHERM-ERR-003 2011 REV 00

	Risk Definition		Risk Analysis	
Risk No.	Risk/Threats in attaining objectives	Impact of the risk (description)	Residual Risk Rating	Additional action required to mitigate risk(s)
6	Inadequate transportation, storage and handling of chemicals	1. Air pollution 2. Damage to the organisation's reputation and image 3. Prosecution and fines	H	None
7	Inadequate transportation, storage and handling of gases	1. Land and water pollution 2. Damage to the organisation's reputation and image 3. Prosecution and fines	M	None
8	Inadequate storage, use and disposal of biological materials	1. Land and water pollution 2. Damage to the organisation's reputation and image 3. Prosecution and fines	M	Process of conducting SHE risk assessments before projects needs to be formalised
9	Inadequate storage and use of genetically modified (GM) material	1. Land and water pollution 2. Damage to the organisation's reputation and image 3. Prosecution and fines	M	Process of conducting SHE risk assessments before projects needs to be formalised
10	Inadequate storage, use and disposal of radioactive sources	1. Land, water and air pollution 2. Damage to the organisation's reputation and image 3. Prosecution and fines	M	Process of conducting SHE risk assessments before projects needs to be formalised
11	Uncontrolled liquid effluents	1. Ground and water pollution 2. Damage to the organisation's reputation and image 3. Prosecution and fines	M	Process of conducting SHE risk assessments before projects needs to be formalised

## APPENDIX C: ABSTRACT FROM ENVIRONMENTAL RISK REGISTER CONTINUED

CSIR-MS-SSHHERM-ERR-003 2011 REV 00

	<b>Risk Definition</b>		<b>Risk Analysis</b>	
<b>Risk No.</b>	<b>Risk/Threats in attaining objectives</b>	<b>Impact of the risk (description)</b>	<b>Residual Risk Rating</b>	<b>Additional action required to mitigate risk(s)</b>
12	Mismanagement of waste generated from CSIR's activities	1. Ground, air and water pollution 2. Damage to the organisation's reputation and image 3. Prosecution and fines	H	Waste audits required to identify all waste streams and suggest improvement plans. All waste generated needs to be quantified. An integrated waste management plan is also required.
13	Improper waste disposal	1. Ground, air and water pollution 2. Damage to the organisation's reputation and image 3. Prosecution and fines	H	Waste audits required to identify all waste streams and suggest improvement plans. All waste generated needs to be quantified. Waste contracts need to be reviewed and centralised.
14	Air pollution, uncontrolled carbon and greenhouse gas emissions	1. Air pollution 2. Damage to the organisation's reputation and image 3. Prosecution and fines	M	Development of CSIR specific policies regarding the use, generation or reduction of greenhouse gases. A standard operating procedure that oversees data capturing relating to air pollutants within the CSIR in order to focus on reduction of greenhouse gas emissions is also required.



**APPENDIX D: TRAINING NEEDS ANALYSIS**

Table 4: Training needs analysis

<b>Training topic</b>	<b>Site, Operating unit, Centre</b>	<b>Tenants</b>	<b>Contractors</b>
Environmental Policy	√	√	√
Environmental Objectives	√	√	√
Risk Assessment*	√	-	-
ISO14001 awareness	√	√	√
Waste management*	√	√	√
Energy efficiency*	√	√	√
Emergency planning*	√	√	√
Pollution prevention*	√	√	√
Water management*	√	√	√

\*Contractors and tenants SHE plans must include how these will be conducted and managed.

The contents and type of training will depend on the position and type of job or project that will be conducted by a person. All new employees, contractors and tenants must go through an induction that will cover all the topics listed in table 4 above. Further area specific Safety, Health and Environment (SHE) induction may be carried out before commencement of a new job or project. This will be the case especially in high risk areas. All persons who have responsibilities in procedures must be trained so that they are capable of carrying out those responsibilities.

## APPENDIX E: ENVIRONMENTAL OPERATIONAL PLAN 2011-2014

Strategic Objective	Deliverables	2011/12				2012/13				2013/14				2014/15			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
<b>Integration</b>																	
Environmental reporting.	Environmental Sustainability reports.	√															
Re-engineer business processes to incorporate environmental sustainability initiatives.	Develop CSIR Green Building guidelines.			√													
	Procurement Processes and procedures to incorporate environmental sustainability requirements.				√												
	Project management processes and procedures to incorporate environmental sustainability requirements.		√														
	Tenant management processes and procedures to incorporate environmental sustainability requirements.		√														
	Contractor management processes and procedures to incorporate environmental sustainability requirements.		√														
Develop environmental Communication plan	Communication plan and implementation of the plan.	√															
Develop environmental training plan	Training plan and implementation of the training plan.	√															
Retain ISO14001 certification	Develop, update and review environmental policies, manuals and procedures.				√								√				
	EMS management review		√				√				√				√		

**APPENDIX E: ENVIRONMENTAL OPERATIONAL PLAN 2011-2014 CONTINUED**

Strategic Objective	Deliverables	2011/12				2012/13				2013/14				2014/15			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Data collection, measurement and verification																	
Provide the current footprint of the CSIR	Collect, analyse and manage waste data	√															
	Collect analyse and manage water data	√															
	Collect, analyse and manage fuel (petrol and diesel) data	√															
	Collect, analyse and manage LPG data									√							
	Collect, analyse and manage electricity data	√															
	Collect, analyse and manage carbon emission data					√											
Data capturing and analysis systems	Data capturing and analysis systems									√							
Pollution prevention																	
Air, water and land pollution prevention.	Project management processes and procedures to incorporate pollution prevention requirements.		√														
	Tenant management processes and procedures to incorporate pollution prevention requirements.		√														
	Contractor management processes and procedures to incorporate pollution prevention requirements.		√														
	Formalise environmental risk assessments in research process.			√													
	Include environmental risk audits in scheduled audits								√								
Air pollution, greenhouse gases and carbon emissions	Develop air pollution, carbon dioxide and greenhouse gas guidelines				√												



**APPENDIX E: ENVIRONMENTAL OPERATIONAL PLAN 2011-2014 CONTINUED**

Strategic Objective	Deliverables	2011/12				2012/13				2013/14				2014/15			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
CSIR to achieve Zero-Waste to Landfill by 2013																	
Set waste targets	Waste targets	√															
Waste management procedures	Develop CSIR Zero-Waste to Landfill framework				√												
	Develop CSIR integrated waste management plan								√								
Develop project plan to achieve waste targets	Project plan		√														
	Conduct waste audits and feasibility study						√										
	Life cycle analysis						√										
Implement waste reduction initiatives	Waste reduction									√							
CSIR to establish water reduction targets by 2013																	
Set water targets	Water targets						√			√							
Develop water management guidelines							√										
Develop project plan to achieve water targets	Conduct water reduction feasibility study and audits									√							
	Project plan										√						
	Introduce sub metering of water												√				
Implement water reduction initiatives	Water usage reduction													√			
CSIR will reduce energy usage by 12% by 2015																	
Reduce electricity usage and demand	Conduct energy audits	√															
	Implement electricity usage and demand initiatives					√											
	Introduce electricity sub metering				√				√								
Implement renewable energy initiatives	Energy usage reduction									√							

**APPENDIX E: ENVIRONMENTAL OPERATIONAL PLAN 2011-2014 CONTINUED**

Strategic Objective	Deliverables	2011/12				2012/13				2013/14				2014/15			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
CSIR to establish carbon reduction targets by 2014																	
Set carbon emission targets	Carbon emission targets													√			
	Conduct carbon emission reduction feasibility study and audits									√							
	Project plan										√						
	Conduct carbon emission audits									√							
Implement carbon emission reduction initiatives	Carbon emission reduction														√		
Biodiversity conservation																	
Eradication of Invasive plants	Eradication of invasive plants	√															
	Develop site Environmental Management Frameworks.												√				

## APPENDIX 8: PLANNED STAKEHOLDER ENGAGEMENT

Stakeholders	Planned dates
Discussion at Forum Level; Environmental Management Committee	Done in April 2011
Discussion at Group level: Infrastructure, Properties and Services	Done is September 2011
Discussion at department level: SSHERM	Done October 2011
Discussion at Forum Level; Technical Energy Forum	November 2011
Discussion at Forum Level; Waste Minimisation Forum	November 2011
Discussion at Management Services Management level	October 2011
Discussion at CSIR Executive level: OPCO for final approval by ExCo	January 2012

## **APPENDIX 9: CSIR INTEGRATED WASTE MANAGEMENT PLAN DEVELOPEMENT (IWMP) PROCESS**

The Nation Environmental Management: Waste Act, 2008 requires that industry should prepare waste management plans. The process that will be followed to complete the CSIR IWMP fulfils these requirements. The following steps will be followed when developing the IWMP:

1. Status quo analysis
  - 1.1 Quantify and qualify all aspects of existing waste management services and practices.
  - 1.2 Review and analyse waste generation patterns.
  - 1.3 Review and analyse composition of waste.
  - 1.4 Review and analyse projected future waste generation trends.
  - 1.5 Assess current services for collection, minimisation, re-use, recover, treatment and disposal and technical and operational aspects there-of.
  - 1.6 Review institutional arrangements, quality of service, legislative and regulatory issues.
2. Determine desired state
  - 2.1 Determine and confirm management objectives and needs through stakeholder engagement.
3. Conduct gap analysis
4. Evaluate alternatives
5. Select preferred alternatives
  - 5.1 Determine the best practical environmental option
  - 5.2 Address all components of the waste management hierarchy
6. Develop implementation plan
  - 6.1 Set specific, measurable, accurate, realistic and time bound (SMART) targets for implementation of waste minimisation alternatives
7. Draft IWMP
  - 7.1 Discuss draft IWMP with stakeholders
  - 7.2 Finalise IWMP based on stakeholders input
8. Implement IWMP
  - 8.1 Train all stakeholder
9. Monitor and review IWMP continuously

*Source: Bosman Carin (2011) Sustainable Solutions; Waste Legislation and Classification Course. Course prepared for KCF Solutions 10-11 May 2011*

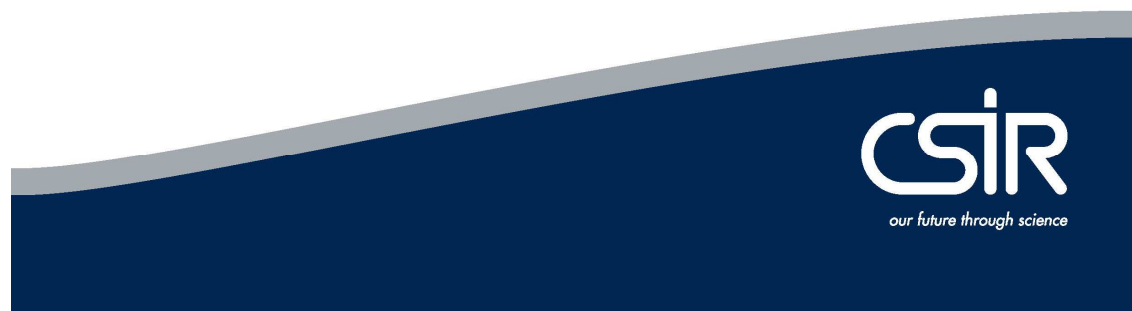
**APPENDIX 10: WASTE MANAGEMENT PROJECT PROPOSAL**

**SECURITY, SAFETY,  
HEALTH, ENVIRONMENT  
AND RISK MANAGEMENT  
(SSHERM)**

**Proposal for CSIR waste management  
project**

**July 2011**

Motivated by  
**Mpendulo Ginindza and  
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## Table of Contents

1.0 INTRODUCTION.....	158
1.1 OBJECTIVES.....	159
1.2 WASTE INFORMATION.....	159
2.0 PROPOSAL.....	161
3.0 CONCLUSION.....	161

## 1.0 INTRODUCTION

Environmentally safe disposal and protection of waste to protect the health of the public are minimum and legal requirements. Current practice and available records on waste disposal suggest that the CSIR is compliant with at least these two (2) minimum requirements. The National Environmental Management Act: Waste Act, 2008 (Act 59 of 2008) requires that further work be done to evolve from mere safe waste disposal to waste management. It has therefore become necessary to develop, implement and monitor plans aimed at various ways in which waste can be re-used, reduced, re-covered and re-cycled to minimise the amount that is disposed of at landfill sites. This also has the benefit of prolonging the life of landfill sites and minimising the adverse impact of waste on the environment and public health. The CSIR has identified several ways in which it will achieve this. This project proposal addresses only Measurement, RECYCLING, RECOVER and TREATMENT.

In order to effectively ensure minimisation of waste to landfill throughout the CSIR in all its activities, and thereby to better comply with the requirements of the new National Environmental Management Act: Waste Act, 2008 (Act 59 of 2008), it is necessary to determine the organisation's current position in relation to the requirements of the new Act, determine all existing waste management processes and to set goals and objectives to continuously improve. The accuracy with which the organisation is able to capture its current position will determine the degree to which it will be able to develop a suitable system of organisational waste management which will enable effective monitoring of progress towards achieving those objectives.

An Integrated Waste Management Plan was developed for the management of waste on the CSIR Pretoria site in 2003. This Integrated Waste Management Plan was developed after conducting a waste management status quo assessment at the site. The difference that this plan made is still evident to this day. Although nine years have passed since the report was published, the organisation still faces some of the waste management challenges identified in 2002.

The issues and gaps that were identified in the 2002 waste management assessment and which remain unresolved are the following:

- Build-up of spent, chemical hazardous samples in laboratories and workshops;
- Poor source separation of recyclables;
- Staff unsure of safe disposal methods of various wastes;

- Need for reliable waste information from the Pretoria site;
- Need for alternatives to waste disposal;
- Not all staff are aware of CSIR procedures;
- Staff are lazy to implement waste minimisation, re-use and recycle initiatives; and
- There is no cost structure in place to promote disposal of wastes generated on site.

This project aims to address these issues and gaps by achieving the objectives that are set below.

## **1.1 OBEJECTIVES**

The objectives of this project are to:

- measure all waste generated at the CSIR;
- develop systems to optimise the recycling and recovery of all waste generated within the CSIR;
- provide information required for developing the CSIR Integrated Waste Management Plan;
- ensure environmentally safe disposal of all waste generated within the CSIR; and
- minimise costs associated with waste disposal at the CSIR.

## **1.2 WASTE INFORMATION**

In order to ensure that the objectives of this project are achieved, it is necessary to obtain quantitative, and where applicable, qualitative information relating to the CSIR's current state of waste management. It will be necessary to:

- establish the degree to which waste generation and disposal is being reduced;
- establish the rate at which waste is being recycled;
- establish the degree of environmentally safe disposal and
- determine the current cost of waste disposal.

Information on the current state of waste management will allow the setting of realistic goals and targets with regard to the objectives. This will also aid in the establishment of appropriate and customised waste management systems and procedures for all CSIR sites and/or organisational units.

The information currently available on to waste management does not provide a representative indication of the current state of waste management within the CSIR in relation to the stated objectives. Where information is available, it is not centralised or even



consistent throughout the organisation. Therefore, the establishment of waste management systems and procedures based on current information would be flawed and there may be a high degree of resistance and non-conformance from organisational units. It is therefore imperative that any system established is based on representative information and takes into account the perspectives of all stakeholders, in particular the sites and units of the organisation.

It is therefore the objective of this project to collect and collate all relevant information that is representative of the CSIR's current position and to use this information in establishing the appropriate system(s) for meeting the desired objectives. Based on this information realistic targets in relation to the said objectives can be set.

Available information includes:

- statistics for recycling of some of the waste;
- safe disposal certificates for disposal of hazardous chemical waste;
- safe disposal certificates for disposal of hazardous biological waste; and
- list of service providers for all waste disposal;

Information required:

- information on all waste types generated at all CSIR units and sites;
- information on all waste disposed of by all CSIR units and sites;
- information on all waste re-used by CSIR units and sites;
- information on all waste recycled by CSIR units and sites;
- information on the current methods adopted for dealing with waste in all units and sites (re-use and reduce, segregation at source etc.);
- list of all service providers used by the CSIR in waste recycling;
- degree of legal compliance of all service provider used by the CSIR in waste disposal;
- degree of legal compliance of all service providers used by the CSIR in waste recycling;
- statistics of all recyclable waste generated in all CSIR units and sites;
- safe disposal certificates for disposal of all hazardous chemical waste in some areas; and
- safe disposal certificates for disposal of all hazardous biological waste in some areas.

## 2.0 PROPOSAL

With the current practice, it would not be possible to obtain the required quantitative and qualitative information to allow any progress towards achieving the set objectives, and current resources available in the environmental management section SSHERM do not allow for the required information to be obtained efficiently. Additional resources will be required in order for there to be progress in realising the waste management objectives.

An intern will work with Environmental Manager at the Pretoria campus. The intern's work will include site visits and audits of all CSIR sites and waste services service providers including waste recyclers. A maximum of ten waste services service providers and recyclers (including Nampak<sup>36</sup>) will be selected. The waste services service providers include those service providers that handle general, hazardous, infectious and all other waste categories of waste generated at the CSIR. The selection will be made from the most preferred suppliers taken from the Purchasing Consortium Southern Africa (PURCO) process<sup>37</sup>. Based on the findings of these audits decisions will be made and a system developed using currently available resources.

The total number of interns needed to complete this work within a year is four: Two on the Pretoria and Johannesburg sites; one on the Durban and Pietermaritzburg sites; one for Cape Town, Stellenbosch and the Port Elizabeth site. This number will be reviewed three months after the intern that has been approved has started work.

## 3. CONCLUSION

The need for the CSIR to manage its waste effectively, efficiently and in line with legal requirements is imperative. There are however insufficient resources to enable such waste management to happen. The resources needed to ensure this are also yet to be determined, pending the type of waste management system ultimately found to be most suitable for the CSIR as a whole. This project aims to determine these needs, measure waste generated at the CSIR and suggest the best options for the CSIR to RECYCLE, RECOVER and TREAT waste generated at all sites.

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<sup>36</sup> PURCO has a contract with Nampak, the agreement is that Nampak recycles for PURCO members and a refund is given back to the member per ton recycled.

<sup>37</sup> PURCO is currently running a waste management tender process for its members. The waste services service providers sourced by PURCO will be able to assist the PURCO members to meet the requirements of the new waste Act.

**APPENDIX 11: ENVIRONMENTAL MANAGEMENT COMMITTEE TERMS OF REFERENCE**

<b>Document Title: Environmental Management Committee Terms of Reference</b>	
Document No	TBA
Revision Status	0
Author	M Ginindza (CSIR Environmental Manager)
Date	11/03/01
Approval by	
Name	R Zondo (CSIR Services Executive Director)
Signature	
Date	

## 1.0 INTRODUCTION

There is increasing pressure on organisations to address environmental impacts in a clear and transparent manner. Environmental management is no longer ‘nice to have’ but it is required in all responsible organisations. According to Agenda 21, “*business and industry should recognise environmental management as among the highest corporate priorities and as a key determinant to sustainable development*<sup>38</sup>.” In addition to this, regulations<sup>39</sup> targeting waste, energy and climate change are getting tougher and are constantly changing. Non compliance with regulation increases the organisation’s risks to prosecution and damages the organisation’s reputation. The cost of materials, water and energy is also increasing. These resources should not be wasted, but should instead be used efficiently. Efficient use requires monitoring and ensuring that where it is possible, improvements are made. The Environmental Management Committee (EMC) will play an important role in monitoring the organisation’s environmental performance in order to ensure that organisation achieves its environmental goals.

## 2.0 PURPOSE OF THE EMC

The role of the EMC is to monitor the organisation’s environmental performance in order to ensure that environmental improvements are made and environmental objectives are achieved. This will include the following activities:

- monitoring the promotion of a culture of environmental sustainability at the CSIR,
- providing recommendations that will facilitate the uptake of environmental sustainability initiatives across capital project at the CSIR,
- ensuring that environmental issues are addressed at other forums and
- ensuring that environmental reports on the programme performance are presented to the CSIR Executive and the Board.

Environmental improvement requires acceptance from Top management and identifying and implementing improvement opportunities throughout the organisation’s supply chain. Figure 1 shows the EMC governance structure. Environmental performance reports will be taken from the EMC to CSIR Executive and Board as shown in figure 1. Relevant environmental issues will be addressed at the Audit, Risk Management, Procurement and ICT forums. This

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<sup>38</sup> UNCED (1992)

<sup>39</sup> An example of this is the New National Environmental Management; Waste Act 59 of 2008 requires that a holder of waste must avoid the generation of waste and where such generation cannot be avoided, to minimize the toxicity and amounts of waste generated.

will be carried out in order to ensure that environmental initiatives of concern are implemented in these areas. The technical energy forum and waste minimisation forum are technical forums which provide technical advice to the Environmental Manager.

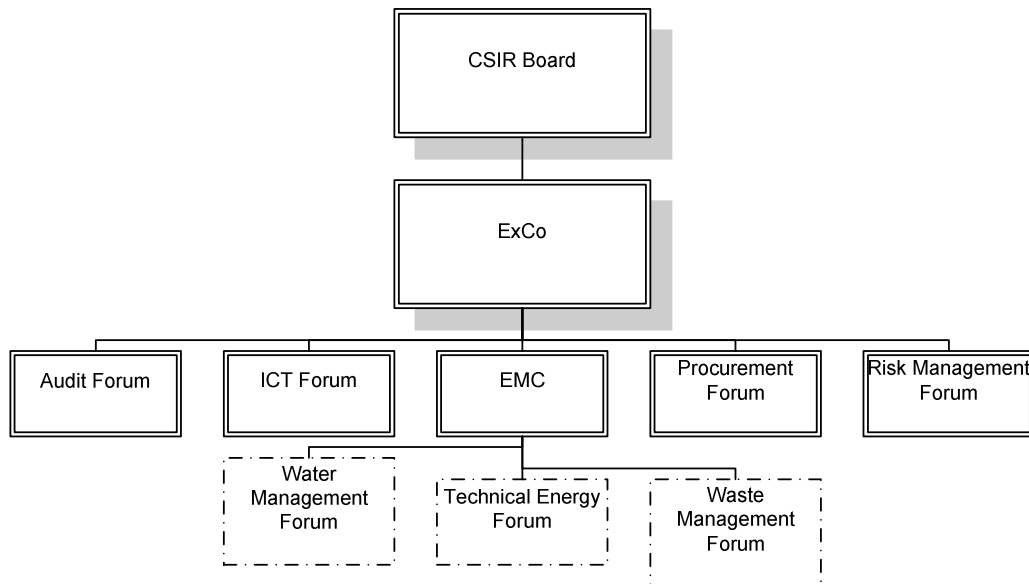


Figure 1: EMC governance structure

Stakeholder Bodies: Audit Forum, Risk Management Forum, Procurement Forum, ICT Forum

Specialist Teams: Technical Energy Forum, Waste Minimisation Forum

### 3.0 EMC Membership

1. Executive Director: Services (Chairperson)
2. Group Manager: Infrastructure, Properties and Services (Deputy Chair)
3. Procurement Manager
4. SSHERM Manager
5. Facilities Management Manager
6. 2 x Representative from (R&D or Operating Units)
7. Secretariat (SSHERM)
8. Environmental Manager
9. ICT Infrastructure Manager
10. Specialist(s) Appointed by the EMC as and when required

#### **4.0 AUTHORITY**

4.1 The EMC is a Governance body that will monitor environmental performance and implementation of environmental initiatives at the CSIR.

4.2 The EMC, in fulfilment of its duties, may call upon competent persons to provide it with information, subject to following a board approved process.

4.3 The Committee will have reasonable access to the company's records, facilities and other resources necessary to discharge its duties and responsibilities.

4.4 The Committee may form, and delegate authority to, sub-committees and may delegate authority to one or more designated members of the Committee.

4.5 The Committee has the right to obtain independent outside professional advice to assist with the execution of its duties, at the company's cost, subject to following the approval framework.

4.6 The Committee instructs the Environmental Manager that it deems appropriate on any area within the ambit of its terms of reference where action or improvement is required.

4.7 The Committee will ensure that environmental issues are adequately covered in the CSIR's business plans and budgeting processes.

4.8 The EMC chairman will report to the CSIR Executive on the Committee's activities when required or deemed appropriate.

#### **5.0 FREQUENCY OF MEETINGS**

The EMC will meet quarterly, although the chair of the committee may arrange additional meetings as considered necessary.

#### **6.0 CORE AGENDA ITEMS**

- A. Report by Environmental Manager on environmental performance.
- B. Changes that could impact on the policy and targets
- C. Future plans

- D. Recommendations to be considered
- E. Other

## **7.0 QUORUM**

The Environmental Management Committee meetings shall be deemed a quorum when attended by at least 50% plus 1 member. A meeting cannot go ahead if it is not a quorum. The Chairman should be available for all meetings but can appoint an alternate. If this occurs the Environmental Management Committee secretariat should arrange a suitable revised date and time to ensure the necessary attendees can attend.

## **APPENDIX 12: INTERNAL ISO14001:2004 AUDITS CONDUCTED IN 2010 – 11**

November 2010 - Rosebank Cape Town

November 2010 – Stellenbosch

November 2010 –Plankenburg Cape Town

January 2011 – Cotteloe Johannesburg

January 2011 – Kloppebos Johannesburg

January 2011 – Carlow Road Johannesburg

February 2011 – Port Elizabeth

February 2011 – Pretoria (Two units)

June 2011 – Pretoria (Three units)