

Closing the loops – Integrated application of environmental management tools throughout the project cycle: lessons learned from a regional shopping mall development project, Potchefstroom, South Africa

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Abstract

Three fundamental arguments are made in this paper. The first is that no single environmental management tool is suitable, adequate and effective to drive environmental management performance throughout the project cycle of large infrastructural developments. It is, therefore, argued that various environmental management tools, all with different performance and weakness characteristics, need to be innovatively selected, adopted and integrated with infrastructural developments to assure sustained environmental performance.

The second argument is that the loop must be closed for all the phases of the project cycle to ensure consistent environmental performance throughout the life cycle of infrastructural developments. Innovative and integrated strategies need to be adopted to ensure continuity of environmental performance as roles and responsibilities are transferred from one role player to the other. One of the major risks to sustained environmental management performance is failure to manage the interfaces between the various project phases and their key role players.

The third argument is that selected tools must also close the plan-do-check-act (PDCA) loop of the Deming cycle to ensure effective environmental management as management entails planning, implementation, checking and improvement steps.

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The argumentative statements made in this paper are supported by both examples from and lessons distilled from a regional retail centre development in Potchefstroom, South Africa.

Keywords: Integrated Environmental Management, Project Life Cycle, Environmental management tools, Environmental Impact Assessment, Environmental Management Plan, Urban Design Framework, monitoring and auditing, communication and reporting, training and awareness, roles and responsibilities.

1. Introduction

A large scale infrastructural mall development is currently planned in the city of Potchefstroom and due to significant environmental, social and financial challenges faced, the development serves as a unique case study for the project life cycle and the role of environmental management tools within the cycle. This paper explains the need for multiple environmental management tools, gives an overview of the city of Potchefstroom and the proposed mall development, explains the concept of integrated environmental management, the project life cycle and the role of environmental management tools within the project life cycle. It also unpacks the tools selected for the proper environmental management of the mall development throughout the life cycle of the mall and explains the roles and responsibilities of the key role-players in the framework of environmental management before reaching a conclusion.

2. The need for multiple environmental management tools

Contradictory to practices in place a single tool, for example an Environmental Impact Assessment (EIA), will not and cannot be the answer to all environmental challenges faced by

large scale infrastructural developments. In the toolbox of environmental management various tools are found, each tool distinctively designed to achieve a specific desired outcome. These tools aim collectively to achieve triple bottom line success through following management principles, approaches and strategies. Ultimately this means that environmental media and resources including, air, land, biota, water and waste as well as social aspects such as aesthetic and cultural issues, should be managed throughout the entire decision making loop of planning, doing, checking and acting. The general principle of IEM supports a creative utilisation of multiple policy and environmental management tools which will ideally result in sustainable environmental management. Table I illustrates the abovementioned.

Table I: Environmental Management Tools

ANALYTICAL TOOLS AND PLANNING	CRITERIA AND STANDARDS	MANAGEMENT TOOLS	CHECK AND ACT	REPORT AND COMMUNICATION
Environmental, Social and Cultural Impact Assessment	SANS Code for Slimes Dams	Environmental Management Systems	Environmental and Social Monitoring and Measurement	Environmental and Social Reporting Triple Bottom Line GRI
Strategic Assessment	ISO 14001 family of management standards	Cleaner Technology	Inspection, Analysis and Records	Environmental and Social Communication
Risk Assessment	SA 8000 Social Accountability	IPPC & WM	Environmental and Social Auditing	Statutory Reporting
Environmental Programme Report	AA Accountability	Environmental Management Plan	Improvement Management	Public participation
Disaster Planning	Environmental Programme Report	Disaster Management Plan	EMP performance monitoring	
Life Cycle Assessment	Triple Bottom Line GRI		Monitoring and evaluation	

All developments should ideally select an ensemble of tools from the abovementioned toolbox in order to address environmental management challenges throughout the planning, management checking and acting phases of the Deming cycle.

3. Potchefstroom city characteristics and the proposed shopping mall development

Potchefstroom is a small city with approximately 204000 people living in the broader municipal area, including the surrounding township areas. The city consists of 51900 households and is estimated to grow to 60000 households by the year 2010. Currently the city has two shopping centres, the Riverwalk Shopping Centre and the West Acres Shopping Centre, which are providing numerous retail facilities and services to the community. Furthermore, the central business district (CBD) and a number of smaller shopping hubs are providing the community with further purchasing opportunities. However, the current retail facilities do not offer a feasible one-stop shopping destination for the Potchefstroom shopper, which is currently resulting in an outflow of disposable income to surrounding cities such as Klerksdorp, Rustenburg and Johannesburg. It is argued that with better retail facilities, such as the proposed Mooirivier Mall development, more of the disposable income would be retained in Potchefstroom itself (Urban Studies, 2005). This will ultimately lead to a better economic climate for the broader community of Potchefstroom.

In the light of the abovementioned, the proponent, Mooi River Mall (Pty) Ltd proposes to develop a single, enclosed, regional retail mall, offices, motor retail facility and hotel of approximately 43 000 m². The mall will mainly be a single storey structure with a portion of first floor offices and a basement as well as underground parking. The proposed activity will be located on the properties Re Ptn 2 Town and Town Lands Potchefstroom 435 IQ and Re Ptn 915 Farm Vyfhoek 428 IQ

North West Province, bounded by Mooi River Boulevard in the west, Lombard Street in the north and the N12 (Potgieter Street) to the east and the south (see Figure 1).

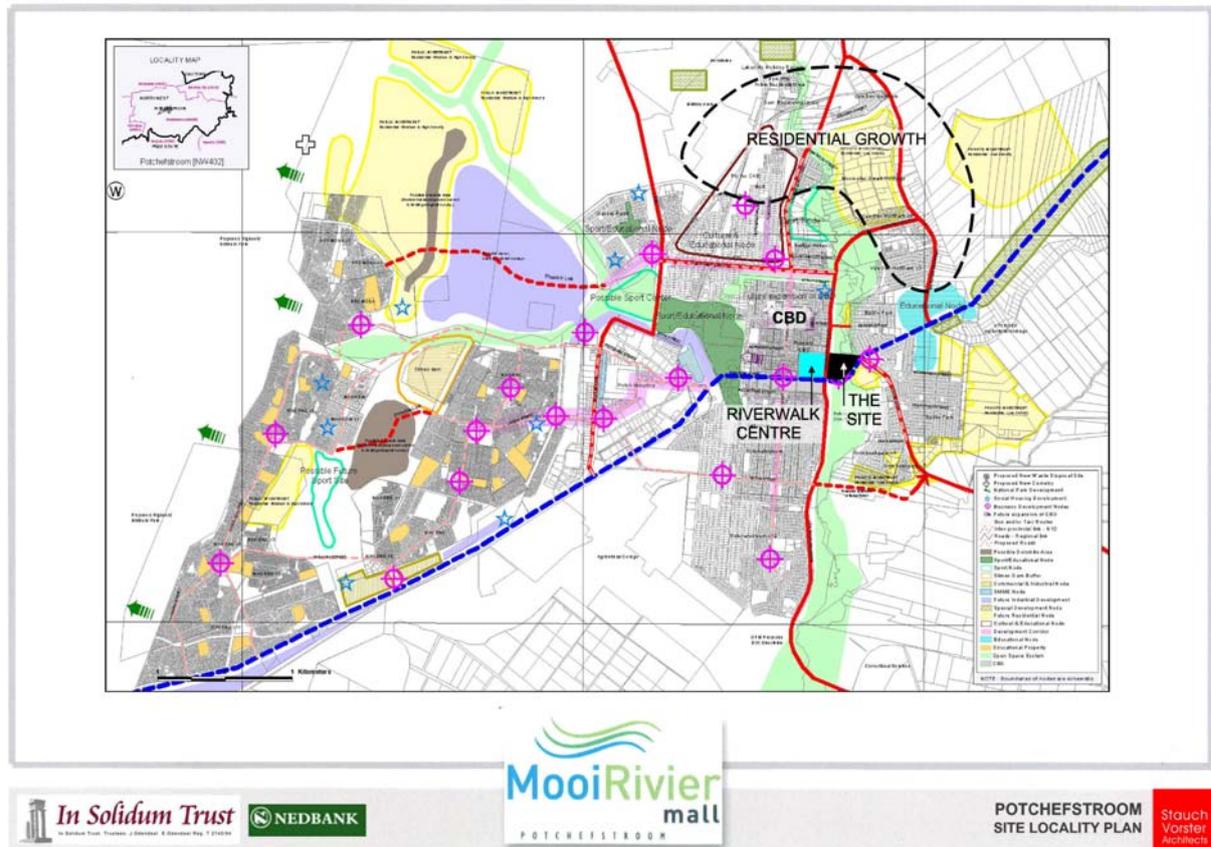


Figure 1. Site location map

The development will stretch across the Mooi River floodplain area between Lombard and Potgieter Streets on two property sites. As neither of the property sites are large enough to accommodate the development, a 60 m wide section of the proposed mall will span the Mooi River at the northern section of the site, just south of Lombard Street and allow shoppers to cross the river inside the proposed development. The structure will be constructed of face brick, plastered and painted walls, aluminium and glass. Eighty percent of the shopping centre will be enclosed and air-conditioned and twenty percent will be exposed, facing the parking area and the river (Centre for Environmental Management, 2005).

4. Site characteristics and potential environmental impacts of the proposed mall

4.1 The Mooi River and its tributaries

The Mooi River and its associated ecology and geology have played and are still playing a central role in the history and development of Potchefstroom. As such the Mooi River and its tributaries are central features in the image of the town and the quality of its residents. However, the river system is under increasing pressure within a context of rapid population growth, urban sprawl, poverty and dwindling financial resources and is currently becoming a liability to the city instead of an asset (Holm Jordaan Group, 2006).

4.2 Social and financial challenges of the proposed site

Currently the site identified for the construction of the mall is underutilised and is creating substantial social challenges for the city. These challenges include increased crime due to non-permanent squatting, littering, illegal dumping of building material, uncontrolled fires and prostitution due to the site being used as an illegal stop-over facility for long distance transport truckers passing through the city. Ultimately the site has been chosen over and above two other macro-alternatives as the only feasible site due to several positive financial and social attributes of the site. These attributes include the close proximity to the CBD, the availability of existing service infrastructure, the proximity and visibility to the N12 (busy provincial road passing through the city centre) and its proximity to available public transportation nodes. It is, therefore, evident that this site is located next to the most important section of the town and is under tremendous development pressure because of its visibility and physical accessibility. The Potchefstroom Municipality and the developer, therefore, recognise the financial and social

opportunities of the proposed mall development to the community of Potchefstroom and are entirely committed to the proposed development of the site.

4.3 Environmental challenges of the proposed site

Although the site is characterised by numerous financial and social positives it also poses significant environmental constraints and challenges to the proposed development due to the sensitive environmental location of the site. Firstly, the site is located within the Mooi River open space system. This open space system is referred to as the “Green Belt of Potchefstroom” and forms part of the open space network of the city, with the river as its central element. The importance of the open space network to the city cannot be overemphasized and should be managed in an integrated manner based on sound ecological principles. Preferably, its protection and rehabilitation should be the first concern when land use decisions are considered (Holm Jordaan Group, 2006).

As mentioned previously, the river system is currently under severe stress and should, therefore, be actively protected by reducing developments within the open space network. However, due to financial constraints this is not always possible and alternative ways, such as the Mooirivier Mall development and its positive financial, social and environmental spin-offs, should be found to protect, rehabilitate and maintain the river system. Secondly, the site is situated within the 1:50 and 1:100 flood lines. This poses significant planning, design, construction and operational challenges to the developer as well as an increase in the potential flooding risk to the surrounding existing developments. Apart from the potential hydrology and flooding impacts of the development, malls are also associated with other known impacts caused by activities, products and services during the design, construction and operational phases of the mall development. In general, all phases of the project life cycle of shopping malls generate large quantities of waste,

consume large volumes of water and consume significant amounts of electricity and other resources, which inevitably leads to the environmental and social impacts. These impacts were identified in the legally required Environmental Impact Assessment (EIA) conducted by the independent consultants and include:

- surface and groundwater pollution impacts;
- soil pollution and erosion impacts;
- air pollution impacts;
- impact on land use;
- impacts causing habitat transformation;
- visual and aesthetic impacts;
- social impacts, and
- traffic impacts.

It is thus evident from the argument made in this section of the paper that proper and innovative environmental management is needed throughout the project life cycle of large infrastructural developments, especially developments in highly sensitive areas such as the Moirivier Mall development to ensure the sustainable protection of the environment.

The following section of the paper discusses the philosophy of integrated environmental management and the project life-cycle and its different facets broadly.

5. Integrated Environmental Management and the project life cycle

5.1 Integrated Environmental Management (IEM)

The concept of IEM has been promoted in South Africa since the late 1980s. However, the implementation of IEM was largely based on one tool, i.e. environmental impact assessment, that focused on new project proposals. Therefore, little emphasis was placed on environmental management and ongoing monitoring during implementation of developments. Only recently in South Africa IEM, evolved to be an underlying philosophy and set of principles, supported by a range of environmental assessment and management tools that are aimed at promoting sustainability. Rather, it provides a ‘way of thinking’ that can either be used to underpin a stand-alone process (e.g. EIA) or be integrated into existing complementary processes (e.g. integrated development planning) that can be infused into decision-making by all sectors of society (e.g. government/public sector, private sector and civil society). Based on the abovementioned evolution of IEM, the following definition was compiled to reflect current views (DEAT 2004, Overview of Integrated Environmental Management, Information Series 0):

IEM provides a holistic framework that can be embraced by all sectors of society for the assessment and management of environmental impacts and aspects associated with an activity for each stage of the activity life cycle, taking into consideration a broad definition of environment and with the overall aim of promoting sustainable development.

It may be concluded from the abovementioned definition and discussion that an ensemble of environmental tools should be selected by a developer to ensure integrated environmental management throughout the entire life cycle of a specific development. Before discussing the

project life cycle it must be explained what is meant by “integration”. According to DEAT (2004), integration may be the following (DEAT 2004, Overview of Integrated Management, Information Series 0):

- Integration of environmental considerations across the full life cycle of the activity: for example, for a project, this implies consideration of environmental issues through the pre-feasibility, feasibility, planning and design, construction, operational and decommissioning phases, i.e. a cradle to grave approach, and then the future re-use of the area or resource, i.e. cradle to cradle.
- Integration of knowledge across specialist disciplines: for example, in specialist studies, tracing and analysing the links between air emissions and potential impacts on human health and subsequent economic costs.
- Integration of stakeholders: for example, in an EIA, providing effective and constructive interaction between authorities, business and labour, civil society and the proponent.
- Integration of appropriate tools into the decision making process (for example, in an EIA, integration of human health risk assessment in air quality dispersion modeling) as well as across the full activity life cycle (for example, linking EIA to EMS and environmental reporting).

In the light of the abovementioned, the project life cycle and the integration of tools specifically chosen for the Mooirivier Mall development are explored in more detail.

5.2 The project life cycle and integrated environmental management

Any development, including large infrastructure developments such as mall developments follows the route of a project life cycle. The project life cycle has clearly identifiable start and end points,

which can be associated with a time scale. A project passes through several distinct phases as it matures, as illustrated in Figure 2.

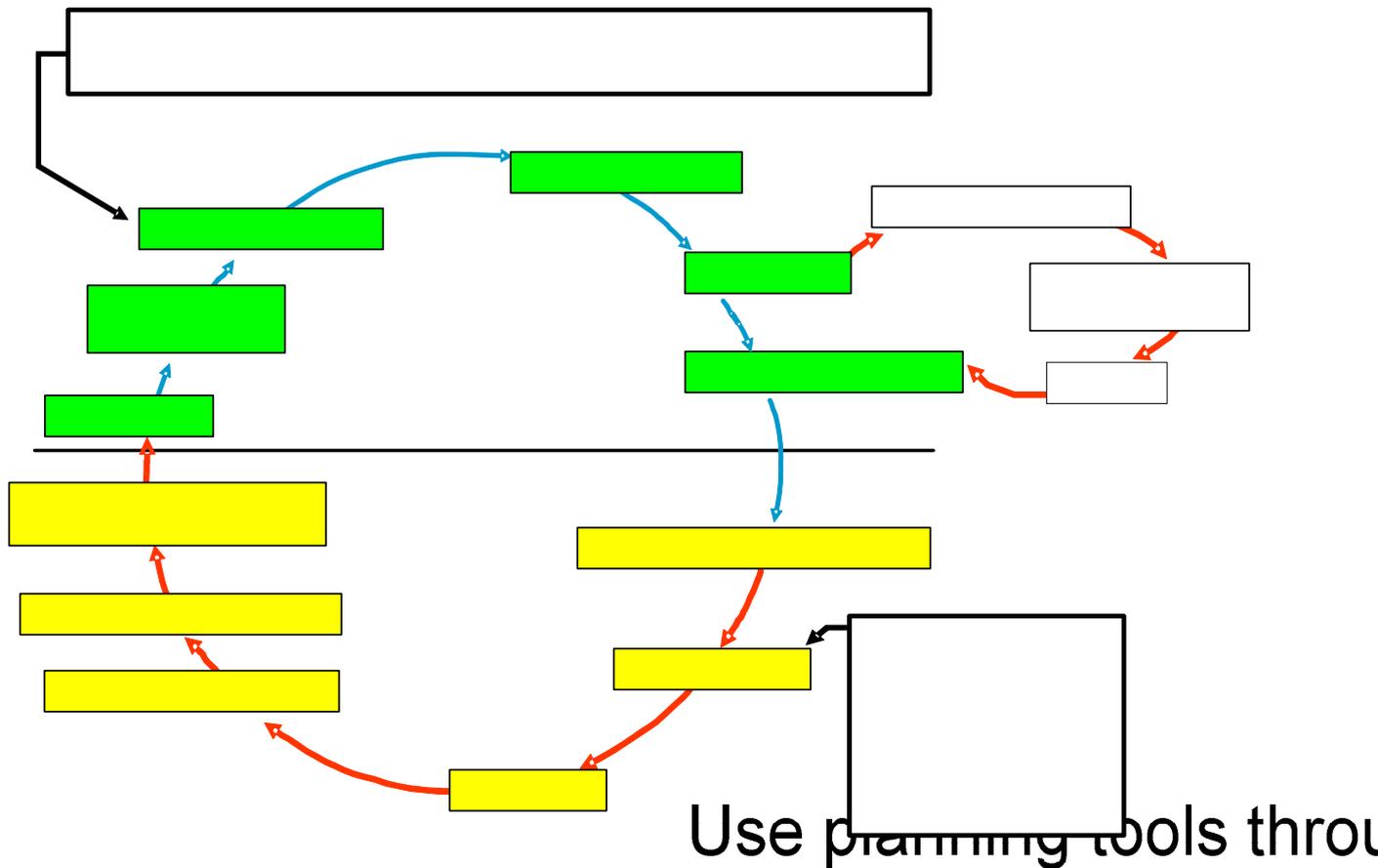


Figure 2. The project life cycle and integrated environmental management

The figure above is an example of a typical project life cycle. Although there are numerous models of the project life cycle, the abovementioned model serves as an example to explain the role of integrated environmental management tools used in the project life cycle of the Mooirivier Mall development. Two distinct phases are recognised in the the project life cycle of Figure 2 namely the planning and design phase and the implementation phase. Each of these phases encompasses different sub-phases. The planning and design phase includes identification, preparation and reconnaissance, followed by the decision to proceed based on the information gathered in the previous phase, as well as the conceptual design, detail design, outsourcing of activities to contractors and the appraisal and changes phases in which any changes are considered

Decision to Proceed
EIA co
Preparation / reconnaissance

before moving the implementation phase of the project. Construction is the first sub-phase of the implementation phase of the project life cycle, followed by commissioning and operation. During operation certain expansions and modifications may be made to the development, which should also be subject to integrated environmental management. The final stages of the project life cycle is closure or decommissioning and project termination which encompasses dismantling and rehabilitation.

The interfaces between the phases discussed in the paragraph above, however, are rarely separated, except in cases where proposal acceptance of formal authorisation to proceed separates the two phases (Wideman, 2004). One of the major risks to sustained environmental management performance is failure to manage these interfaces and their key role players. It is, therefore, critical that the developer or management of an organisation be committed to sustained integrated environmental management throughout the entire project life cycle and that the selected environmental management tools be implemented in the different phases of the project to aid the environmental objective.

As indicated in Figure 2 different environmental management tools may be used in the different phases of the project life cycle. These tools are planning tools such as; Urban Design Framework, Environmental Impact Assessment (EIA) and design specifications; management tools such as the Environmental Management Plan (EMP); checking and acting tools, which include auditing, reporting; and communication tools such as auditing and public participation (also refer to Table I and Table II). The said tools were selected for the Mooirivier Mall development and are discussed in more detail in the following section of the paper.

6. Selected tools for the Mooirivier Mall development

Various environmental management tools, all with different performance and weakness characteristics, need to be innovatively selected, adopted and integrated with infrastructural developments to assure sustained environmental performance. The selected tools must also close the plan-do-check-act (PDCA) loop of the Deming cycle to ensure effective environmental management as management entails planning, implementation, checking and improvement steps. Table II illustrates the tools selected for the mall development in the context of the Deming cycle.

Table II. Environmental tools and the Deming cycle

ANALYTICAL TOOLS AND PLANNING	CRITERIA AND STANDARDS	MANAGEMENT TOOLS	CHECK AND ACT	REPORT AND COMMUNICATION
Urban Design Framework	SAEDES energy efficiency standards	Environmental Management Plans	Environmental Monitoring	Public participation
Environmental Impact Assessment	SANS 0306:1999 water efficiency code of practice	Design specifications and parameters	Environmental Auditing	Consultation and Reporting

Environmental Impact Assessment (EIA), Environmental Plans, consultation, Public Participation and monitoring are required by South African law as part of the EIA process, whereas the Urban Design Framework, design specifications and parameters including the South African Energy and Demand Efficiency Guidelines (SAEDES) and auditing were selected to support the required tools in closing the plan-do-check-act (PDCA) loop of the Deming cycle. These tools and their specific roles in the project life cycle of the mall development are discussed in more detail in the following sections of the paper.

6.1. Urban design framework

As mentioned in section 4 of the paper, the Mooi River system is under increasing pressure due to several financial, social and environmental factors. Furthermore, any site specific development, such as the Mooirivier Mall will result in an increase in pressure in the river system. It was, therefore, decided by the city council and the independent consultants to use the mall development as an opportunity to assess strategically to what extent the Mooi River system is currently degraded and what the impacts of further developments such as the mall will be in the future. As a condition to the development, the developer, Mooi River Mall (Pty) was tasked to fund the Urban Design Framework (UDF) for the Mooi River system in Potchefstroom.

The framework focuses on the length of the Mooi River and its tributaries. It thus includes the green belt including the following:

- The Mooi River itself from where it enters Potchefstroom in the north through the Potchefstroom Dam to OPM Prezetsky Bird Sanctuary in the South; and
- The Wasgoed Spruit from the Poortjies Dam in the east to where it enters the Mooi River in the west.

Furthermore, the study encompasses the river and its floodplains as well as open and undeveloped land along its edge.

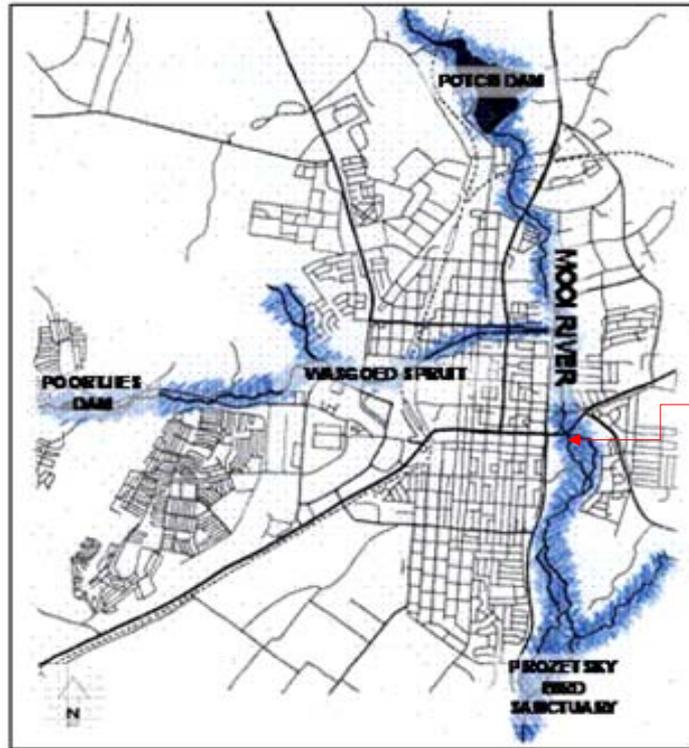


Figure 3. Mooi River study area for the UDF

The aim of the UDF is to protect the river and its floodplain and to provide guidelines for development on the edges of the river and to ensure that development enhances the river and its ecological and social functions. It will also ensure integrated decision-making, taking into account environmental aspects, socio-economic aspects, land use patterns development pressure, amenity value and character. Furthermore, the UDF will guide development to ensure that proposed development adjacent to the river contributes rather than detracts from the amenity and ecological value of the river. The UDF will also provide measures for the protection of natural processes to ensure the ecological integrity of the system (Holm Jordaan Group, 2006).

At the time of writing the paper, the UDF was still in development but will ultimately serve as a very important strategic decision making process for the city council with regards to any new developments within the Mooi River system and the open space network of Potchefstroom. It

will, therefore, complement the project level assessment of the Mooirivier Mall development and intent to seek long term, statutory entrenchment of the guidelines generated as outcomes of this assessment in order to ensure that the linear integrity of the Mooi River is maintained upstream and downstream of the proposed development.

6.2. *Environmental Impact Assessment (EIA)*

As mentioned previously, Integrated Environmental Management (IEM) is a continuous process that ensures that environmental impacts are avoided or mitigated throughout the project life cycle from design to implementation, operation and decommissioning (DEAT,2004a). After the feasibility and design stage of a project, the project proposal is usually subjected to an EIA as a legal requirement if the proposed development is deemed to be a listed activity.

At the time of initiating the project the proposed Mooirivier Mall development was identified in terms of section 21 of the Environment Conservation Act 73 of 1989 (ECA) as an activity that may have significant detrimental effects on the environment and, therefore, requires an authorisation from the North-West Department of Agriculture Conservation, Environment and Tourism (NWDACET), in terms of section 21 of the ECA. The specific activity was listed in GN R1182, published in terms of section 21 of the ECA as activity 2(c): “The change of land use from agricultural or zoned undetermined use to any other land use”. The developer, Mooi River Mall (Pty) Ltd, has in line with the EIA regulations, appointed a team of independent consultants to conduct the EIA. The Centre for Environmental Management (CEM), together with independent environmental management and impact evaluation practitioners, have been appointed to conduct the environmental impact assessment (EIA) and facilitate the EIA process for the Mooirivier Mall, Potchefstroom. The NWEACET has since issued a Record of Decision (ROD) in favour of the mall development.

An EIA refers to the process of identifying, predicting and assessing the potential positive and negative social, economic and biophysical impacts of any proposed project, plan, programme or policy which requires an authorisation or permission by law and which may significantly affect the environment. The EIA includes:

- an evaluation of reasonable alternatives;
- recommendations for appropriate mitigation measures for minimising or avoiding negative impacts;
- measures for enhancing the positive aspects of the proposal, and
- environmental management and monitoring arrangements.

The objective of the EIA is to provide decision-makers with relevant and objective environmental information to determine whether or not a proposal should be accepted or rejected. The findings of an EIA are conventionally presented to stakeholders (including decision-makers) in the form of a written report, known in South Africa as an Environmental Impact Report (EIR). The EIR is at the heart of the EIA process. For this reason, and given its importance as a communications tool, its preparation is perhaps the most important component of the EIA process. An EIR forms the basis for review by I&APs and for decision-making. It does not define whether a project is “good” or “bad”, but provides a neutral, independent assessment of the proposed project’s impacts on the environment. The purpose of the EIR is to provide the decision-makers with an understanding of the environmental consequences of approving a project by giving them useful, reliable and sufficient information. The EIR also provides a discussion of alternatives to the proposal, which would meet the stated need for the activity and ways to reduce the impact of the project by imposing mitigating measures. The information provided in an EIR should assist the decision-maker by focusing on those criteria that have to be considered in reaching a decision with regard to the environment and sustainable development. The EIR also provides the point of

departure for the preparation of a plan or programme to mitigate, manage and monitor environmental impacts during the implementation and operational phases of the proposed project. As such, it should give sufficient reliable information at an appropriate level of detail to enable the preparation of a sound environmental management plan or programme (Centre for Environmental Management, 2005).

As mentioned in section 5.1 of the paper, the onus of implementation of IEM in South Africa was largely based on environmental impact assessment in the past, which is focused on new project proposals and the assessment of potential impacts thereof. This resulted in the neglect of physical environmental management and ongoing monitoring during implementation and operation of developments. In some instances this may still be the case in South Africa, but as indicated in the previous paragraph, the focus of EIA's has moved from pure assessment to EIR's being a point of departure for environmental management plans (EMP's).

Another weakness of EIA's is that it focuses on project level and tends to disregard the assessment of systems such as the Mooi River system. This supports the notion of this paper that various environmental management tools, all with different performance and weakness characteristics, need to be innovatively selected, adopted and integrated with infrastructural developments to assure sustained environmental performance. Furthermore, the importance of potential hierarchical relationships between IEM tools should be noted. An example of this relationship is the Urban Design Framework (UDF) of the Mooi River System of Potchefstroom which complements project level assessment and the EMP which complements the EIA at the project implementation and operation phase. EMP is discussed in more detail in the next section of the paper.

6.3. *Environmental Management Plan (EMP)*

Considering the previous arguments made in the paper it is evident that most environmental assessment practice appears to be directed at the scoping and assessment stages of the Environmental Impact Assessment (EIA) process. As mentioned before, the ever important mitigation, monitoring and management component of EIAs receive less attention. However, attention is now being focused on the need to demonstrate that impacts can be monitored and managed (DEAT 2004, Environmental Management Plans, Information Series 12) through the EMP, which is a requirement of the EIA process.

The Environmental Management Plan (EMP) is recognised as the tool that can provide the assurance that the project proponent has made suitable provisions for mitigation. The EMP is the document that provides a description of the methods and procedures for mitigating and monitoring impacts. The EMP also contains environmental objectives and targets which the project proponent or developer need to achieve in order to reduce or eliminate negative impacts. The EMP document can be used throughout the project life cycle as indicated in Figure 2. It must be regularly updated and reviewed to be aligned with the project progress from construction and operation to decommissioning. EMPs provide a link between the impacts predicted and mitigation measures specified within the EIA report, and the implementation and operational activities of the project. EMPs outline the environmental impacts, the mitigation measures, roles and responsibilities, timescales and cost of mitigation. Three broad categories of EMPs can be recognised in the project lifecycle. They are the construction phase EMP, the operational phase EMP and the decommissioning phase EMP. According to DEAT (2004), the difference between the EMPs mentioned in the paragraph above is related to the difference in mitigation actions required for the different stages of the project cycle. However, the objectives of the mentioned

EMPs are all the same, namely to identify the possible environmental impacts of the proposed activity and to develop measures to minimise, mitigate and manage these impacts.

Currently the EMP has been developed for the design and construction phase of the Mooirivier Mall development and includes principles that must be adhered to throughout the project life cycle. The operational phase EMP is currently being drafted. The principles referred to are (Centre for Environmental Management, 2006):

- **Principle 1:** The linear functionality of the river system shall be maintained.
- **Principle 2:** The development shall not alter the flow regime such that it would result in alleviated floods downstream or upstream of the development.
- **Principle 3:** Development shall follow a phased approach, which will ensure that construction starts from the river outwards.
- **Principle 4:** Training and awareness shall be ongoing requirements for contractors during construction and for tenants and the public during operations.
- **Principle 5:** Continual monitoring and auditing shall be central to the management of the mall.
- **Principle 6:** The EMP differs from the rest of the EIA because it serves as a working document to be reviewed and updated as becomes necessary.

In conclusion, the development and implementation of a successful EMP has benefits beyond merely meeting legal obligations. It contributes to environmental awareness of the workforce. It can facilitate the prevention of environmental degradation and minimise impacts when they are unavoidable. DEAT (2004) also argues that given the current focus on the assessment stage of EIA, EMPs add value to decision-making by demonstrating commitment to implementation of mitigation actions. The EMP facilitates progress towards environmental targets and provides a tool for continual improvement of a company's environmental performance at the project

implementation and operation phase (DEAT 2004, Environmental Management Plans, Information Series 12).

However, the key to the success of an EMP relies on successful implementation and in the commitment by all levels of management and the workforce. An effective compliance monitoring programme is, therefore, crucial for ensuring successful implementation of the EMP. The role of the monitoring and auditing programme is discussed in section 6.6.1 of the paper in the line of the programme developed for the Mooirivier Mall development.

6.4. *Design specifications*

The first phases of the project life cycle, namely project inception and design is a critical component in ensuring the success of sustained environmental performance. Bluntly stated, failure to design for the environment is designing to fail in environmental performance. In other words, failing to consider environmental issues in the design phase of large scale infrastructural development may lead to unavoidable and irreversible environmental damage. This is particularly true in the case of the Mooirivier Mall development. The fact that the potential site is situated within a sensitive environment with severe hydrology and engineering challenges due to the location of the river, made the design of the development key and critically challenging. This was recognised by the independent consultant as the single challenge that will determine the success of the project. In fact, it was made clear by the relevant authorities that the development will not be approved if the design does not meet the requirements of ensuring the integrity of the Mooi River system up and downstream of the development.

A base case mall design was designed by the architect (refer to Figure 4) and presented to the independent consultant for review in the early stages of the mall development. The base case mall

design does not include any design mitigations for the sustainable protection of the environment and the Mooi River system.



Figure 4. Base case mall design (without design mitigations)

Figure 4 clearly indicates the loss of the river system within the proposed site. This design would totally change the physical aspects of the river as it entails the canalisation, boxing and redirection of the Mooi River underneath the shopping mall and around the initial design of the basement parking area for almost the entire site, with an artificial pond at the southern end of the site. In essence this would remove the river from the landscape and have highly significant long-term impacts on the linear functionality of the river and adjacent terrestrial and aquatic ecosystems. Most of the riparian vegetation, including the willow trees would also be lost in this design (Centre for Environmental Management, 2005).

As part of the EIA all the potential impacts of a development should be identified and assessed to determine the significance (low, medium or high) of the potential impacts of the development. The significance of the impacts was determined by considering the nature, extent (spatial scale), duration and intensity (severity) of the impacts. For the base case mall design it was determined that 0 low impacts, 19 medium and 26 high impacts would occur. Clearly the base case mall design would not ensure the integrity of the Mooi River system up and downstream of the development. Design specifications and parameters were, therefore, agreed upon by the developer, architect, engineer and environmental specialists in consultation with the relevant authorities. Some of the more important design parameters include (Centre for Environmental Management, 2005):

Corridors:

- To maintain the linear functionality of the river system by ensuring a 30m 'no-go' corridor along the Mooi River. The only activities allowed within this corridor shall be the construction of the mainspan, road bridge, stormwater related infrastructure and landscaping linking the 30m corridor and the adjacent parking areas.
- Corridors for butterfly and bird movement shall be provided to the west and eastern sides of the river.

Main span and road bridge:

- The main span crossing the river shall not exceed a maximum length of 60m along the river banks and ensure a minimum span width of 30m across the river.
- The design of the span shall incorporate the need to allow natural light to penetrate to ground level. Where natural light is not able to penetrate, artificial lighting shall be installed to compensate.

- The road bridge linking the parking areas to the western and eastern sides of the river shall be located so as not to impact on the existing reed bed adjacent to Potgieter Street bridge, as well as to limit damage to the trees in the vicinity.

Main Structure:

- The design shall ensure a visually acceptable façade through landscaping and soft features.
- The design of the mall shall incorporate energy efficiency standards and comply with South African Energy and Demand Efficiency Guidelines (SAEDES) requirements.
- To ensure water efficiency the mall design shall apply with the SANS 0306:1999 code of practice for the managing of potable water in distribution systems.

Transport:

- The design shall ensure access for public transport, pedestrians, disabled individuals, including bicycle access and private parking as determined by the road agency and the local authority.

Waste:

- The design of the mall shall consider the contents of the mall waste management plan.
- Waste management facilities shall be designed to optimise recycling of waste.
- Access of municipal waste collection and transportation vehicles shall be provided by means of adequate design.

Stormwater:

- Stormwater flowing from the centre car parks and roofs shall be dispersed at various points into the Mooi River so as to avoid it being flushed at high velocity via a single entry point.

Landscaping:

- Trees and invader plants shall be maintained and removed as predetermined.
- Landscaping shall be done through the use of indigenous plant species and aim to restore and recreate riparian habitats as agreed with the ecological specialists.

The base case mall design was revised in line with environmental principles and the abovementioned design parameters to ensure that the identified environmental impacts are proactively addressed and mitigated through appropriate design solutions. The revised design is illustrated in Figure 5.



Figure 5. Modified design to ensure maximum functionality of the Mooi River

As can be seen in Figure 5, the modified design of the mall entails the design in such a way as to (Centre for Environmental Management, 2005):

- minimise the impacts on the river;
- restore the river to its semi-natural form;
- maximise the linear functionality of the Mooi River system by not altering the river bed characteristics, by reducing the bridging the effect of the mall to a minimum and by maintaining the river system as a flowing aquatic system, avoiding any ponds or dams.
- integrate the design of the mall with the river landscape;
- connect people with the Mooi River by means of life style design;
- minimise the loss of willow trees.

In the assessment of the impacts of the modified design it was determined that 3 low, 24 medium and only 17 high impacts would occur. It may be concluded from the abovementioned example that design may influence the impacts on large scale infrastructural significantly. Proper design will ultimately lead to a decline in the significance of impacts and will, therefore, play a major role in the success of sustained environmental management throughout the project life cycle.

6.5. *Monitoring and Auditing*

As stated in section 6.3 the role of compliance auditing and monitoring is crucial in the successful implementation of the EMP. Principle 5 of the EMP states that continual monitoring and auditing shall be central to the management of the mall. The principle elaborates by stating that technical specialists will conduct monitoring programmes while registered auditors will conduct audits every six months during construction and annually during operations. According to the principle,

auditing shall be done against legal compliance and the EMP and detailed records must be kept of all audit reports and monitoring data (Centre for Environmental Management, 2006).

6.6.1 Monitoring

Monitoring in EIA refers to repetitive measurement undertaken primarily to address uncertainty in environmental impact predictions. The information collected needs to be stored, analysed and communicated to relevant participants in the EIA process. A primary requirement, therefore, is to focus monitoring activity only on “those environmental parameters expected to experience a significant impact, together with those parameters for which the assessment methodology or basic data were not as well established as desired” (Lee & Wood, 1980).

Monitoring ensures that the environmental requirements stipulated in the EMP are being complied with. It also allows for ongoing impacts to be tracked so that the effectiveness of the mitigation can be measured. The ideal instrument for ensuring successful monitoring is monitoring programme (DEAT 2004, Environmental Management Plans, Information Series 12). Figure 6 explains the overall process of developing the EMP, monitoring programme and performance assessment.

There are numerous factors influencing the decision on what, when, where and how to measure certain variables of a project in South Africa. Firstly, the authorities involved in the process may make certain conditions in the authorisations needed for the commencement of the development and secondly the costs involved in monitoring.

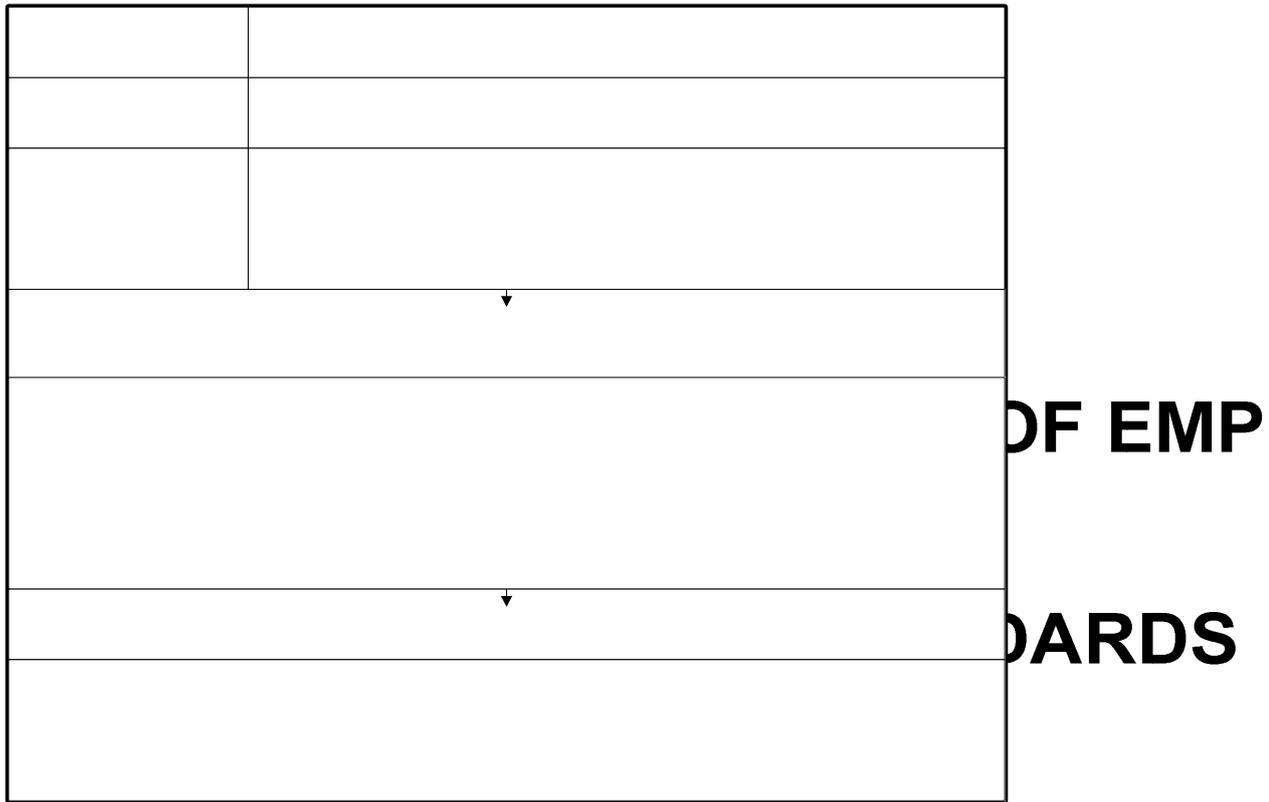


Figure 6. Framework process for developing the EMP and monitoring programme (adapted from DEAT, 2004)

Currently the monitoring specifications stipulated in the EMP of the Mooirivier Mall requires that monitoring should focus on water quality, water quantity (flooding) and bio-monitoring during the construction phase. These are briefly discussed below.

In terms of water quality, the impact of the development on surface water quality shall be monitored on a monthly basis by taking a grab sample upstream and downstream of the proposed development. The variables to be sampled include Suspended Solids (SS), Total Dissolved Solids (TDS), ph, soap, oil and grease. This monitoring must prove that no deterioration of water quality takes place during the construction phase.

The fact that the development will take place within the 1:50 and 1:100 year flood lines makes the monitoring of water quantity for flooding on a continuous basis essential. Monitoring of water levels, sedimentation and obstruction of the flow of the river will take place at selected sampling points.

As mentioned in section 4 of the paper, the Mooi River system is already stressed and the development of the mall within the system will further stress the linear functionality of the river system. The monitoring of the linear functioning of the Mooi River is, therefore, crucial and shall be monitored bi-annually (summer and winter) at selected sampling points. Erosion of the natural channel, riparian vegetation integrity, Fish Health Integrity Index and the latest SASS scoring system for aquatic invertebrates are some of the sampling methods and techniques used to monitor the linear functionality of the river.

The monitoring specifications may change in the future when the authorisations and their conditions are received from the relevant authorities. At the time of writing the paper the Department of Water Affairs stipulated some monitoring requirements as conditions to be set in the ROD of the EIA. These conditions include:

- The developer shall monitor the sustainability and stability of the structure after every rainfall event exceeding a 1:100 year rainfall event, or at least once every year.
- The developer shall monitor the establishment of vegetation at any disturbed areas.
- The developer shall monitor the maintenance of the vegetation, banks and any other disturbed areas associated with the activity, including any erosion problems.

The simplest form of monitoring is the periodic inspection of some activity for any stated purpose, for example, to ensure that safe operating procedures are being followed, and that visible

environmental degradation is not occurring. As part of the handover document prepared for the developer, the independent consultant has developed various checklists that will aid the project engineer to monitor the progress made in terms of the objectives and targets stipulated in the EMP successfully during the construction phase of the project. These checklists include, a checklist for the start-up of the construction phase, a daily checklist, a weekly checklist, a monthly checklist and a site closure checklist.

Another useful monitoring strategy is to establish an Environmental Monitoring Committee (EMC) to monitor progress and performance of a development. In the case of the Mooirivier Mall development an Environmental Liaison Committee (ELC) will be established. The ELC will fulfil a representative watchdog and advisory role and monthly meetings will be held to verify compliance to the EMP from the first month preceding construction. The functions and representation of the ELC is discussed in more detail in section 7 of the paper.

6.6.2 Auditing

Environmental auditing is a process whereby an organisation's (or development's) environmental performance is tested against numerous requirements, for example, clearly defined policies, legislated requirements (including conditions of authorisations) and key performance indicators. The approach includes interviews and asking of questions, review of relevant documentation, and visual observations (DEAT 2004, Overview of Integrated Environmental Management, Information Series 0). The International Organisation for Standardization (ISO) defines auditing as "a systematic, independent and documented process for obtaining audit evidence and evaluating it objectively to determine the extent to which the audit criteria are fulfilled" (SANS, 2003).

As indicated in Figure 2, auditing may be used in different stages of the project life cycle. An important function of auditing is to ensure that the design specifications are in-line with building regulations and other environmental efficiency criteria such as the South African Energy and Demand Efficiency Guidelines (SAEDES). This will ensure maximum energy efficiency and sustainability in the life cycle of infrastructural developments. It was, however, agreed upon that the design will not be audited in this project. The design should, however, conform to the design principles as stipulated in the EMP. With regards to the overall Mooirivier Mall development, it was agreed that auditing reports will be prepared every six months during construction and annually during operation by registered auditors to check compliance to applicable legislation and to the EMP, which will then be presented to the NWDACET for their records (Centre for Environmental Management, 2006).

6.6. Reporting and communication: public participation

Public participation is both a legal and ethical requirement within the environmental impact assessment (EIA) process. Reference to public participation is made in the relevant EIA legislation and provides opportunities for the interested and affected parties (I&AP) to become involved in the EIA process. At the time of conducting the EIA the GN R1183 in terms of the Environment Conservation Act 73 of 1989 required that environmental impact reports include a description of the public participation process that is to be followed, including a list of identified interested parties and their comments (reg 6(1)(e)). The applicant/proponent *“is responsible for the public participation process to ensure that all interested parties, including government departments that may have jurisdiction over any aspect of the activity, are given the opportunity to participate in all the relevant procedures contemplated in these regulations”* (reg 3(1)(f)). This process is to be managed by a competent consultant (reg 8(c)(iii)). NEMA further promotes the principle of public participation in environmental governance (section 2(4)(f)), as *“all people must*

have the opportunity to develop the understanding, skills and capacity necessary for achieving equitable and effective participation, and participation by vulnerable and disadvantaged persons must be ensured” (Nel, 2001).

The degree of involvement in the public participation process is an ethical requirement as often the I&AP are affected the most by the proposed activity. It affords an opportunity to stakeholders to be both informed about the project and to participate on an informed basis to ensure that their needs and requirements are reported and considered. The Stakeholder Engagement Process (SEP) principles listed by the Department of Environmental Affairs and Tourism (DEAT) (1998) include:

- Meaningful and timely participation of interested and affected parties (I&APs);
- Focus on important issues;
- Due consideration of alternatives;
- Accountability for information used for decision-making;
- Encouragement of co-regulation, shared responsibility and a sense of ownership;
- Application of "due process" particularly with regard to public participation in environmental governance as provided for in the Constitution, and
- The needs, interests and values of I&APs must be considered in the decision-making process (inclusively).

When the public participation process has not been properly conducted, it provides the opportunity for the I&AP to take legal action and obtain an injunction. A Stakeholder Engagement Process (SEP) was, therefore, conducted by the independent consultant in the Mooiriver Mall EIA in an effort to involve as many potential interested and affected parties (I&APs) as possible. Registrations of 124 stakeholders were received by the independent

consultant. The comments received and issues raised were used to assist the independent consultant to identify possible impacts and suitable mitigation proposals for the development and are included in the Environmental Impact Report (EIR).

The approach towards any SEP is dependent upon the details of the development, the reason being that each project has particular geographical and technical characteristics and hence the SEP should be structured accordingly. Where possible and in line with the current statutory requirements, it is also desirable to structure any such a process to address the process needs of the stakeholders. The following public participation techniques were used during the EIA process of the mall development to involve I&APs (Centre for Environmental Management, 2005):

- Identification and registration of stakeholders.
- Personal visits to all landowners and tenants in the immediate vicinity of the site.
- On site advertisements.
- Information articles published in the local press.
- Formal advertisements in the local press.
- Letters to registered water users along the Mooi River.
- Focused information sessions.
- Scheduled and advertised public meetings.
- Availability of relevant reports in public libraries.

The benefits of public participation are numerous, however, public participation has also its negative components. It has the potential to complicate the planning process and may cause possible delays in the development. Furthermore, it may empower opposition to the development and may, therefore, increase the risk of the development being terminated. Public participation is also a costly exercise and is not always truly representative. Due to the lack of education in South

Africa, some of the technical issues may not always be understood, which may ultimately lead to confusion of important issues and more time delays.

6.7. *Training and awareness*

The importance of training as an environmental management tool in the project life cycle should not be underestimated. Ideally the workforce should undergo an environmental awareness training course to understand how they may play a role in achieving the objectives specified in the EMP (DEAT 2004, Environmental Management Plans, Information Series 12).

A critical lesson learned in the Mooirivier Mall development is the awareness raising of the developer or top management of a large scale infrastructural development in the project identification and inception phase. In the Potchefstroom Mooirivier Mall case study, the developer and top management were made aware of the critical importance of the sustainable design of the mall in the highly sensitive environment in this phase and it led to more financial and time commitments made by the developer in the design and planning phases of the mall, which ultimately resulted in the consideration of the development for approval by the competent authority (NWDACET). If these resources were not allocated for sufficient designing and planning the changes of the mall development being approved would have decreased considerably. The lack of commitment from management may, therefore, lead to inadequate resources being allocated to the design, construction, operation and termination phases of the life cycle, which may ultimately lead to failure of obtaining a license to develop and operate.

Another critical role of training is the induction training of contractors. The adequate training and control of contractors will ensure the protection of the environment in the construction phase of the project. Because of the highly sensitive environment of the proposed mall contractors must be

given ample training to highlight their activities and products which may cause environmental degradation. The contractors should also be trained in responding to these impacts before they enter the development site to conduct their daily activities.

In the Mooirivier Mall case study it was agreed by the developer that a specific environmental function will be assigned to deal with the construction and operational phases of the project respectively. The project engineer will be responsible for the environmental function during construction and the mall manager will be responsible for the environmental function during the operational phase of the mall. These assigned responsible persons should receive appropriate environmental management competence training to ensure that the function is conducted responsibly. Roles and responsibilities are discussed in more detail in the following section of the paper.

7. Roles and responsibilities

As mentioned in section 5.2 of the paper, one of the major risks to sustained environmental management performance is failure to manage the interfaces between the various project phases and their key role players. Therefore, innovative and integrated strategies need to be adopted to ensure continuity of environmental performance as roles and responsibilities are transferred from one role player to the other. Key role players should, therefore, be identified and their roles and responsibilities appropriately defined and assigned for each interface of the project life cycle.

Ten broad functions of key role players have been defined for the construction and operational phase of the Mooirivier Mall development. The relationships between the role players and the interfaces between the project phases envisaged for the development are illustrated in Figure 8.

The functions of key role players mentioned above may be described as follows (Centre for Environmental Management, 2005):

- **North West Department of Agriculture Conservation, Environment and Tourism (NWDACET) (1):** NWDACET is responsible for the issuing of the ROD and to verify conformance. In terms of this development NWDACET will be assisted through the submission of audit reports, by the PE during construction and the MM during operations on environmental performance and compliance to the ROD.
- **Environmental Liaison Committee (ELC) (2):** The ELC will be chaired by the PE during construction and MM during operations. It will fulfil a representative watchdog and advisory role and the functioning of the ELC will be governed by a constitution. Monthly meetings will be held to verify compliance to the EMP from first month preceding construction. The ELC will be made up of the developer, PE or MM, members of the consultation team (environmental specialists), PLC (councillors and officials), NWDACET and I&APs (such as Birdlife Wesvaal).

Box 1: Functions of the ELC

- Ad hoc monitoring
- Advisory role to the developer, RE and Mall Manager
- Watch dog function

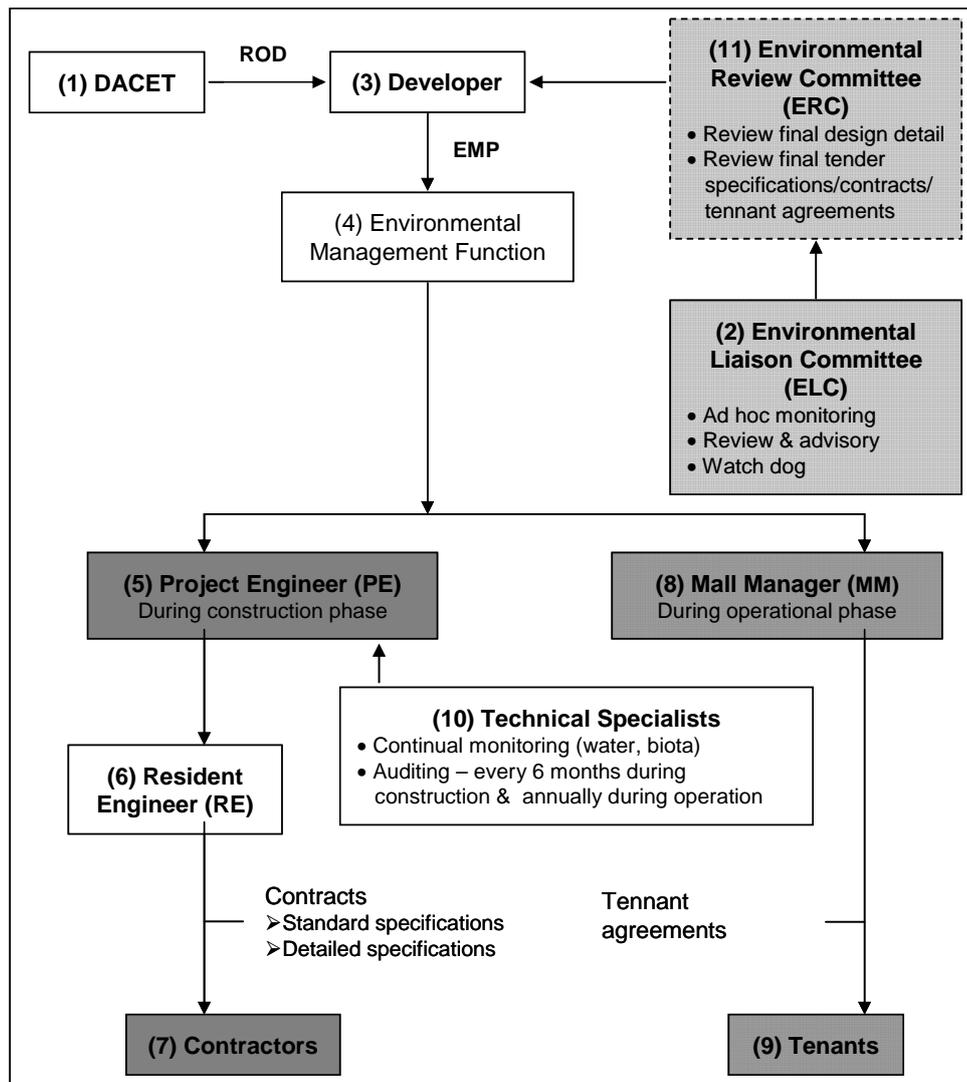


Figure 8: Institutional arrangements

- **Developer (3):** Provides the funding for the development and appoints the relevant expertise to implement the project. Final environmental liability associated with the implementation of the EMP will also vest with the developer.
- **Environmental management function (4):** It was agreed with the developer that a specific environmental function will be assigned to deal with the construction and operational phases respectively. Figure 8 shows that the ‘environmental management

function' will be located with the 'project engineer' during construction and the 'mall manager' during operations.

The developer shall assign in writing the 'environmental management function' which will, irrespective of other responsibilities, require the following clearly defined roles and responsibilities:

Box 2: Environmental Management Function

- Ensuring that the EMP is implemented
- That all people working for and on behalf of the developer are competent to conduct his or her activities in line with the EMP
- To communicate issues pertinent to the EMP to people for or on behalf of the developer
- To conduct regular monitoring and inspections as specified in the EMP
- To keep records as specified in the EMP
- To submit reports as specified in the EMP
- To implement emergency arrangements

- **Project Engineer (PE) (5):** During construction the 'environmental management function' will vest with the project engineer. The engineer will also be responsible for managing and enforcing contractual agreements and obligations as well as providing technical support.
- **Resident Engineer (RE) (6):** Although the PE will be responsible for monitoring, reviewing and verifying compliance with the EMP by the contractors, the RE will also

ensure compliance and assist the PE when necessary, especially in relation to aspects that can be dealt with easily on site.

- **Contractors (7):** Mainly responsible for carrying out construction operations on site in line with contractual agreements and method statements. The contractors report directly to the PE (and/or RE as agreed beforehand). The contractor shall comply with the specifications of the EMP and abide by the PE's instructions regarding the implementation of the EMP. The contractor can appoint an environmental representative to deal with all environmental requirements through daily site inspections and monitoring.
- **Mall Manager (MM) (8):** During operations the 'environmental management function' will vest with the mall manager. The mall manager will also be responsible for the day to day functioning and management of the mall.
- **Tenants (9):** During the operational phase the environmental responsibilities of tenants will be incorporated in the tenant agreements. These will be agreed upon between the mall manager and respective tenant.
- **Technical specialists (10):** Technical specialists will, where necessary, assist the PE and MM with monitoring of some biophysical components of the environment, as well as audits to verify conformance to the EMP and ROD. Six monthly audits will be required during the construction phase and annually during the operational phase and audit reports will be presented to NWDACET and the ELC.

- **Environmental Review Committee (ERC) (11):** The review committee will be an *ad hoc* committee with the function to review the environmental aspects of the final detailed mall design, as well as of the tender specifications, contracts and lease agreements. The committee will consist mainly of the EIA team and other co-opted specialists as required. Once the RC is satisfied that the final design and tender specs and contracts are in line with the EIA and EMP requirements, the RC will be replaced by the ELC.

An important function not indicated in Figure 8 is the role and responsibilities of the architect in the design phase. Although the Project Engineer and the Resident Engineer will be responsible for monitoring, reviewing and verifying compliance to the EMP during construction, the architect will ensure compliance to the EMP in terms of design. The architect's duties in this regard shall include the following (Centre for Environmental Management, 2006):

- To ensure conformance of the overall mall design to the agreed upon environmentally friendly design parameters.
- To communicate the final design and related parameters to the developer as well as the project engineer who will be responsible for the construction phase.
- To integrate the agreed parameters into later detailed design specification related to for example landscaping, visual and aesthetical aspects, energy efficiency, etc.

The functions mentioned above all play an intrinsic role in sustained environmental management performance throughout the project life cycle. These functions must be managed accordingly. Failure to do so will surely lead to unsustainable environmental management and ultimately environmental degradation of the Mooi River system. This principle applies to any large infrastructural development.

8. Conclusion

It is argued and demonstrated by means of the Moirivier Mall development that no single environmental management tool is suitable, adequate and effective to drive environmental management performance throughout the project cycle of large infrastructural developments. The philosophy of selecting an ensemble of unique environmental management tools, which need to be innovatively selected, adopted and integrated to ensure sustained environmental performance is strongly supported by this paper. In the Moirivier Mall case study the following tools are selected, Urban Design Framework (UDF), Environmental Impact Assessment (EIA), Environmental Management Plan (EMP), design specifications, environmental monitoring and auditing as well as public participation, consultation and reporting, to address the environmental management portfolio of the development. As indicated in the paper these tools have different performance and weakness characteristics and are selected to support one another in the project life cycle of the specific development. The selection of tools, however, depends on numerous factors such as site characteristics, legal requirements, institutional arrangements and conditions determined by relevant authorities and may, therefore, differ from development to development.

The second argument of the paper is that the loop should be closed for all the phases of the project life cycle to ensure consistent environmental performance and management of interfaces between the various project phases. As demonstrated by this paper, a method of dealing with these scenarios is to identify all the key-role players of each phase of the project, to define their roles and responsibilities and to assign them with appropriate duties to ultimately ensure consistent management of the said interfaces of the project life cycle. Another, highly effective method is the multiple tiered EMP's drafted for the design, construction and operational phases of the project. The different EMP's for each phase provides insurance of closing the loop for all phases of the project life cycle.

The third argument of the paper is that selected tools should close the plan-do-check-act (PDCA) loop of the Deming cycle. Effective environmental management in general entails planning, implementation, checking and improvement steps. The selection of tools for integrated and sustained environmental management for large infrastructural developments should, therefore, support and close the plan-do-check-act (PDCA) loop of the Deming cycle in its entirety. As demonstrated in this paper an UDF and EIA are selected as analytical and planning tools as part of the Planning phase of the development. Management tools selected for the development include, Environmental Management Plans (EMP's) and design specifications. It is also demonstrated that environmental monitoring and auditing may be used as tools for checking and acting within the Deming cycle.

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