APPENDIX 11: ENVIRONMENTAL MANAGEMENT PROGRAMME

DRAFT ENVIRONMENTAL MANAGEMENT PROGRAMME

PROPOSED CONSTRUCTION OF A HOUSING DEVELOPMENT AND ASSOCIATED INFRASTRUCTURE ON ERF 61, PIETERMARITZBURG, MSUNDUZI LOCAL MUNICIPALITY, KWAZULU-NATAL

EDTEA REF: DC22/0020/2019

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Terratest (Pty) Ltd Reference No. 41748

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TITLE:
PROPOSED HOUSING DEVELOPMENT AND ASSOCIATED INFRASTRUCTURE ON ERF 61, PIETERMARITZBURG, KWAZULU-NATAL

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SYNOPSIS:
Draft EMPr for the proposed housing development and associated infrastructure, Lincoln Meade, KwaZulu-Natal.

KEY WORDS:
EMPr, Lincoln Meade, housing development.

QUALITY VERIFICATION

This report has been prepares under the controls established by a quality management system that meets the requirements of ISO9001: 2015, which has been independently certified by DEKRA Certification under certificate number 90906882.

VERIFICATION	CAPACITY	NAME	SIGNATURE	DATE
By Author	Environmental Scientist	Riona Patak		27/11/2019
Checked by	Senior Environmental Scientist	Liz Dralle		27/11/2019
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LIST OF ACRONYMS

DWS	-	Department of Water and Sanitation
EDTEA	-	Economic Development, Tourism and Environmental Affairs - Provincial
EMPr	-	Environmental Management Programme
ECO	-	(Independent) Environmental Control Officer
MSDS	-	Material Safety Data Sheet
NEMA	-	National Environmental Management Act (Act 107 of 1998)
WUL	-	Water Use Licence

1. INTRODUCTION

Terratest (Pty) Ltd has been appointed by Person Drive Trading (Pty) Ltd to undertake the environmental services required for the proposed construction works associated with the proposed residential development and associated infrastructure located at 55 Grimthorpe Avenue, Lincoln Meade, Msunduzi Local Municipality, KwaZulu-Natal. The property description is Erf 61, Pietermaritzburg.

In accordance with the Integrated Environmental Management Guidelines published by the Department of Environmental Affairs & Tourism (DEAT) in 1992, the purpose of an EMPr is *"to describe how negative environmental impacts will be managed, rehabilitated or monitored and how positive impacts will be maximised".*

1.1 National Environmental Management Act, (Act 107 of 1998)

Section 28 of NEMA (National Environmental Management Act, Act 107 of 1998) which pertains to "Duty of care and remediation of Environmental Damage" states that:

"(1) Every person who causes, has caused or may cause significant pollution or degradation of the environment, must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot be reasonably avoided or stopped, to minimise and rectify such pollution or degradation of the environment."

This EMPr must form an integral part of the contract documents for the proposed construction, as it outlines the methodology & duties required such that construction can be achieved in an environmentally sustainable manner; with particular reference to the prevention and mitigation of environmental impacts caused by construction activities associated with the project. Such mitigation measures will have a financial impact on the project's costings.

This EMPr is a dynamic document that may need to evolve during its implementation period, such that it recognises any new issues that may arise; or changes in the parameters of identified issues which can be addressed with the required/amended mitigation.

1.2 The Polluter-Pays Principle

This principle provides for *"the costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimizing further pollution, environmental damage or adverse health effects must be paid for by those responsible for harming the environment."* The Polluter Pays Principle must be rigorously applied throughout the Construction Phase of this project.

1.3 Progressive Rehabilitation

Progressive rehabilitation must also be undertaken throughout the Construction Phase of the project with areas that have been impacted on. Rehabilitation should commence as soon as construction is completed in the specific area and not at the end of the entire project.

2. PROJECT DETAILS

The proposed housing development consists of the construction of 23 residential units and the upgrade of the existing residential unit on site and associated infrastructure. The project is located on Erf 61, Pietermaritzburg / 55 Grimthorpe Avenue, Lincoln Meade, Pietermaritzburg (refer Figures 1 and 2). The site is zoned as Residential.

The proposed construction will consist of 20 x 3 bedroom units (each 104.69m^2) and 3 x 2 bedroom units (each 81.72m^2) and will cater to the middle income household. The total size of the property is 1.85ha. The land development area will transform approximately 52% of the Erf (i.e. 0.98ha) to provide new units, parking and the internal road network. The remaining 48% (i.e. 0.87Ha) will be retained as open space for the preservation of the wetland system identified on-site (refer Section 10 of this report). Alternative layout options have previously been examined as per Section 8 of this Report.

There are currently has two different access points to the site. Both access points will be utilised for the development. Movement within the development will be via one-way traffic i.e. one entrance point to the site only and one exit point for the site only. The proposed entrance to the site, for the development, is via Grimethorpe Avenue, number 55. The GPS co-ordinates at the approximate entrance of the site are 29°37'11.00"S; 30°26'06.70"E. All units will form part of a sectional title development. Should the project be granted a positive Environmental Authorisation, a decision as to weather a Body Corporate or a Managing Agent will be tasked with maintenance of the wetland system will be determined.
An Engineering Report and Stormwater Management Plan have been developed for the site. Refer Appendices 5 and 6 respectively. Based on the assessments undertaken in these reports, the following information is provided specific to the site and the chosen layout:

- **Existing services:**
    - Roads
    - Grimthorpe Avenue is a 7m wide surfaced residential collector street stretching from Murray Road to Rogers Avenue which thereafter transitions from a surfaced road to a gravel road up until the causeway traversing over the Msunduzi River.

    - Water
    - There is an existing 225mm Ø distribution main on Erf 61s' side of Grimthorpe Avenue and an existing 150mm Ø reticulation pipe on the adjacent side of the road.

    - Sanitation
    - The surrounding properties are linked into an existing 150mm Ø gravity fed sewer line. The sewer line gravitates along the lower portion of Erf 61.

    - Stormwater
    - There are no existing stormwater systems in place on site.

- **Proposed services:**
    - Roads
    - <u>Bulk Road Network:</u>

The access to the site is along Grimthorpe Avenue, which is a 7m wide surface road serving most of the surrounding residential sites in the area. Grimthorpe Avenue is not a through road, although it does gain access to a small agricultural community known as Bishopstowe on the adjacent side of the Msunduzi River. The proposed entrance to the development is approximately 835m from the intersection between Murray Road and Grimthorpe Avenue. The site layout shows a separate entrance and exit off Grimthorpe Avenue, which shall be able to accommodate the expected traffic volumes generated from the proposed development. The access will need to be upgraded to meet the required municipal standards.

- <u>Internal Road Network:</u>

The proposed development will have an entrance and an exit gate. Internal roads are therefore designed to cater for a single vehicle forward movement with no oncoming obstructions. The following criteria will be followed:

- Internal Roads: 5m wide road
- Design Speed: 20 km/hr
- Min Vertical Length: 20m
- Pavement Design: 30mm Asphalt (minimum)

125mm G2 base
150mm G5 subbase
150mm G7 selected subgrade
150mm *in situ* material
Alternatives to asphalt surfacing are concrete and interlocking pavers with associated layerworks.

- **Sewer:**

The internal sewer network will connect to the existing Municipal sewer infrastructure (150mm Ø gravity fed line) in the area. The Municipal sewer infrastructure links to the Darville Wastewater Treatment Site.

- **Stormwater Management:**

As per the Engineering Report (Appendix 5) and Stormwater Management Plan (Appendix 6), generated, the stormwater management strategy will be to manage and collect all surface runoff which will gravitate, via stormwater pipes or swales[1], and discharge into two stormwater attenuation ponds located at two outlet points along the site. The stormwater attenuation ponds shall be earth-lined structures designed to contain volumes of stormwater generated by a 1:50 year rainfall over a 15-minute period. The ponds shall be designed to receive stormwater from the development at a post-development flow and will be able to release the stormwater at a pre-development flow through stormwater pipe outlets.
The stormwater infrastructure will be constructed in accordance with the "Guidelines for Human Settlement Planning and Designs"[2].

- **Electricity:**

There is an existing electrical connection to the site given the existing dwelling on the property and other infrastructure is available along Grimthorpe Avenue. The Developer will, however, have to apply, should the development be authorised, to the Msunduzi Municipality for an increase in bulk supply, which will be distributed after the bulk connection to each of the dwellings contained within the development footprint. Downfacing lighting is encouraged to ensure minimal disturbance to neighbouring properties.

- **Wetland Rehabilitation:**

A wetland is present on a portion of the site outside the development footprint. As per the Specialist Recommendations (Section 10), a Wetland Rehabilitation Plan will be developed for the area. No tracks or activities within the wetland area will be permitted. The grassed swales will direct runoff from the development area into the attenuation ponds. Water collected in the attenuation ponds will be discharged into the wetland at pre-development flow rates.

- **Refuse:**

The Home Owner's Association/Body Corporate will be responsible for the weekly collection and disposal of refuse to a registered landfill site, unless otherwise provided by the Msunduzi Municipality.

The provision of services from the Msunduzi Municipality will be confirmed during the Spatial Planning and Land Use Management Act (SPLUMA) process, which will only occur if Environmental Authorisation is granted for the proposed development.

- **Construction Access Routes:**

It is anticipated that both site entrances will be utilised for the construction period.

3. LEGISLATIVE REQUIREMENTS

3.1 Signing of the EMPr

The Acknowledgement Form in Appendix 2 of the EMPr must be signed by the Authorisation Holder, all Contractors and sub-contractors appointed to undertake works on the site, and the Environmental Control Officer (ECO); acknowledging that all parties are familiar with the requirements of the EMPr.

[1] A shallow channel with gently sloping sides.

[2] http://researchspace.csir.co.za/dspace/bitstream/handle/10204/3750/CSIR%20Red%20Book_Vol1_2000.pdf;sequence=4

3.2 Legislation

Of importance are all national, provincial and municipal by-laws and regulations. Statutes are amended periodically and it is the Authorisation Holder's responsibility to identify legislation relevant to their proposed activities at the time.

4. COMPLIANCE WITH THE EMPr

4.1 Roles and Responsibilities

The implementation of this EMPr requires the involvement of several stakeholders, each fulfilling a different, but vital role to ensure sound environmental management during the construction phase. The stakeholders are discussed below.

4.1.1. Department of Economic Development, Tourism and Environmental Affairs (EDTEA)

EDTEA is the designated provincial authority responsible for authorising the environmental application EMPr related to the project. EDTEA has overall responsibility for ensuring that the Applicant complies with the Conditions of EA and EMPr.

4.1.2. Applicant: Person Drive Trading

Under South African environmental legislation, the Applicant/Employer is accountable for the potential impacts of the activities that are undertaken and is responsible for managing these impacts. Person Drive Trading as the Applicant/Employer therefore has overall environmental responsibility to ensure that the implementation of this EMPr complies with the relevant legislation and the conditions of the EA.

4.1.3. Environmental Control Officer (ECO)

The independent ECO appointed will monitor and review the on-site environmental management and implementation of this EMPr by the contractor throughout the project. This will be done by conducting site audits and issuing monthly audit reports to the relevant parties.

EDTEA requires that the ECO be at the forefront of all environmental management issues.

4.1.4. Environmental Manager / Health, Safety and Environmental Officer (HSE)

The Environmental Manager, or his appointee, will conduct daily inspections of the site and plant, to identify potential non-compliances and potential negative impacts to the environment. The inspections will take the form of an inspection sheet and will be kept as a record. Findings thereof will be made available to the ECO and raised in construction meetings for mitigation or avoidance measures.

4.1.5. Contractor

This refers to the main contractor(s) appointed by the Employer for the construction of the project, or a portion of the project i.e. subcontractors. The main contractor(s) will be responsible for complying with the EMPr commitments and any other legislative requirements, as applicable to the contractors' appointment for the proposed development. The contractor/s will also be responsible for drafting method statements appropriate to activities under his direct control.

The contractor must ensure that all employees under their appointment receive appropriate training prior to the commencement of construction, taking cognisance of this EMPr and the Conditions of the Environmental Authorisation.

4.1.6. Organisational Structure

Details of the organizational structure are presented in Figure 4-1. The structure illustrates the reporting procedures for all stakeholders responsible in the implementation of this EMPr.

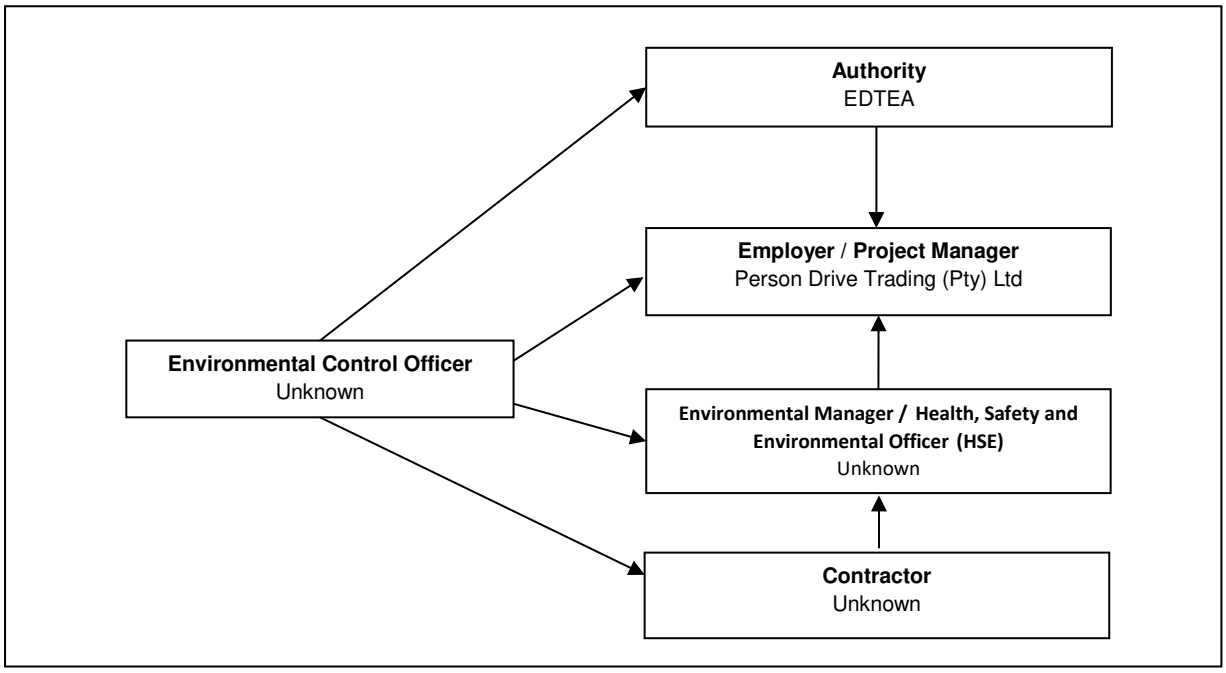

FIGURE 4-1: *Organisational Structure*

4.2 Record Keeping, Monitoring and Compliance

During the construction phase the Authorisation Holder must monitor the Contractor's adherence to the approved impact prevention procedures on a weekly basis and must issue the Contractor a Notice of Non-compliance whenever transgressions are observed. The Authorisation Holder must document the nature and magnitude of any non-compliance, the action taken to correct the non-conformance, the actions taken to mitigate its effects and the results of those actions. This reporting must be kept on file for inspection by the ECO and/or the Department of Economic Development, Tourism and Environmental Affairs (EDTEA) when required. Significant, emergency or ongoing non-compliance findings must be immediately reported to the appointed Project Manager / Engineer for the project who must report these to the Department of Economic Development, Tourism and Environmental Affairs (EDTEA) or any other state department who may have jurisdiction over the matter.

During the construction phase of bulk services infrastructure, the Authorisation Holder must appoint a competent independent individual (Environmental Control Officer – ECO) to monitor and report on the contractor/s compliance with the conditions contained within the Environmental Authorisation and Environmental Management Programme (EMPr). Monitoring audits and reporting must take place on a monthly basis during the construction phase and a closeout audit must be undertaken post rehabilitation of areas affected by construction activities.

In the case of non-compliance giving rise to physical environmental damage or destruction, the Project Manager, in consultation with the ECO and the Msunduzi Municipality: Environmental Unit, shall be entitled to undertake, or to cause to be undertaken, such remedial works as may be required to make good such damage and to recover from the contractor the full costs incurred in doing so. All parties, however, must be mindful of the fact that any remedial work may trigger a separate Listed Activity not included in the initial application for Environmental Authorisation and therefore may require its own separate environmental assessment prior to implementation.

In the event of a dispute or difference of opinion between any parties arising out of the interpretation of the conditions of the EMPr, or a disagreement regarding the implementation or method of implementation of conditions of the EMPr, the Project Manager will act as the arbitrator, unless the Project Manager feels the need to seek specialist advice.

The Project Manager shall at all times have the right to stop work and/or certain activities on site in the case of non-compliance or failure to implement remediation measures. The Project Manager has the authority to instruct the Authorisation Holder or Contractor to cease a particular construction activity causing, or liable to cause, significant environmental damage.

4.3 Failure to complete corrective actions

In the event that the Authorisation Holder or Contractor fails to complete the corrective action within the allocated timeframes, the Project manager / Engineer must:

- Formally (in writing) inform the EDTEA; and
- Request that a Stop-work Order be issued to the Authorisation Holder or Contractor by the EDTEA.

The Authorisation Holder is responsible for resolving any issues with the Contractor. Failure to address any non-compliance may lead to the termination of the contract and removal of the Contractor and staff from the site.

The Authorisation Holder or Contractor are deemed not to have complied with the EMPr if:

- Within the boundaries of the site there is evidence of a contravention of clauses of the EMPr; or
- Environmental damage occurs due to negligence / inappropriate actions taken by the Authorisation Holder or Contractor or any of his staff.

On receiving a Notice of Non-compliance, the Authorisation Holder and Contractor is required to swiftly address the issue/s taking all corrective actions required to rectify the situation. Penalties can be applied for non-compliant situations. Penalties/fines are advocated to ensure corrective measures are successfully undertaken and the necessary standard of rehabilitation is achieved. The penalties imposed per incident or violation can be imposed by EDTEA or the Applicant.

The penalty associated with a chemical spill is not a set amount but will depend on the nature and extent of the spill; the cost of any soil and / or groundwater monitoring; and any soil and / or groundwater remediation required by Authorities will be to the Authorisation Holder or Contractors account.

The imposition of such penalties / fines will not preclude the relevant Competent Authority from applying an additional penalty in accordance with statutory powers.

Failure to address the cause must be reported to the relevant Authority for them to deal with the transgression as deemed fit.

4.4 Environmental Awareness Training

The contractor shall ensure that adequate environmental awareness training of senior site personnel takes place and that all construction workers receive an induction presentation on the importance and implications of the EMPr and Conditions of the Environmental Authorisation.

The presentation shall be conducted, as far as possible, in the employees' language of choice.

As a minimum, training shall include:

- Explanation of the importance of complying with the EMPr;
- Discussion of the potential environmental impacts of, and environmental risks presented by, construction activities;
- Employees' roles and responsibilities, including emergency preparedness;
- Explanation of the mitigation measures that must be implemented when carrying out their activities;
- Explanation of the specifics of this EMPr; and
- Explanation of the management structure of individuals responsible for matters pertaining to the EMPr.

The contractor shall keep records of all environmental training sessions, including names, dates and the information presented. These records will be presented to EDTEA and the ECO on request during audits.

5. GENERAL CONSTRUCTION PHASE EMPR REQUIREMENTS

Construction Phase EMPr activities are those relating to the preparation of the site prior to commencing the Construction Phase, as well as the construction and rehabilitation activities themselves.

5.1 Preparation of Method Statements / Management Plans

Method Statements and/or Management Plans must be submitted by the Contractor to the ECO and Authorisation Holder for approval for the following activities prior to any construction commencing on site:

1. Wetland Rehabilitation Plan;
2. Construction camp locality and layout plan;
3. Management, use and storage of hazardous goods / substances, including petrochemicals;
4. Stormwater management at the construction Camp/s and at the construction work front;
5. Traffic, accommodation and construction vehicle movement routes during the Construction Phase;
6. Spill Contingency Plan; and
7. Emergency Response Procedures.

The Authorisation Holder must monitor the implementation of the Method Statements and Management Plans during the Construction Phase of the project.

5.2 Permit Requirements

The necessary permits (if any) must be obtained by the Authorisation Holder prior to the commencement of any activities requiring such a permit. These could include permits for activities such as:

- The disposal of effluent on site; and
- Impacting on water resources - This would constitute a Water Use Licence (WUL) from the Department of Water and Sanitation (DWS).

6. AMENDMENTS TO THE EMPr

This EMPr outlines the environmental practices and mitigation measures to be adhered to during the Construction Phase, in order to curtail and/or minimise potential negative impacts and promote sound environmental practices.

The EMPr is a dynamic document and is subject to change as and when required. Amendments to the EMPr will require consultation and approval from the EDTEA: Compliance and Monitoring Department.

7. SPECIALIST RECOMMENDATIONS

All recommendations within the Wetland Assessment must be adhered to including the following:

- A grassed buffer of at least five meters must be implemented, in addition to a sediment fence during the construction phase. During the operational phase, a five meter grassed buffer must be implemented and maintained.
- The wetland is in very poor condition partly because of the abundance alien invasive plants within it. It is therefore required that the wetland is cleared of all alien vegetation and an appropriate herbaceous (grass and or sedge) indigenous plant community be established in its place. This can be undertaken concurrently with the construction of the development or post construction of the development.
- A Wetland Rehabilitation Plan must also be developed and adhered to. The Wetland Rehabilitation Plan must consider sediment management as the wetland may be denuded of much vegetation during its rehabilitation. It must be noted, as per the Wetland Specialist, it is acceptable to have the grassed swales and attenuation ponds located within the 5m grassed buffer.

8. ENVIRONMENTAL MANAGEMENT PROGRAMME

The following Pre-Construction Phase actions detailed in Table 8-1 must be adhered to at all times. Construction related actions are detailed in Table 8-2. These also require continuous adherence during the Construction Phase. Post-Construction and Rehabilitation Management Actions are detailed in Table 8-3.

TABLE 8-1: *Pre-Construction Management Actions and Outcomes*

PRE-CONSTRUCTION PHASE				
Impact management objectives of an EMPr	**Impact management actions**	**Impact management outcomes of an EMPr**	**Responsibility**	**Frequency/Timing**
A thing aimed at or sought, a goal	*The process of doing something, typically to achieve an aim*	*The way a thing turns out; a consequence*		
Prevent soil contamination	• Hazardous materials/dangerous goods must be stored in a clearly marked, lockable, designated storage area; • Hazardous materials/dangerous goods must be stored within a bunded area which has the capacity to store 110% of the volume of the materials stored; and • Chemical toilets must be placed at least 50m outside any watercourse. A registered chemical waste company is to be used to remove waste from the chemical toilets on site. Proof of servicing of chemical toilets must be kept by the contractor, in the on-site environmental file, for review purposes by the ECO if needed.	Avoidance of soil loss Re-use of viable soils in rehabilitation. Avoidance of disposal of hazardous waste	Implementation: Contractor Inspection: EM Verification: ECO	Implementation: Ongoing Inspection: *Ad hoc* Verification: Monthly
Prevent soil loss	• Soil should be stockpiled in such a way as to minimize erosion; • Topsoil should be stockpiled such that re-use in rehabilitation is feasible; • The exposed soil surfaces should be protected from wind derived fugitive dust generation, if to be exposed for a period exceeding 2 months or in high wind conditions. • Where exposed surfaces will be exposed to surface run-off, diversion of surface run-off must be implemented to ensure erosion is avoided; and • The re-use of soil and stockpiles must be prioritised in the construction phase, where geotechnically appropriate.	Re-use of viable soil in rehabilitation. Low / No fugitive dust deposition. No loss of topsoil or soils from the site during construction.	Implementation: Contractor & Engineer Inspection: EM and ECO Verification: ECO	Implementation: Pre-construction and prior to implementation of rehabilitation Inspection: Prior to implementation Verification: Prior to implementation

PRE-CONSTRUCTION PHASE				
Impact management objectives of an EMPr	**Impact management actions**	**Impact management outcomes of an EMPr**	**Responsibility**	**Frequency/Timing**
Preservation of flora	• All construction areas must be demarcated prior to construction to ensure that the footprint of the impacts are limited (including areas where vehicles may traverse); • No-go areas must be suitably demarcated; and • All alien invasive species within the construction and development footprint must be removed and follow up monitoring and removal programmes should be initiated once construction is complete.	A robust landscaped open space with appropriate indigenous vegetation to support flora and fauna	Implementation: Contractor Specialist when required Inspection: EM and ECO Verification: ECO	Implementation: Pre-construction and during bulk earthworks Inspection: Pre-construction; Verification: Pre-construction
Preservation of fauna	• Hunting and/or fishing activities on site are prohibited. This includes the setting of traps, or the killing of any animal caught in construction works; • No animal, reptile or bird of any sort found on site may be killed. This specifically includes snakes or other animals considered potentially dangerous discovered on site. If such an animal is discovered on site an appropriately skilled person should be summoned to remove the animal from the site. Consideration should be given to selection and nomination of such a person prior to site establishment. If no-one is available, training should be provided to at least two site staff members; and • Environmental training must be conducted by the responsible ECO.	A robust landscaped open space with appropriate indigenous vegetation to support flora and fauna	Implementation: All Inspection: EM Verification: ECO	Implementation: Construction to closure Inspection: *Ad hoc* Verification: *Ad hoc*
Prevent increased surface runoff	• Care must be taken to ensure that in removing vegetation adequate erosion control measures are implemented; and • A stormwater management plan (SWMP), including sufficient erosion-control measures, has been compiled in consultation with a suitably qualified environmental practitioner / control officer during the detailed design phase prior to the commencement of construction. This SWMP must be stringently implemented on site (Appendix 3).	A well covered dense rehabilitated open space to reduce run-off energy and reduce peak flows. Establishment of approved water retention facility	Implementation: Contractor & Engineer Inspection: EM & Engineer Verification: ECO	Implementation: Construction to closure Inspection: Pre-construction Verification: Pre-construction
Preserve air quality	• Heavy vehicles and machinery should be serviced regularly to minimise exhaust fume pollution;	No fugitive dust exceeding SANS regulations or creating nuisance conditions	Implementation: Contractor Inspection:	Implementation: Pre-construction for placement of

PRE-CONSTRUCTION PHASE				
Impact management objectives of an EMPr	**Impact management actions**	**Impact management outcomes of an EMPr**	**Responsibility**	**Frequency/Timing**
	• Soil stockpiles must be located in areas to limit the erosive effects of the wind, which will limit dust; • Removal of vegetation must be avoided until such time as soil stripping is required, which will limit dust; • Limit vehicle speeds on unpaved roads to 20 km/h to limit the amount of dust generated; • Haulage distances must be at a minimum; • Dust control measures should be implemented when warranted. The use of water as a dust suppression measured is not preferred, and alternative measures should be utilised; • Environmentally friendly soil stabilisers may be used as additional measures to control dust on gravel roads and construction areas; • All equipment must be kept in good working order; • Equipment must be operated within its specifications and capacity and must not be overloaded; and • All machinery/plant must be serviced and lubricated regularly to ensure good working order.		EM Verification: ECO	stockpiles and stabiliser use Prior to establishment on site for plant Inspection: As above and on an *ad hoc* basis for daily management aspects Verification: Pre-construction
Prevent noise pollution	• Potential disturbance to the resident's adjacent to the construction site; • The potential noise source must conform to the South African Bureau of Standards recommended code of practice, SANS Code 0103:1983, so that it will not produce excessive or undesirable noise when it is released; and • All of the Contractors' vehicles must be fitted with effective exhaust silencers and must comply with Road Traffic Act (Act 29 of 1989) when any such vehicle is operated on a public road, as well as complying with the South African Bureau of Standards recommended code of practice and the South African National Standard (SANS) Code 0103:1983, for construction plant noise generation.	No ambient noise impacts relating to plant operations Compliance to municipal by-laws No nuisance conditions created Operational Hours: No works shall be executed between sunset and sunrise	Implementation: Contractor Inspection: EM Verification: ECO	Implementation: Pre-construction and *ad hoc* Inspection: Pre-construction and *ad hoc* Verification: *Ad hoc* and monthly as a minimum

PRE-CONSTRUCTION PHASE				
Impact management objectives of an EMPr	**Impact management actions**	**Impact management outcomes of an EMPr**	**Responsibility**	**Frequency/Timing**
Prevent unnecessary impedance of traffic	• Minimise possible lane closures, traffic delays and congestion during the pre-construction phase; • Appropriate flagmen and signage must be provided on the roadside in compliance with the requirements of relevant road department authority; • Sufficient area for the storage of heavy vehicles within the construction site must be provided; • Vehicle traffic which may obstruct traffic flow must be scheduled outside of peak travelling times; • Heavy / large load traffic must be appropriately routed and appropriate safety precautions must be taken to prohibit road collisions and traffic incidences; • All vehicle operators must be suitably licensed, must have had appropriate environmental and safety induction, must aware of specific site procedures, and must be well rested and cognisant when operating heavy or unsafe vehicles / machinery; and • Public consultation informing residents of alternative routes prior to the commencement of construction activities, or duration of construction activities must occur. Proof is to be provided to the ECO.	The prevention or the mitigation of the impedance of traffic Avoidance of collisions associated with the construction operations Informed IAPs	Implementation: Contractor & Engineer Inspection: EM & ECO Verification: ECO	Implementation: Planning and approval stages Inspection: Pre-construction and *ad hoc* Verification: *Ad hoc* and monthly as a minimum
Prevent the spread of waste	• Minimise accumulation of construction and general waste; • Demarcated areas where waste can be securely contained and stored on a temporary basis during the construction phase must be established. When adequate volumes (not more than 1 month) have accumulated all waste is to be removed from site and disposed of at a licensed facility; • Litter must be removed from all construction areas prior to construction commencement; • Should skips be used for the storage and transportation of waste, these must be emptied once full and must be covered to prevent waste from being blown away; • Waste is not to be buried or burned on site;	The prevention or the mitigation of the spread of waste Compliance to the Norms and Standards for the storage of waste Prevention of soil and or water contamination Avoidance of nuisance vectors	Implementation: EM & Contractor Inspection: EM & ECO Verification: ECO	Implementation: Planning and approval stages Inspection: Pre-construction and *ad hoc* Verification: *Ad hoc* and monthly as a minimum

PRE-CONSTRUCTION PHASE				
Impact management objectives of an EMPr	**Impact management actions**	**Impact management outcomes of an EMPr**	**Responsibility**	**Frequency/Timing**
	• All waste must be recycled where possible or disposed of at a registered landfill, proof of which must be provided and kept in the on-site environmental file; • All hazardous materials including paints, turpentine and thinners must be stored appropriately to prevent these contaminants from entering the environment; and • Spill-sorb or similar type product must be used to absorb hydrocarbon spills in the event that such spills should occur.			
Prevent unnecessary loss of heritage artefacts	• In the event of a cultural or heritage artefact being found all work must stop until the matter is resolved. Amafa aKwaZulu-Natali (Amafa) is to be contacted immediately and direction from the Amafa representative must be taken and adhered to; • The importance of heritage finds and the correct mitigation measures must be included in the environmental awareness training.	The prevention or the mitigation of the loss of heritage artefacts	Implementation: EM & Contractor Inspection: EM & ECO Verification: ECO	Implementation: Planning and approval stages Inspection: Pre-construction and *ad hoc* Verification: *Ad hoc* and monthly as a minimum
Protection of water resources	• A five meter grassed buffer from the edge of the wetland system, plus a sediment fence be employed during the construction phase; • No-go areas must be included in the environmental awareness training; • A Wetland Rehabilitation Plan must be generated.	The prevention or the mitigation of the loss of wetland systems.	Implementation: EM & Contractor Inspection: EM & ECO Verification: ECO	Implementation: Planning and approval stages Inspection: Pre-construction and *ad hoc* Verification: *Ad hoc* and monthly as a minimum

TABLE 8-2: *Construction Management Actions and Outcomes*

CONSTRUCTION PHASE				
Impact management objectives of an EMPr	**Impact management actions of an EMPr**	**Impact management outcomes of an EMPr**	**Responsibility**	**Frequency/Timing**
A thing aimed at or sought, a goal	*The process of doing something, typically to achieve an aim*	*The way a thing turns out; a consequence*		
Prevent soil contamination	• Hazardous materials/dangerous goods must be stored in a clearly marked, lockable, designated storage area; • MSDS's must be kept on site for all hazardous materials used on site; MSDS's must be easily accessible to staff; • Hazardous materials/dangerous goods must be stored within a bunded area which has the capacity to store 110% of the volume of the materials stored, and in accordance with the relevant MSDS's; • When decanting hazardous substances, drip trays must be used; • Should a spillage occur, an absorbent material e.g. sawdust / Oilcap must be spread on areas where oil spills have occurred. The resultant contaminated soil and sawdust must be lifted and placed within a high density plastic bag for storage / disposal; • Oil-contaminated soils are to be removed to a contained storage area and disposed of at a licensed facility. Disposal slips are to be retained in the environmental file as proof of safe disposal; and • Chemical toilets must be placed at least 100m outside of any watercourse. A registered chemical waste company is to be used to remove waste from the chemical toilets on site. Proof of servicing of chemical toilets must be kept by the contractor, in the on-site environmental file, for review purposes by the ECO if needed.	Avoidance of soil loss Re-use of viable soils in rehabilitation Avoidance of disposal of hazardous waste	Implementation: Contractor Inspection: EM & ECO Verification: ECO	Implementation: Ongoing Inspection: *Ad hoc* Verification: Monthly
Prevent soil loss	• Soil must be stockpiled in such a way as to minimize erosion; • Topsoil must be stockpiled such that re-use in rehabilitation is feasible; • The exposed soil surfaces must be protected from wind derived fugitive dust generation, if to be exposed for a period exceeding 2 months or in high wind conditions; • Where exposed surfaces will be exposed to surface run-off, diversion of surface run-off must be implemented to ensure erosion is avoided; and	Re-use of viable soil in rehabilitation Low / No fugitive dust deposition	Implementation: Contractor Inspection: EM Verification: ECO	Implementation: Ongoing Inspection: *Ad hoc* and weekly as a minimum Verification: Monthly

CONSTRUCTION PHASE				
Impact management objectives of an EMPr	**Impact management actions of an EMPr**	**Impact management outcomes of an EMPr**	**Responsibility**	**Frequency/Timing**
	• The re-use of soil and stockpiles must be prioritised in the construction phase, where geotechnically appropriate.			
Preservation of flora	• All construction areas must be demarcated prior to construction to ensure that the footprint of the impacts are limited (including areas where vehicles may traverse); • All alien invasive species within the construction and development footprint must be removed and follow up monitoring and removal programmes must be initiated once construction is complete; and • Reseed cleared areas with an indigenous seed mix to prevent soil erosion and enable rehabilitation.	A robust landscaped open space with appropriate indigenous vegetation to support flora and fauna. The wetland rehabilitation plan must be implemented. Progressive rehabilitation is encouraged;	Implementation: Contractor & Specialist where required Inspection: EM Verification: ECO	Implementation: Ongoing and during rehabilitation Inspection: *Ad hoc* and weekly as a minimum Verification: Monthly
Preservation of fauna	• Hunting and/or fishing activities on site is prohibited. This includes the setting of traps, or the killing of any animal caught in construction works; and • No animal, reptile or bird of any sort found on site may be killed. This specifically includes snakes or other animals considered potentially dangerous discovered on site. If such an animal is discovered on site, an appropriately skilled person should be summoned to remove the animal from the site. Consideration should be given to selection and nomination of such a person prior to site establishment. If no-one is available, training should be provided to at least two site staff members.	A robust landscaped open space with appropriate indigenous vegetation to support flora and fauna.	Implementation: Contractor Inspection: EM Verification: ECO	Implementation: Ongoing Inspection: *Ad hoc* and weekly as a minimum Verification: Monthly
Prevent increased surface runoff	• Care must be taken to ensure that in removing vegetation adequate erosion control measures are implemented; • A stormwater management plan, including sufficient erosion-control measures, has been compiled in consultation with a suitably qualified environmental practitioner / control officer during the detailed design phase prior to the commencement of construction, and must be implemented (Appendix 3); and	A well covered dense rehabilitated open space to reduce run-off energy and reduce peak flows. Establishment of stormwater retention facility	Implementation: Contractor Inspection: EM Verification: ECO	Implementation: Ongoing Inspection: *Ad hoc* and weekly as a minimum Verification:

CONSTRUCTION PHASE				
Impact management objectives of an EMPr	**Impact management actions of an EMPr**	**Impact management outcomes of an EMPr**	**Responsibility**	**Frequency/Timing**
	• The propagation of low-growing dense vegetation suitable for the habitat such as grasses, sedges or reeds is the best natural method to reduce erosion potential in sensitive areas and therefore must be implemented.			Monthly
Preserve air quality	• Heavy vehicles and machinery must be serviced regularly to minimise exhaust fume pollution; • Soil stockpiles must be located in areas to limit the erosive effects of the wind, which will limit dust; • Removal of vegetation must be avoided until such time as soil stripping is required, which will limit dust; • Limit vehicle speeds on unpaved roads must be set at 20 km/h to limit the amount of dust generated; • Haulage distances must be at a minimum; • Environmentally friendly soil stabilisers may be used to control dust on gravel roads and construction areas; • All equipment must be kept in good working order; • Equipment must be operated within its specifications and capacity and must not be overloaded; • All machinery/plant must be serviced and lubricated regularly to ensure a good working order; and • The entire Contractors' vehicles must be fitted with effective exhaust silencers and shall comply with Road Traffic Act (Act 29 of 1989) when any such vehicle is operated on a public road.	No fugitive dust exceeding SANS regulations or creating nuisance conditions	Implementation: Contractor Inspection: EM & ECO Verification: ECO	Implementation: Monthly or at the prescribed vehicle/plant manufacturers specifications Daily for management measures Inspection: *Ad hoc* and weekly as a minimum Verification: Monthly
Prevent noise pollution	• Noise sources must conform to the South African Bureau of Standards recommended code of practice, SANS Code 0103:1983,; and • All the Contractors' equipment must be fitted with effective exhaust silencers and shall comply with the South African Bureau of Standards recommended code of practice and the South African National Standard (SANS) Code 0103:1983, for construction plant noise generation.	No ambient noise impacts relating to plant operations Compliance to municipal by-laws No nuisance conditions created	Implementation: Contractor Inspection: EM & ECO Verification: ECO	Implementation: Monthly or at the prescribed vehicle/plant manufacturers specifications Daily for management measures

CONSTRUCTION PHASE				
Impact management objectives of an EMPr	**Impact management actions of an EMPr**	**Impact management outcomes of an EMPr**	**Responsibility**	**Frequency/Timing**
				Inspection: *Ad hoc* and weekly as a minimum Verification: Monthly
Prevent unnecessary impedance of traffic	• Minimise possible lane closures, traffic delays and congestion during the pre-construction phase; • Appropriate flagmen and signage must be provided on the roadside in compliance with the requirements of relevant road department authority; • Sufficient area for the storage of heavy vehicles within the construction site must be provided; • Vehicle traffic which may obstruct traffic flow must be scheduled outside of peak travelling times; • Heavy / large load traffic must be appropriately routed and appropriate safety precautions must be taken to prohibit road collisions and traffic incidences; • All vehicle operators must be suitably licensed, must have had appropriate environmental and safety induction, must aware of specific site procedures, and must be well rested and cognisant when operating heavy or unsafe vehicles / machinery; and • Public consultation informing residents of alternative routes prior to the commencement of construction activities, or duration of construction activities must occur. Proof is to be provided to the ECO.	The prevention or the mitigation of the impedance of traffic Avoidance of collisions associated with the construction operations Informed IAPs	Implementation: Contractor & Engineer Inspection: EM & ECO Verification: ECO	Implementation: Planning and approval stages Inspection: Pre-construction and *ad hoc* Verification: *Ad hoc* and monthly as a minimum
Prevent the spread of waste	• Demarcated areas must be established where waste can be securely contained and stored on a temporary basis during the construction phase. When adequate volumes (not more than 1 month) have accumulated all waste must be removed from site and disposed of at a licensed facility. Proof of safe disposal slips must be maintained in the on-site environmental file;	The prevention or the mitigation of the spread of waste Compliance to the Norms and Standards for the storage of waste	Implementation: Contractor Inspection: EM & ECO Verification:	Implementation: Daily and *ad hoc* Inspection: *Ad hoc* and weekly as a minimum

CONSTRUCTION PHASE				
Impact management objectives of an EMPr	**Impact management actions of an EMPr**	**Impact management outcomes of an EMPr**	**Responsibility**	**Frequency/Timing**
	• Litter must be removed from all construction areas prior to construction commencing; • Should skips be used for the storage and transportation of waste, these must be emptied once full and covered to prevent waste from being blown away; • Waste is not to be buried or burned on site; • All waste must be recycled where possible or disposed of at a registered landfill, proof of which must be provided; • All hazardous materials including paints, turpentine and thinners must be stored appropriately to prevent these contaminants from entering the environment; and • Spill-sorb or similar type product must be used to absorb hydrocarbon spills in the event that such spills should occur.	No presence of nuisance vectors	ECO	Verification: Monthly
Prevent unnecessary loss of heritage artefacts	• In the event of a cultural or heritage artefact being found all work must stop until the matter is resolved. Amafa aKwaZulu-Natali (Amafa) is to be contacted immediately and direction from the Amafa representative must be taken and adhered to; • The importance of heritage finds and the correct mitigation measures must be included in the environmental awareness training.	The prevention or the mitigation of the loss of heritage artefacts	Implementation: EM & Contractor Inspection: EM & ECO Verification: ECO	Implementation: Planning and approval stages Inspection: Pre-construction and *ad hoc* Verification: *Ad hoc* and monthly as a minimum
Employee training and skills development	• Environmentally focused toolbox talks must be undertaken at least once a week. Content must include matters included in this EMPr e.g. alien vegetation control, littering, erosion control etc.; and • A register of attendance at each toolbox talk must be maintained in the environmental file.	Educate staff regarding environmental protection	Implementation: Contractor Inspection: EM & ECO Verification: ECO	Implementation: Daily and *ad hoc* Inspection: *Ad hoc* and weekly as a minimum Verification: Monthly

CONSTRUCTION PHASE				
Impact management objectives of an EMPr	**Impact management actions of an EMPr**	**Impact management outcomes of an EMPr**	**Responsibility**	**Frequency/Timing**
Water resources	• A five meter grassed buffer from the edge of the wetland system, plus a sediment fence be employed during the construction phase; • No-go areas must be included in the environmental awareness training; A Wetland Rehabilitation Plan must be generated.	The prevention or the mitigation of the loss of wetland systems.	Implementation: EM & Contractor Inspection: EM & ECO Verification: ECO	Implementation: Planning and approval stages Inspection: Pre-construction and *ad hoc* Verification: *Ad hoc* and monthly as a minimum

TABLE 8-3: *Post-Construction and Rehabilitation Management Actions and Outcomes*

POST-CONSTRUCTION AND REHABILITATION PHASE				
Impact management objectives of an EMPr	**Impact management actions of an EMPr**	**Impact management outcomes of an EMPr**	**Responsibility**	**Frequency/Timing**
A thing aimed at or sought, a goal	*The process of doing something, typically to achieve an aim*	*The way a thing turns out; a consequence*		
Rehabilitation	• On completion of the project, the appointed contractor must ensure that all structures, equipment, materials, waste, rubble, notice boards and temporary fences used during construction are removed; • All construction waste / debris must be removed from within the construction footprint and disposed off-site at an approved landfill site; • Progressive rehabilitation must be undertaken throughout the construction phase of the project where areas have been impacted upon. Rehabilitation should commence as soon as construction is completed in a specific area and not at the end of the entire project; • Post construction, any areas disturbed outside of the construction footprint due to construction activities must be rehabilitated by appropriate landscaping, topsoil dressing, alien plant rehabilitation and vegetation establishment; • Post construction, all disturbed and open surfaces must be planted with indigenous grasses; and • Where necessary, topsoil must be imported to the site in question, prior to regrassing of the site. It is preferred that the topsoil used is excess topsoil from another portion of the site.	Ensure environmental degradation associated with construction is remediated	Implementation: Contractor Inspection: EM Verification: ECO	Implementation: Ongoing Inspection: Ad hoc Verification: In conjunction with monthly construction audits during the construction phase, and in accordance with EA during operational phase.

9. STAFF CONDUCT CONTROL AND INFORMATION SHEET

ALL STAFF MUST OBEY THE FOLLOWING RULES:	
1	**DO NOT** tamper with or destroy nesting sites, lairs or any other form of animal shelter.
2	**DO NOT** leave the construction sites untidy and strewn with rubbish that will attract animal pests.
3	**DO NOT** trespass on private properties not linked to the project or adjacent to the project.
4	**DO NOT** carry a weapon on the construction sites or in the vehicles transporting workers to and from the construction sites.
5	**DO NOT** set fires unnecessarily.
6	**DO NOT** cause any unnecessary disturbing noise at the construction site or at any designated worker collection/drop off points.
7	**DO NOT** drive a vehicle under the influence of alcohol.
8	**DO NOT** exceed the national speed limits on public roads.
9	**DO NOT** drive a vehicle that is generating excessive noise (noisy vehicles must be reported and repaired as soon as possible).
10	**DO NOT** litter along the roadsides, including both public and private roads.
11	**DO NOT** remove or destroy vegetation at the construction camp / construction site without the prior consent of the Contractor and ECO.
12	**DO NOT** tamper with, destroy or remove vegetation from any areas that have been fenced off or marked.
13	**DO NOT** pollute watercourses, whether flowing or not.
14	**DO NOT** drive through the watercourses except at designated points.
15	**DO NOT** operate critical items of mechanical equipment without having been trained and certified.
16	**ALL** employees must undergo the necessary safety training and wear the necessary protective clothing at all times.
17	**NO** ad-hoc activities are to be undertaken e.g. fires for cooking, the use of surrounding bush as a toilet facility is strictly forbidden
18	**NO** worker may be forced to do work that is potentially dangerous or for what he / she is not trained to do.

10. ALIEN PLANT CONTROL

Best practice measures that must be undertaken during site clearing include the following:

(i) Cut plants as low to ground as possible.
(ii) All alien plants must be removed carefully and exposed soil should be covered with cut vegetation or leaf litter that is free of weed seeds to ensure that regrowth will not occur.
(iii) Press any loosened soil down carefully and firmly and mulch with plant material where possible.
(iv) All alien seeds, fruit bulbs, tubers and stems must be collected and placed in a sealable container/plastic bag for disposal at a landfill site.
(v) The roots system of mature trees including alien invasive play an important role in stabilising soil and therefore the up-rooting of large mature specimen of trees is not advocated. It is better to fell the trees and paint the stump with the relevant herbicides.

Alien plant control methods are provided in Table 10-1.

TABLE 10-1: *Control methods*

METHOD	DESCRIPTION
MECHANICAL METHOD	
Hand pulling/ hoeing	• Hand pulling is most effective with small (30cm), immature or shallow rooted plants. • Shake the excess sandy material from the plant, this makes the plant easier to stockpile and lighter to transport. • However, make sure there is no seed on the plant first to eliminate the spread of seed while shaking.
Chopping/ cutting/ slashing	• This method is most effective for plants in the immature stage, or for plants that have relatively woody stems/ trunks. • This is an effective method for non-re-sprouters or in the case of re-sprouts (coppicing) it must be done in conjunction with chemical treatment of the cut stumps. **Note** • Cut/slash the stem of the plant as near as possible to ground level. • Paint re-sprouting plants (i.e. Black Wattle, Lantana and Port Jackson willow) with an appropriate herbicide immediately after they have been cut. • Stockpile removed material into piles as prescribed.
Felling	• De-branch trees and where possible remove all material. • Where possible large trees that are to be felled such that they fall uphill. • Cut the tree down as low as possible to the ground. • Apply herbicide immediately (no later than 30mins) to the cambium layer. • Ensure all the cuts in the cambium layer are treated.
Ring barking	• Remove bark in a 30-40cm centimetre band and leave the tree to die • Can be used with or without chemicals but is more successful when herbicide is used

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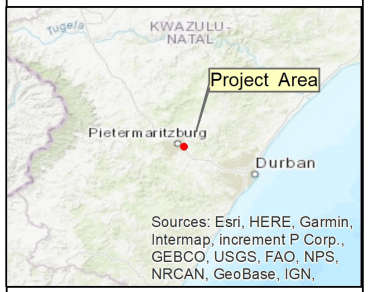
Proposed Lincoln Meade Residential Development Msunduzi Municipality

Date: 22/11/2019

Site Map



Legend

- Property Boundary
- Wetland Area
- 1:100 Year Floodline
- 1:50 Year Floodline
- Proposed Internal Roads
- Proposed Stormwater Attenuation Ponds
- Existing Residential Unit
- Proposed Residential Units

Services

- Exisitng Municipal Sewer Line
- Proposed Internal Sewer Line
- Existing Water Main
- Internal Water Reticulation
- Grass Swales
- Trapezoidal Stormwater Drain

Scale (A3): 1:800

APPENDIX 2: EMPR ACKNOWLEDGEMENT FORM

ERF 61, LINCOLN MEADE HOUSING DEVELOPMENT

Record of signatures providing acknowledgment of being aware of, and committed to complying with the contents of this Environmental Management Programme (EMPr), which relates to the environmental management, mitigation and rehabilitation measures for the project outlined above, and the environmental conditions contained in the civil and other construction contract documents.

AUTHORISATION HOLDER:

Signed: …….. Date: …….....

CONTRACTOR:

Signed: …….. Date: …….....

SUB-CONTRACTOR/S:

Signed: …….. Date: …….....

ECO:

Signed: …….. Date: …….....

APPENDIX 3: STORMWATER MANAGEMENT PLAN

ERF 61 LINCOLN MEADE DEVELOPMENT

STORMWATER MANAGEMENT PLAN

REVISION 0

UMSUNGULI PROJECT MANAGEMENT

PO Box 68, Merrivale 3291
Phone: 033-330 8386

JULY 2018

ERF 61 LINCOLN MEADE
PIETERMARITZBURG

RESIDENTIAL DEVELOPMENT

STORMWATER MANAGEMNT PLAN
REVISION 0

INDEX

1. INTRODUCTION

In support of the rezoning and environmental applications for the proposed development, Umsunguli Project Management cc has been appointed by Person Drive Trading (Pty) Ltd to undertake a Stormwater Management Plan for the proposed development to establish 24 residential units on Erf 61 along Grimthorpe Avenue in Lincoln Meade, located within Msunduzi Municipality.

The purpose of the Storm Water Management Plan is

- The protection of development and public interests
- The preservation of the natural environment
- The preservation of the existing stream, wetlands and drainage lines
- The management of the expected increase of surface runoff into natural drainage areas
- Protection of underground resources and water quality
- Conservation of water and making it available to public
- The desire to provide optimum methods of controlling runoff
- Striving for sustainable environment while pursuing economic development

2. EXISTING SYSTEM

The land development area is overgrown vegetation including a small dwelling and outbuildings. It was not possible to walk down to the stream due to the thickness of the vegetation on site. The site has a gentle slope towards the stream and there is no formal stormwater system in place, with all run-off from gutters, roofs and unpaved parking area flowing towards the stream. Stormwater from Grimthorpe Avenue does not enter the site and this should be maintained.

3. PROPOSED SYSTEM

a. Overview

The proposed storm water system must be designed to have minimal impact on the stream, through the careful implementation of sustainable drainage systems (SuDS) and stormwater management systems.

The transformation of the undeveloped land to hardened surfaces increases the surface runoff from the transformed areas, which reduces the infiltration of surface water into the underground resources. It is thus important to create artificial filtration areas, through the encouragement of rainwater harvesting, construction of two strategically located attenuation ponds along the edge of the development footprint as illustrated in Annexure A. The attenuation ponds will blend into the landscaping of the development and should be located outside the main channel of the stream, but be along the edge of the degraded wetland area.

All stormwater related structures, pipes, attenuation ponds and drains must be designed by the project engineer in consultation with the project Environmental Control Officer.

This can be achieved through three main stormwater management systems, namely:

- The encouragement of rainwater harvesting tanks to act as the first form of attenuation;
- The construction of two, off channel, attenuation ponds within the degraded wetland area with controlled outlets into the stream; and
- The construction of stormwater catchpits and pipes along the hardened road areas

b. Erosion Control

The design of the storm water system must make provision for erosion protection, as the transformed area, after construction will have a greater surface run-off that will contribute to higher flows. It is therefore essential that the transformed areas have to be vegetated and rehabilitated as soon as possible after the completion of bulk earthworks, roadworks and foundation work. Erosion control measures could be a combination of attenuation ponds, grass sods, soilsaver, stone pitching, silt traps, geofabrics, gabion baskets and mattresses, energy dissipaters and grass lined drains.

Additional methods to minimise erosion within the development area include:

- Open exposed areas should be planted with grass or landscaped into gardens.
- Using natural rock and boulders to act as energy dissipaters.
- All exposed embankments should be covered in 100mm topsoil and planted with grass sods and staked to prevent washing away.
- All cut/fill embankments steeper than 1:2 should be covered in Soilsaver with sufficient overlaps, covered in 100mm topsoil and planted with grass.
- Reducing the velocity of all stormwater run-off through energy dissipaters
- Promotion of infiltration of surface run-off through the introduction of sustainable drainage systems, especially at the outlets from the stormwater attenuation ponds

c. Surface run-off

The implementation of rainwater harvesting must form part of the Home Owners Association rules and rainwater harvesting tanks will act at the first form of attenuation, whilst it could also serve other uses. It should however be noted, that rainwater tanks are not recognized by the municipality as a form of attenuation, as the tanks could be full and not attenuate any flow – thus the surface run-off must be calculated by excluding the rainwater harvesting tanks in order to size pipes and attenuation ponds. Run-off from roofs should be collected in gutters and stored in rainwater tanks for the utilization of gardening and other domestic activities. Any overflow from the tanks or gutters will be dispersed into swales and thereafter directed and collected into

attenuation ponds. Surface run-off from roads, parking areas and other hardened areas will be collected in kerb and channels along the roads and diverted into the two strategically positioned stormwater attenuation ponds. The stormwater attenuation ponds should be located outside the main stream area within the rehabilitated wetland buffer area and be fenced off to ensure contractors do not interfere with the wetland rehabilitation program.

The stormwater system must be kept separate from the sewage system and any contamination of surface runoff must be avoided.

4. INTERNAL ROADS AND PARKING AREAS

A site development plan has been produced by the architect and environmentalist, showing the various residential sites and road reserves in relation to the land development area. The hardened surface areas from the roads, house roofs and other buildings are the main contributing factors in the increased run-off within the development. Where possible, grass blocks and rain gardens should be introduced along roads and in parking areas to promote infiltration of storm water run-off.

The geometric design of the internal road network will include crossfalls that direct the run-off along kerbs into grid inlets and catchpits. Once collected, stormwater will be conveyed through underground concrete pipes, with an outlet into the respective stormwater attenuation pond. As mentioned in "section 3.b", methods of dissipating the kinetic energy of run-off and silt collection will be incorporated into the design of stormwater infrastructure serving the road network.

The storm water infrastructure will be constructed in accordance with the *"Guidelines for Human Settlement Planning and Designs",* service agreements concluded or municipal bylaws, where applicable.

For sizing and design of storm water infrastructure and the attenuation pond, calculation of the anticipated storm water run-off will be determined on the assumption that all roofed areas, roads and parking are considered hardened with an appropriate run-off co-efficient. Roof and gutter run-off will be included in the calculations due to the fact that rainwater tanks are not recognized by the municipality as a form of attenuation.

The standards for the storm water infrastructure to be installed in the proposed development can be summarised as follows:

- Flood recurrence interval : 5 years and at critical points 10 years
- Attenuation structures : 50 years
- Pipe material : Concrete
- Pipe Class : 100D in traffic areas, 75D in other areas
- Pipe diameters : 300mm Ø (minimum)
- Bedding : Class C
- Inlets : Catchpits / Steel Grid Inlets
- Outlets : Headwalls
- Junctions : Points of deflection on pipelines
- Road / Parking surface : Asphalt/concrete/pavers

5. STORMWATER MANAGEMENT

The objective of a storm water management plan should be to manage the storm water resources of the collective watersheds to:

- Prevent flood damage or concentration of run-off
- Divert storm water and surface run-off from buildings, roads and parking areas into rainwater harvesting tanks, swales or a piped system flowing into a stormwater attenuation pond
- Protect the stream and keep all construction outside the 1:100 year floodline
- Preserve the natural and beneficial functions of the natural drainage system downstream
- Preserve and enhance storm water quality
- Attenuate the difference between pre and post development flows

The proposed storm water management system has been designed to be self-regulating with no external control. It will aim to collect run-off into rainwater harvesting tank, swales, underground pipes with an attenuation pond to attenuate and manage the increase in flow between the pre and post development stages from the transformed areas.

The run-off from the roofs, gutters and downpipes shall be collected in rainwater harvesting tanks taking into account any overflows being dispersed overland into swales and ultimately collected into underground stormwater systems and contained in two stormwater attenuation ponds. Hardened areas, like roads and parking areas will be routed overland, collected in kerbs and channels and into grid inlets or catchpits where it is collected in concrete stormwater pipes and diverted into the two stormwater attenuation ponds along the lower boundary of the site where increased flow will be attenuated, whilst silt is deposited. The stormwater attenuation ponds should be located along the lower end of the site, but outside the main stream area to encourage the infiltration of stormwater, whilst silt is collected. The outlet or discharge from the attenuation pond will be protected with gabion mattresses and other energy dissipaters from where it will be released into the natural drainage areas and stream in a controlled manner. Both attenuation ponds will form part of the rehabilitation program of the wetland buffer zones, which are fairly degraded.

6. STORMWATER RUNOFF

Current storm water runoff volumes are based on the following information and assumptions:

- Site Development Plan provided by the architect and environmentalist
- Internal roads areas calculated from layout
- The hardened transformed area for the proposed type of units varies between 82m^2 (two bedroom) and 105m^2 (three bedroom) per residential site
- The use of grid inlets and storm water pipe network to collect, transport and divert run-off into the two attenuation ponds
- Constructing two stormwater attenuation ponds along the lower portion of the site

The storm water run-off has been calculated using the accepted "Rational Method" that takes into account the drainage area, nature of the soil surface and the storm intensity. The storm intensity used for calculation purposes is:

- 25,0mm for a 1:10 year return period; and
- 41,3mm for a 1:50 year return period
- Time of Concentration is 15 minutes
- Retention time is 15 minutes

This equates to a storm intensity of 100mm/hour and 165mm/hour for a 1:10 and 1:50 year storm return period respectively. These values are the norm for Msunduzi Municipality.

Allowances have been made for the various areas and their contribution to the flow and the coefficient of discharge for the various areas is as follows:

- Pre development grassed areas are taken as 0,29
- Post development grassed areas are taken as 0,45
- Buildings are taken as 0,85
- Roads and Parking areas are taken as 0,85

The changes in the ground cover in the post development phase are tabulated in Table 1.

Table 1: Site Coverage

ERF 61 LINCOLN MEADE - SUMMARY OF SITE COVERAGE									
Area	Site Size (m^2)	Pre Development		Post Development					
		Grass	%	Grass	%	Buildings	%	Roads / Parking	%
AP1	3 779	3 779	100%	1958	52%	978	26%	843	22%
AP2	5 152	5 152	100%	3118	61%	1518	29%	516	10%

The Pre and Post Development storm water runoff has been calculated for buildings, parking areas and roads within the development and are summarised in Table 2 below.

Table 2: Summary of Storm Water Calculations

ERF 61 LINCOLN MEADE SUMMARY OF STORMWATER CALCULATIONS					
Site Number	Site Size (m^2)	Pre Development Flow (m^3/s)	Post Development Flow (m^3/s)	Increase in Flow (m^3/s)	Attenuation Volume Required (m^3)
AP1	3 779	0,041	0,092	0,051	46
AP2	5 152	0,057	0,119	0,062	56
TOTALS	**8 931**	**0,098**	**0,212**	**0,114**	**102**

The detailed calculations of the storm water run-off for the pre and post development are attached as Annexure B for reference purposes.

7. STORMWATER FLOW ATTENUATION

The need for attenuation of the storm water flow is recognised in order to minimise the peak flow across the property and from each of the buildings, hardened parking areas and roads before its eventual discharge. The distribution of the increase flow is of importance to ensure that any downstream facility is not negatively affected.

The proposed development will be transformed from the existing overgrown vegetation, gradually sloped profile to levelled platforms. This transformation in ground profile will reduce the velocity as the new platforms will be flatter than the original ground profile. However, it's the transformation of natural vegetation to grass embankments, buildings, roads and parking areas that will increase the run-off and storm water flow. It is due to this increase from the pre-development flow to the post-development flow that attenuation of this increased run-off would be required.

Refer to Annexure C to see examples of the stormwater attenuation pond, whilst Annexure A shows the proposed stormwater infrastructure on the site development plan.

Storm water attenuation calculations have been using:

The Rational Method $Q=f_t \times C \times I \times A/360$, where

Q = the maximum/peak rate of run-off in cumecs (m^3/s)
f_t = an adjustment factor for the recurrence interval storm considered
C = run-off coefficient
I = rainfall intensity (mm/hour)
A = area of the catchment in hectares (1ha = 10,000m^2)

The following basic factors were used during the calculations, being:

- Return Period of 1:50 years
- Rainfall intensity of 165mm/hour
- f_t of 0,83 is used for 1:50 year return period
- C-factor of 0,29 for pre development areas
- C-factor of 0,45 for post development grassed areas
- C-factor of 0,85 for building and roof areas
- C-factor of 0,85 for roads and parking areas
- Time of Concentration = 15 minutes
- Retention Time = 15 minutes

Typical open attenuation ponds can vary in depth depending on the requirements, slope at outlet, available space and downstream conditions although a water depth of 1,5m is normally acceptable, including a freeboard of at least 0,5m above the full water level to prevent overtopping. This depth can however vary, but not less than 1m should landscaping and aesthetics require it to be shallower. It should be noted that ponds less than 1m in depth could lead to plant growth covering the entire pond over time (depending on the type of plants and reeds used). This could seriously impact on the effectiveness of the attenuation pond during periods of high rainfall and flow. All attenuation ponds will also be provided with at

least 300mm silt trap, where the base of the attenuation pond is 300mm lower than the pre-development outlet structure – this allows for silt to settle in the pond and plants to grow in the shallow water.

The size of the various attenuation structures and supporting calculations are included as Annexure B with this report for reference purposes.

8. MONITORING AND MAINTENANCE

a. Monitoring

The storm water system must to be monitored during construction at regular intervals by the Environmental Control Officer (ECO) in terms of the Environmental Management Programme (EMPr). It is also critically important that the site is fenced off prior to construction, including the stormwater attenuation pond area, to ensure that the wetland rehabilitation process and area outside the site development area remains in its natural condition during the construction process.

During the construction phase of the development, the construction process should be monitored against the EMPr, but should pay attention to the following aspects:

- Implementing temporary attenuation measures, such as earth berms to retain surface run-off until the attenuation areas are complete and functional.
- Providing a silt screen at all grid inlets to collect debris and silt during times of heavy rain.
- Controlling dust, especially during the construction of roads and house platforms.
- Placing topsoil and grass sods onto cut/fill embankments to reduce runoff and velocity, including the use of Soilsaver where embankments are steep.
- Construction of the stormwater attenuation pond as soon as possible.
- Planting of grass and other vegetation as soon as open areas are complete to prevent scouring and erosion of the low cohesion soils found on site.
- Fencing off the construction area and keeping all construction vehicles off the undeveloped portions of vegetation and buffer areas.

On completion of the construction, the Home Owners Association will be responsible to monitor their internal storm water system and attenuation facilities to identify improvements / maintenance. The factors to be monitored include the functionality and impact of the rainwater harvesting tanks on the properties, internal roads, stormwater pipes and attenuation ponds and how they are functioning and if they are adequate.

The post development monitoring process should be done at regular intervals (suggested 6 monthly) to include the following activities:

- Product (catchpits, headwalls, concrete pipes, attenuation ponds and rainwater harvesting tanks)
- Type of maintenance (rehabilitation, improvement, new)
- Urgency (immediate, next 6 months, next 12 months) and description of work to be carried out

b. Operation and Maintenance

The system as designed requires no manual operation, and is self-regulating. Maintenance work should be undertaken as required to restore and maintain the system to its original design, especially to repair and maintain scouring and erosion, especially at the outlets from the stormwater attenuation ponds.

The operation and maintenance of the storm water system is essential to ensure it functions properly to prevent damages or failures and must receive high priority from the Home Owners Association.

During the construction period, it is important that surface runoff is monitored, controlled and temporary measures be implemented until the construction is complete and the system can function independently. This is therefore an important aspect to be monitored by the ECO during the construction stage.

Routine maintenance will be the responsibility of the Home Owners Association and should include:

- Clearing of kerb and channels, catchpits, stormwater pipes and attenuation ponds (rainwater harvesting tanks will be maintained by homeowners)
- Removal of silt from collection points and attenuation pond
- Plant/weed control
- Cutting grass on embankments

It is however recommended that specialist service providers implement more technical works like the replacement of storm water pipes and remedial work to the stormwater attenuation ponds, if required.

9. RECOMMENDATIONS

The following recommendations are made for the proposed development situated on Erf 61 Lincoln Meade:

9.1 That the storm water design parameters used in the design of the storm water management system are accepted and approved.

9.2 The detail design of the storm water system includes recommendations of this plan.

9.3 Rainwater harvesting should be encouraged at all residential dwellings.

9.4 Rainwater harvesting tanks should be included in building plans submitted to the municipality for building plan approval.

9.5 The stormwater attenuation ponds should be constructed off-channel and within the buffer zone where the wetland rehabilitation process will be undertaken.

9.6 The storm water system must be kept separate from the sewerage system.

9.7 All chemicals, cement, fuel and other hazardous material used during construction should be stored in controlled areas and not lower than the internal road.

9.8 Concentration of storm water should be prevented where possible, but energy dissipaters should be provided in areas of concentration.

9.9 On completion of every construction phase within the development, comprising the construction of buildings, roads and parking areas, all remaining exposed embankments and open areas must be vegetated as soon as possible, including the use of “Soilsaver”, where necessary.

9.10 During the construction phase, the following aspects should be closely monitored by the ECO to ensure the contractor complies:

- Temporary berms and cut-off drains must be provided on site to collect run-off, especially until the stormwater attenuation pond is complete and functional.
- Silt screens must be provided at the catchpits during road/stormwater construction.
- Topsoil must be conserved on site and prevented from entering the stormwater system.
- Exposed embankments, cut/fill slopes and open areas must be vegetated as soon as possible to reduce runoff.
- Dust control during construction must be applied at all times.
- Excess spoil material from topsoil or bulk earthworks must be placed in areas or even removed entirely off site to minimise silt deposition, scouring and soil erosion.
- Post construction, all exposed areas must be covered in vegetation, grass or landscaped.

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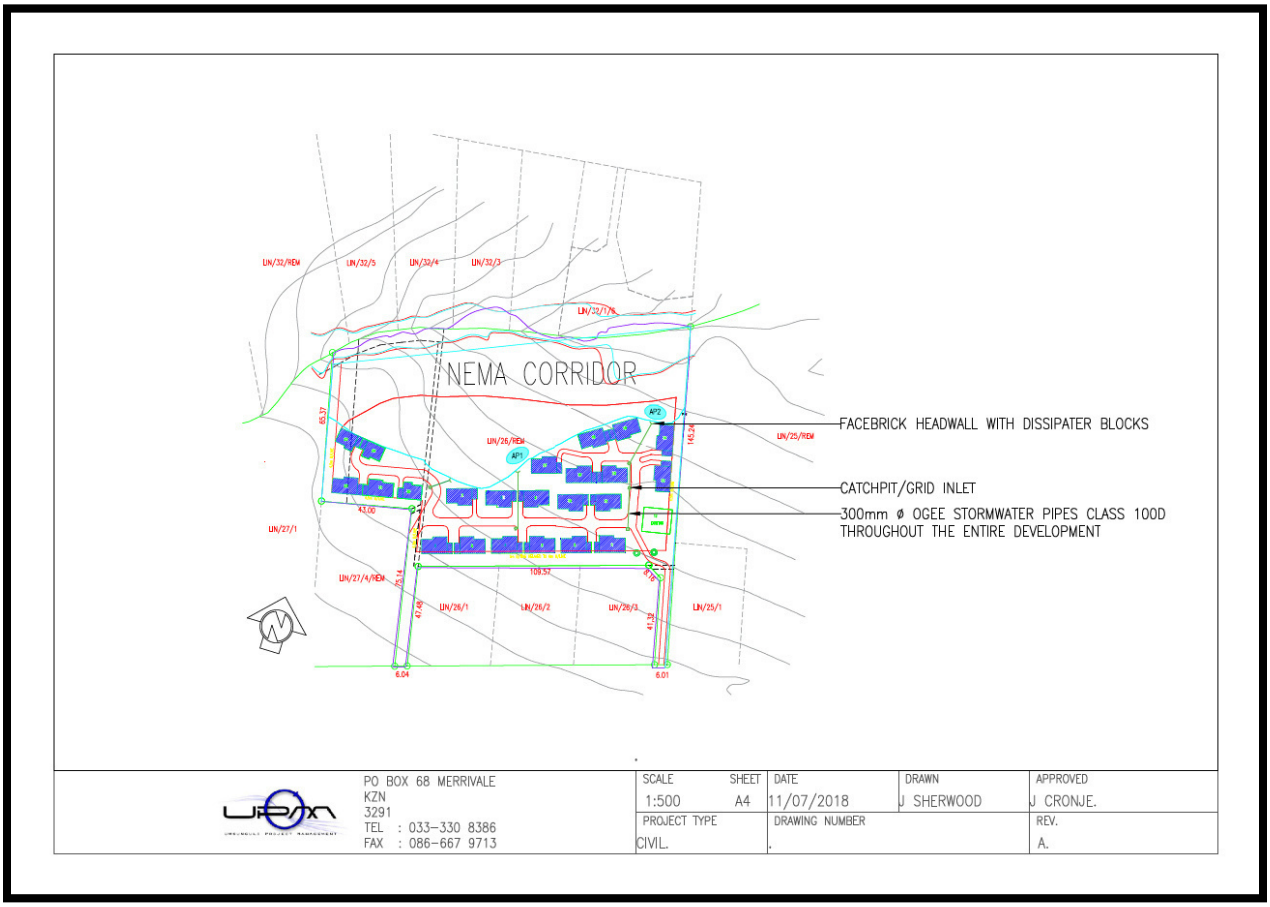
ANNEXURE A

STORMWATER LAYOUT PLAN



ANNEXURE B

STORM WATER CALCULATIONS

ERF 61 LINCOLN MEADE - STORMWATER FLOW CALCULATIONS					
TIME OF CONCENTRATION:	15	minutes			**Attenuation Pond 1**
RETURN PERIOD:	1:50	years			
DEPTH INTENSITY:	165	mm/hour			
PRE DEVELOPMENT RUN OFF CALCULATIONS					
Surface Description	**Area (m^2)**	**C**	**Ft**	**A*C**	**Peak Flow (m^3/sec)**
Natural Veld/Grass	3779	0,29	0,83	894	0,041
TOTAL	**3779**			**Qri(pre)**	**0,041**
POST DEVELOPMENT RUN OFF CALCULATIONS					
Surface Description	**Area (m^2)**	**C**	**Ft**	**A*C**	**Peak Flow (m^3/sec)**
Grassed areas around buildings	1958	0,45	0,83	731	0,034
New Buildings	978	0,85	0,83	690	0,032
New internal roads and parking areas	843	0,85	0,83	595	0,027
TOTAL	**3779**			**Qri(post)**	**0,092**
AVERAGE RUN OFF COEFFICIENT IN DEVELOPED AREA		0,72			
PRE-DEVELOPMENT RUN OFF Vri(pre)=Qri*60*15(m^3)		37			
POST-DEVELOPMENT RUN OFF Vri(post)=Qri*60*15(m^3)		83			
REQUIRED STORAGE (m^3) [Vri(post) - Vri(pre)]		**46**			

ERF 61 LINCOLN MEADE - STORMWATER FLOW CALCULATIONS					
TIME OF CONCENTRATION:	15	minutes			**Attenuation Pond 2**
RETURN PERIOD:	1:50	years			
DEPTH INTENSITY:	165	mm/hour			
PRE DEVELOPMENT RUN OFF CALCULATIONS					
Surface Description	**Area (m^2)**	**C**	**Ft**	**A*C**	**Peak Flow (m^3/sec)**
Natural Veld/Grass	5152	0,29	0,83	1240	0,057
TOTAL	**5152**			**Qri(pre)**	**0,057**
POST DEVELOPMENT RUN OFF CALCULATIONS					
Surface Description	**Area (m^2)**	**C**	**Ft**	**A*C**	**Peak Flow (m^3/sec)**
Grassed areas around buildings	3118	0,45	0,83	1165	0,053
New Buildings	1518	0,85	0,83	1071	0,049
New internal roads and parking areas	516	0,85	0,83	364	0,017
TOTAL	**5152**			**Qri(post)**	**0,119**
AVERAGE RUN OFF COEFFICIENT IN DEVELOPED AREA		0,72			
PRE-DEVELOPMENT RUN OFF Vri(pre)=Qri*60*15(m^3)		51			
POST-DEVELOPMENT RUN OFF Vri(post)=Qri*60*15(m^3)		107			
REQUIRED STORAGE (m^3) [Vri(post) - Vri(pre)]		**56**			

ANNEXURE C

PRACTICAL EXAMPLES OF SWALES

AND ATTENUATION PONDS