

Appendix D: Screening Tool Report

**SCREENING REPORT FOR AN ENVIRONMENTAL AUTHORIZATION AS
REQUIRED BY THE 2014 EIA REGULATIONS – PROPOSED SITE
ENVIRONMENTAL SENSITIVITY**

EIA Reference number: Old 2013 16/3/1/5/D2/19/0021/12

Project name: EA Part 2 Amendment

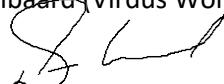
Project title: Erf 28005, George

Date screening report generated: 10/04/2026 14:40:30

Applicant: George Residential Apartments (Pty) Ltd

Compiler: Dupré Lombard (Virdus Works (Pty) Ltd) EAP 2019/304

Compiler signature:


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Application Category: Transformation of land | Indigenous vegetation

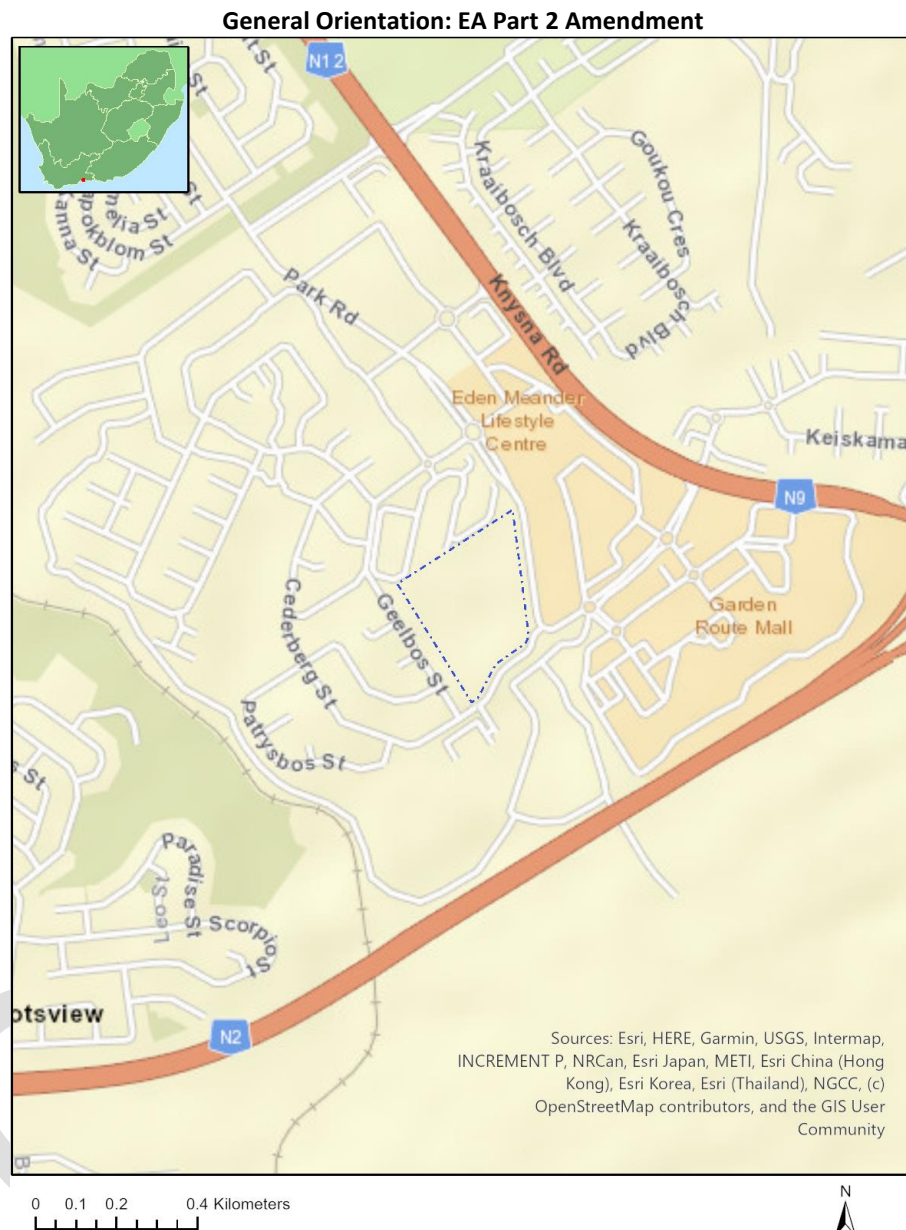


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Proposed Project Location

Orientation map 1: General location



Map of proposed site and relevant area(s)



Cadastral details of the proposed site

Property details:

No	Farm Name	Farm/ Erf No	Portion	Latitude	Longitude	Property Type
1	GEORGE	25492	0	33°59'8.6S	22°29'55.16E	Erven
2	GEORGE	25361	0	33°59'7.72S	22°29'54.24E	Erven
3	GEORGE	25359	0	33°59'11.11S	22°29'50.25E	Erven
4	GEORGE	28005	0	33°59'10.84S	22°29'50.26E	Erven
5	GEORGE	28004	0	33°59'10.95S	22°29'50.28E	Erven
6	KRAAI BOSCH	195	22	33°59'11.36S	22°29'50.34E	Farm Portion
7	KRAAI BOSCH	195	22	33°59'22.63S	22°29'51E	Farm Portion

Development footprint¹ vertices:

No development footprint(s) specified.

Wind and Solar developments with an approved Environmental Authorisation or applications under consideration within 30 km of the proposed area

No	EIA Reference No	Classification	Status of application	Distance from proposed area (km)
1	14/12/16/3/3/1/1292	Solar PV	Approved	12

¹ "development footprint", means the area within the site on which the development will take place and includes all ancillary developments for example roads, power lines, boundary walls, paving etc. which require vegetation clearance or which will be disturbed and for which the application has been submitted.

2	14/12/16/3/3/1/1292/AM1	Solar PV	Approved	12
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Environmental Management Frameworks relevant to the application

No intersections with EMF areas found.

Environmental screening results and assessment outcomes

The following sections contain a summary of any development incentives, restrictions, exclusions or prohibitions that apply to the proposed development site as well as the most environmental sensitive features on the site based on the site sensitivity screening results for the application classification that was selected. The application classification selected for this report is:

Transformation of land | Indigenous vegetation.

Relevant development incentives, restrictions, exclusions or prohibitions

The following development incentives, restrictions, exclusions or prohibitions and their implications that apply to this site are indicated below.

Incentive, restriction or prohibition	Implication
Strategic Gas Pipeline Corridors-Phase 2: Mossel Bay to Coega	https://screening.environment.gov.za/ScreeningDownloads/DevelopmentZones/Combined_GAS.pdf
Main Electricity Distribution Substation	https://screening.environment.gov.za/ScreeningDownloads/DevelopmentZones/Distribution_Transmission.pdf
Garden Route National Park Buffer	https://screening.environment.gov.za/ScreeningDownloads/DevelopmentZones/grnp_approved_plan.pdf
South African Conservation Areas	https://screening.environment.gov.za/ScreeningDownloads/DevelopmentZones/SACAD_OR_2025_Q3_Metadata.pdf

Proposed Development Area Environmental Sensitivity

The following summary of the development site environmental sensitivities is identified. Only the highest environmental sensitivity is indicated. The footprint environmental sensitivities for the proposed development footprint as identified, are indicative only and must be verified on site by a suitably qualified person before the specialist assessments identified below can be confirmed.

Theme	Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
Agriculture Theme		X		
Animal Species Theme			X	
Aquatic Biodiversity Theme	X			
Archaeological and Cultural Heritage Theme	X			
Civil Aviation Theme		X		
Defence Theme				X
Plant Species Theme			X	
Terrestrial Biodiversity Theme	X			

Specialist assessments identified

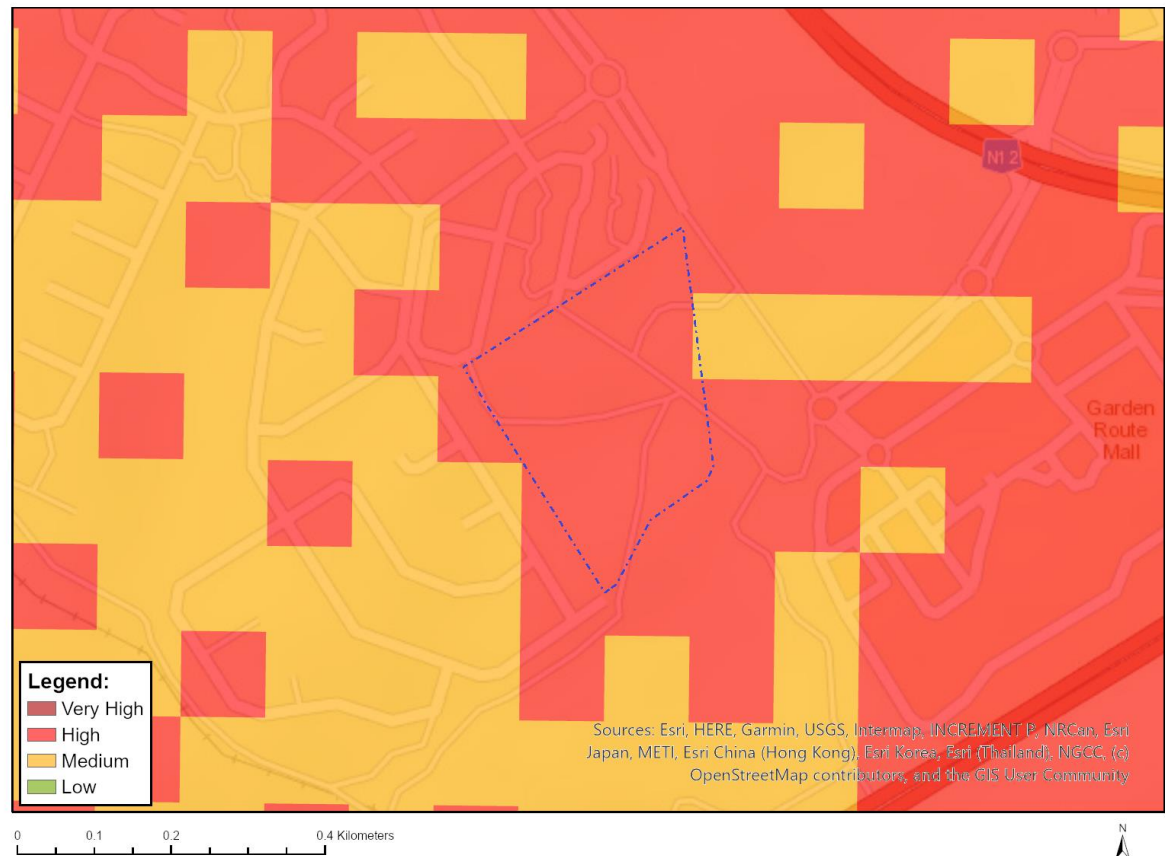
Based on the selected classification, and the known impacts associated with the proposed development, the following list of specialist assessments have been identified for inclusion in the assessment report. It is the responsibility of the EAP to confirm this list and to motivate in the assessment report, the reason for not including any of the identified specialist study including the provision of photographic evidence of the site situation.

No	Specialist assessment	Assessment Protocol
1	Landscape/Visual Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
2	Archaeological and Cultural Heritage Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/GuidanceforHIA.pdf
3	Palaeontology Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/GuidanceforPIA.pdf
4	Terrestrial Biodiversity Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Terrestrial_Biodiversity_Assessment_Protocols.pdf
5	Aquatic Biodiversity Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Aquatic_Biodiversity_Assessment_Protocols.pdf
6	Socio-Economic Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
7	Plant Species Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Plant_Species_Assessment_Protocols.pdf
8	Animal Species Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Animal_Species_Assessment_Protocols.pdf

Results of the environmental sensitivity of the proposed area.

The following section represents the results of the screening for environmental sensitivity of the proposed site for relevant environmental themes associated with the project classification. It is the duty of the EAP to ensure that the environmental themes provided by the screening tool are comprehensive and complete for the project. Refer to the disclaimer.

MAP OF RELATIVE AGRICULTURE THEME SENSITIVITY

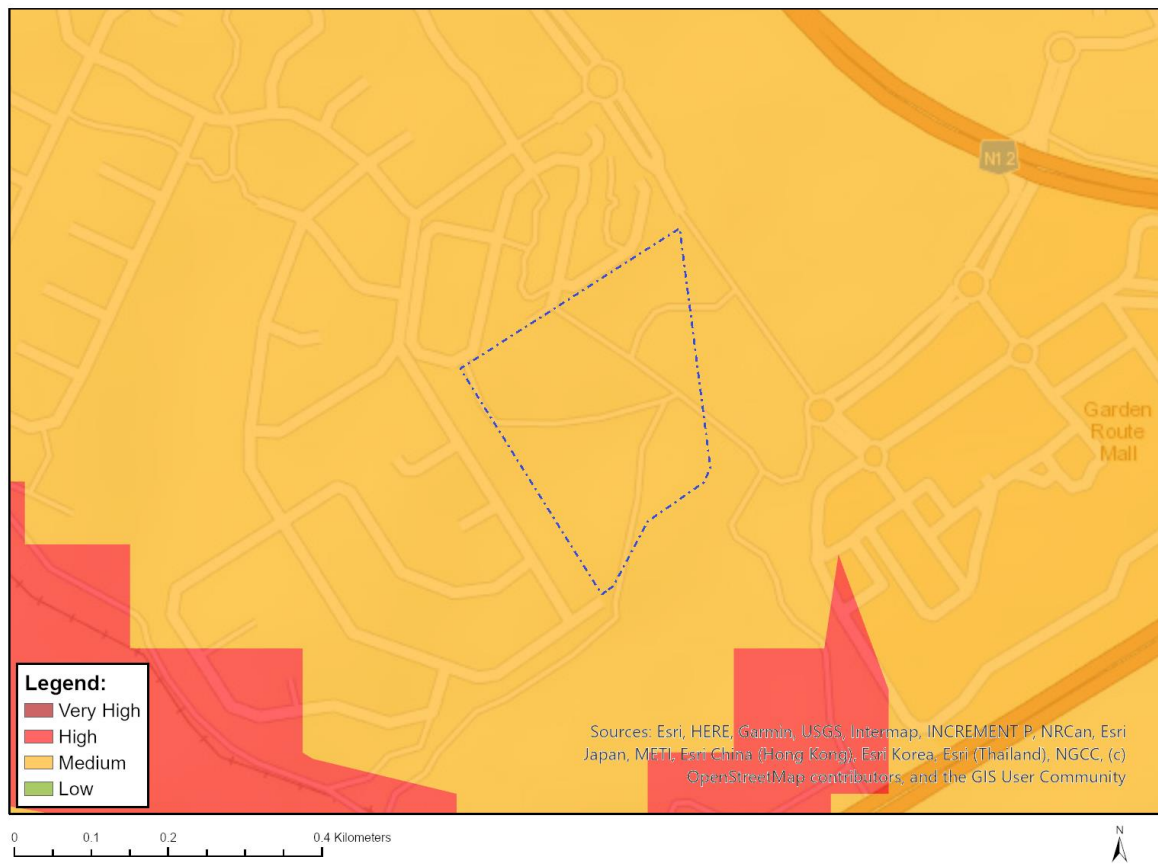


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	09. Moderate-High
High	08. Moderate
Medium	07. Low-Moderate

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Medium	Mammalia-Chlorotalpa duthieae
Medium	Sensitive species 13
Medium	Invertebrate-Aneuryphymus montanus

MAP OF RELATIVE AQUATIC BIODIVERSITY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Very High	SWSA (sw)_Outeniqua

MAP OF RELATIVE ARCHAEOLOGICAL AND CULTURAL HERITAGE THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Very High	Within 2km of a Grade II Heritage site

MAP OF RELATIVE CIVIL AVIATION THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Within 15 km of a civil aviation radar
High	Between 8 and 15 km from a major civil aviation aerodrome
Medium	Within 5 km of an air traffic control or navigation site

MAP OF RELATIVE DEFENCE THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity

MAP OF RELATIVE PLANT SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Medium	Lampranthus pauciflorus
Medium	Diosma passerinoides
Medium	Sensitive species 683

MAP OF RELATIVE TERRESTRIAL BIODIVERSITY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Very High	CBA2: Terrestrial
Very High	SWSA (sw)_Outeniqua
Very High	CR_ Garden Route Granite Fynbos

Appendix E: Site Sensitivity Verification Report

SITE SENSITIVITY VERIFICATION REPORT FOR:

THE PROPOSED PART 2 EA AMENDMENT FOR RESIDENTIAL DEVELOPMENT ON ERF 28005, GEORGE



Report terms of the Protocols for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes (Government Notice No. 320 of 20 March 2020).

Western Cape Department of Environmental Affairs and Development Planning Reference: 16/3/3/6/7/5/D2/19/0099/26

14 April 2026

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SITE SENSITIVITY VERIFICATION REPORT FOR: THE PROPOSED PART 2 EA AMENDMENT FOR RESIDENTIAL DEVELOPMENT ON ERF 28005, GEORGE SG Code: C02700020002800500000 / Location: Lat: 33° 59' 10.892" S Lon: 22° 29' 50.686" E	
<u>Applicant:</u> George Residential Apartments (Pty) Ltd Reg. No. 2026/016581/07 Represented by: Mr Japie Vos Telephone: +27 11 300 8700 / +27 72 240 4739 E-mail: japie@century.co.za Address: 5 Lynx Street, Treesbank AH, Midrand, 1682	<u>EAP:</u> Virdus Works Environmental (Pty) Ltd Reg. No. 2019/133896/07 Represented by: Mr Dupré Lombaard SACPLAN: B/8076/1998 // EAPASA: 2019/304 Mobile: +27 82 895 6362 E-mail: dupre.lombaard@virdus.com Address: 11 Elektron Street, Techno Park, Stellenbosch, 7600

1. INTRODUCTION

The site sensitivity report is related to an application for a Part 2 Amendment of the Environmental Authorisation (EA) issued on 26 February 2013 with reference: 16/3/1/5/D2/19/0021/12 for the development of Portion 22 of Farm Kraaibosch and Erf 23333, George. The original EA approved a mixed-use development (Business Zone I) on what was then described as Portion 8, now Erf 28005, George. Erf 28005 has been fully serviced and can at any time be used for business purposes, for which there appears to be no demand. While standing vacant it has been covered in natural vegetation. The applicant intends to deviate from the approved double storey business/office use and to use the land purely for residential purposes, thus changing the scope of the development necessitating the application.

The Minister of Forestry, Fisheries and the Environment (DFFE) published Regulations Laying Down the Procedure to be Followed for the Adoption of Spatial Tools or Environmental Management Instruments, in Government Notice No. 542 of 5 April 2019 in terms of the National Environmental Management Act, 1998, Act 107 of 1998 (NEMA). In terms thereof, prior to making any application for activities listed in terms of the Environmental Impact Assessment (EIA) Regulations, 2014 or undertaking any assessment of a subject site, the environmental sensitivities of the site have to be determined by the use of the environmental screening tool. Such screening report has been prepared for the decommissioning of the aquaculture facility on a 1,21 ha portion of Erf 28005, George, which has an area of 3,12 ha.

The Minister further published requirements for undertaking of site sensitivity assessments and verification thereof where environmental authorisation is required in terms of NEMA EIA Regulations. In terms of the Site Sensitivity Verification Requirements where a Specialist Assessment is Required but no Specific Assessment Protocol has been Prescribed, the current land use and environmental sensitivity of the subject site must be confirmed by a site sensitivity verification. The Assessment Protocol determines that where any part of the site is indicated as having a "high" or "very high" sensitivity, the requirements prescribed for such sensitivity must be followed, unless the site sensitivity verification report (SSVR) can show that the required specialist assessment is not required.

In terms of the Protocol, the appointed independent environmental assessment practitioner (EAP) may prepare the SSVR, as is presented herewith.

1.1 Details of the EAP

Dupré Lombaard as registered EAP and planner (EAPASA 2019/304 / SACPLAN B/8076/1998) has been appointed by the applicant for the EA amendment process. Dupré Lombaard has been in environmental practice since 2000. Since then, he has prepared and submitted many environmental authorisation applications and undertaken assessment and management processes.

Education and training

- M.Sc. (Earth Sciences), 2000 – 2002 (cum laude) - University of the Western Cape. Focus on Fluvial Geomorphology, Hydrogeology, GIS, and Environmental Law.
- M.A. (Geography), 1985 – 1989 - University of the Orange Free State. Research in Urban Geography.
- Honns. B.A. (Geography), 1981 – 1982 - University of South Africa.
- B.Mil. (Economics and Geography), 1978 – 1980 - Military Academy (Faculty of Military Science, University of Stellenbosch).

Other certified training courses

- Introduction to nature conservation, 1979 - Cape Provincial Administration.
- Transport and traffic engineering, 1991- SA Institute for Town and Regional Planners.
- Project Management for Environmental Managers, 2009 - University of the Free State.
- Integrated Water Resource Management, 2010 - University of the Western Cape.
- Accredited Green Building Professional, 2010 – Green Building Council of South Africa.
- SAMTRAC (SHEQ), 2010 - National Occupational Safety Association.
- Municipal Minimum Competency Training, 2014 - University of Stellenbosch.
- Commercial Mediation, 2016 - University of Cape Town.

Membership of professional and registration bodies

- Registered Planner - SA Council for Town and Regional Planners since 1998 (B/8076/1998).
- Registered Environmental Assessment Practitioner - Environmental Assessment Practitioners Association of South Africa since 2021 (2019/304).
- Member of IAIA SA since 2001 (member 1060).

1.2 Details of the site

Erf 28005, George, 5,6987ha in extent is located on the corner of Park Road and Platinum Drive in the Blue Mountain neighbourhood, on the southern side of the Eden Meander Lifestyle shopping centre. It is abutted by residential development inside of the Blue Mountain Estate on the north and southwestern sides, with office development to the south thereof. The site is relatively flat with a slight southeasterly slope of 1:33, draining towards the so-called Schaapkop Dam. It is fully serviced and the George Municipality has confirmed the availability of bulk services to accommodate the proposed development.

Since the development of the site in keeping with the 2013 EA, it was not further developed, and it has been covered in natural vegetation since then.



Figure 1: Erf 28005, George site images

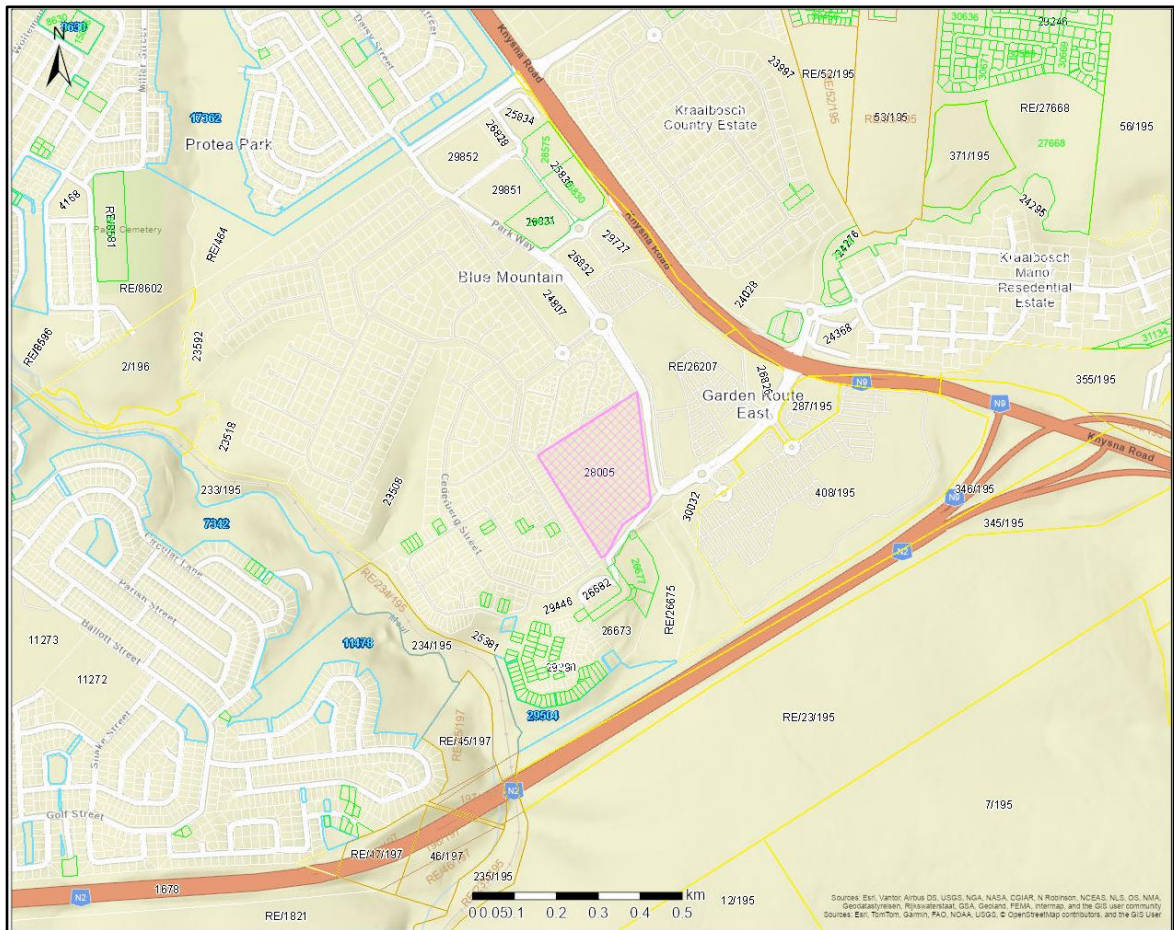


Figure 2: Erf 28005, George locality



Figure 3: Erf 28005, George site situation

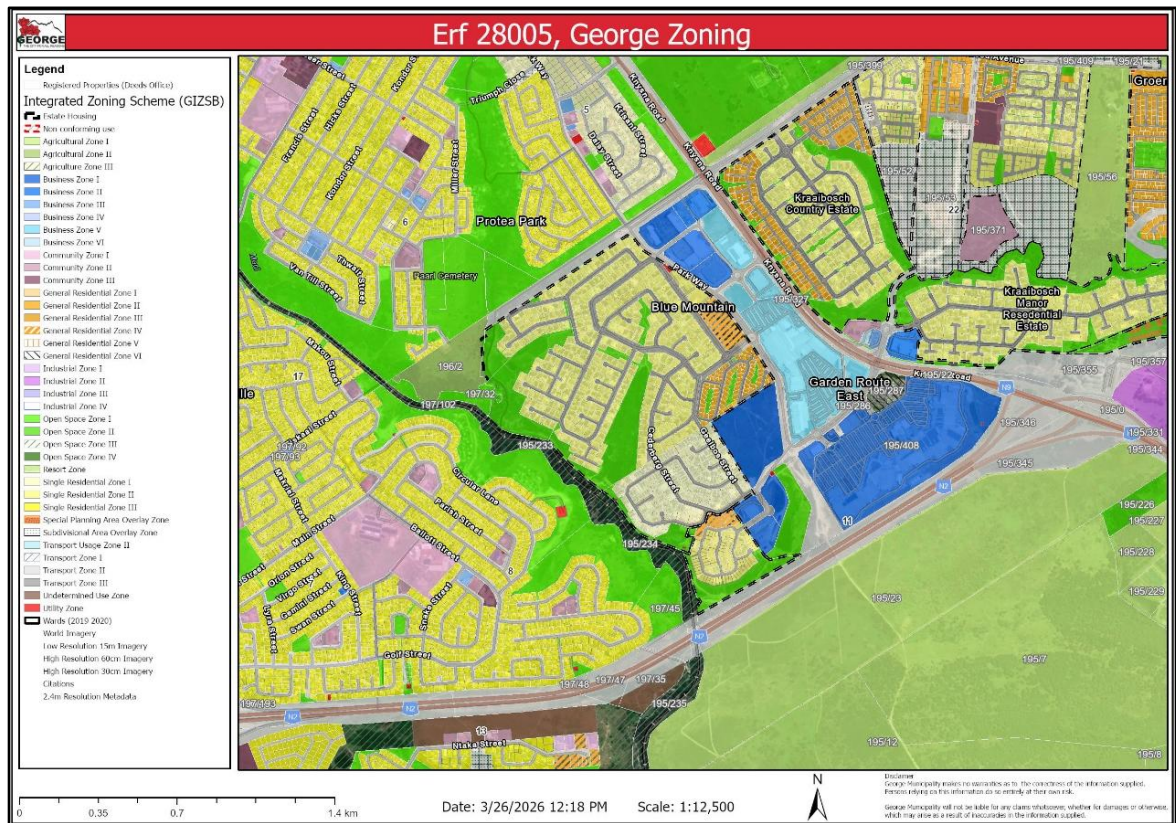


Figure 4: Erf 28005, George zoning

1.3 Screening report details of the site

The site screening report returned the following outcome:

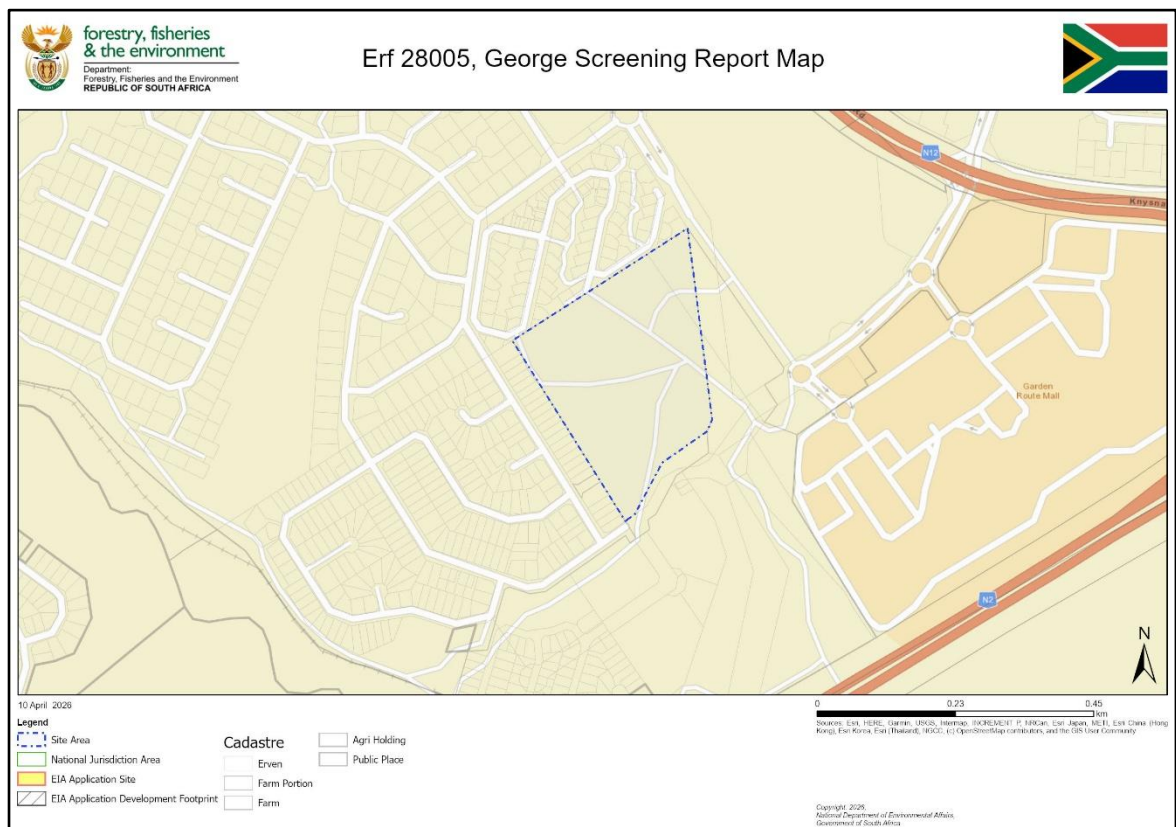


Figure 5: Site screening report map

The following summary of the development site environmental sensitivities is identified. Only the highest environmental sensitivity is indicated. The footprint environmental sensitivities for the proposed development footprint as identified, are indicative only and must be verified on site by a suitably qualified person before the specialist assessments identified below can be confirmed.

Theme	Very high sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
Agricultural Theme		X		
Animal Species Theme			X	
Aquatic Biodiversity Theme	X			
Archaeological and Cultural Heritage Theme	X			
Civil Aviation Theme		X		
Defence Theme				X
Plant Species Theme			X	
Terrestrial Biodiversity Theme	X			

Based on the selected classification, and the known impacts associated with the proposed development, the following list of specialist assessments have been identified for inclusion in the assessment report. It is the responsibility of the EAP to confirm this list and to motivate in the assessment report, the reason for not including any of the identified specialist study including the provision of photographic evidence of the site situation.

- 1.3.1 Landscape/Visual Impact Assessment;
- 1.3.2 Archaeological and Cultural Heritage Impact Assessment;
- 1.3.3 Palaeontology Impact Assessment;
- 1.3.4 Terrestrial Biodiversity Impact Assessment;
- 1.3.5 Aquatic Biodiversity Impact Assessment;
- 1.3.6 Socio-Economic Assessment;
- 1.3.7 Plant Species Assessment; and
- 1.3.8 Animal Species Assessment.

2. SITE VERIFICATION

2.1 Agricultural Theme

Rating: High.

The assessment does not support, and the EAP does not agree with the rating. It is recommended that it be negligible or very low in view of the urban nature thereof and the fact that it has been fully serviced for development that can commence at any time without any further environmental authorisation process.

2.2 Animal Species Theme

Rating: Medium.

No animals were observed on the site during site visits, inclusive of site visits by SACNASP registered ecologists. Small mammals (rodents) and reptiles might occur on the site. The assessment however does not support, and the EAP does not agree with the rating. It is recommended that it be negligible or very low in view of the urban nature thereof and the fact that it has been fully serviced for development that can commence at any time without any further environmental authorisation process.

2.3 Aquatic Biodiversity Theme

Rating: Very high.

Assessments by SACNASP registered ecologists indicate that the rating is not correct. It is recommended that it be negligible or very low in view of the specialist findings and the fact that it has been fully serviced for development that can commence at any time without any further environmental authorisation process.

2.4 Archaeological and Cultural Heritage Theme

Rating: Very High.

Heritage Western Cape has issued a permit for the development of the site in keeping with the 2013 EA and accordingly agrees with a lower rating. It is recommended that it be negligible or very low in view of the fact that it has been fully serviced for development that can commence at any time without any further heritage or environmental authorisation process.

2.5 Civil Aviation Theme

Rating: High.

Disagree with the rating. It is recommended that it be negligible or very low in view of the existing rights and permitted use and distance to civil aviation infrastructure.

2.6 Defence Theme

Rating: Low.

Agreement with the rating in general. It is recommended that it be negligible or very low in view of the existing use and distance to any defence infrastructure. The site is not located close to any national key point, or strategic infrastructure and the intended use thereof does not pose a threat to national security.

2.7 Plant Species Theme

Rating: Medium.

Agreement with the rating in general but recommended that it be negligible or very low in view of the complete transformation of the habitat. It has been fully serviced for

development that can commence at any time without any further environmental authorisation process.

2.8 Terrestrial Biodiversity Theme

Rating: Very High.

Disagree with the rating. It is recommended that it be negligible or very low in view of the complete transformation of the habitat. As indicated above, the site is completely transformed, and development can commence at any time without any further environmental authorisation process.

3. ANALYSIS

3.1 Desktop

The desktop assessment of the site sensitivity from the perspective of the authorised development and use of the site as per the 2013 EA.



Figure 6: Site transformation: 2005, 2012, 2014, and 2022

3.2 Site assessment

See attached specialist assessment and site verification by Ms Desirée du Preez, registered ecologist and environmental scientist with the SA Council for Natural Science Professions (Pri Sci Nat 400050/98).

Mr Ludwig van der Merwe (SACNASP 133969 ecologist) also assessed the site situation in view of the aquatic biodiversity theme and the related submission is attached.

Dr Johan van der Waals, of Terra Soil Science, also assessed the site and presented a specialist report indicating that the wetland signatures on the site have developed due to increased stormwater ingress from surrounding sealing of the landscape, and not from original wetland character or features. The site did not show any original wetland signatures from 1939 to 2005 when the land use changes were effected.

The proposed development of apartment blocks departs from the authorised double storey business use development. A four-storey development is proposed with potential effect on the visual and cultural landscape.

Business and residential uses have different effects on the socio-economic environment and use of services infrastructure, community and commercial facilities.

While the biophysical elements of the environment have been appropriately addressed with the three quoted specialist reports, there is a need to further consider the social and economic elements.

4. SPECIALIST STUDIES REQUIRED

4.1 Traffic Impact Assessment

The requirement for a specialist study is based on the requirements of the Municipality and the potential effects of changing traffic patterns on the existing road and transport infrastructure.

4.2 Socio-economic Assessment

A socio-economic assessment was prepared for the original application, assessing the effects of the development of the area. The specialist assessment then determined a need for offices and business, which assessment must be reconsidered to determine if there is a need for residential development as proposed, and if so, what the impacts of such development might be. The recommended socio-economic impact assessment will form part of the amendment application process.

4.3 Visual Impact Assessment

The initial visual impact assessment determined that the visual effect of a development on the area would be low. This was based on the proposed double-storey business development. An increased height to four storeys causes the physical height of buildings to change from 10,5m to 15m, which might have visual effects to be assessed by a specialist.

5. CONCLUSION

In view of the above, three specialist assessments are recommended for the amendment application process as in paragraph 4 above. The recommended specialist assessments are not those required by the screening tool report but are of relevance to the authorisation application.

There are valid reasons for not undertaking the recommended specialist assessments as determined by the screening report and it is recommended that the exclusion thereof be accepted by the competent authority.

Annexure A: Site verification reports by specialists

Annexure A: Site verification reports by specialists

Site Sensitivity Verification Report

Erf 28005, George



Greenfire Enviro

GREENFIRE ENVIRO (Pty) Ltd 2019/599177/07

On fire to bless our environment



Greenfire Enviro

GREENFIRE ENVIRO (Pty) Ltd 2019/599177/07

On fire to bless our environment

Site Sensitivity Verification Report

ERF 28005, George

July 2023

Prepared by: Desireé du Preez

Registered ecologist and environmental scientist with the SA Council for Natural Science Professions (Pri Sci Nat 400050/98)

Registered Environmental Assessment Practitioner (Number 2020/1486)

BSc Forestry with Nature Conservation (US)

MPhil Environmental Science (UCT)

10 years' experience in nature conservation and nature reserve planning and ecological management.

21 years' experience in environmental assessment and planning





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1. INTRODUCTION

Erf 28005 forms part of a development approved in 2011 as Portion 22 of Farm Kraaibosch no 195 and Erf 23333, George (Ref EG 12/2/3/2-02/ 11/1192/08). The erf is situated between the Garden Route Mall, the SA Revenue Service, Blue Mountain Village and Eden Meander and has not yet been developed. Soil disturbance activities related to the surrounding development acts as the onset of development and activation of the Environmental Authorisation and the listed activities identified therein.

This site sensitivity verification report serves to identify potential sensitive features on the specific erf towards responsible environmental stewardship.



Figure 1. Locality of Erf 28005





Figure 2. View from southwest to southeast accross Erf 28005



Figure 3. View from southwest to northwest accross Erf 28005



Figure 4. View from north to south accross Erf 28005



2. SITE SENSITIVITY VERIFICATION

Site verification was undertaken by Desireé du Preez who is a registered EAP and ecologist.

The Web Based Screening Tool Report created on 26 July 2023 identified the following Specialist assessments for the study area:

No	Specialist assessment	Assessment Protocol
1	Landscape/Visual Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
2	Archaeological and Cultural Heritage Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
3	Palaeontology Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
4	Terrestrial Biodiversity Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Terrestrial_Biodiversity_Assessment_Protocols.pdf
5	Aquatic Biodiversity Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Aquatic_Biodiversity_Assessment_Protocols.pdf
6	Socio-Economic Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
7	Plant Species Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Plant_Species_Assessment_Protocols.pdf
8	Animal Species Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Animal_Species_Assessment_Protocols.pdf

4.1 VERIFICATION METHOD

Site verification was undertaken with the following methods:

- Desktop analysis, starting with various layers of Cape Farm Mapper, George Municipality GIS Public Viewer and Google Earth imagery.
- Further desktop analysis using the Web Based Screening Tool.
- Desktop research was undertaken on the sensitive species identified in the Web Based Screening Tool Report.
- Desireé du Preez visited the study site for site verification on 25 July 2023 (during late winter).

4.2 SITE VERIFICATION FINDINGS AND RECOMMENDATIONS

The findings and recommendations are discussed per theme identified in the Online Screening Tool Report.



4.2.1 Agriculture

The property identified with a high sensitivity for agriculture due to a small portion overlapping a high sensitivity area. The erf is zoned Business Zone 1 and is not available for agricultural use, which renders it not sensitive for agricultural use.

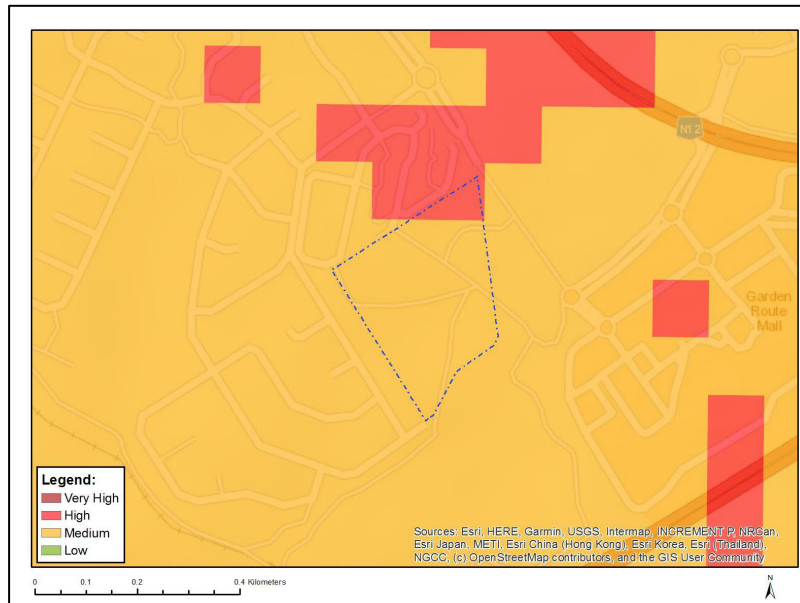


Figure 5 : Agricultural Sensitivity: Red = High potential soils, Yellow = Medium potential soils

4.2.2 Landscape and Visual, Archaeology and Heritage, Palaeontology

The property is situated within 2 km of a Grade II Heritage Site. As the larger development has already been approved, it is assumed that Heritage Western Cape has already approved the development of this property.

4.2.3 Terrestrial Biodiversity and plant species.

Sensitivity	Feature(s)
Very High	CBA 2: Terrestrial
Very High	SANParks (Buffer)_Garden Route National Park
Very High	SWSA (SW) _Outeniqua
Very High	CR_Garden Route Granite Fynbos

The Environmental Screening Report indicates the sensitivity of the site as high in terms of Terrestrial Biodiversity. A large section of the site is classified as an Ecological Support Area for conservation of the Garden Route Granite fynbos. Historically, the fynbos on the site area was part of the Garden Route Granite Fynbos, which is regarded as Critically Endangered, while the entire study area is identified as Critical Biodiversity Area 2: Terrestrial.

a. Critical Biodiversity Areas (CBAs)

Areas that are required to meet biodiversity targets for species, ecosystems or ecological processes and infrastructure. These include:

- All areas required to meet biodiversity pattern (e.g., species, ecosystems) targets;



- Critically Endangered (CR) ecosystems (terrestrial, wetland and river types);
- All areas required to meet ecological infrastructure targets, which are aimed at ensuring the continued existence and functioning of ecosystems and delivery of essential ecosystem services; and
- Critical corridors to maintain landscape connectivity.

CBA's are areas of high biodiversity and ecological value and need to be kept in a natural or near-natural state, with no further loss of habitat or species. Degraded areas should be rehabilitated to natural or near-natural condition. Only low-impact, biodiversity-sensitive land uses are appropriate.

In the maps, a distinction is made between CBA's that are likely to be in a natural condition (CBA 1) and those that are potentially degraded or represent secondary vegetation (CBA 2). This distinction is based on best available land cover data, but may not be an accurate or current reflection of condition.

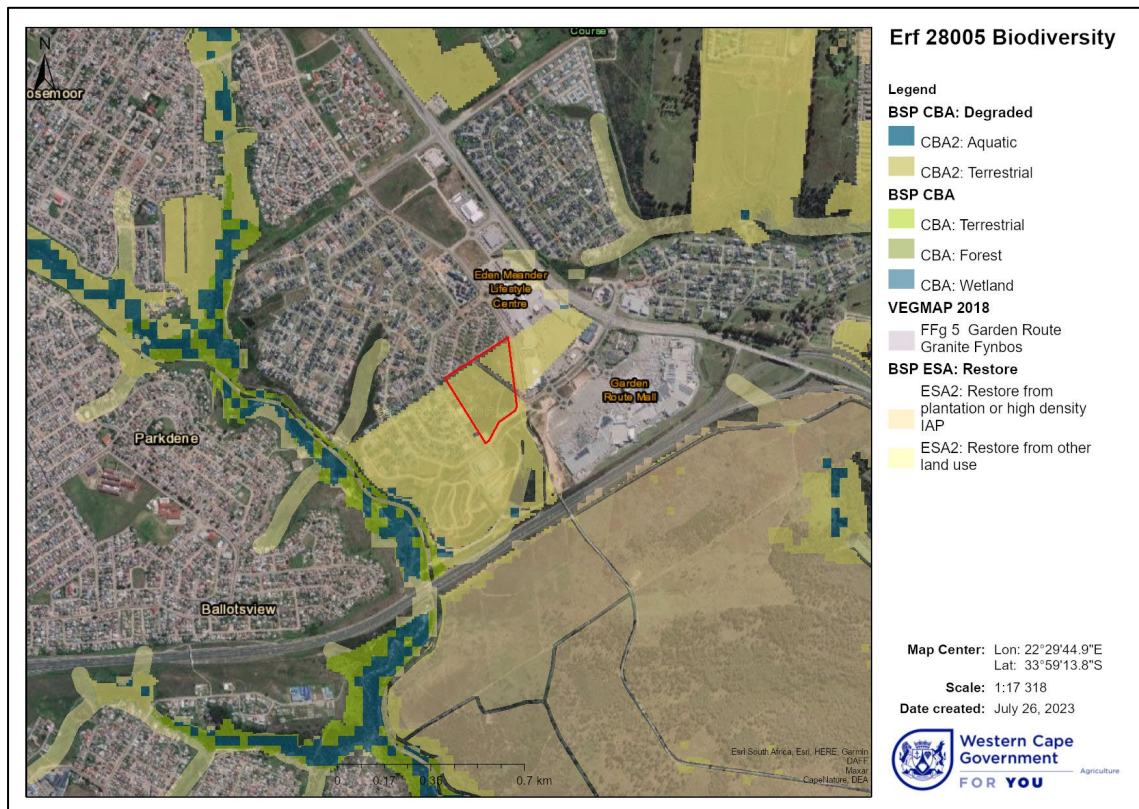
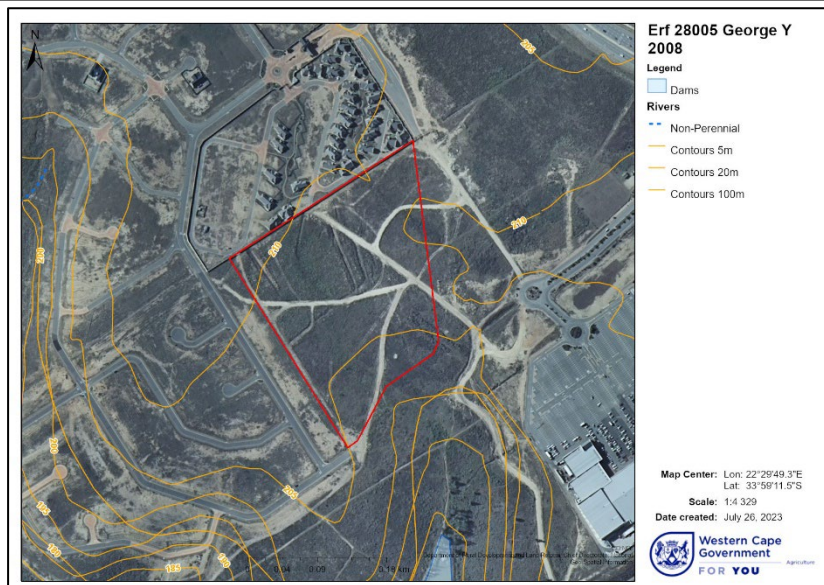
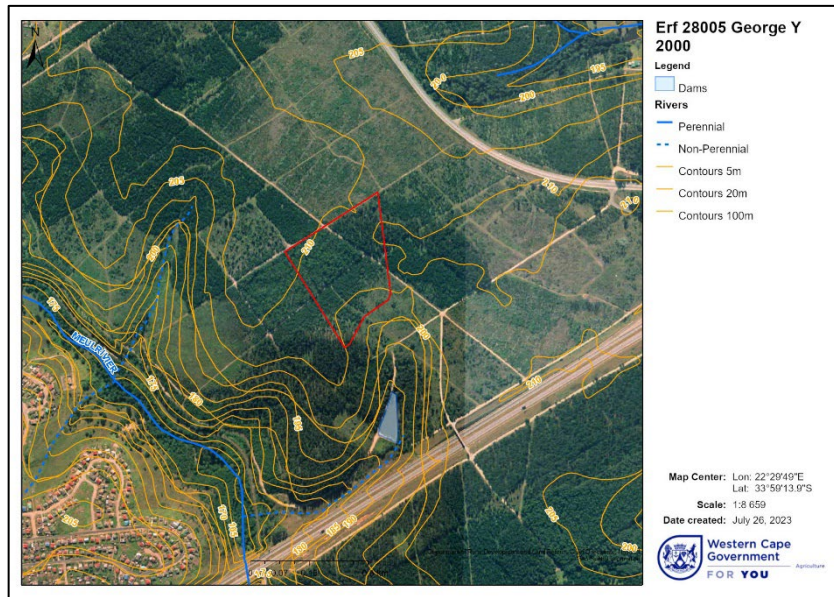


Figure 6. Critical Biodiversity in the study area





Figures 7-9 indicate disturbance on Erf 28005 between 2000 and 2023





Figures 10 & 11 indicate the level of transformation and disturbance on Erf 28005

b. Characteristics of the Study Area

The area is mapped to fall within the natural distribution range of the Garden Route Granite Fynbos (Critically Endangered) which led to the site being classified with a high sensitivity for plant species.

Only about 1 % of this vegetation type is conserved while more than 70% has been transformed for cultivation, plantations and urban development. Remnants are mostly limited to isolated steeper slopes of the area.

Garden Route Granite fynbos is described by Mucina & Rutherford (2006) as dense proteoid and ericoid shrubby grassland. Proteoid and graminoid fynbos are dominant with ericaceous fynbos occurring in seeps. Important plant taxa include the tall shrubs *Passerina corymbosa*, *Cliffortia serpyllifolia*, *Protea coronata*, *P.lanceolata*, *p.nerifolia*. Smaller shrubs include *Erica discolour*, *E. peltata*, *Phyllica confusa*, *Syncarpha paniculata* *Agathosma ovate*, *Mimetes cucullatus*, *Pelargonium fruticosum*. Grasses include *Themeda triandra*, *Heteropogon contortus*, *Brachiaria serrate*, *Eragrostis capensis* and the Restio species *Restio triticeus*.

The description of the environmental that includes the study area, as found in the Environmental Authorisation, identifies the site as *highly transformed due to historical disturbance (forestry, vegetation clearance and the most recent construction of the existing Kraaibosch Blue Mountain Retirement Village)*. The vegetation cover on the site is dominated by grass (*Urochloa* sp. & *Melinis* sp.) and *Helichrysum* species (*Helichrysum petiolare* & *Helichrysum cymosum*). According to the Fine Scale Biodiversity mapping conducted for the Garden Route, the site is neither recognised as part of a Critical Biodiversity or Ecological Support Area. The vegetation on-site is



considered to be of very low conservation value and does not form part of any riparian habitat or conservation worthy indigenous vegetation.

Natural vegetation on the site is limited to the river corridor of the Meul River, as is the case with the entire surrounding area (1 500 m radius). The site is characterised by moderate slopes with a substantial slope down towards the natural drainage watercourses to the south east / the N2 (in Blue Mountain Gardens) and the north / Knysna Road (in Blue Mountain Village). Previous vegetation surveys or overviews indicated no vegetation that is of conservation significance.

The study area was found to contain remnants of *Eucalyptus* stumps, with some *Eucalyptus* saplings establishing as a result of the past forestry land use. The NVI 2000 satellite photo in Cape Farm Mapper shows various plantation roads and logging routes crisscrossing the area. This disturbance is still visible on the ground. Subsequent to the plantation land use, further disturbance has occurred in the form of construction routes through the area at the time of construction of Blue Mountain Retirement Centre & Village. These construction roads were converted into stormwater swales by removal of the top surface up to the clay substrate.

The soil of the general area is described on Cape Farm Mapper as mainly gneissic granite and granodiorite, as well as phyllite, schist, grit, hornfels and quartzite of the Kaaimans Group. The soil superficially seem to have a thin grey sandy layer over a strongly structured red B horizon. Grey mottling in the soil visible where the clay rich soils were dug up, usually indicate a high water content.

The condition of the vegetation varies on the property, but it is generally characteristic of secondary succession vegetation with low species diversity and some invasive alien plants spreading. The proteoid layer has been removed completely and has not yet recovered, due to isolation of the study area from other proteoid populations and seed sources. None of the plants identified as potential sensitive species in the Screening Tool Report were found, making the study area of low value for plant species conservation. The north/northwestern half of the property (north of an old east-west lying plantation road) is particularly poor in species diversity and showing many signs of disturbance. A population of *Kniphofia* plants is the most significant feature of this area.

The southern portion of the property has more plant diversity with *Erica*, *Restios* and other species. The plants identified in the study area are found in Table 1.

The study area does not conform to the requirements for CBA 2 habitat, which constitute natural (untransformed) habitat, but with comparative high levels of deterioration. Habitat fragmentation and transformation by forestry and urban development have rendered the area of low potential for rehabilitation, to be at most Ecological Support Area (ESA). Successful rehabilitation would require a high animal species diversity for pollination and propagule distribution. The depauperate terrestrial animal biodiversity consisting of generalist species strengthens the motivation for ESA rather than CBA.





Taxon Name	Scientific Name	Common Name	Conservation Status
Aves	<i>Burhinus capensis capensis</i>	Southern Spotted Dikkop	Common
Aves	<i>Cinnyris chalybeus</i>	Southern Double-collared Sunbird	Common
Aves	<i>Cisticola tinniens</i>	Levaillant's Cisticola	Common
Aves	<i>Telophorus zeylonus zeylonus</i>	Cape Bokmakierie	Common
Insecta	<i>Papilio demodocus demodocus</i>	Christmas Butterfly	Common
Insecta	<i>Cheilomenes sulphurea</i>	Sulfurous Lady Beetle	Common
Insecta	<i>Lepidoptera</i>	Butterflies and Moths	Common
Insecta	<i>Papilio demodocus demodocus</i>	Christmas Butterfly	Common
Insecta	<i>Phymateus morbillosus</i>	Red Milkweed Locust	Common
Insecta	<i>Pseudonympha magus</i>	Silver-bottom Brown	Common
Insecta	<i>Tenthredinoidea</i>	Typical Sawflies	Common
Insecta	<i>Vanessa cardui</i>	Painted Lady	Common
Plantae	<i>Andropogon eucomus</i>	Snowflake Grass	Common
Plantae	<i>Andropogon eucomus</i>	Snowflake Grass	
Plantae	<i>Cheilanthes viridis viridis</i>	Common Lip Fern	Least Concern
Plantae	<i>Cortaderia selloana</i>	Pampas Grass	Invasive alien
Plantae	<i>Cyperus</i>	flatsedges	
Plantae	<i>Diospyros dichrophylla</i>	Poison Starapple	Least Concern
Plantae	<i>Erica gracilis</i>	Graceful Heath	Least Concern
Plantae	<i>Halleria lucida</i>	Tree Fuchsia	Least Concern
Plantae	<i>Helichrysum petiolare</i>	Silver Everlasting	Least Concern
Plantae	<i>Hibiscus trionum</i>	flower-of-an-hour	Common
Plantae	<i>Hypoxis villosa</i>	Shaggy Stargrass	Least Concern
Plantae	<i>Indigofera stricta</i>	Uniform Indigo	Least Concern
Plantae	<i>Isolepis</i>		

Plantae	<i>Juncus</i>	rushes	
Plantae	<i>Kniphofia uvaria</i>	Red Hot Poker	Least Concern
Plantae	<i>Liliopsida</i>	monocots	
Plantae	<i>Lobelia erinus</i>	Common Lobelia	Least Concern
Plantae	<i>Nidorella ivifolia</i>	Ovenbush	Least Concern
Plantae	<i>Osteospermum moniliferum</i>	Bietou	Least Concern
Plantae	<i>Oxalis ciliaris</i>	Fringe Sorrel	Data deficient
Plantae	<i>Oxalis polyphylla</i>	Manyleaf Sorrel	Least Concern
Plantae	<i>Paspalum urvillei</i>	Vasey Grass	Not Evaluated
Plantae	<i>Passerina corymbosa</i>	Common Gonna	Least Concern
Plantae	<i>Pauridia flaccida</i>		Least Concern
Plantae	<i>Psoralea acuminata</i>	Longsepal Dottlepea	Common
Plantae	<i>Psoralea stachyera</i>	Spike Dottlepea	Common
Plantae	<i>Pteridium aquilinum</i>	common bracken	Least Concern
Plantae	<i>Rubus pinnatus</i>	South African Raspberry	Least Concern
Plantae	<i>Typha capensis</i>	Cape Bulrush	Least Concern
Plantae	<i>Zantedeschia aethiopica</i>	Common Arum	Least Concern

4.2.4 Fauna species

a. Birds

The highly disturbed and secondary succession state of the vegetation on the site means that it is not very suitable as habitat for avifauna. It does provide habitat to a few common birds, but do not provide potential habitat for some species. Species and or signs of bird species that was noted during the site visit includes the Spotted Thick-knee (*Burhinus capensis*) and the Blacksmith lapwing (*Vanellus armatus*). Other birds observed by other iNaturalist users are listed in Table 1.

The avifauna sensitivity of the development site is regarded as low,

b. Mammals

Using the screening tool, **Sensitive species 8 and Chlorotalpa duthieae** are listed for the site.

The absence of dense forest or thicket patches on the study area means that the habitat is not suitable for either of these species, that are forest dwellers.

The study site is therefore not sensitive for mammals.

c. Amphibians

The Knysna banana frog (*Afrixalus knysnae*) is endemic to the Western and Eastern Cape provinces. It was not possible to confirm its presence on the site during the site visit, as it is not yet its breeding season. The artificial wetland habitat may provide potential habitat for this species, but it does not appear to be their preferred habitat and the study area is not near a large population of the frogs.

d. Invertebrates

The Yellow-winged Agile Grasshopper (*Aneuryphymus montanus*) is listed as a vulnerable species for the region. This species is listed as Vulnerable by the IUCN. This species has, however, not been recorded in the Garden Route region. The IUCN lists the preferred habitat of the species as scrubby fynbos in rocky areas. It is not likely to



be found in Garden Route Granite Fynbos, The species is therefore not of concern for the study area.

Several other invertebrate species were collected and noted during the site visit, using sweeping nets, including the moth *Neurosymploca concinna*. Butterfly species included the African monarch (*Danaus chrysippus*), Painted lady (*Cynthia cardui*), Meadow white (*Pontia helice*), Common skipper (*Gegenes hottentotta hottentotta*) and the Grass blue (*Sizula hylax*). Other species recorded include the Green grasshopper (*Gastrimargus* species), a small brown grasshopper (*Viticatantops humeralis*) and the Lamenting grasshopper (*Ayprepocnemis plorans*). None of these species are of conservation concern.

4.2.5 Aquatic biodiversity

The Screening Tool Report identifies the area as highly sensitive for aquatic biodiversity due to the area lying in the Outeniqua Strategic Water Source Area. The site, however, is not located near any important stream or water source feature in this regard.

No rivers, dams or wetlands are identified in the study area and no watercourse related listed activities are included in the Environmental Authorisation.

The property drains gently towards the southeast and the southeastern corner of the property forms part of a drainage line that used to drain towards a dam that is still present on the adjacent property.

The presence of grey mottled clayey soils point towards the presence of wetland on the property.

A wetland is defined in the National Water Act, Act No 36 of 1998 to 'mean land which is transitional between terrestrial and aquatic systems **where the water table is usually at or near the surface**, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would **support vegetation typically adapted** to life in saturated soil.

Most of the study area does not contain vegetation typically adapted to saturated soil. Two small artificial wetlands have developed on the property due to stormwater directed over the property from Blue Mountain Village and altered drainage by construction of a filled road to the south of the property. The wetland in the south is dominated by *Juncus* sedges and drains across the dirt road towards the stormwater drain (figures 14, 15, 17). The wetland in the north against the boundary fence is dominated by *Typha* bulrush, with shorter herbaceous vegetation and grasses. Frog calls were observed at both wetlands, with a greater diversity of calls at the northern wetland.





Figure 13. Mottled red soil with a high clay content.



Figure 14. Small Juncus dominated wetland



Figure 15. Water draining from the small wetland





Figure 16. Typha dominated wetland



Figure 17 Stormwater drain in the south

4.2.6 Civil Aviation

The Civil aviation sensitivity was rated high due to the site being located within 15km from George airport and the airport radar, which is restricted airspace. The site falls within **FAGG ACC East airspace zone**. Therefore, the EAP does not agree with the stated sensitivity for this site due to the height restrictions of a minimum of 1370 meters over residential areas of George for air traffic towards and from the aerodrome within this zone. Furthermore, the proposed development will be of a similar nature to the existing infrastructure found at the Garden Route Mall.

4.3 CONCLUSIONS AND RECOMMENDATIONS

The study area is not sensitive for any biophysical feature and soil disturbance and installation of stormwater drainage during surrounding construction phases has caused at least some of the listed activities in the EA to be triggered, which constitute commencement of construction.

Despite this low sensitivity, it is recommended that Kniphofia, Halleria and Diospyros plants be rescued and used in natural landscaping or replanting in a natural environment.



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QUALIFICATIONS

- BSc Forestry Univ Stell
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REFERENCES

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WORK EXPERIENCE

Environmental Assessment

Greenfire Enviro Pty Ltd

2018-2023

- Basic Assessment: Clearance of Indigenous Vegetation on Remainder of Portion 29 of Farm Wolwedans 129, Mossel Bay for Group Editors Company Pty (Ltd.) (Wolwedans West)
- Scoping & EIA: New dam for Spitskop farm, Oudtshoorn.
- Successful appeal of Pre-directive and Compliance Notice: Alleged Unlawful Construction of dams, and excavation of material from the Vlei River, on Portions of Farm 9, Kruisrivier, Calitzdorp.
- NEMA 24G Application for rectification for the alleged unlawful commencement of the clearing of indigenous vegetation on the Samber farm, Riversdale (2020).
- NEMA 24G Application for rectification for the alleged unlawful commencement of the clearing of indigenous vegetation on Bright Berries Farm, Elandsdraal, Knysna (2019)
- NEMA 24G Application for rectification for the alleged unlawful expansion of off-stream storage dams and the degradation of the surrounding environment at farms Buffelskloof 14/97, 18/97 And Annex Dwars Rivier, Ladismith (2019)
- Basic assessment study for repair of a flood damaged bridge on Montagu Springs Holiday Resort. (2016)

Ecological Studies & Rehabilitation

Greenfire Enviro Pty Ltd

2020-2023

- Site Sensitivity Verification Report for the Upgrade of Pacaltsdorp Sewer Pumpstation nr 3 and associated rising main and Repurposing Pumpstation 6 and installation of gravity main October 2022
- Site Sensitivity Verification Report Eden Palms Residential development on Portion 21/438, Ladywood Estate, Plettenberg Bay November 2022
- Terrestrial Biodiversity Specialist Assessment: Irrigation Dam Extension Uitsig Farm, Farm RE/2 Jonkershoek 220, Mossel Bay May 2022
- Terrestrial Biodiversity Specialist Assessment: Extension of Lucerne fields Kruis Rivier 206 Portions 4 and 13 Riversdale (Samber) March 2021
- Terrestrial Biodiversity Specialist Assessment: New Avocado Orchards (Agricultural Expansion) on the Group Editors Farm Wolwedans, Mossel Bay October 2021
- Terrestrial Biodiversity Specialist Assessment: New Irrigation Dam for Spitskop Farm, Oudtshoorn October 2020
- Site Assessment and Rehabilitation plan for the Clearing of Natural Vegetation and making a drainage channel on the farms Vaalevalley RE/219 and Hartenbosch 99/217
- Rehabilitation Plan Earthworks on Farm 227/16 George July 2020

Management Plans

Greenfire Enviro Pty Ltd

2020-2022

- Construction Environmental Management Plan for Outeniqua Retail Village George December 2022
- Environmental Impact Study and Management Plan for Honeybush Natural Products (Pty)Ltd for Rainforest Alliance and SIZA certification 2021
- Revision of the Pinnacle Point Beach and Golf Estate Operational Management Plan.
- Pinnacle Point Beach and Golf Estate Conservation Management Plan and Golf Course Management Plan.



herewith certifies that

Desiree du Preez

Registration Number: 400050/98

is a registered scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following field(s) of practice (Schedule 1 of the Act)

Environmental Science (Professional Natural Scientist)
Ecological Science (Professional Natural Scientist)

Effective **19 August 1998**

Expires **31 March 2024**



A handwritten signature in black ink, appearing to read 'S. Neph'.

Chairperson

A handwritten signature in black ink, appearing to read 'N. du Preez'.

Chief Executive Officer





Registration No. 2020/1486

Herewith certifies that

Desirée du Preez

is registered as an

Environmental Assessment Practitioner

***Registered in accordance with the prescribed criteria of Regulation 15. (1)
of the Section 24H Registration Authority Regulations
(Regulation No. 849, Gazette No. 40154 of 22 July 2016, of the
National Environmental Management Act (NEMA), Act No. 107 of 1998, as
amended).***

Effective: 01 March 2023

Expires: 29 February 2024

Chairperson

Registrar



12 July 2023

Mr Carlo Abrahams
Manager at Berg-Olifants Catchment
Management Agency
101 York Street
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per: cabrahams@bocma.co.za

DESCRIPTION OF THE CURRENT SITUATION REGARDING THE APPLICABILITY OF THE NATIONAL WATER ACT, ACT NO. 36 OF 1998, ERF 25008, GEORGE, WESTERN CAPE

Virdus Works Environmental was tasked with drafting a letter to the catchment management agency to provide an overview of why the actions in terms of the National Water Act, Act no. 36 of 1998, do not apply to the planned activity on Erf 25008, George, Western Cape. The reason for the letter is in response to concerns that were raised over a potential wetland on the above-mentioned property. A desktop study and site visit however indicated that this is not the case, and that water on the property is from stormwater runoff from the abutting property. The property forms part of the greater Garden Route East and Eden Meander multi-phased development, which was approved by the Department of Environmental Affairs and Development Planning (DEA&DP) on 22 August 2011. During the environmental authorisation process that was done by Calidris Development Management Services and the accompanying specialist assessments, no reference has been made to a potential wetland on Erf 25008. At the time, Erf 25008 was still formed part of Portion 22 of Farm Kraaibosch, where it was used for Agriculture in the past. See Figure 1 below for a historic satellite image of the site in 2010. From the above, it is evident that no wetland occurred on the property historically.



Figure 1: Satellite Image showing the study site at the time of the Environmental Authorisation Process in 2010 (Google Earth).

The planned activity which involves the building of a supermarket on the property is Phase 6 of the approved development. Engineering services such as stormwater and sewage have already been installed at the site. However, as the developers knew the property was going to remain empty for several years a temporary stormwater solution was implemented until a final layout for the planned activity has been finalised and a permanent solution can be implemented. This involved creating furrows so that water that enters the site through stormwater pipes from the Blue Mountain Estate on the northwestern side of the property can drain naturally towards the southeastern border of the property and then further downstream. The gradient of the site is relatively flat, which causes stormwater to build up during high rainfall events, leading to water being dispersed across a large portion of the property. See recent photos of the site below.

From the images, it's clear that the predominant vegetation on the site is not associated with wetland habitats. Although some vegetation can be associated with aquatic habitats, these have only become visible after 2011 when stormwater started to be diverted to the site. A habitat that is suitable for aquatic-type vegetation thus only became available after 2011. If the stormwater is to be diverted to the existing stormwater network as part of the larger Garden Route East and Eden Meander development, the habitat would become unsuitable again for aquatic vegetation. Consequently, it would be incorrect to claim that a wetland is present on Erf 25008.



Figure 2: Image illustrating where the water enters the site through stormwater pipes along the northwestern border (June 2023).



Figure 3: Image illustrating where furrows have been created to aid the drainage of stormwater on the site (June 2023).

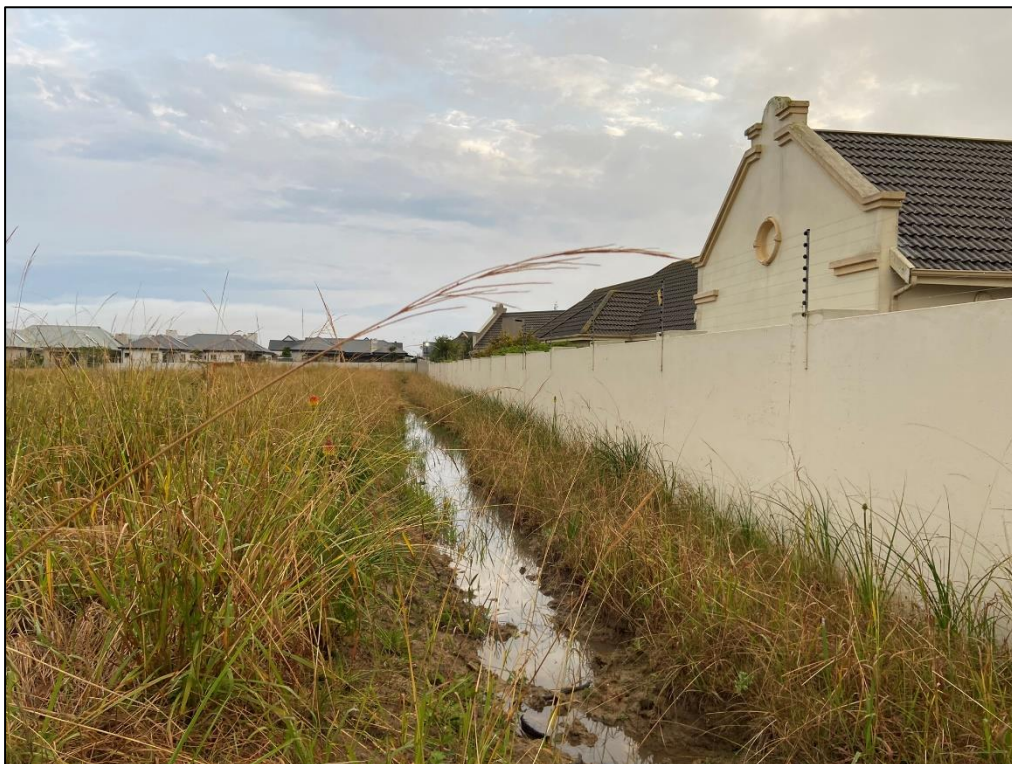


Figure 4: Another image illustrating where furrows have been created to aid drainage (June 2023).



Figure 5: Image illustrating engineering services available at the site (June 2023).



Figure 6: Image illustrating the dominant vegetation type on site (June 2023).

The National Water Act, Act No. 36 of 1998 regulates any activity with 500 m of a NFEPA Classified Wetland. The study site falls 500 m from the Schaapkop Dam, which is indicated as an Artificial Wetland. As such in normal circumstances a General Authorisation would need to be applied for in terms of Section 21 (i) and (g) of the National Water Act, Act No. 36 of 1998. See Figure 7 below for details.

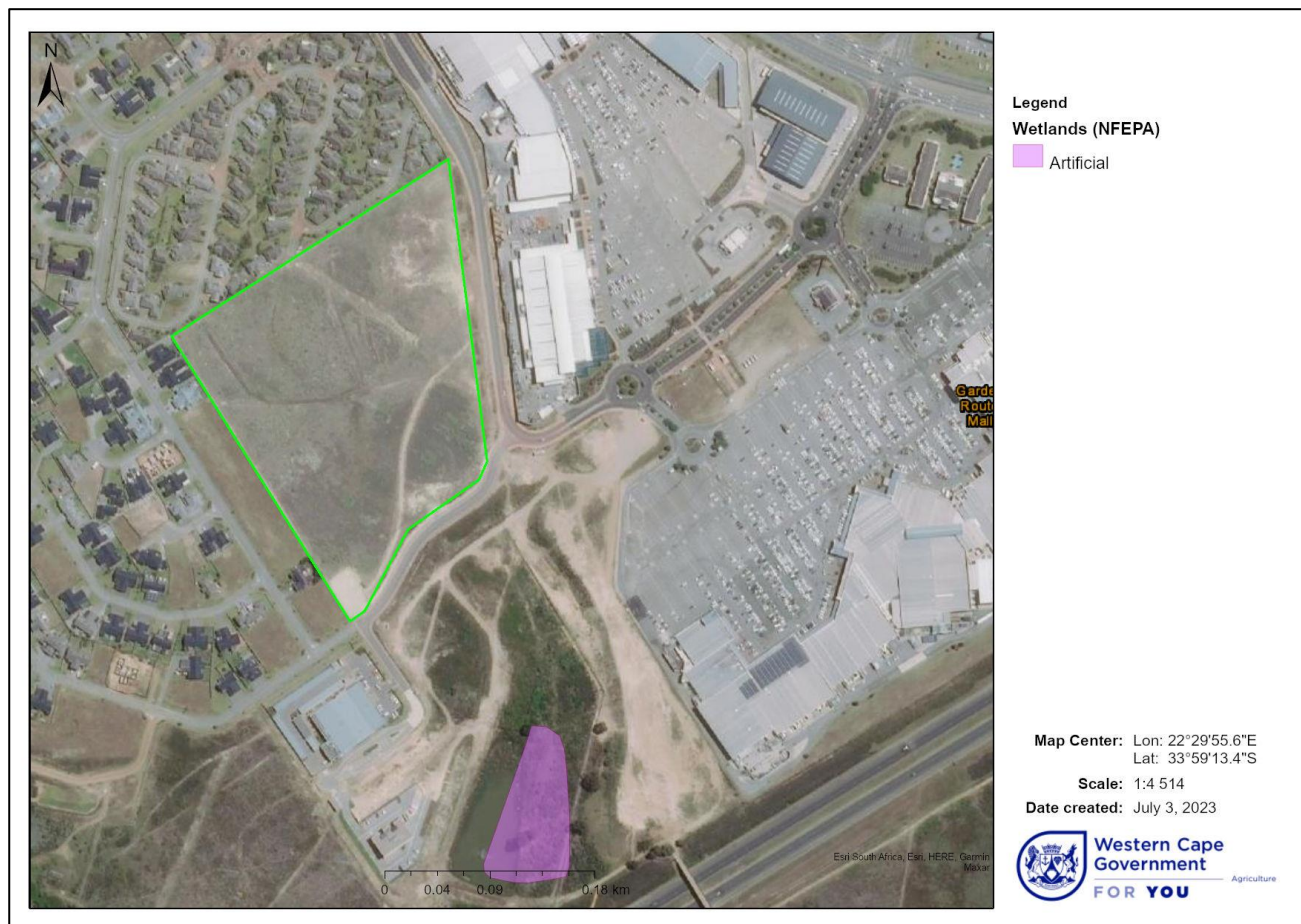


Figure 7: Satellite image indicating the Study site (in green) relative proximity to the Schaapkop Dam/ NFEPA classified wetland (in pink) (Cape Farm Mapper, 2023).

However, the stormwater which will be generated by the planned development will flow into the existing stormwater network as part of the larger stormwater management plan. The existing stormwater management plan for the larger development was designed by WorleyParsons in 2012. Provisions for environmental standards, legislation as well as municipal regulations from the following acts were considered in the development of the Stormwater Management Plan:

- National Water Act, Act No. 36 of 1998
- National Environment Management Act, Act No. 107 of 1998
- Environmental Conservation Act, Act No. 73 of 1989
- Water Services Act, Act No. 30 of 2004

The stormwater management plan was approved by the relevant authorities. As such the potential increase in stormwater generated by the proposed development has already been accounted for as the stormwater management plan was designed to have capacity for future phased developments. The effluent generated by the proposed development will also tie into the existing sewage network, whose capacity also accounted for the proposed development. Consequently, the proposed development will not have any impact on the Artificial wetland/ dam located within 500m of the development site.

In addition, a General Authorisation in terms of Section 21 (c) and (i) have already been registered for the larger development (Register number 29012693), which considered the potential impacts of the approved development(s) in the area of the artificial wetland/ dam on Erf 26675.

Considering the current situation, we feel it would be a waste of the applicant/ client's and the Catchment Management Agency's resources to apply for another General Authorisation as all potential impacts have already been accounted for and no additional impacts will be generated by the proposed approved development. As such the client/ applicant is proceeding with the submission of final approval documents and views this matter as resolved.

Yours Faithfully,



Ludwig van der Merwe
(SACNASP 133969/ EAPASA 2020/2817)

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REPORT

HYDROPEDOLOGY (LEVEL 2) AND WETLAND SOIL CONTEXT REPORT:

ERF 28005 GEORGE, WESTERN CAPE PROVINCE

14 August, 2023

Compiled by:

Dr J.H. van der Waals

(PhD Soil Science, Pr.Sci.Nat.)

Registered with the South African Council for Natural Scientific Professions
(Registration number: 400106/08)

Member of:

Soil Science Society of South Africa (SSSSA)

Accredited member of:

South African Soil Surveyors Organisation (SASSO)

Declaration

I, Johan Hilgard van der Waals, declare that:

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing
 - any decision to be taken with respect to the application by the competent authority; and
 - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.



J.H. VAN DER WAALS
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EXECUTIVE SUMMARY

Terra Soil Science was appointed by **Adriaan Venter Attorneys & Associates** to provide a specialist assessment on the presence and context of wetland signatures identified on Erf 28005, George, in the Western Cape Province. The site was included in an positive record of decision for development but has subsequently developed wetland related signatures due to increased stormwater ingress.

The aim of this report is to provide 1) a detailed summary of the historical wetland presence and soil and hydrogeology context of the area including Erf 28005; 2) the statutory context regarding wetland identification and expression in the highly altered urban environment and 3) the drivers of the increased expression of wetland signatures on the site.

The site lies between 33° 59' 04" and 33° 59' 20" south and 22° 29' 41" and 22° 30' 00" east in George in the Western Cape Province falls into the **Db33** land type that is characterised by a bleached and yellow duplex soil dominated landscape with shallow sandy loam soil profiles overlying clay rich subsoils grading into underlying weathered granite.

A detailed historical aerial photograph and Google Earth image interpretation exercise was conducted. In addition, contours of the site were used to generate a digital elevation model and a topographic wetness index to determine water flow paths on the site as well as from surrounding developments.

The following conclusions are drawn from this investigation:

1. The site did not show any original wetland signatures from 1939 to 2005 when the land use changes were effected.
2. The historical images indicate a gradual change in the surrounding landscape with increasing stormwater ingress evident. The stormwater report is rather high level and my experience in the Western Cape is that the stormwater reports miss many critical aspects related to volumes and effects. I have had very significant interaction with the BGCMA on other sites regarding this exact issue. The implication is that the client may have to re-assess their stormwater designs to accommodate for larger volumes than originally planned.
3. It is evident that stormwater is not adequately managed in terms of flow reduction and attenuation on the surrounding sites. This is a bit after the fact, and it may require the client to augment the site's stormwater plan. I would advise this as the complete sealing up of the site will yield much altered water flow dynamics that may impact on downslope stormwater infrastructure.
4. The soils, due to their duplex nature, exhibit stormwater ingress very rapidly as ponding water and subsequent man-induced vegetation signatures. Stormwater signatures, if not within a pre-existing wetland / watercourse (natural condition), do not have the same status as natural wetland signatures.

The main conclusion is that the wetland signatures on the site have developed due to increased stormwater ingress from surrounding sealing of the landscape, and not from original wetland character or features. None of the historical sources of data indicate wetland features or wetness on the site. Newly developed wetness features are of anthropogenic origin and as such preclude these from qualifying as “wetland” in the definition provided in the NWA. However, the stormwater inflows are significant, and it would be prudent for the developer to augment the stormwater management measures to 1) diminish the risks of stormwater related damage to structures on the site itself and 2) to contribute to more sustained stormwater management and water release into the downstream drained features.

DRAFT

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HYDROPEDOLOGY (LEVEL 2) AND WETLAND SOIL CONTEXT REPORT: ERF 28005 GEORGE, WESTERN CAPE PROVINCE

1. INTRODUCTION

1.1 TERMS OF REFERENCE

Terra Soil Science was appointed by **Adriaan Venter Attorneys & Associates** to provide a specialist assessment on the presence and context of wetland signatures identified on Erf 28005, George, in the Western Cape Province. The site was included in an positive record of decision for development but has subsequently developed wetland related signatures due to increased stormwater ingress.

1.2 AIM OF THIS REPORT

The aim of this report is to provide 1) a detailed summary of the historical wetland presence and soil and hydrogeology context of the area including Erf 28005; 2) the statutory context regarding wetland identification and expression in the highly altered urban environment and 3) the drivers of the increased expression of wetland signatures on the site.

1.3 DISCLAIMER

This report was generated under the regulations of NEMA (National Environmental Management Act) that guides the appointment of specialists. The essence of the regulations is 1) independence, 2) specialisation and 3) duty to the regulator. The independent specialist has, in accordance with the regulations, a duty to the competent authority to disclose all matters related to the specific investigation should he be requested to do such (refer to declaration above).

It is accepted that this report can be submitted for peer review (as the regulations also allow for such). However, the intention of this report is not to function as one of several attempts by involved parties to obtain favourable delineation outcomes. Rather, the report is aimed at addressing specific site conditions in the context of current legislation, guidelines and best practice with the ultimate aim of ensuring the conservation and adequate management of the water resource on the specific site.

2. SITE LOCALITY AND DESCRIPTION

2.1 LOCATION

The site lies between 33° 59' 04" and 33° 59' 20" south and 22° 29' 41" and 22° 30' 00" east in George in the Western Cape Province (**Figure 1**).

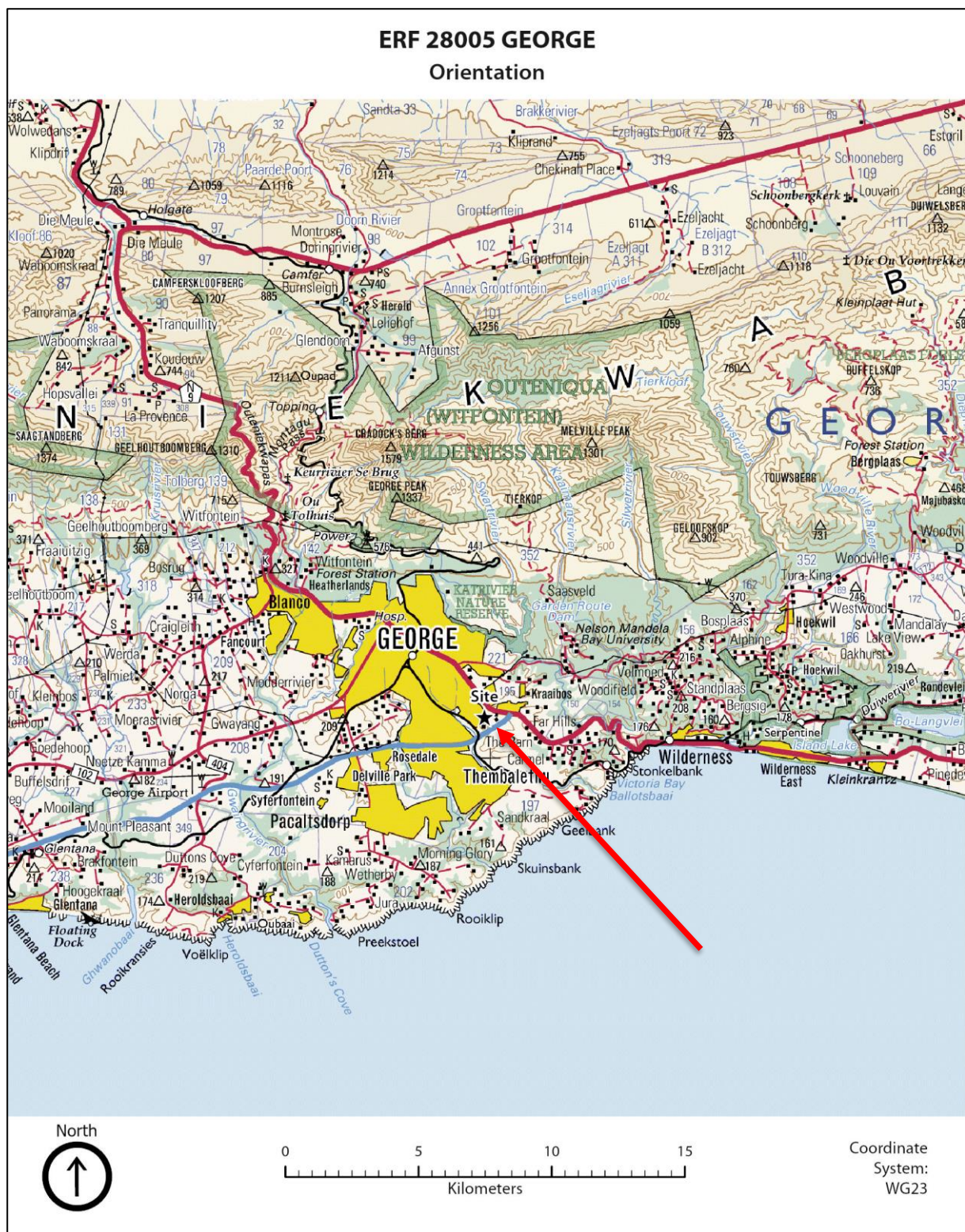


Figure 1 Location of the investigation site

2.2 LAND TYPE DATA

Land type data for the site was obtained from the Institute for Soil Climate and Water (ISCW) of the Agricultural Research Council (ARC). The land type data is presented at a scale of 1:250 000 and

entails the division of land into land types, typical terrain cross sections for the land type and the presentation of dominant soil types for each of the identified terrain units (in the cross section). The soil data is classified according to the Binomial System (MacVicar et al., 1977). The soil data was interpreted and re-classified according to the Taxonomic System (Soil Classification Working Group, 1991). The investigation site falls into the **Db33** land type (Land Type Survey Staff, 1972 – 2006: **Figure 2**). The **Db33** land type is characterised by a bleached and yellow duplex soil dominated landscape with shallow sandy loam soil profiles overlying clay rich subsoils grading into underlying weathered granite.

2.3 GEOLOGY

The geology of the site consists of gneissic granite and granodiorite of the George Pluton with schist (Saasveld) to the north (1:250 000 Geological Map of South Africa, Council for Geoscience; Ferre and Ameglio, 2000; Scheepers and Schoch, 2006; Browning and Macey, 2015). The site itself is situated on Maalgate granite with a transition to Modderkloof granodiorite to the east of site (simplified geological map provided in Ferre and Ameglio, 2000)

2.4 TOPOGRAPHY

The topography of the site and catchment is undulating with distinct drainage features in lower landscape positions (**Figure 3**).

3. PROBLEM STATEMENT

The delineation of wetlands on old granite geology landscapes is challenging (refer to extensive work conducted on the Johannesburg Dome (JD) area by Terra Soil Science) due to a range of factors that leads to difficulty in distinguishing between wetland and terrestrial zones. From a soil form and wetness perspective the specific land type exhibits some form of “wetland” characteristic, according to the present wetland delineation guidelines (DWAF, 2005), in a large section of the landscape due to the ubiquitous occurring bleached and grey coloured topsoils (through crest to valley bottom positions). A compounding factor is the extensive alteration of landscape hydrology through historical plantation and forestry activities as well as more recent urban infrastructure with the development of numerous anthropogenic vegetation related wetland signatures as a result of the altered hydrological drivers.

The following section provides a perspective regarding the statutory as well as biophysical context of wetland delineation in the granites of the George area. This investigation will therefore focus on the identification of the wetland features based on soil hydromorphy, landscape hydrology as well as various historical modifiers through a dedicated assessment and elucidation of hydro-pedological processes and drivers experienced in the catchment and on the site.

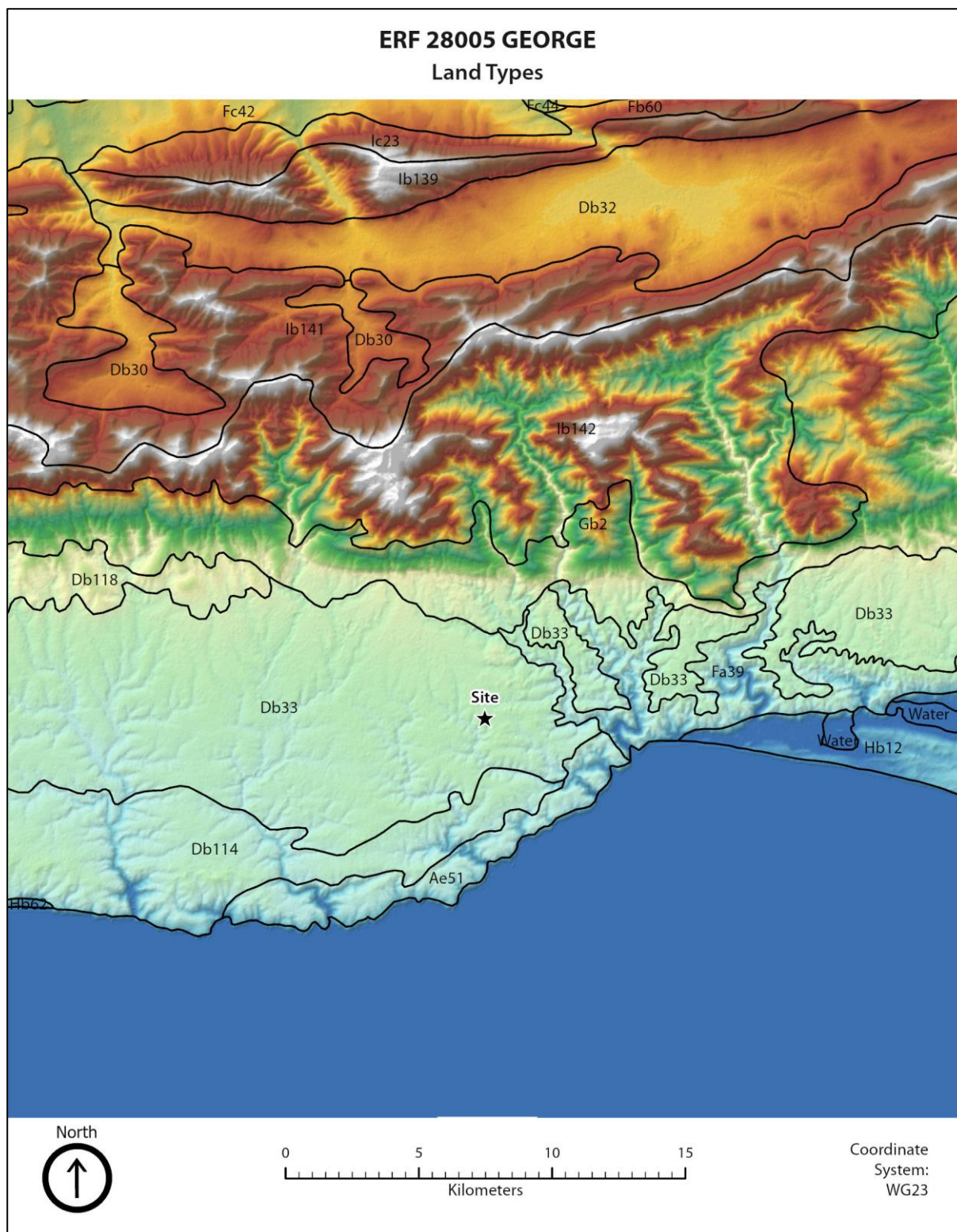


Figure 2 Land type map of the investigation area (data from Land Type Survey Staff, 1972 – 2006)

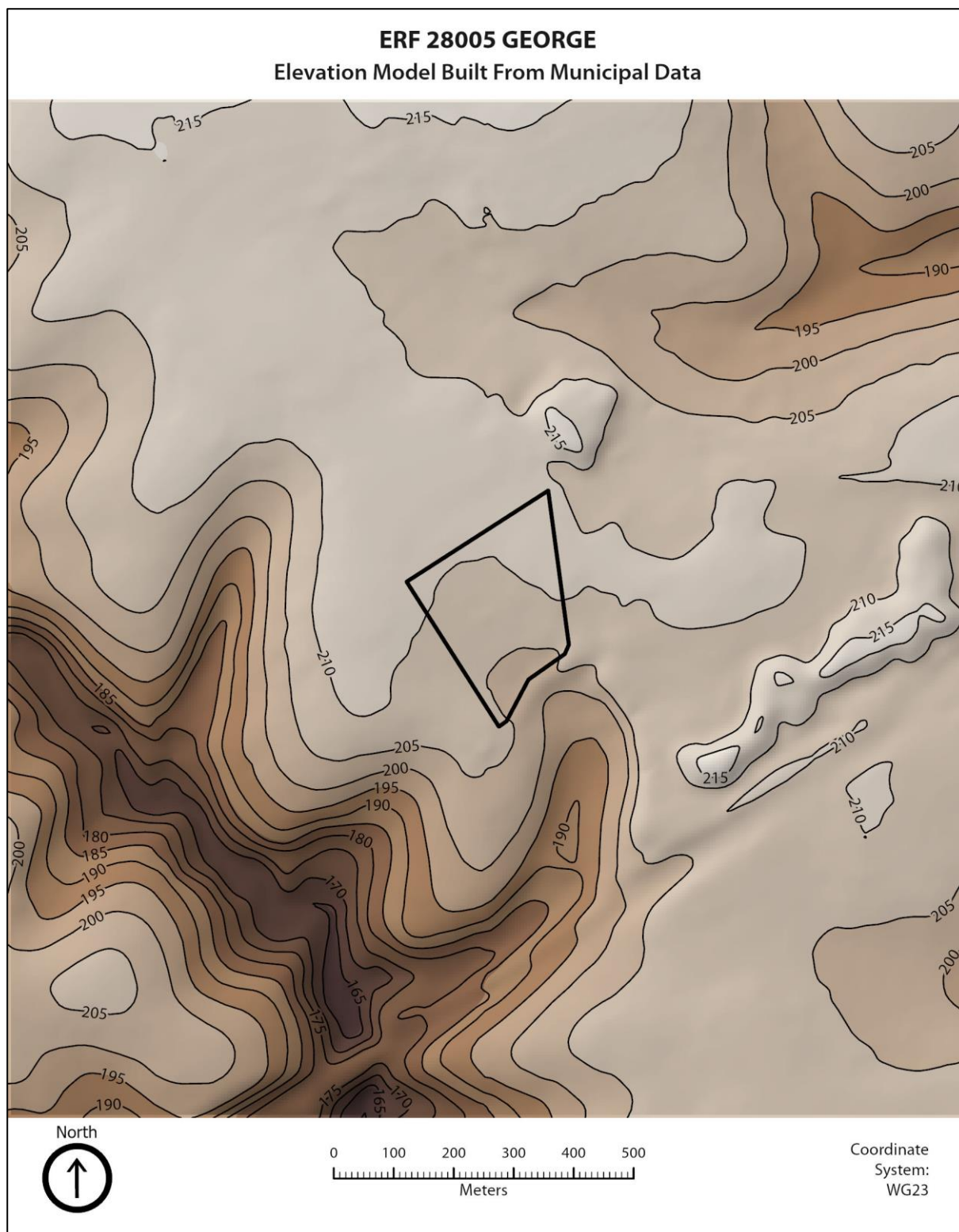


Figure 3 Digital elevation model (DEM) for the investigation site

4. WETLAND STATUTORY CONTEXT

The following is a brief summary of the statutory context of wetland delineation and assessment. Where necessary, additional comment is provided on problematic aspects or aspects that, according to this author, require specific emphasis.

4.1. WETLANDS

4.1.1 WETLAND DEFINITION

Wetlands are defined, in terms of the National Water Act (Act no 36 of 1998) (NWA), as:

“Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.”

4.1.2 INTERPRETATION OF THE WETLAND DEFINITION

In order to address wetland identification, delineation and assessment it is necessary to interpret the definition and discuss specific challenges as follows:

1. *“Land which is transitional between terrestrial and aquatic systems ...”*: This implies areas with variable hydrological and ecological characteristics of which the variation can be described as the linear (assumed) transition from one pole (terrestrial/dry) to another (aquatic/wet).
2. *“... where the water is usually at or near the surface ...”*: Although the regular condition is implied there is no reference to any empirical interpretation. This aspect therefore introduces uncertainty and the potential for significantly variable interpretation.
3. *“... or the land is periodically covered with shallow water ...”*: This statement introduces an alternative to the above statement but, again there is no reference to any empirical interpretation and it therefore introduces uncertainty and the potential for significantly variable interpretation.
4. *“... and which land in normal circumstances ...”*: Normal circumstances are not defined with a subsequent introduction of uncertainty and variability in interpretation. According to Mernewecke and Kotze (as cited in DWAF, 1999) “normal circumstances” in the definition refers to “without human modifications”.
5. *“... supports or would support vegetation typically adapted ...”*: Vegetation species and communities can be described and named and can provide distinctly measurable indicators of wetland conditions. This is therefore a clear indicator if the requisite scientific knowledge is available.
6. *“... to life in saturated soil.”*: Soil saturation (degree, intensity and duration) can be measured empirically (although at significant financial and time cost) or deduced from the soil morphology to varying degrees of certainty (Lin, 2012; Van Tol et al, 2010). The soil morphological indicators (all functions of soil forming factors and processes) have been studied and described extensively in the soil science literature.

An evaluation of the disaggregation above yields that the only certain descriptors, from a scientific, practical and legal perspective, are vegetation and soil indicators. It is also clear that the emphasis is on “saturated soil” and the plants that are adapted to grow under such conditions.

Additionally, from the definition and the purpose of the NWA it can be concluded that wetlands are merely the expression of wetness in landscapes and that the water resource can occur in landscapes in many other forms. One form that is not explicitly mentioned is seasonally perched water tables and their associated vadose zones that are instrumental in the “feeding” of wetlands through lateral flow mechanisms in the landscape. From the purpose of the NWA it is concluded that these water resources are included in the Act. This aspect has a significant bearing on the contents of rehabilitation plans and reports.

Important Note: Point 4 above refers to the understanding of “normal conditions” as described in the definition of a wetland. This aspect has a significant bearing on the unpacking of authorisation and compliance processes regarding wetland impacts and as such will be discussed in further detail under the relevant sections in this report. However, it is critical that cognisance is taken of this concept and its implications as these determine the context of the discussions and findings of this report.

4.2 WATERCOURSE DEFINITION

“Catchment” is defined, in terms of the National Water Act (Act no 36 of 1998) (NWA), as:

“..., in relation to a watercourse or watercourses or part of a watercourse, means the area from which any rainfall will drain into the watercourse or watercourses or part of a watercourse, through surface flow to a common point or common points;”

“Watercourse” is defined, in terms of the National Water Act (Act no 36 of 1998) (NWA), as:

- “(a) a river or spring;
 - (b) a natural channel in which water flows regularly or intermittently;
 - (c) a wetland, lake or dam into which, or from which, water flows; and
 - (d) any collection of water which the Minister may, by notice in the *Gazette*, declare to be a water course,
- and a reference to a watercourse includes, where relevant, its bed and banks;”

4.3 THE WETLAND DELINEATION GUIDELINES

In 2005 the Department of Water Affairs and Forestry published a manual titled “A practical field procedure for identification and delineation of wetland and riparian areas” (DWAF, 2005). The “...manual describes field indicators and methods for determining whether an area is a wetland or riparian area, and for finding its boundaries.” The definition of a wetland in the guidelines is that of the NWA and it states that wetlands must have one or more of the following attributes:

- **“Wetland (hydromorphic) soils** that display characteristics resulting from prolonged saturation”
- “The presence, at least occasionally, of **water loving plants (hydrophytes)**”
- **“A high water table** that results in saturation at or near the surface, leading to anaerobic conditions developing in the top 50 cm of the soil.”

The guidelines further list four indicators to be used for the finding of the outer edge of a wetland. These are:

- **Terrain Unit Indicator.** The terrain unit indicator does not only identify valley bottom wetlands but also wetlands on steep and mild slopes in crest, midslope and footslope positions.
- **Soil Form Indicator.** A number of soil forms (as defined by MacVicar et al., 1991) are listed as indicative of permanent, seasonal and temporary wetland zones.
- **Soil Wetness Indicator.** Certain soil colours and mottles are indicated as colours of wet soils. The guidelines stipulate that this is the primary indicator for wetland soils. (Refer to the guidelines for a detailed description of the colour indicators.) In essence, the reduction and removal of Fe in the form of “bleaching” and the accumulation of Fe in the form of mottles are the two main criteria for the identification of soils that are periodically or permanently wet.
- **Vegetation Indicator.** This is a key component of the definition of a wetland in the NWA. It often happens though that vegetation is disturbed and the guidelines therefore place greater emphasis on the soil form and soil wetness indicators as these are more permanent whereas vegetation communities are dynamic and react rapidly to external factors such as climate and human activities.

The main emphasis of the guidelines is therefore the use soils (soil form and wetness) as the criteria for the delineation of wetlands. The applicability of these guidelines in the context of the survey site will be discussed in further detail later in the report.

4.4 THE RESOURCE DIRECTED MEASURES FOR PROTECTION OF WATER RESOURCES

For a detailed discussion on the relevance of the Resource Directed Measures (RDM) for Protection of Water Resources to this investigation refer to Appendix A.

Critical Application: Water resources in South Africa are gauged in relation to a parameter termed the “present ecological state” (PES). In essence this parameter is a measure of the water resource’s quality and functionality. The relevance of the RDM applies specifically to the requirement for the description of a **“reference state”** when applying the PES determination procedures. In other words, a wetland and its status cannot be determined without determining the reference state – before human impact. This distinction applies specifically in this report as the wetland are on the site has been subject to significant alteration when compared to the reference state.

4.5 PERSPECTIVE ON HUMAN-INDUCED WETLAND FEATURES

Thompson (2006) provides an extensive discussion on the juristic and practical nature of wetlands and watercourses. Stormwater effects in man-made structures and impoundments that do not form

part of natural drainage features are excluded from the definition and description of wetlands and watercourses. **Important Note:** This reference therefore implies that stormwater outlets and the effect of culverts that develop a wetland signature after the activity are therefore excluded from the formal definitions of a wetland and watercourse in the NWA.

4.6 HYDROPEDOLOGY INVESTIGATIONS

In 2021 the Department of Water and Sanitation (DWS) issued a “Guideline for Hydropedological Assessments and Minimum Requirements” for the conducting of such investigations in the event where developments will have impacts on wetlands and watercourses through their proximity (within 500 m) to the development.

The guideline proposes four levels of increasing detail termed “steps”. For all hydropedological surveys a Step 1 and Step 2 investigation is required. The guideline assumes that the area of assessment has a relatively intact hillslope that the investigation can be conducted on. However, the document is silent on highly transformed hillslopes where hillslope hydrology has been altered in the past.

4.7 SUMMARY AND PROPOSED APPROACH

When working in environments where the landscape and land use changes affect the regulatory standing and biophysical context of wetland assessment it is important to answer the following critical questions regarding the assessment and management planning for wetlands:

1. What is the reference condition?
2. What is the difference between the reference condition and the current condition and how big is this difference from a hydrological driver perspective?
3. What are the hydrological drivers (as a function of geology, topography, rainfall and soils) and what are the relative contributions of these drivers to the functioning of the wetland system?
4. What is the intended or planned land use in the wetland as well as terrestrial area and how will these developments impact on the hydrology of the landscape and wetlands?
5. How can the intended land use be plied to secure the best possible hydrological functioning of the landscape in terms of storm water attenuation, erosion mitigation and water quality?

5. CHALLENGES REGARDING WETLAND DELINEATION AND HYDROPEDOLOGY ASSESSMENTS IN QUARTZ RICH AND GRANITE/GNEISS ENVIRONMENTS FOR THE PURPOSE OF WETLAND ASSESSMENT

An overview discussion of the challenges regarding the delineation of wetlands in quartz rich and granite/gneiss environments is provided in Appendix B. This discussion provides the biophysical context of the specific wetland drivers and signatures and is critical to the understanding why soil

characteristics of wetlands in this setting require proper contextualisation to correctly delineate these features.

Critical Application: Due to the specific geology and landscape age, duplex profiles with bleached surface horizons and high clay-content subsoil materials occur throughout on the George Pluton. The reliance on grey soil matrix features will therefore overestimate wetland distribution significantly and a critical contextualisation is therefore required. Due to the landscape features any change in hydrological functioning of the landscape through urban development and surface sealing will lead to the rapid development of new, but anthropogenic, wetland expressions.

6. METHOD OF SITE INVESTIGATION AND IDENTIFICATION

6.1 WETNESS CONTEXT DETERMINATION

The context of the wetness features on the site was conducted through 1) the assessment of the development of wetness features over time as a function of landscape features and 2) the thorough consideration of the geological, topographical, climatic, hydropedological, catchment and historical impact context of the site.

6.2. AERIAL PHOTOGRAPH INTERPRETATION

An aerial photograph interpretation exercise was conducted through the use of historical aerial photographs and Google Earth images of the site. This data was used to obtain an indication of the extent of the wetlands on the site as well as to provide an indication of the artificial modifiers evident on the site and in the catchment.

6.3 TERRAIN UNIT INDICATOR

Contours of the site were obtained from the George Municipality as well as from the site stormwater plan. These were used to provide an indication of drainage depressions and drainage lines. From this data the terrain unit indicator was interpreted.

6.4 SOIL FORM AND SOIL WETNESS INDICATORS / HYDROPEDOLOGY INVESTIGATION

The soil form and wetness indicators were assessed in in the context of numerous soil surveys on surrounding plots as well as the soil information available from various references. Where relevant this information will be discussed in this report.

6.5 VEGETATION INDICATOR

The vegetation indicators were deduced from the aerial photography due to the extent of modification evident on site.

6.6 ARTIFICIAL MODIFIERS AND ALTERED HYDROLOGICAL DRIVERS

Artificial modifiers of the landscape and wetland area were identified during the different components of the investigation and are addressed in the context of the biophysical setting and a “wetland drivers and responses” philosophy. The altered hydrological drivers on the site were identified and elucidated in terms of the expected change in wetland response signatures.

7. WETLAND INVESTIGATION RESULTS AND DISCUSSION

7.1 WETNESS CONTEXT

The expressed wetness on the site relates to increased surface water and associated wetness features as reported after recent site visits.

7.2 AERIAL PHOTOGRAPH INTERPRETATION

7.2.1 Historical Aerial Photographs

The historical aerial photographs range from 1939 to 1991. The 1939, 1957, 1980 and 1991 images are provided in **Figure 4** and indicate the approximate site area to be characterised by forestry activities. The watercourse draining the general site is evident to the south and south-west of the site.

7.2.2 Google Earth Images – High Level

The high-level Google Earth images (2005 to 2022) for the site are provided in **Figure 5**. These indicate the progression in urban development up to the present.

7.2.3 Google Earth Images – Detail Level

The detailed level Google Earth images, ranging from 2005 to the 2022, are provided in **Figures 6 to 8**. These images indicate the development of stormwater ingress signatures and trenches as well as a developing associated vegetation signature in the lower portion of the site.

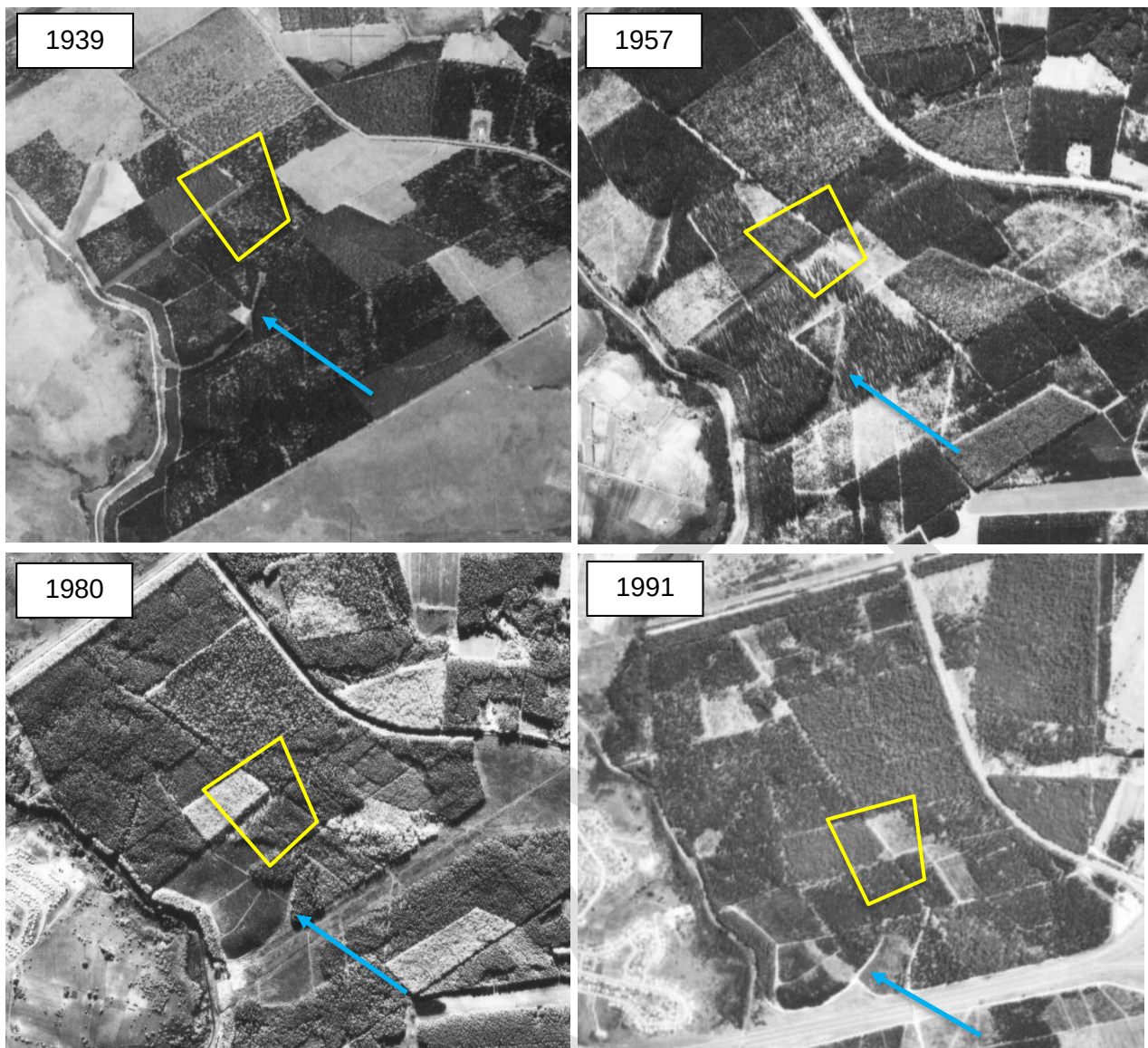


Figure 4 Historical aerial photographs (with year dates) indicating the approximate position of the investigation site (yellow polygon), the dominance of forestry activities and the watercourse to the south and south-west of the site (blue arrow)



Figure 5 Google Earth images (dates at the top left) of the site indicating the developing urban infrastructure and roads surrounding the site



Figure 6 Google Earth images (top: 2005/04/13; bottom: 2006/05/09) indicating an increasing urban footprint surrounding the site



Figure 7 Google Earth images (top: 2011/04/08; bottom: 2014/02/04) indicating dirt access roads and stormwater trenches on the site



Figure 8 Google Earth images (top: 2017/04/10; bottom: 2020/04/03) indicating developments with stormwater outlets onto the site surrounding it, as well as a developing wetness footprint



Figure 9 Google Earth image (2022/08/31) indicating developments with stormwater outlets onto the site surrounding it and the resultant wetness footprint in the southern section

7.3 TERRAIN UNIT INDICATOR

The detailed contours of the site that were obtained from the George Municipality are provided as a DEM in **Figure 10** and as a topographic wetness index (TWI) in **Figure 11** for the broader site. The TWI is an algorithm that is used to indicate preferential flow paths of water as a function of the topography. Darker zones indicate areas of water flow concentration. These images indicate the site located in a lower lying area within the general development and as such prone to accumulation of stormwater.

The detailed contours for the stormwater plan are indicated as a DEM in **Figure 12** and as a TWI in **Figure 13**. These contours clearly indicate the excavated stormwater trenches as well as the elevated road (narrow sliver) signature on the site. It is apparent that these measures were implemented by surrounding developments to manage stormwater away from their sites.

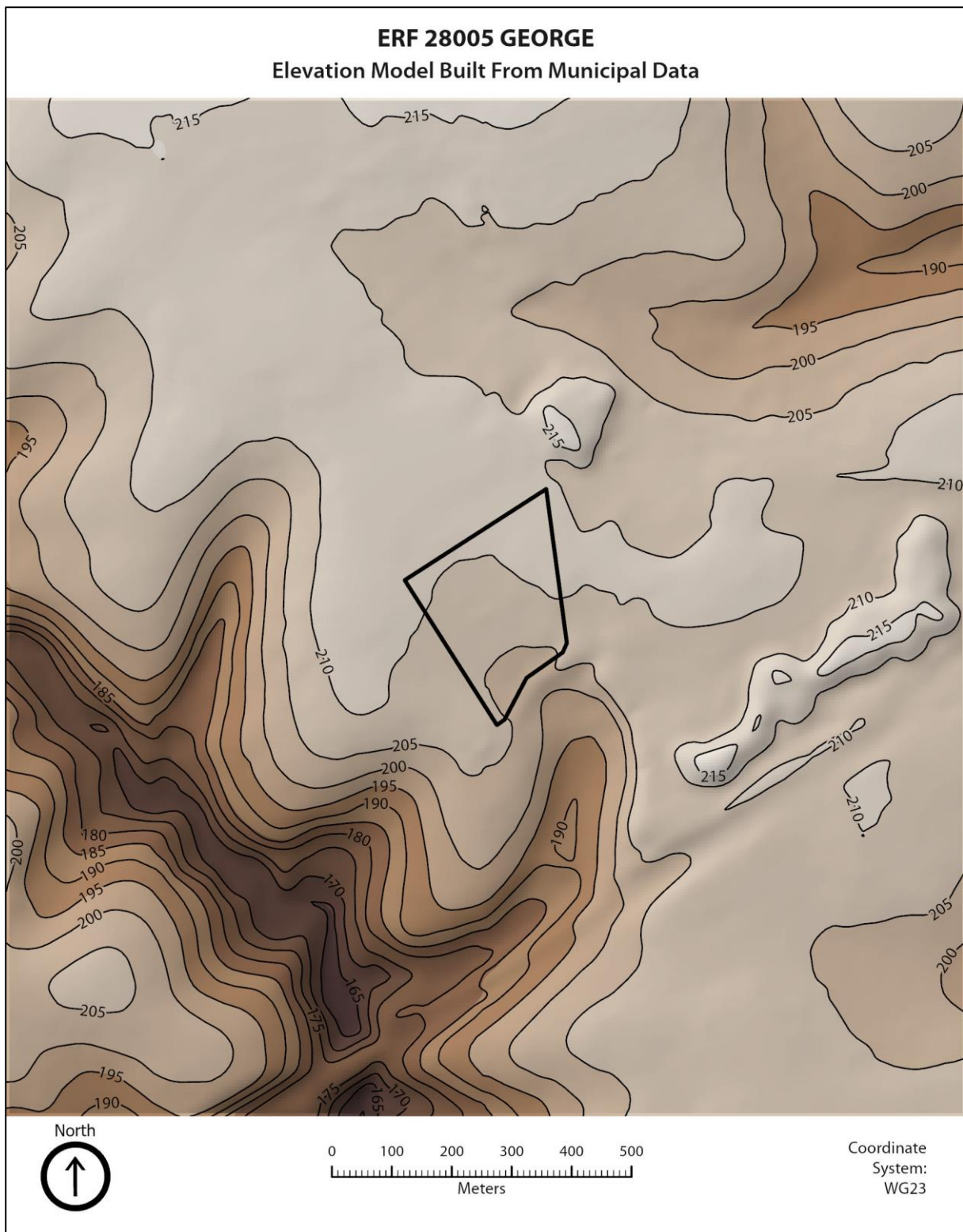


Figure 10 Digital elevation model for the site from George Municipality contour data

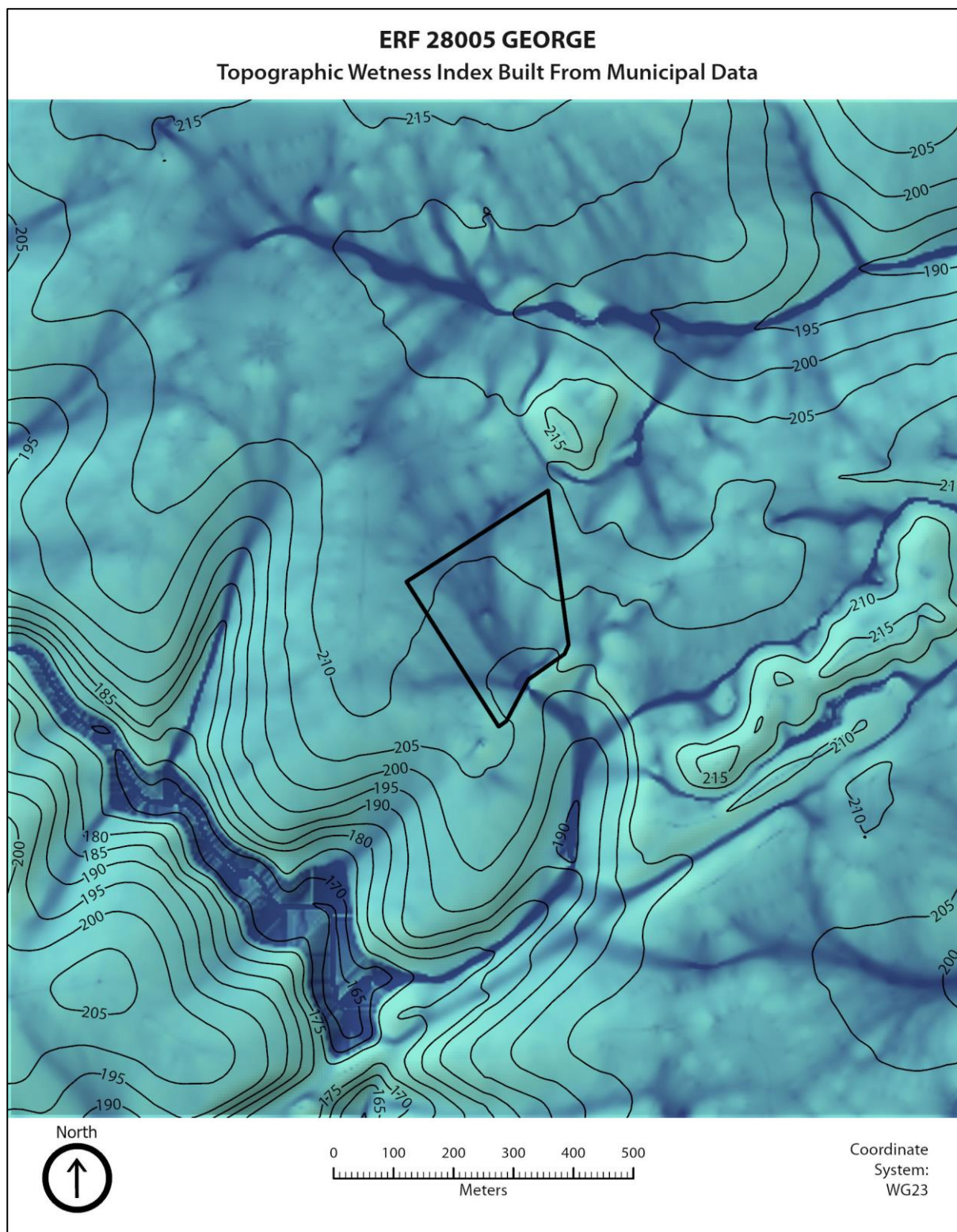


Figure 11 Topographic wetness index for the site from George Municipality contour data

ERF 28005 GEORGE
Elevation Model Built From Survey Data



ERF 28005 GEORGE
Topographic Wetness Index Built From Survey Data

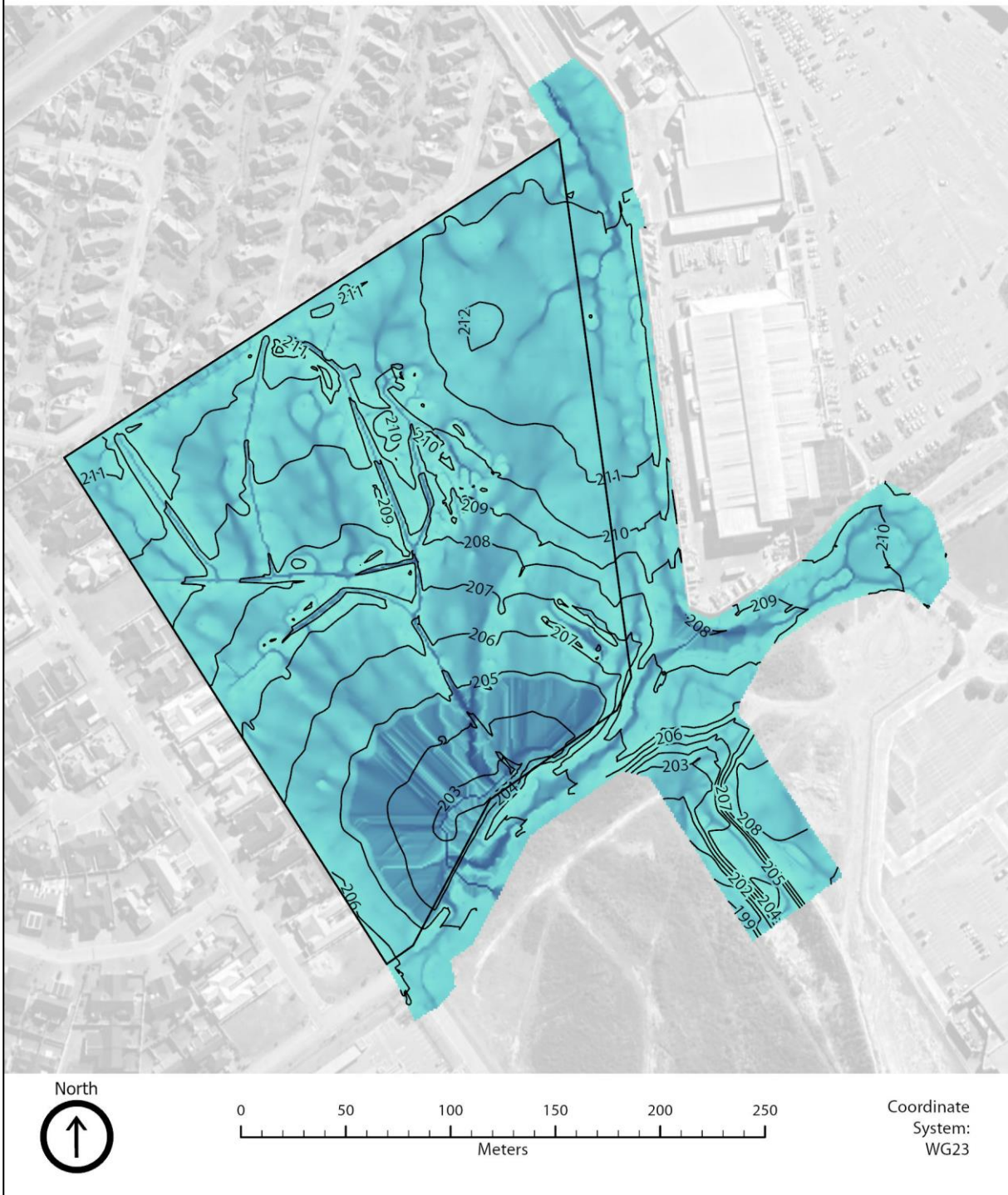


Figure 13 Topographic wetness index for the site from stormwater plan contour data

7.4 SOIL FORM AND SOIL WETNESS INDICATORS / HYDROPEDOLOGY INVESTIGATION

Due to the extent of the disturbances on the site a dedicated soil survey is considered moot. However, detail from surrounding sites that have been surveyed was used for the generation of the discussion on the soils of the Db33 land type in section B8 of Appendix B. The principles discussed in the relevant sections apply to this site.

The essence is that the soils, even though exhibiting bleached colours and mottling, do not qualify as wetland soils due to the lack of wetland vegetation and signatures during the past 80 years. As the South African landscape is littered with geologically old soils, often with bleached or kaolinized character outside of current wetland zones, caution should be exercised when identifying wetlands on soil properties alone.

7.5 VEGETATION INDICATORS

The wetness associated vegetation indicators have developed during the past 10 years. A distinct causal link is evident in the increased stormwater ingress onto the site as these vegetation features were absent prior to that, as is evident from the data relied upon for the original environmental authorisation.

7.6 ARTIFICIAL MODIFIERS AND ALTERED HYDROLOGICAL DRIVERS

The artificial modifiers on the site have been elucidated in the previous sections. These include:

1. Very significant large scale hydrological alteration of the site through surrounding urban related development;
2. Increased and altered stormwater flows onto the site; and
3. Clear attempts on the site of channelling stormwater ingress towards the lowest point and subsequent culvert on the site.

These modifiers yield altered ecological drivers that elicit an altered ecological response in the form of increased wetness expression.

8. CONCLUSIONS AND RECOMMENDATIONS

The following conclusions are drawn from this investigation:

5. The site did not show any original wetland signatures from 1939 to 2005 when the land use changes were effected.
6. The historical images indicate a gradual change in the surrounding landscape with increasing stormwater ingress evident. The stormwater report is rather high level and my experience in the Western Cape is that the stormwater reports miss many critical aspects related to volumes and effects. I have had very significant interaction with the BGCMA on other sites regarding this exact issue. The implication is that the client may have to re-

assess their stormwater designs to accommodate for larger volumes than originally planned.

7. It is evident that stormwater is not adequately managed in terms of flow reduction and attenuation on the surrounding sites. This is a bit after the fact, and it may require the client to augment the site's stormwater plan. I would advise this as the complete sealing up of the site will yield much altered water flow dynamics that may impact on downslope stormwater infrastructure.
8. The soils, due to their duplex nature, exhibit stormwater ingress very rapidly as ponding water and subsequent man-induced vegetation signatures. Stormwater signatures, if not within a per-existing wetland / watercourse (natural condition), do not have the same status as natural wetland signatures.

The main conclusion is that the wetland signatures on the site have developed due to increased stormwater ingress from surrounding sealing of the landscape, and not from original wetland character or features. None of the historical sources of data indicate wetland features or wetness on the site. Newly developed wetness features are of anthropogenic origin and as such preclude these from qualifying as "wetland" in the definition provided in the NWA. However, the stormwater inflows are significant and it would be prudent for the developer to augment the stormwater management measures to 1) diminish the risks of stormwater related damage to structures on the site itself and 2) to contribute to more sustained stormwater management and water release into the downstream drained features.

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APPENDIX A: APPLICATION OF THE RESOURCE DIRECTED MEASURES FOR PROTECTION OF WATER RESOURCES

The following are specific quotes from the different sections of the “Resource Directed Measures for Protection of Water Resources.” as published by DWAF (1999).

A1. THE RESOURCE DIRECTED MEASURES FOR PROTECTION OF WATER RESOURCES: VOLUME 4: WETLAND ECOSYSTEMS.

From the Introduction:

“This set of documents on Resource Directed Measures (RDM) for protection of water resources, issued in September 1999 in Version 1.0, presents the procedures to be followed in undertaking **preliminary determinations of the class, Reserve and resource quality objectives for water resources**, as specified in sections 14 and 17 of the South African National Water Act (Act 36 of 1998).

The development of procedures to determine RDM was initiated by the Department of Water Affairs and Forestry in July 1997. Phase 3 of this project will end in March 2000. Additional refinement and development of the procedures, and development of the full water resource classification system, will continue in Phase 4, until such time as the detailed procedures and full classification system are ready for publication in the Government Gazette.

It should be noted that until the final RDM procedures are published in the Gazette, and prescribed according to section 12 of the National Water Act, all determinations of RDM, whether at the rapid, the intermediate or the comprehensive level, will be considered to be preliminary determinations.”

A2. THE RESOURCE DIRECTED MEASURES FOR PROTECTION OF WATER RESOURCES: GENERIC SECTION “A” FOR SPECIALIST MANUALS – WATER RESOURCE PROTECTION POLICY IMPLEMENTATION PROCESS

“Step 3: Determine the reference conditions of each resource unit”

“What are reference conditions?”

“The determination of reference conditions is a very important aspect of the overall Reserve determination methodology. Reference conditions describe the natural unimpacted characteristics of a water resource. Reference conditions quantitatively describe the ecoregional type, specific to a particular water resource.”

Important Note: The discussion of the reference conditions is often omitted from wetland investigations. This is considered a critical flaw as the hydrological functioning of the landscape has as its template the reference, or pre-human impact, condition of the site. The assessment of wetlands

therefore invariably use the “reference state” as a departure point and as such has to describe how far the site conditions have changed from the original. This is especially relevant within a soil hydrological context as these parameters constitute the drivers of the conditions that are being assessed. It is critical that cognisance is taken of this concept and its implications as it determines the context of the discussions and findings of this report.

A3. THE RESOURCE DIRECTED MEASURES FOR PROTECTION OF WATER RESOURCES: APPENDIX W1 (ECOREGIONAL TYPING FOR WETLAND ECOSYSTEMS)

Artificial modifiers are explained namely:

“Many wetlands are man-made, while others have been modified from a natural state to some degree by the activities of humans. Since the nature of these alterations often greatly influences the character of such habitats, the inclusion of modifying terms to accommodate human influence is important. In addition, many human modifications, such as dam walls and drainage ditches, are visible in aerial photographs and can be easily mapped. The following Artificial Modifiers are defined and can be used singly or in combination wherever they apply to wetlands:

Farmed: the soil surface has been physically altered for crop production, but hydrophytes will become re-established if farming is discontinued

Artificial: substrates placed by humans, using either natural materials such as dredge spoils or synthetic materials such as concrete. Jetties and breakwaters are examples of Non-vegetated Artificial habitats

Excavated: habitat lies within an excavated basin or channel

Diked/Impounded: created or modified by an artificial barrier which obstructs the inflow or outflow of water

Partially Drained: the water level has been artificially lowered, usually by means of ditches, but the area is still classified as wetland because soil moisture is sufficient to support hydrophytes.”

A4. THE RESOURCE DIRECTED MEASURES FOR PROTECTION OF WATER RESOURCES: APPENDIX W4 IER (FLOODPLAIN WETLANDS) PRESENT ECOLOGICAL STATUS (PES) METHOD

In Appendix W4 the methodology is provided for the determination of the present ecological status (PES) of a palustrine wetland.

The present ecological state (PES) of the wetland was determined according to the method described in “APPENDIX W4: IER (FLOODPLAIN WETLANDS) PRESENT ECOLOGICAL STATUS (PES) METHOD” of the “Resource Directed Measures for Protection of Water Resources. Volume 4: Wetland Ecosystems” as published by DWAF (1999). However, the PES methodology already forms an adaptation from the methodology to assess palustrine wetlands. Hillslope seepage wetlands have a range of different drivers and as such some modification of the criteria has been made by this author to accommodate the specific hydrology drivers of hillslope seepage wetlands.

The criteria as described in Appendix 4 is provided below with the relevant modification or comment provided as well.

The summarised tasks in the PES methodology are (for detailed descriptions refer to the relevant documentation):

1. Conduct a literature review (review of available literature and maps) on the following:
 - a. Determine types of development and land use (in the catchment in question).
 - b. Gather hydrological data to determine the degree to which the flow regime has been modified (with the “virgin flow regime” as baseline). The emphasis is predominantly on surface hydrology and hydrology of surface water features as well as the land uses, such as agriculture and forestry, that lead to flow modifications. Important Note: The hydrology of landscapes is not explicitly mentioned in the RDM documentation and this author will make a case for its consideration as probably the most important component of investigating headwater systems and seepage wetlands and areas.
 - c. Assessment of the water quality as is documented in catchment study reports and water quality databases.
 - d. Investigate erosion and sedimentation parameters that address aspects such as bank erosion and bed modification. Important Note: The emphasis in the RDM documentation is again on river and stream systems with little mention of erosion of headwater and seepage zone systems. Again a case will be made for the emphasis of such information generation.
 - e. Description of exotic species (flora and fauna) in the specific catchment in question.
2. Conduct an aerial photographic assessment in terms of the parameters listed above.
3. Conduct a site visit and make use of local knowledge.
4. Assess the criteria and generate preliminary PES scores.
5. Generation of report.

Table A1 presents the scoresheet with criteria for the assessment of habitat integrity of palustrine wetlands (as provided in the RDM documentation).

Scoring guidelines per attribute:

natural, unmodified = 5; Largely natural = 4, Moderately modified = 3; largely modified = 2; seriously modified = 1; Critically modified = 0.

Relative confidence of score:

Very high confidence = 4; High confidence = 3; Moderate confidence = 2; Marginal/low confidence = 1.

Important Note: The present ecological state (PES) determination is, as discussed earlier in the report, based on criteria originally generated for palustrine and floodplain wetlands. Seepage wetlands very rarely have the same degree of saturation or free water and consequently often do not have permanent wetland zones. These wetlands are therefore often characterised by seasonal

or temporary properties and as such a standard PES approach is flawed. The existing criteria is provided below as is a comment on the applicability as well as proposed improvements.

Table A1 “Table W4-1: Scoresheet with criteria for assessing Habitat Integrity of Palustrine Wetlands (adapted from Kleynhans 1996)”

Criteria and attributes	Relevance	Score	Confidence
Hydrologic			
Flow modification	Consequence of abstraction, regulation by impoundments or increased runoff from human settlements or agricultural land. Changes in flow regime (timing, duration, frequency), volumes, velocity which affect inundation of wetland habitats resulting in floristic changes or incorrect cues to biota. Abstraction of groundwater flows to the wetland.		
Permanent Inundation	Consequence of impoundment resulting in destruction of natural wetland habitat and cues for wetland biota.		
Water Quality			
Water Quality Modification	From point or diffuse sources. Measure directly by laboratory analysis or assessed indirectly from upstream agricultural activities, human settlements and industrial activities. Aggravated by volumetric decrease in flow delivered to the wetland		
Sediment load modification	Consequence of reduction due to entrapment by impoundments or increase due to land use practices such as overgrazing. Cause of unnatural rates of erosion, accretion or infilling of wetlands and change in habitats.		
Hydraulic/Geomorphic			
Canalisation	Results in desiccation or changes to inundation patterns of wetland and thus changes in habitats. River diversions or drainage.		
Topographic Alteration	Consequence of infilling, ploughing, dykes, trampling, bridges, roads, railwaylines and other substrate disruptive activities which reduces or changes wetland habitat directly or through changes in inundation patterns.		
Biota			
Terrestrial Encroachment	Consequence of desiccation of wetland and encroachment of terrestrial plant species due to changes in hydrology or geomorphology. Change from wetland to terrestrial habitat and loss of wetland functions.		
Indigenous Vegetation Removal	Direct destruction of habitat through farming activities, grazing or firewood collection affecting wildlife habitat and flow attenuation functions, organic matter inputs and increases potential for erosion.		
Invasive plant encroachment	Affect habitat characteristics through changes in community structure and water quality changes (oxygen reduction and shading).		
Alien fauna	Presence of alien fauna affecting faunal community structure.		
Overutilisation of biota	Overgrazing, Over-fishing, etc		
TOTAL MEAN			

Criteria

Hydrological Criteria

- “Flow modification: Consequence of abstraction, regulation by impoundments or increased runoff from human settlements or agricultural land. Changes in flow regime (timing, duration,

frequency), volumes, velocity which affect inundation of wetland habitats resulting in floristic changes or incorrect cues to biota. Abstraction of groundwater flows to the wetland.”

Comment: Although the description is wide it is very evident that seepage or hillslope wetlands do not become inundated but rather are fed by hillslope return flow processes. The main criterion should therefore be the surface and subsurface hydrological linkages expressed as a degree of alteration in terms of the surface, hydropedology and groundwater hydrology.

- “Permanent inundation: Consequence of impoundment resulting in destruction of natural wetland habitat and cues for wetland biota.” Comment: Mostly not applicable to hillslope seepage wetlands.

Water Quality Criteria

- “Water quality modification: From point or diffuse sources. Measure directly by laboratory analysis or assessed indirectly from upstream agricultural activities, human settlements and industrial activities. Aggravated by volumetric decrease in flow delivered to the wetland.” Comment: Water quality in this context applies generally but cognisance should be taken of seepage water quality that can be natural but significantly different to exposed water bodies. The main reason for this being the highly complex nature of many redox processes within the hillslope.
- “Sediment load modification: Consequence of reduction due to entrapment by impoundments or increase due to land use practices such as overgrazing. Cause of unnatural rates of erosion, accretion or infilling of wetlands and change in habitats.” Comment: This is a very relevant concept but on hillslopes should be linked to erosivity of the soils as well as the specific land use influences.

Hydraulic / Geomorphic Criteria

- “Canalisation: Results in desiccation or changes to inundation patterns of wetland and thus changes in habitats. River diversions or drainage.” Comment: Again this is a very relevant concept but on hillslopes should be linked to erosivity of the soils as well as the specific land use influences. This concept does however not address the influences on the hydropedology of the hillslope. These aspects should be elucidated and contextualised.
- “Topographic Alteration: Consequence of infilling, ploughing, dykes, trampling, bridges, roads, railwaylines and other substrate disruptive activities which reduces or changes wetland habitat directly or through changes in inundation patterns.” Comment: Again this is a very relevant concept but on hillslopes should be linked to erosivity of the soils as well as the specific land use influences. This concept does however not address the influences on the hydropedology of the hillslope. These aspects should be elucidated and contextualised.

Biological Criteria

- “Terrestrial encroachment: Consequence of desiccation of wetland and encroachment of terrestrial plant species due to changes in hydrology or geomorphology. Change from wetland to terrestrial habitat and loss of wetland functions.” Comment: Again this is a very relevant concept but on hillslopes should be linked to erosivity of the soils as well as the specific land use influences. This concept does however not address the influences on the hydropedology of the hillslope. These aspects should be elucidated and contextualised.

- “Indigenous vegetation removal: Direct destruction of habitat through farming activities, grazing or firewood collection affecting wildlife habitat and flow attenuation functions, organic matter inputs and increases potential for erosion.”
- “Invasive plant encroachment: Affect habitat characteristics through changes in community structure and water quality changes (oxygen reduction and shading).”
- “Alien fauna: Presence of alien fauna affecting faunal community structure.”
- “Overutilisation of biota: Overgrazing, Over-fishing, etc.”

Scoring Guidelines

Scoring guidelines per attribute:

Natural, unmodified = 5

Largely natural = 4

Moderately modified = 3

Largely modified = 2

Seriously modified = 1

Critically modified = 0

Relative confidence of score:

Very high confidence = 4

High confidence = 3

Moderate confidence = 2

Marginal/low confidence = 1

A5. THE RESOURCE DIRECTED MEASURES FOR PROTECTION OF WATER RESOURCES: APPENDIX W5 IER (FLOODPLAIN WETLANDS) DETERMINING THE ECOLOGICAL IMPORTANCE AND SENSITIVITY (EIS) AND THE ECOLOGICAL MANAGEMENT CLASS (EMC)

In Appendix W5 the methodology is provided for the determination of the ecological importance and sensitivity (EIS) and ecological management class (EMC) of floodplain wetlands.

"Ecological importance" of a water resource is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales. "Ecological sensitivity" refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred. The Ecological Importance and sensitivity (EIS) provides a guideline for determination of the Ecological Management Class (EMC)." Please refer to the specific document for more detailed information.

The following primary determinants are listed as determining the EIS:

1. Rare and endangered species
2. Populations of unique species
3. Species / taxon richness
4. Diversity of habitat types or features
5. Migration route / breeding and feeding site for wetland species

6. Sensitivity to changes in the natural hydrological regime
7. Sensitivity to water quality changes
8. Flood storage, energy dissipation and particulate / element removal

The following modifying determinants are listed as determining the EIS:

1. Protected status
2. Ecological integrity

DRAFT

APPENDIX B: CHALLENGES REGARDING WETLAND DELINEATION AND HYDROPEDOLOGY ASSESSMENTS IN QUARTZ RICH AND GRANITE/GNEISS ENVIRONMENTS FOR THE PURPOSE OF WETLAND ASSESSMENT

Disclaimer: The following section represents a discussion that I use as standard in describing the challenges regarding wetland delineation and management in quartz rich and granite/gneiss environments. This implies that the section is verbatim the same as in other reports provided to clients and the authorities. Copyright is strictly reserved.

In order to discuss the procedures followed and the results of the wetland identification exercise it is necessary at the outset to provide some theoretical background on soil forming processes, soil wetness indicators, water movement in soils and topographical sequences of soil forms (catena).

B1. WETLAND DRIVERS AND ECOLOGICAL RESPONSES

The identification and assessment of wetlands rest on the elucidation and description of wetland habitat and wetland biota. These parameters have value in terms of their expression of ecosystem health and biodiversity characteristics of specific landscapes as they constitute the responses to a range of drivers centred around water (**Figure B1**). The response is specifically related to the physical / hydrological parameters of water summarised in the concept of “flow regime” and in the chemical / biological parameters summarised in the concept of “water quality” and is referred to in general as the ecosystem services associated with the responses (**Figure B1**). The flow regime, water quality and geomorphology characteristics (drivers) of a landscape determine the types and characteristics of the response expressed as habitat and biota. It therefore follows that in the event that the drivers are altered the responses, and therefore ecosystem services, will be altered as well. This concept is central to the understanding and elucidation of wetland (habitat and biota) impacts and is currently emphasised by the Department of Water and Sanitation (DWS) when considering water use licence application processes.

The ecosystem drivers are contextualised in the geological, topographical and climatic setting. Together with biota and the relative age of the landscape these parameters constitute five soil forming factors that determine the specific soil profiles and characteristics encountered in a landscape. It is therefore no coincidence that two of the four wetland indicators relate to soil namely soil form (formal classification: SA Taxonomic System – Soil Classification Working Group, 1991) and soil wetness (redox morphology indicators of long-term water regime in the form of soil material colours and mottles as a function of iron chemistry and mineralogy) (DWAF, 2005). The remaining two are landscape position (geomorphology – ecosystem driver) and vegetation (biota – ecosystem response).

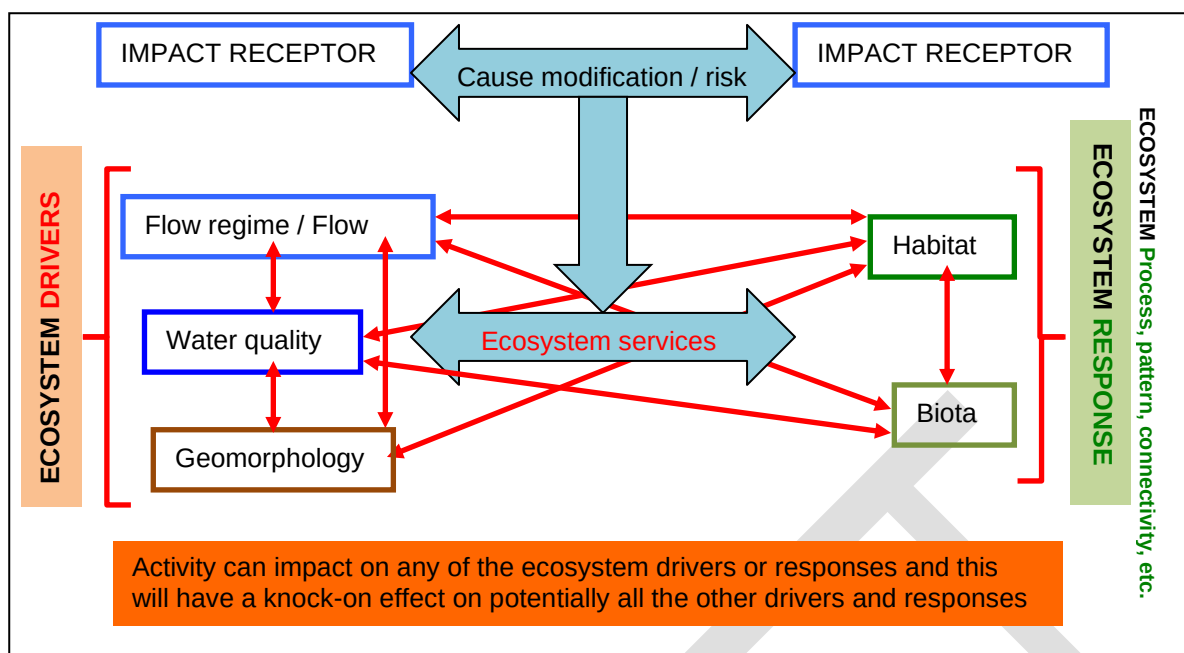


Figure B1 Ecosystem services drivers and responses (sourced from DWS)

The assessment of wetlands is usually based on the measurement of ecological properties of the specific wetland or landscape. These relate to a host of living organisms that indicate the status and quality of the wetland with values assigned by specialists to these indicators. The wetland specialist therefore provides a snapshot of the condition of the wetland and this snapshot indicates the characteristics or “value” that will be lost once the wetland is impacted.

However, the ecological response is entirely dependent on the hydrological drivers of the wetland system. The drivers are numerous and include the following:

1. Surface hydrology of the landscape: This parameter determines flow dynamics of water with subsequent accumulation zones that correspond to depressions and low points. This driver is accounted for in the terrain unit indicator (wetland delineation guidelines) on a landscape scale but is often overlooked on a much more localised scale in furrows, erosion features and micromorphological features encountered in many landscapes. The typical responses to these features relate to the well-established knowledge on wetland ecology in that wetter zones will indicate ecological signatures associated with the degree and duration of wetness. It therefore follows that surface runoff characteristics of a landscape, when altered, will alter the responses accordingly. Examples include road, paving or roof surfaces that seal the soil or complete alteration of landscape surfaces through cut and fill operations. The typical response to these operations are reflected in storm water signatures related to wetland vegetation establishment in culverts / channels, erosion of unstable soils and materials, and/or rapid filling of depressions with water following rainfall events.
2. Interflow or hillslope hydrology: This parameter is described in much more detail below and is a function of a number of soil, geology and landscape characteristics. The essence

is that interflow or hillslope water can manifest in any position in the landscape and surface or near surface water will elicit an ecological response that can be measured and assessed. If however the soil, geological or landscape characteristics are altered the seepage pathways will also be altered and the wet ecological response may vary from disappearing in the areas that have become drier or being amplified in areas that have become wetter. Alteration of the surface, as discussed above, may also impede or increase infiltration with a subsequent increase in interflow and wet ecological response.

3. Groundwater hydrology: This parameter is influenced by both of the parameters described above and constitutes the water resource that is often accessed through boreholes or deep wells. Groundwater can in some cases intercept the land surface and in such conditions it will elicit a wet ecological response. If the water level changes the response will change accordingly.
4. Water quality: This parameter is a significant driver of the specific wet ecological response in that different organisms will provide distinct perspectives on the chemical signature of the water that manifests near or on land surfaces. However, this parameter can also be altered to varying degrees by the above parameters and their alteration and it therefore also constitutes a response to the above three.

It is critically important to note here that the natural landscape condition, with its equilibrium in terms of surface, hillslope, groundwater and water quality characteristics, forms the reference state for the assessment of ecological and hydrological parameters. Any alteration in these parameters would elicit altered responses that may be desirable or not. This also forms the philosophical and practical basis for integrated storm water management, wetland rehabilitation and artificial wetland design and construction.

B2. SOIL AS A TOOL FOR LANDSCAPE CONTEXT AND HYDROLOGICAL DRIVER DESCRIPTION

The relevance of soils as tools for the elucidation and description of landscape context and hydrological drivers is discussed in detail below. It is however important to emphasize the differences that are evident in South African soils when these are compared to the soils of countries where wetland assessment processes based on the identification of hydric soil indicators are used in administrative and legal compliance processes. One such example is the large body of knowledge underpinning the identification, assessment, management and protection of wetlands in the USA that served as a motivation for the processes followed in South Africa.

Laker (2003) describes three main soil regions in the world namely 1) soils of the high latitudes and continental land masses in the northern hemisphere, 2) the soils of the humid and subhumid tropics around the equator and 3) the soils of the southern hemisphere lying between 20 and 35 degrees south. The first regions is characterised by cooler to cold climates and have experienced relatively recent glaciation. The soils are therefore indicative of the cold weather in that they contain significant organic carbon and the soils also exhibit signs of youthful age when compared to older tropical soils. The second region is characterised by older and very pronounced pedogenesis. Both the aforementioned groups have been studied extensively and are adequately accommodated in several

local and international soil classification systems. The third region is characterised by hard geology, old age and moderate to low rainfall leading to the development of very distinct soils that are not always comfortably accommodated in international classification systems. The South African Taxonomic System therefore accommodates the soils in a structure that is somewhat different to the well-known international systems (USDA Soil Taxonomy and WRB).

The benefit of the above third soil region is that the soils are found on predominantly stable and old land surfaces with the consequence that the soil morphology clearly indicates the hydrological functioning in the expression of redox morphology. This aspect therefore leads to a very distinct redox morphology foundation for wetland delineation. The extension of this argument is that the soil morphology, described within a distinct geological, topographical and climate context provides an excellent tool for the elucidation of landscape hydrological process. The hydrological drivers of wetland conditions can therefore be elucidated through a dedicated assessment of the soils and the weathered zone of the land surface. This argument forms the basis for the discussion to follow as well as the foundation for the determination of the “reference state” as required for ecological assessment techniques.

B3. PEDOGENESIS

Pedogenesis is the process of soil formation. Soil formation is a function of five (5) factors namely (Jenny, 1941):

- Parent material;
- Climate;
- Topography;
- Living Organisms; and
- Time.

These factors interact to lead to a range of different soil forming processes that ultimately determine the specific soil formed in a specific location. Central to all soil forming processes is water and all the reactions (physical and chemical) associated with it. The physical processes include water movement onto, into, through and out of a soil unit. The movement can be vertically downwards, lateral or vertically upwards through capillary forces and evapotranspiration. The chemical processes are numerous and include dissolution, precipitation (of salts or other elements) and alteration through pH and reduction and oxidation (redox) changes. In many cases the reactions are promoted through the presence of organic material that is broken down through aerobic or anaerobic respiration by microorganisms. Both these processes alter the redox conditions of the soil and influence the oxidation state of elements such as Fe and Mn. Under reducing conditions Fe and Mn are reduced and become more mobile in the soil environment. Oxidizing conditions, in turn, lead to the precipitation of Fe and Mn and therefore lead to their immobilization. The dynamics of Fe and Mn in soil, their zones of depletion through mobilization and accumulation through precipitation, play an important role in the identification of the dominant water regime of a soil and could therefore be used to identify wetlands and wetland conditions.

B4. WATER MOVEMENT IN THE SOIL PROFILE

The dynamics of water movement in a soil profile and hillslope is too complex to address in detail here. However, the reader is referred to various investigation and publications provided below for further detail.

Publications list:

Bouwer, et al., (2015), Le Roux and du Preez (2006), Le Roux and du Preez (2008), Le Roux et al., (2015), Le Roux et al., (2011), Van Tol et al., (2013a), Van Tol et al., (2013b), Van Tol et al., (2010a), Van Tol et al., (2010b), Van Zijl et al., (2013), Van Zyl and Le Roux (2014), Van der Waals (2013), Van Huyssteen et al., (1997), Van Huyssteen et al., (2007), Van Huyssteen et al., (2009).

B5. WATER MOVEMENT IN THE LANDSCAPE

Water movement in a landscape is a combination of the different flow paths in the soils and geological materials. The movement of water in these materials is dominantly subject to gravity and as such it will follow the path of least resistance towards the lowest point. In the landscape there are a number of factors determining the paths along which this water moves. **Figure B2** provides a simplified schematic representation of an idealised landscape (in “profile curvature”. The total precipitation (rainfall) on the landscape from the crest to the lowest part or valley bottom is taken as 100 %. Most geohydrologists agree that total recharge, the water that seeps into the underlying geological strata, is less than 4 % of total precipitation for most geological settings. Surface runoff varies considerably according to rainfall intensity and distribution, plant cover and soil characteristics but is taken as a realistic 6 % of total precipitation for our idealised landscape. The total for surface runoff and recharge is therefore calculated as 10 % of total precipitation. If evapotranspiration (from plants as well as the soil surface) is taken as a very high 30 % of total precipitation it leaves 60 % of the total that has to move through the soil and/or geological strata from higher lying to lower lying areas. In the event of an average rainfall of 750 mm per year it results in 450 mm per year having to move laterally through the soil and geological strata. In a landscape there is an accumulation of water down the slope as water from higher lying areas flow to lower lying areas.

To illustrate: If the assumption is made that the area of interest is 100 m wide it follows that the first 100 m from the crest downwards has 4 500 m³ (or 4 500 000 litres) of water moving laterally through the soil (100 m X 100 m X 0.45 m) per rain season. The next section of 100 m down the slope has its own 4 500 m³ of water as well as the added 4 500 m³ from the upslope section to contend with, therefore 9 000 m³. The next section has 13 500 m³ to contend with and the following one 18 000 m³. It is therefore clear that, the longer the slope, the larger the volume of water that will move laterally through the soil profile.

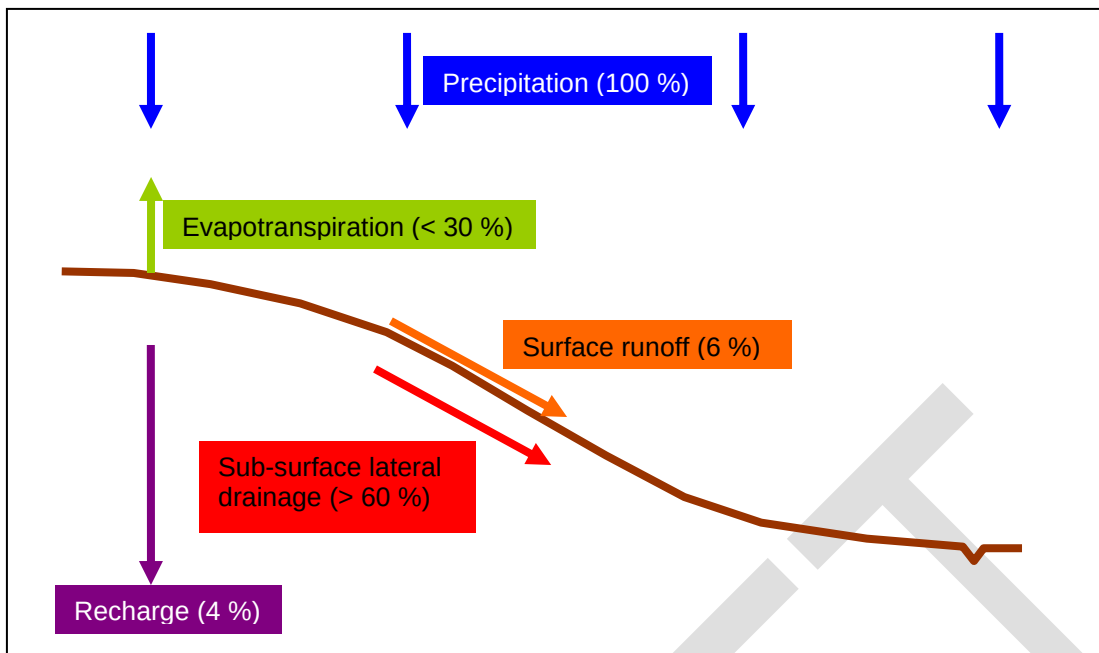


Figure B2 Idealised landscape with assumed quantities of water moving through the landscape expressed as a percentage of total precipitation (100 %)

Flow paths through soil and geological strata, referred to as “interflow” or “hillslope water”, are very varied and often complex due to difficulty in measurement and identification. The difficulty in identification stems more from the challenges related to the physical determination of these in soil profile pits, soil auger samples and core drilling samples for geological strata. The identification of the morphological signs of water movement in permeable materials or along planes of weakness (cracks and seams) is a well-established science and the expression is mostly referred to as “redox morphology”. In terms of the flow paths of water large variation exists but these can be grouped into a few simple categories. **Figure B3** provides a schematic representation of the different flow regimes that are usually encountered. The main types of water flow can be grouped as 1) recharge (vertically downwards) of groundwater; 2) lateral flow of water through the landscape along the hillslope (interflow or hillslope water); 3) return flow water that intercepts the soil/landscape surface; and 4) surface runoff. Significant variation exists with these flow paths and numerous combinations are often found. The main wetland types associated with the flow paths are: a) valley bottom wetlands (fed by groundwater, hillslope processes, surface runoff, and/or in-stream water); b) hillslope seepage wetlands (fed by interflow water and/or return flow water); and wetlands associated with surface runoff, ponding and surface ingress of water anywhere in the landscape.

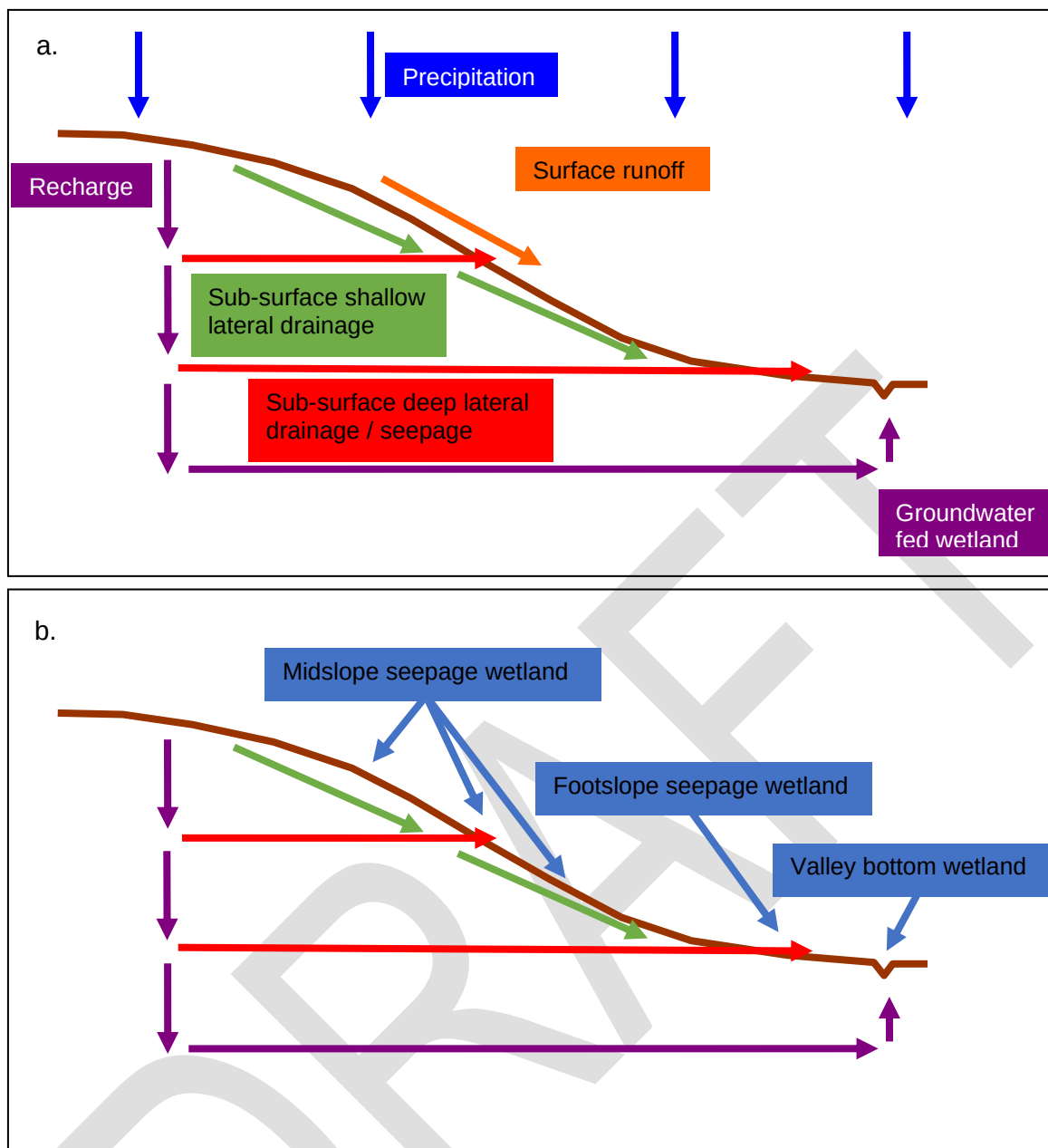


Figure B3 Different flow paths of water through a landscape (a) and typical wetland types associated with the water regime (b)

Amongst other factors, the thickness of the soil profile at a specific point will influence the intensity of the physical and chemical reactions taking place in that soil. **Figure B4** illustrates the difference between a dominantly thick and a dominantly thin soil profile. If all factors are kept the same except for the soil profile thickness it can be assumed with confidence that the chemical and physical reactions associated with water in the landscape will be much more intense for the thin soil profile than for the thick soil profile. Stated differently: The volume of water moving through the soil per surface area of an imaginary plane perpendicular to the direction of water flow is much higher for the thin soil profile than for the thick soil profile. This aspect has a significant influence on the expression of redox morphology in different landscapes of varying soil/geology/climate composition.

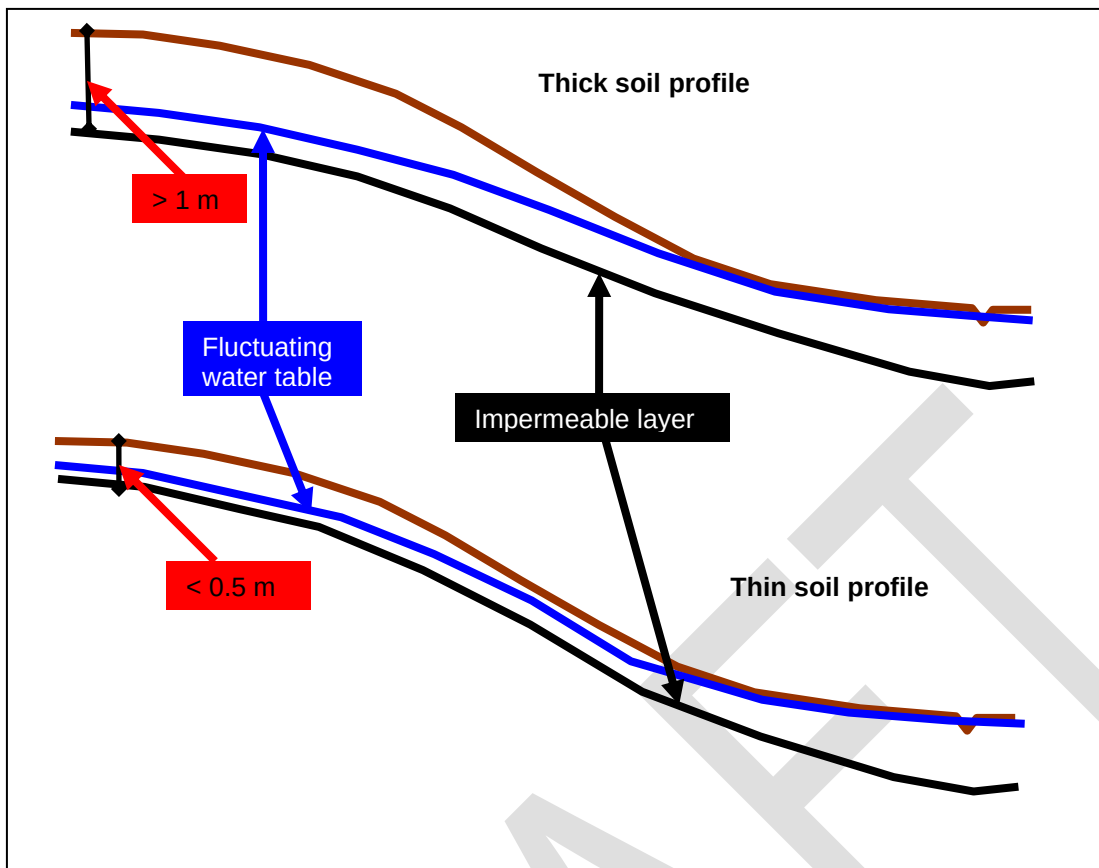


Figure B4 The difference in water flow between a dominantly thick and dominantly thin soil profile

B6. THE CATENA CONCEPT

Here it is important to take note of the “catena” concept. This concept is one of a topographic sequence of soils in a homogenous geological setting where the water movement and presence in the soils determine the specific characteristics of the soils from the top to the bottom of the topography. **Figure B5** illustrates an idealised topographical sequence of soils in a catena for a quartz rich parent material. Soils at the top of the topographical sequence are typically red in colour (Hutton and Bainsvlei soil forms) and systematically grade to yellow further down the slope (Avalon soil form). As the volume of water that moves through the soil increases, typically in midslope areas, periodic saturated conditions are experienced and consequently Fe is reduced and removed in the laterally flowing water. In the event that the soils in the midslope positions are relatively sandy the resultant soil colour will be bleached or white due to the colour dominance of the sand quartz particles. The soils in these positions are typically of the Longlands and Kroonstad forms. Further down the slope there is an accumulation of clays and leaching products from higher lying soils and this leads to typical illuvial and clay rich horizons. Due to the regular presence of water the dominant conditions are anaerobic and reducing and the soils exhibit grey colours often with bright yellow and grey mottles (Katspruit soil form). In the event that there is a large depositional environment with prolonged saturation soils of the Champagne form may develop (typical peat land). Variations on this sequence (as is often found on the Mpumalanga Highveld) may include the presence of hard

plinthic materials instead of soft plinthite with a consequent increase in the occurrence of bleached soil profiles. Extreme examples of such landscapes are discussed below.

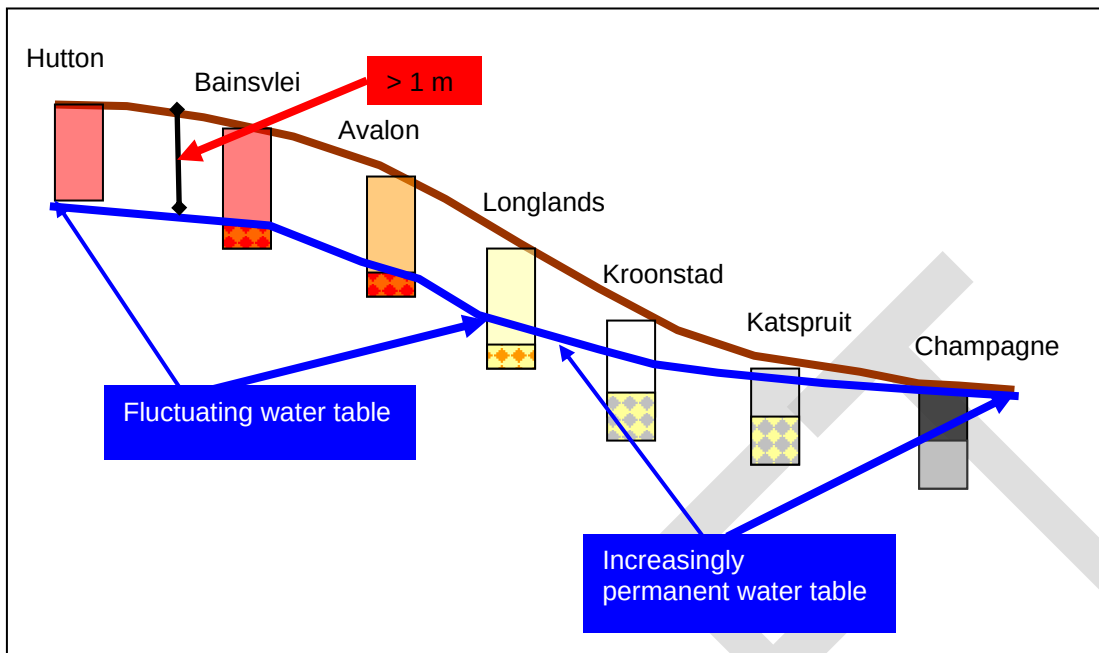


Figure B5 Idealised catena on a quartz rich parent material

B7 CONVEX VERSUS CONCAVE LANDSCAPES IN AN IDEALISED CATENA

An additional factor of variation in all landscapes is the shape of the landscape along contours (referred to a “plan curvature”). Landscapes can be either concave or convex, or flat. The main difference between these landscapes lies in the fact that a convex landscape is essentially a watershed with water flowing in diverging directions with a subsequent occurrence of “drier” soil conditions. In a concave landscape water flows in converging directions and soils often exhibit the wetter conditions of “signs of wetness” such as grey colours, organic matter and subsurface clay accumulation. **Figure B6** presents the difference between these landscapes in terms of typical soil forms encountered in an idealised catena. In the convex landscape the subsurface flow of water removes clays and other weathering products (including Fe) in such a way that the midslope position soils exhibit an increasing degree of bleaching and relative accumulation of quartz (E-horizons).

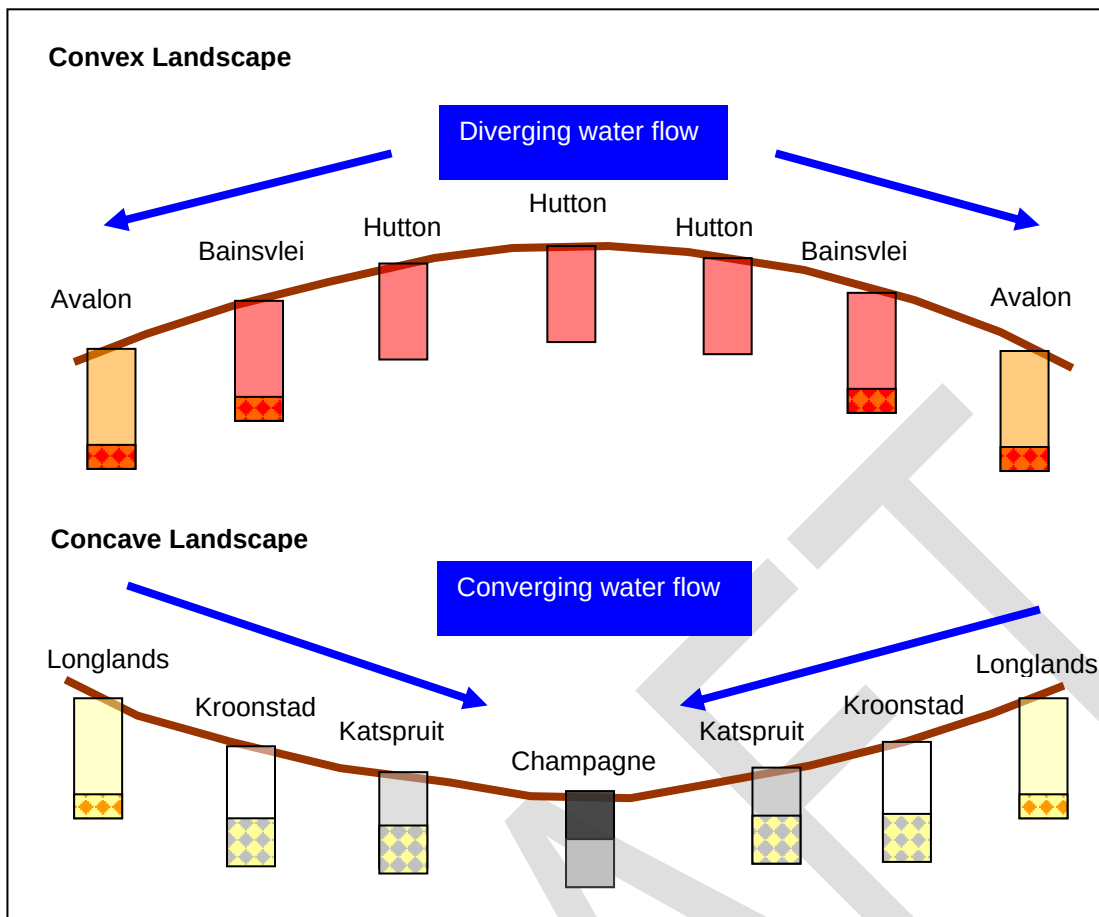


Figure B6 Schematic representation of the soils in convex and concave landscapes in an idealised catena

In the concave landscapes clays and weathering products are transported through the soils into a zone of accumulation where soils start exhibiting properties of clay and Fe accumulation. In addition, coarse sandy soils in convex environments tend to be thinner due to the removal of sand particles through erosion and soils in concave environments tend to be thicker due to colluvial accumulation of material transported from upslope positions. Similar patterns are observed for other geological areas with the variation being consistent with the soil variation in the catena.

Often these concave and convex topographical environments occur in close proximity or in one topographical sequence of soils. This is often found where a convex upslope area changes into a concave environment as a drainage depression is reached (**Figure B7**). The processes in this landscape are the same as those described for the convex and concave landscapes above.

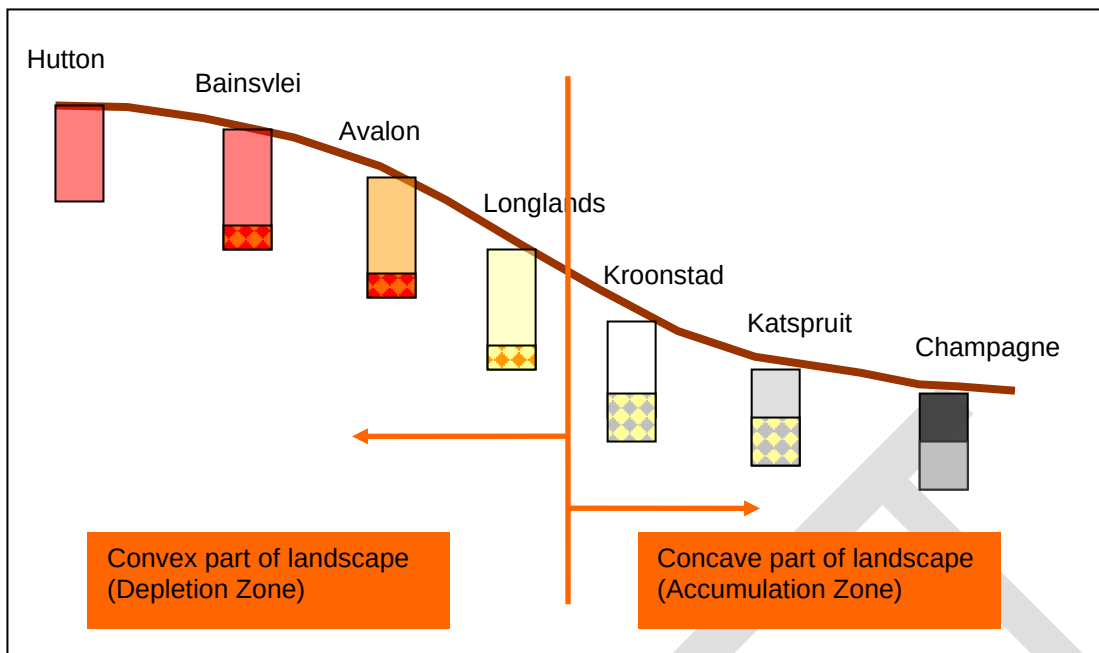


Figure B7 Schematic representation of the soils in a combined convex and concave landscape in an idealised catena

B8 THE DB33 LAND TYPE CATENA

The duplex catena of the Db33 land type, as found in the George area, is characterised by soils with a fine to medium sandy loam surface horizon overlying a clay rich subsoil via an abrupt transition. The sandier material is often thick enough and bleached to yield an orthic A and E horizon overlying the high clay content prismatic B horizon (Estcourt and Sterkspruit soil forms – **Figure B8**). The materials under the prismatic B horizon is often a thick layer of unconsolidated material grading into granite saprolite. As bleaching of A horizons occur throughout the landscape wetland delineations based on bleached soil colours only overestimate the extent of the wetland. In lower lying landscape positions the A horizons may exhibit an increase in organic carbon content with a darker surface horizon colour and then also more pronounced mottling in subsoil horizons. The valley bottom positions are mostly characterised by eroded and incised watercourses with exposed streambed and occasionally sediment accumulation to form soil with stratified alluvium.

The resultant wetland identification outcomes often flag seepage wetlands, due to the bleached surface soil colours, and distinct water courses in the incised areas of the landscape.

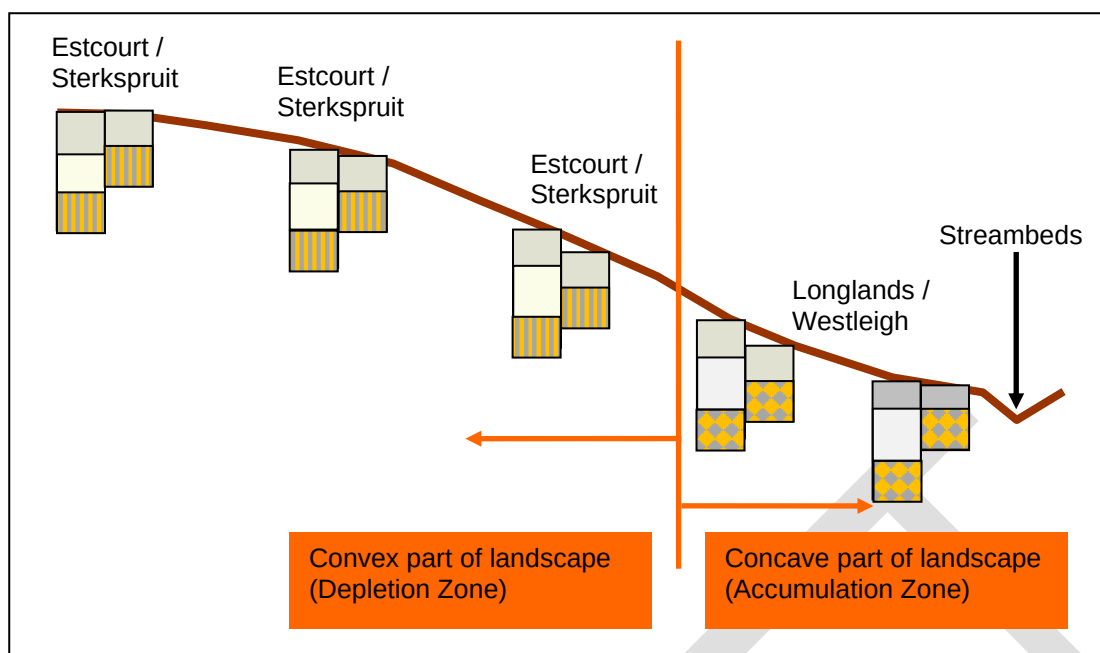


Figure B8 Schematic representation of the soils in the Db33 land type catena

B9. IMPLICATIONS FOR WETLAND DELINEATION AND APPLICATION OF THE GUIDELINES

When the 50 cm criterion is used to delineate wetlands in the granite/gneiss environments, the soils in convex positions often “qualify” as temporary wetland soils due to their relatively thin profile and the presence of concretions (often weathering to yield “mottles”) within this zone. In conjunction with a low Fe content in the soils and subsequent bleached colours (as defined for E-horizons) in the matrix a very large proportion of the landscape “qualifies” as temporary wetland zones. On the other hand, the soils in the concave environments, especially in the centre of the drainage depression, tend to be thicker and the 50 cm criterion sometimes does not flag these soils as being wetland soils due to the depth of the signs of wetness (mottles) often occurring only at depths greater than 80 cm. Invariably these areas are always included in wetland delineations due to the terrain unit indicator flagging it as a wetland area and drainage feature.

B10. IMPLICATIONS FOR WETLAND CONSERVATION IN URBAN ENVIRONMENTS

Whether an area is designated a wetland or not loses some of its relevance once drastic influences on landscape hydrology are considered. If wetlands are merely the expression of water in a landscape due to proximity to the land surface (viz. the 50 cm mottle criterion in the delineation guidelines) it follows that potentially large proportions of the water moving in the landscape could fall outside of this sphere – as discussed in detail above. **Figures B9** and **B10** provide schematic representations (as contrasted with **Figure B3**) of water dynamics in urban environments with distinct excavations and surface sealing activities respectively.

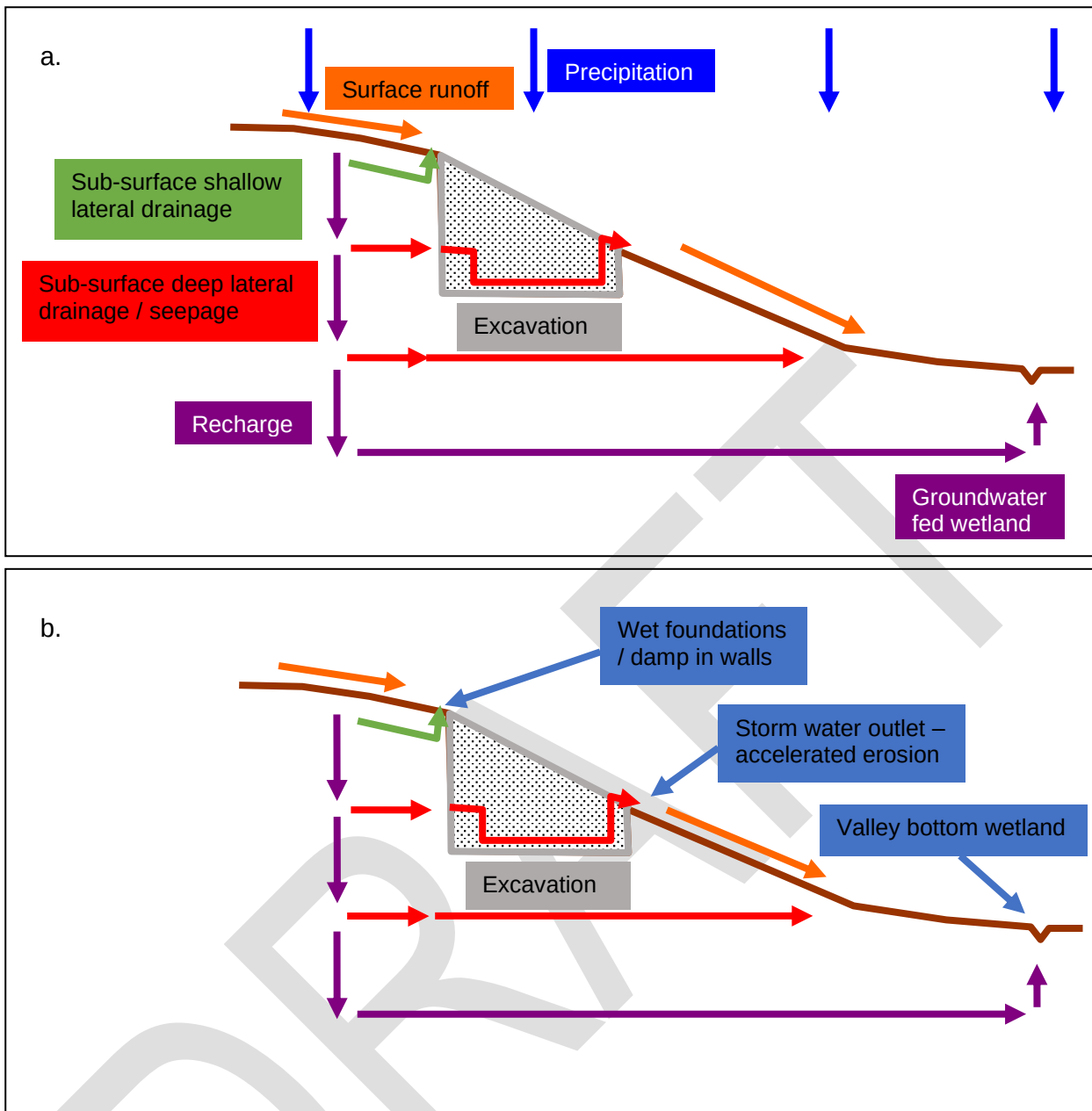


Figure B9 Different flow paths of water through a landscape with an excavated foundation (a) and typical wetland types associated with the altered water regime (b)

Through the excavation of pits (**Figure B9**) for the construction of foundations for infrastructure or basements for buildings the shallow lateral flow paths in the landscape are severed. As discussed above these flow paths can account for up to 60 % of the volume of water entering the landscape in the form of precipitation. These severed flow paths often lead to the ponding of water upslope from the structure with a subsequent damp problem developing in buildings. A different impact is experienced once the surface of the land is sealed through paving (roads and parking areas) and the construction of buildings (in this case the roof provides the seal) (**Figure B10**). In this case the recharge of water into the soil and weathered rock experienced naturally is altered to an accumulation and concentration of water on the surface with a subsequent rapid flowing downslope. The current approach is to channel this water into storm water structures and to release it in the

nearest low lying position in the landscape. These positions invariably correlate with drainage features and the result is accelerated erosion of such features due to a drastically altered peak flow regime.

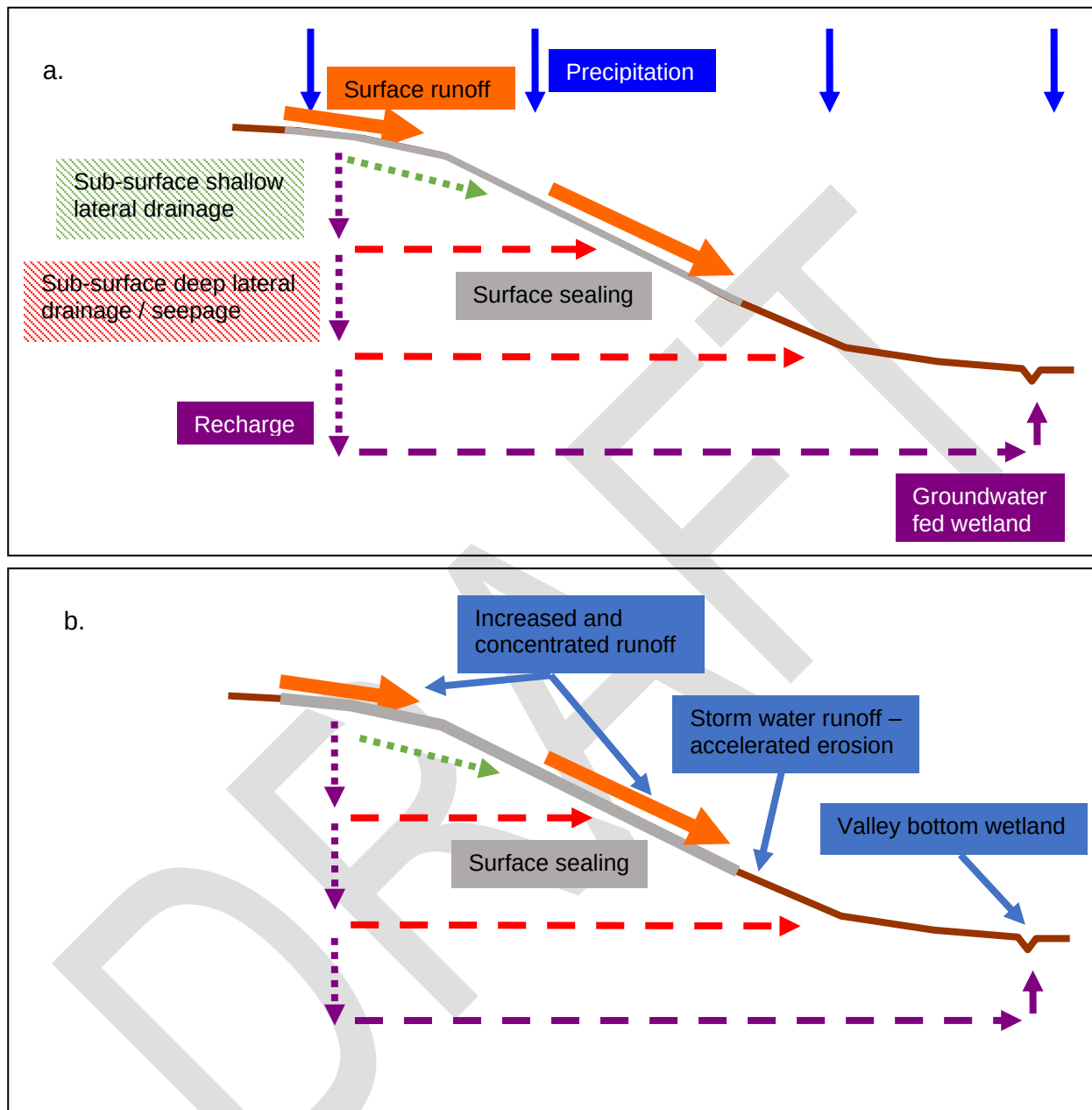


Figure B10 Different flow paths of water through a landscape with surface sealing (buildings and paving) (a) and typical wetland types associated with the altered water regime (b)

The result of the above changes in landscape hydrology is the drastic alteration of flow dynamics and water volume spikes through wetlands. This leads to wetlands that become wetter and that experience vastly increased erosion pressures.

B11. IMPLICATIONS FOR DOWNSTREAM WETLANDS, WATERCOURSES AND LANDSCAPES

An impact that is very often overlooked in urban drainage systems is the increase in water volume flowing through the catchment. Water is pumped from dams and reservoirs into “new” areas that have not had such volumes under pre-human impact conditions. In the event that all the water that is pumped into an urban area is removed through sewers and storm water infrastructure there is barely a perceptible increase in water in surface water structures. However, as the area serviced increases in size with storm water and sewer infrastructure releasing water into surface water bodies within the area the volume of water increases above the natural background volumes.

Additionally, changes in water runoff volumes through land surface sealing and runoff timing considerations lead to increased wetness and spikes in water volumes in drainage features. The main contrast in the landscape is evident in comparing infiltration and slow percolation with associated lateral flow spread over months versus rapid and immediate runoff from extensive and linked hard surfaces with runoff occurring within minutes and hours. The drastic temporal difference is mainly due to a diversion of water from slow subsurface lateral seepage pathways to rapid surface channelling routes. Even though total volumes may therefore be the same, in some cases, to the pre-development volumes the energy in the system is completely different in terms of experienced water volumes in specific areas.

The above discussion is simplified in the sense that it does not take into account the numerous water interception zones in the form of slow but constant water uptake by plants and increased evaporative losses due to slow water movement through soils near to the surface. The implication is therefore that urban systems are consequently wetter (both perceived and actual) than pre-development landscapes. The increased degree of wetness, linked with the diversion of water from subsoils flow pathways to surface pathways, has a direct bearing on the ecological response in the wetland / watercourse system. Apart from the ecological response there is often also a physical response to the increased water volumes and flow rates in the form of watercourse degradation and erosion that is exacerbated by erosion sensitive soils.

B12. SUSTAINABLE URBAN DRAINAGE CONSIDERATIONS

B12.1 SuDS Philosophy and Options

A relatively new approach to the management of urban water is known as sustainable drainage systems (SuDS) (Armitage et al., 2013). The SuDS philosophy states that there are three options namely:

1. Source controls: management of storm water as close to as possible on the property (eg: green roofs, rainwater harvesting, soakaways, permeable pavements);
2. Local controls: management of storm water as a “second line of defence” in public areas such as roadway reserves and parks (eg: filter strips, swales, infiltration trenches, bio-retention areas, sand filters); and

3. Regional controls: management of storm water as a “last line of defence” in the form of large-scale interventions constructed on municipal land (detention ponds, retention ponds, constructed wetlands).

These options are not prescriptive but provide an indication of the variation in storm water management approach that can be considered on specific sites.

B12.2 SuDS – Practical Considerations in the Granite/Gneiss Duplex Soil Areas

Although this document does not aim to address SuDS in detail some very practical considerations apply to the duplex soils in granite/gneiss areas. These are:

1. The use of permeable paving or processes to ensure water infiltration into soil is of limited benefit in soils and landscapes where the water flows laterally in shallow profiles through the bulk of the landscape. The main restriction is that the soil volume available for water storage and transport is limited with the effect that it saturates rapidly. Once a soil is saturated it cannot accommodate more water and the consequence is that surface ponding or runoff starts. In such cases unprotected soils become more susceptible to erosion, especially if surface water has a high energy due to slopes or concentration through channelling.
2. Forced and augmented infiltration leads to an increase in lateral water flow volumes with an increased risk of intercept by structures excavated into the soil profile (**Figure B11**). Under increased infiltration it has been observed that damp problems in foundations, walls and basements occur more frequently with increased damage if these structures are not protected.
3. The construction of pipelines and other trenched infrastructure leads to the “breaking” of the hard plinthite or clay aquaclude (**Figure B12**) that keeps most of the water close to the soil surface. The fill material has a significantly higher bulk density when compared to the natural soil of the E horizon and this leads to a significantly lower hydraulic conductivity within the fill. With the lateral drainage of water through the landscape’s soils this leads to a ponding effect immediately upslope of the fill in the trench (**Figure B13**). Due to the ponding that results from the lower transmissivity of the fill material it is often observed that areas where pipelines have been installed exhibit an increase in surface ponding on the upslope side of the structure with a subsequent colonisation of pioneer wetland species. In cases such as these it is important not to artificially increase infiltration upslope of the structure and rather to allow water from the upslope areas to flow over the in-filled trench in a controlled manner with stabilisation measures to prevent erosion and ponding.
4. The ecological response of plants and animals to lateral flowing water is not a universal one. The specific ecological response depends on the aeration state of the water as well as its quality. Often forced lateral flow is touted as a solution to urban water impacts but this is a highly simplified assumption. Lateral flowing water in undisturbed landscapes can have a range of redox states (depending on the amount of oxygen dissolved in the water). Specific plant species are adapted to certain of these varying conditions and

specific wetland plants colonise various seepage zones related to their preference (in terms of oxygen content of the water). The mimicking of lateral flow through anthropogenic means does not mean the desired ecological response will be evident and this aspect has to be emphasised during rehabilitation and SuDS planning processes.

5. The most realistic option for the shallow and poorly drained soil areas is to bring water to the surface and deal with this water in a dedicated manner there. The drawback of this solution is that the water on the surface will elicit an ecological response limited to the aerated nature of the water. The typical plant species will be plants that colonise open water systems or soils of which the aeration state is relatively good. Plants adapted to anoxic seepage zones will not colonise such systems. In this regard the specific vegetation response will determine the macro invertebrate and animal response.

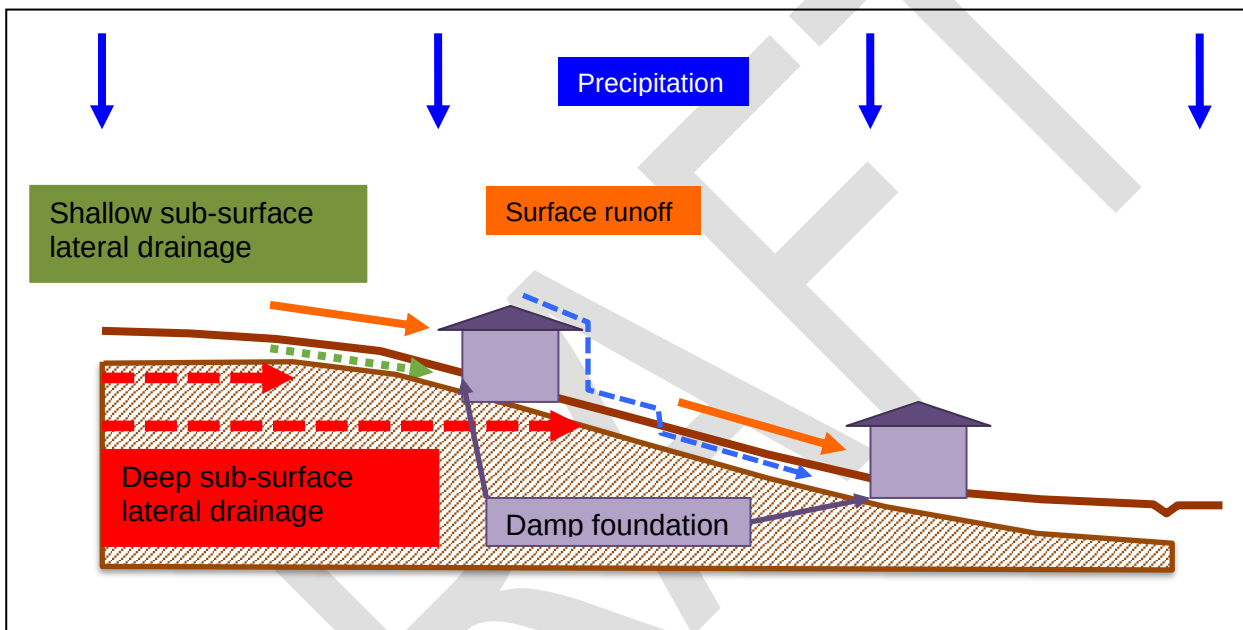


Figure B11 Challenges regarding infiltration SuDS approaches on the HHGI with its shallow lateral water flow zones

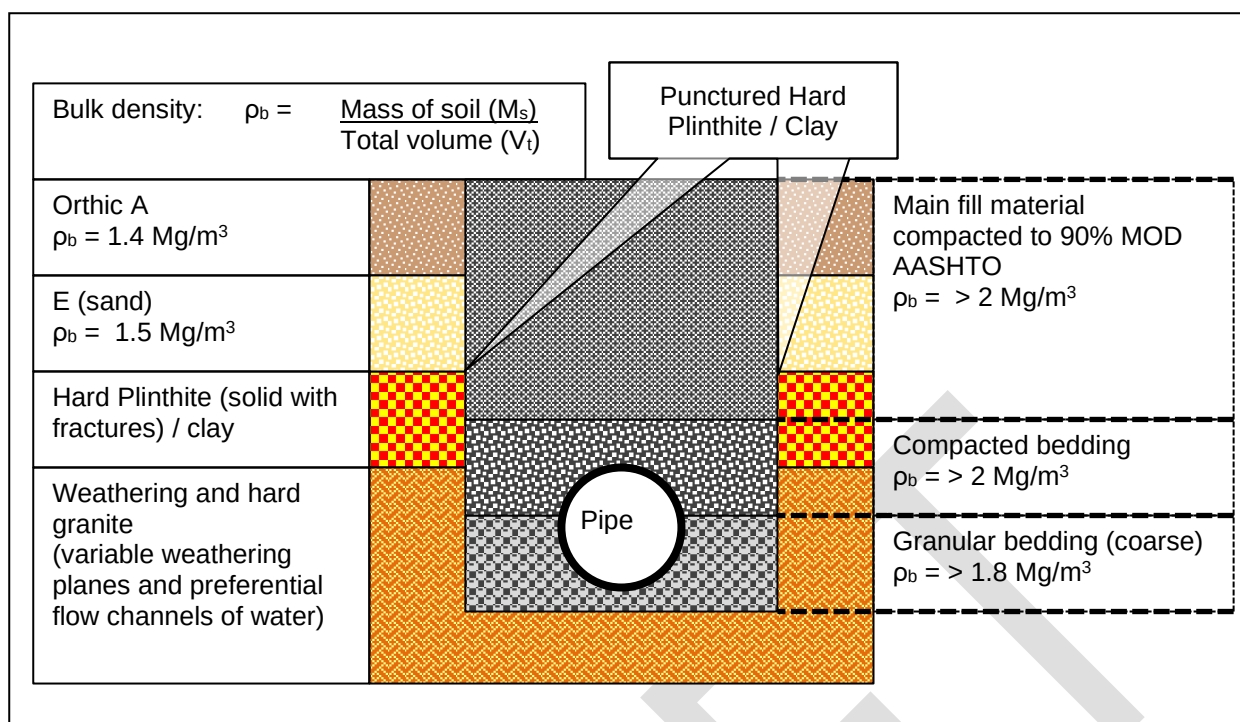


Figure B12 Typical pipeline trench fill and natural soil profile (with punctured hard plinthite / clay aquaclude) with different soil and fill material bulk densities

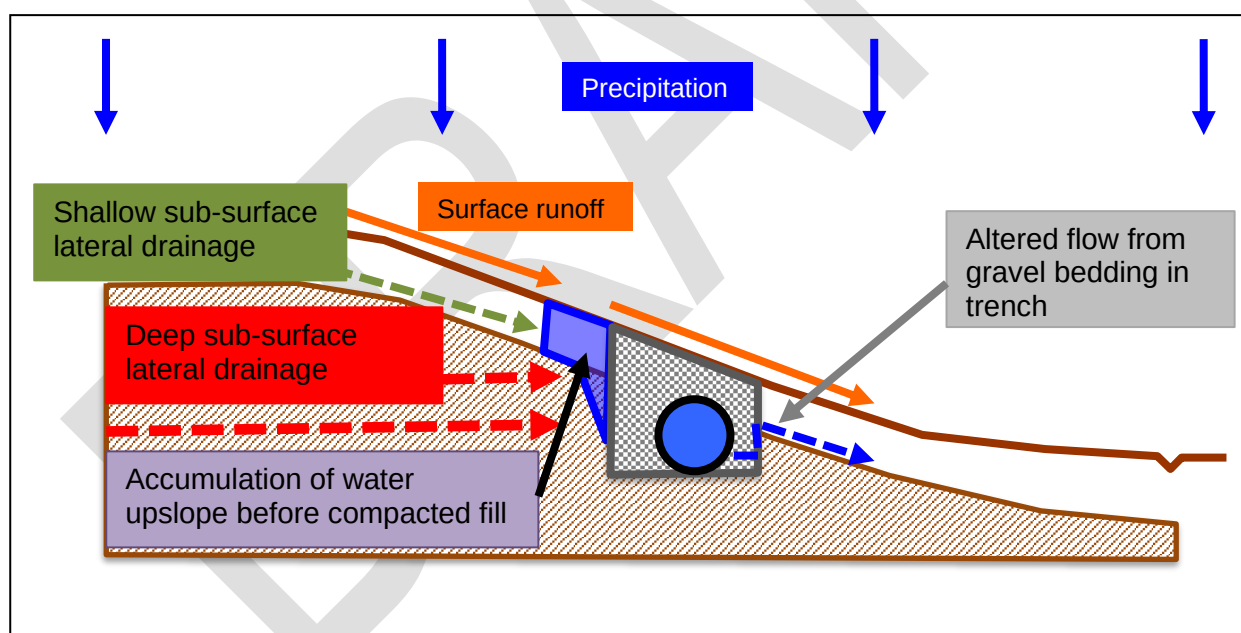


Figure B13 Challenges regarding SuDS approaches and pipeline construction in duplex soil areas with its shallow lateral water flow zones and areas of water ponding

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