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HYDROPEDOLOGY REPORT

Great. Nice fancy words, but what is in a report?

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PRACTICAL DEFINITION

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Topics

Methodology

- Desktop- Planning and data
- Fieldwork- what data is needed for different scales

Results

- Inferred response of soils- properties
- Response map- spatial distribution
- Conceptual response model
- Appropriate modelling

Discussion

- Impact on the drivers
- Mitigation

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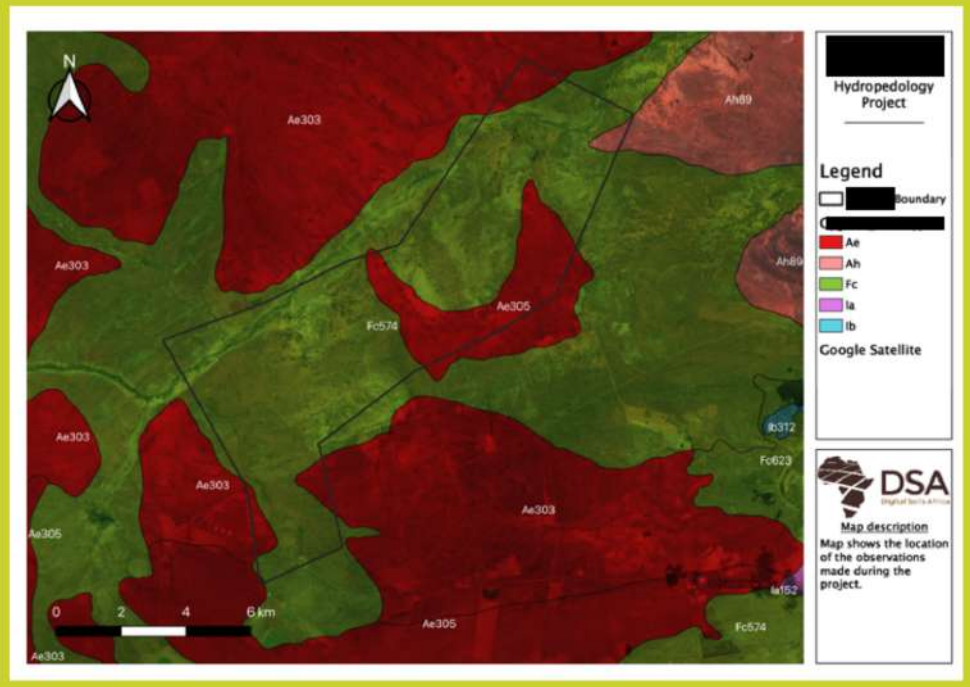
Methodology

Desktop

Freely available data

Climate, vegetation etc.



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Methodology

Planning

Land use should guide the methodology

Open cast mine

- Identify dominant hillslopes
- Transect starting above the development to wetland
- Quantify loss

Housing complex

- Spatial distribution very important
- Design mitigation

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Methodology Fieldwork

- Classify so
  - Covert t
- NB measu
  - Eg. Gulf
- Use appro

South African Journal of Plant and Soil 2019: 1–3
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SOUTH AFRICAN JOURNAL OF PLANT AND SOIL
ISSN 0257-1862 EISSN 2167-034X
https://doi.org/10.1080/02571862.2018.1537012

Short Communication

Hydropedological grouping of South African soil forms

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The science of hydropedology has progressed significantly in the past two decades, especially with regards to the interpretation of soil morphology and relating these interpretations to the hydrological behaviour of horizons, profiles, hillslopes and catchments. Soil classification is pivotal to hydropedological interpretation and several studies have attempted to relate soil forms (as in the South African soil classification) to hydropedological behaviour. Here we present a cohesive grouping of the soil forms into four main hydropedological types, namely recharge, interflow, responsive and stagnating soils. This grouping will improve the efficiency of hydropedological assessments of soils, hillslopes and catchments for hydrological and ecological purposes.

Keywords: hydrology, morphological properties, pedology, soil classification

Results Soils

SOIL FORMS (SOIL CLASSIFICATION WORKING GROUP, 2018)	KEY HYDROPEDOLOGICAL FEATURES OF THE SOIL FORMS ON SITE	HYDROPEDOLOGICAL SOIL TYPE (VAN TOL & LE ROUX, 2019)
Nkonkoni (Nk)	The A and the B horizon of the Nk is similar to the Hutton soil form, although the underlying material is lithic. Due to red colour and lack of signs of wetness, it is generally accepted that water infiltrates and drains through the lithic into the underlying rock.	Recharge
Sepane (Se)	Is the only soil type with prominent strong structure development. Water is expected to infiltrate the A and pedocutanic B horizons (Slow flow due to the high clay content) and saturate the gleyed C horizon.	Interflow (soil/bedrock)
Bainsvlei (Bv)	Classification is similar to the Py soil form and both have an impeding layer. The Bv, however, had water seeping out the soft plinthic horizon. This indicates that the horizon acts a flowpath rather than stagnant water. The Bv are limited but found at the transition from recharge to lower lying Cg soils.	Interflow (soil/bedrock)

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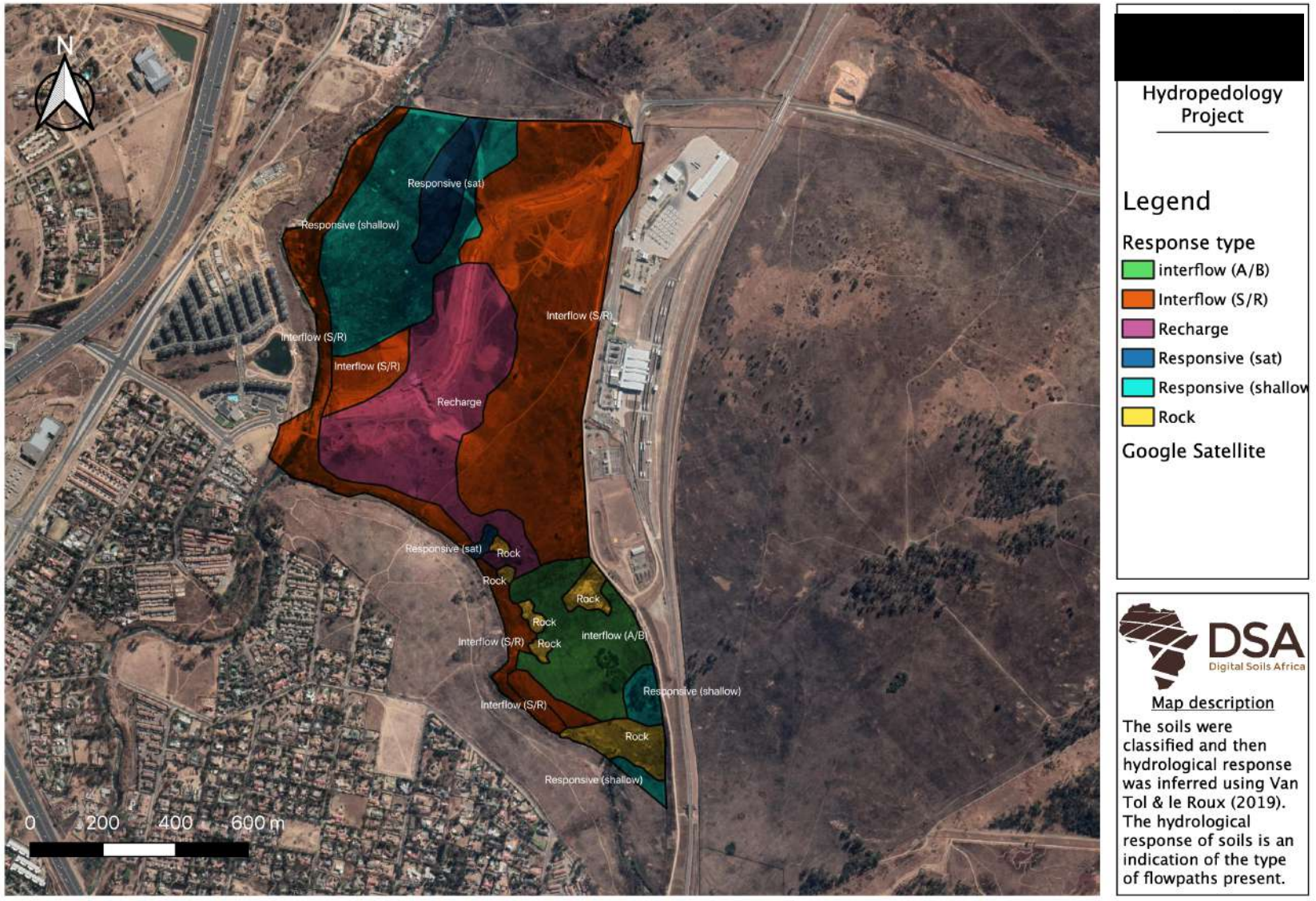
Results

Response map



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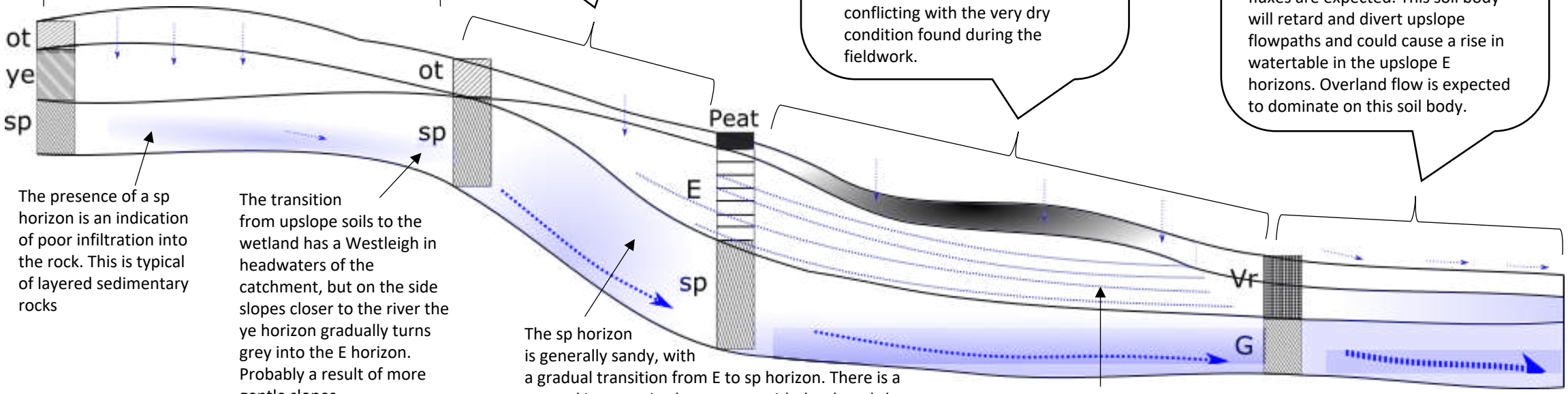
The upper slopes are dominated by soil bedrock interflow soils. Vertical infiltration is expected through the apedal ot and ye horizons. The sp horizon is a indicator of poor drainage, therefore water is expected to stagnate at the soil bedrock interface in this horizon. If the horizon is saturated, then lateral flows are possible.

Westleigh soil is classified as A/B interflow. The sp horizon generally has a lower Ks and therefore lateral flow is possible at the A/B interface. Sp horizon is an indication of saturation, therefore, lateral flow in the saturated stated is possible.

Vertical infiltration is expected through the peat into the E horizon. Hydrophobicity is possible due to the high C content of the peat. The E horizons are very sandy and therefore flux is potentially very high. If the soil is dry, then fast vertical fluxes are expected, but since the morphology indicates saturation, lateral fluxes are likely. The dry state of the soils are conflicting with the very dry condition found during the fieldwork.

The vr horizon is characterised by big cracks due to shrinking and swelling. When the soil is dry, high infiltration through the vr horizon is possible. The soil will then swell and almost no infiltration will occur when saturated. The G horizon has a high clay content and therefore low fluxes are expected. This soil body will retard and divert upslope flowpaths and could cause a rise in watertable in the upslope E horizons. Overland flow is expected to dominate on this soil body.



The presence of a sp horizon is an indication of poor infiltration into the rock. This is typical of layered sedimentary rocks

The transition from upslope soils to the wetland has a Westleigh in headwaters of the catchment, but on the side slopes closer to the river the ye horizon gradually turns grey into the E horizon. Probably a result of more gentle slopes.

The sp horizon is generally sandy, with a gradual transition from E to sp horizon. There is a general increase in clay content with depth and slope length. The bottom of the profiles often had a blue and green colours present in the clay layers.

The E horizon is characterized by pure white and the followed by sand coloured by reduced Fe. The reduced Fe can be an indication of a more reduced water, rather infiltrated rain water.

Results

Modelling

	Current		Developed	
	mm	%	mm	%
Rainfall	266.1		266.1	
Stream flow	3.3	1.2	5.1	1.9
Surface Runoff	2.7	1.0	4.6	1.7
Lateral flow	0.2	0.1	0.1	0.0
ET	253.5	95.3	253.3	95.2
Percolation	9.9	3.7	8.1	3.0

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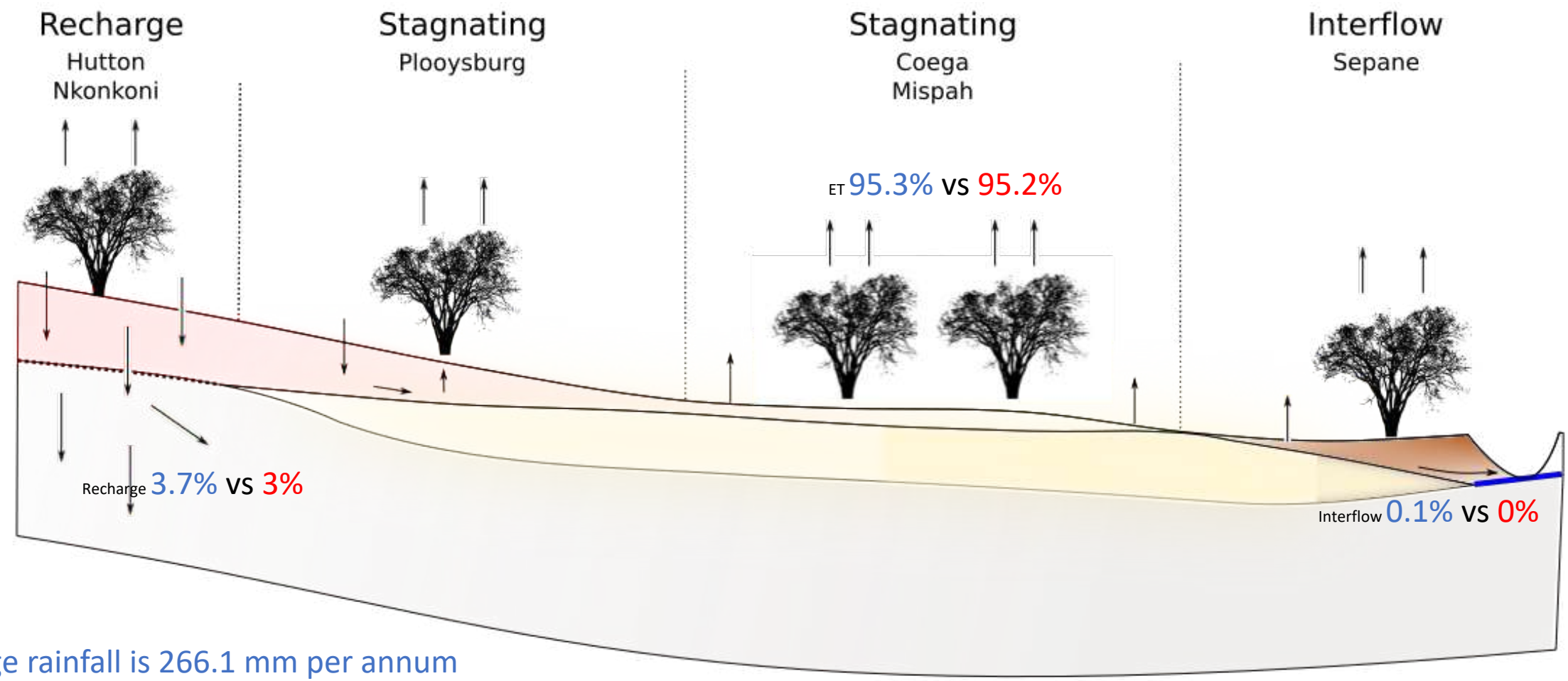
Blue represents figures before development and red after the development



Average rainfall is 266.1 mm per annum

Discussion Risk and Mitigation

POTENTIAL ENVIRONMENTAL IMPACT	MECHANISM OF POSSIBLE IMPACT	BEFORE MITIGATION					SUMMARY OF MITIGATION	AFTER MITIGATION				
		Temporal	Spatial	Reversibility	Magnitude	Probability		Duration	Extent	Reversibility	Magnitude	Probability
Groundwater contamination	Contaminants that leached out and the underlying soils are recharge soils, the contaminated leachate can easily enter the groundwater	Long term	Catchment	Low	Very high	Very High	Don't use recharge soils for stockpiling or make use of linings to prevent seepage	Short term	Profile	High	Low	Low

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What do you see in the soil?

We use soil properties for two reasons

How the soil will respond

- Clay soil vs sandy soil
- Structured vs unstructured

How they have historically responded

- Soil colour
- Mottling

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A


D


G

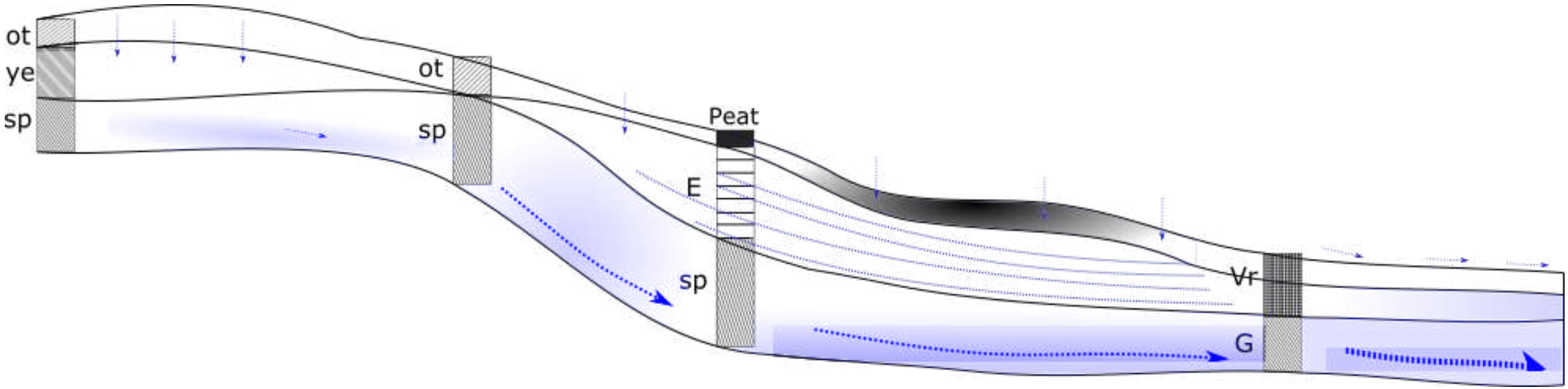

B

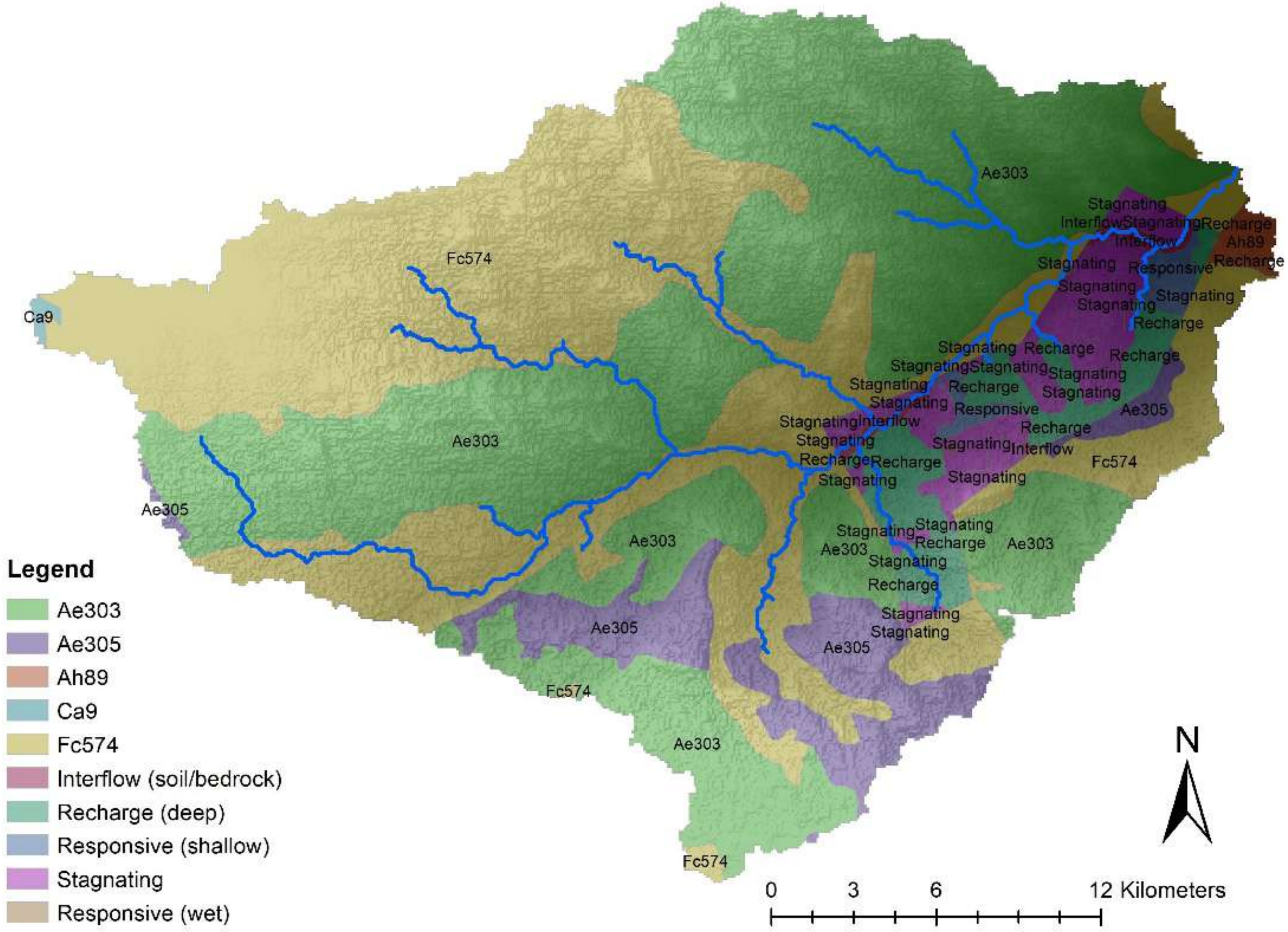

E

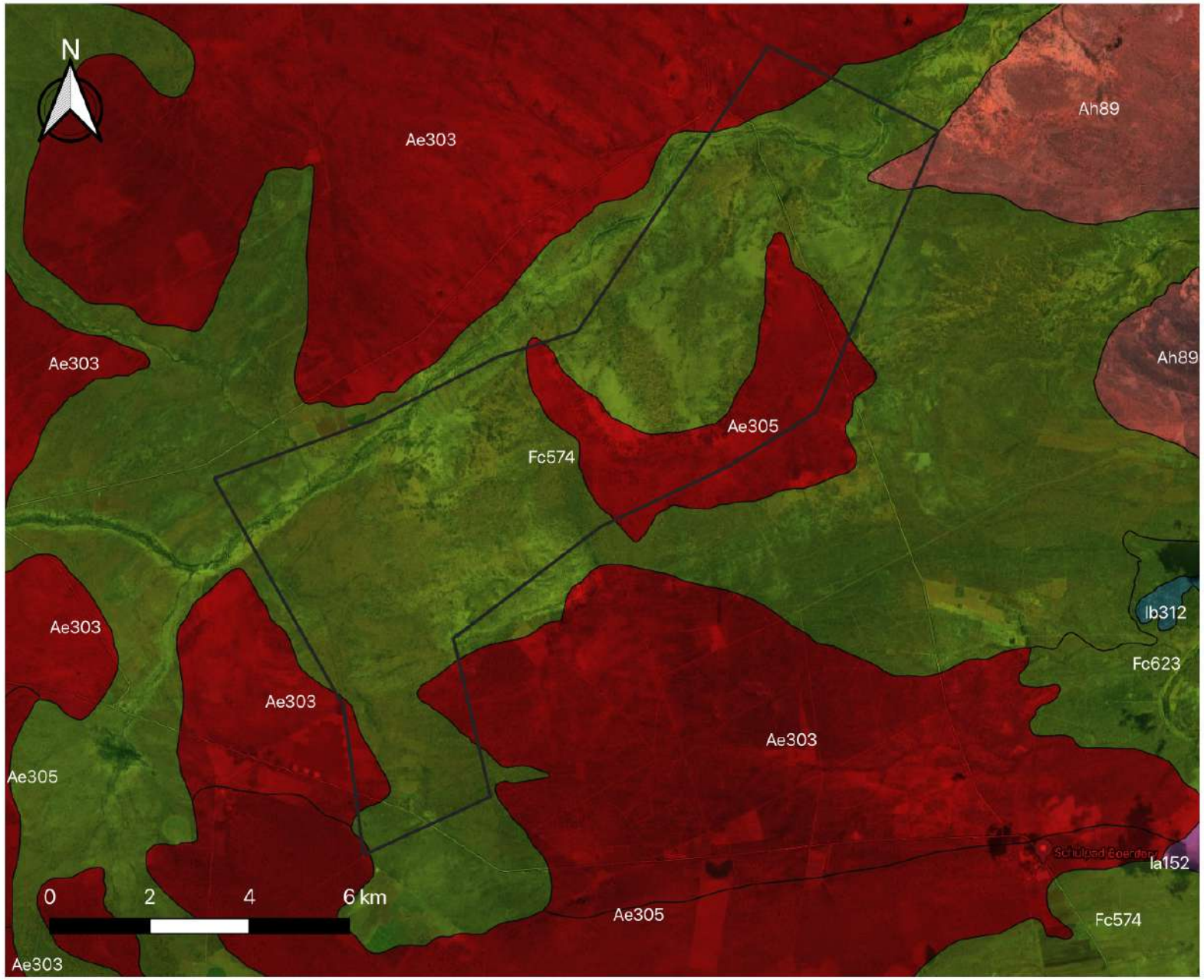

H


C


F


ot
ye
sp
ot
sp
Peat
E
sp
Vr
G


Legend
Ae303
Ae305
Ah89
Ca9
Fc574
Interflow (soil/bedrock)
Recharge (deep)
Responsive (shallow)
Stagnating
Responsive (wet)
N
0
3
6
12 Kilometers
Ae303
Fc574
Ca9
Ae305
Ah89
Stagnating
Interflow
Recharge
Responsive



[redacted]

Hydropedology Project

Legend

[redacted] Boundary

[redacted]

Ae

Ah

Fc

Ia

Ib

Google Satellite

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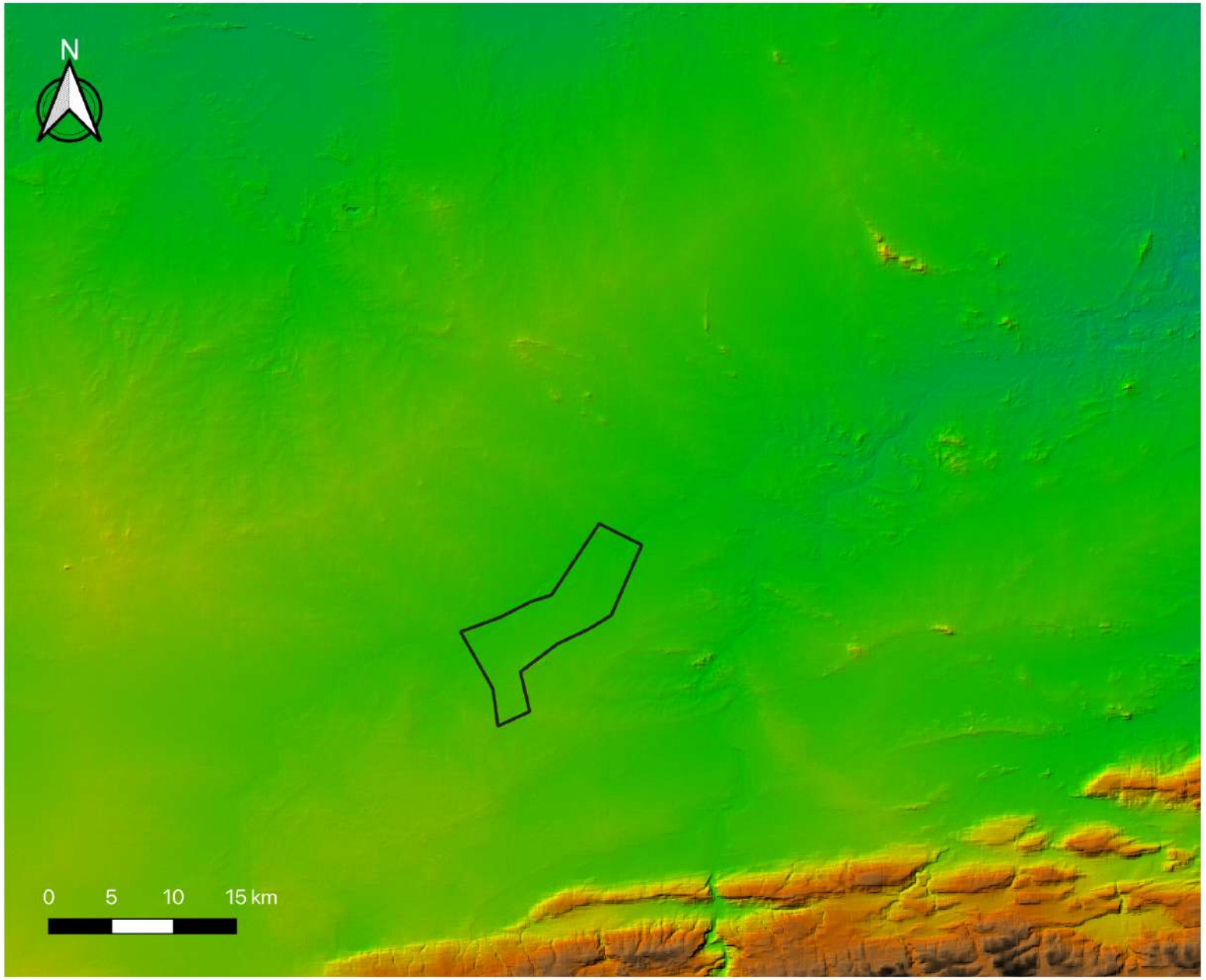
Map description

Map shows the location of the observations made during the project.



Hydropedology Project

Legend

Boundary

Elevation (m)

- 429
- 673.6
- 918.2
- 1163
- 1407
- 1652

Google Satellite

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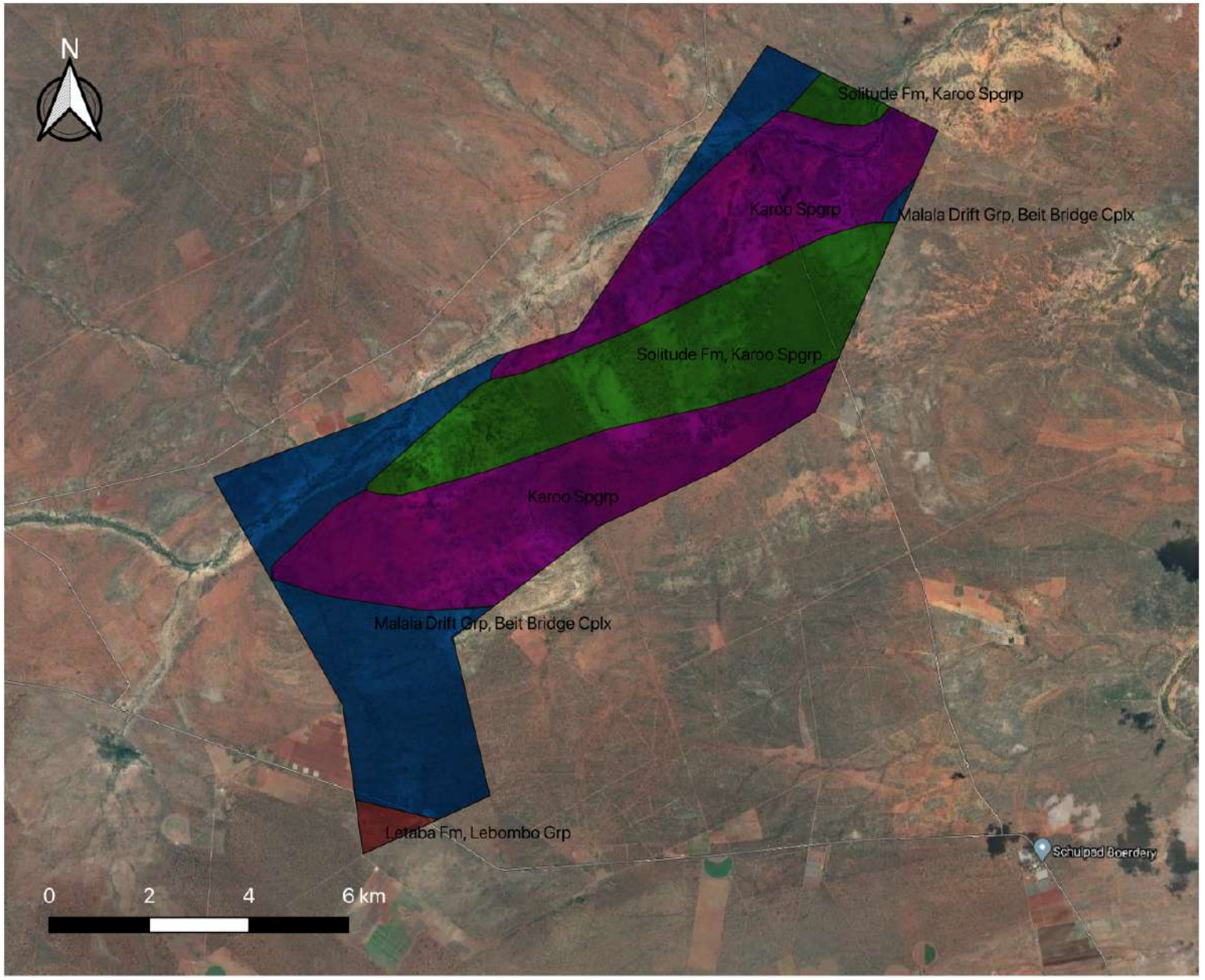
Map description

The flatness is very apperant in the elevation map with Soutpansberg mountain range to the south of the site.



Hydropedology Project

Legend

Geology

- Karoo Spgrp
- Letaba Fm
- Malala Drift Grp
- Solitude Fm

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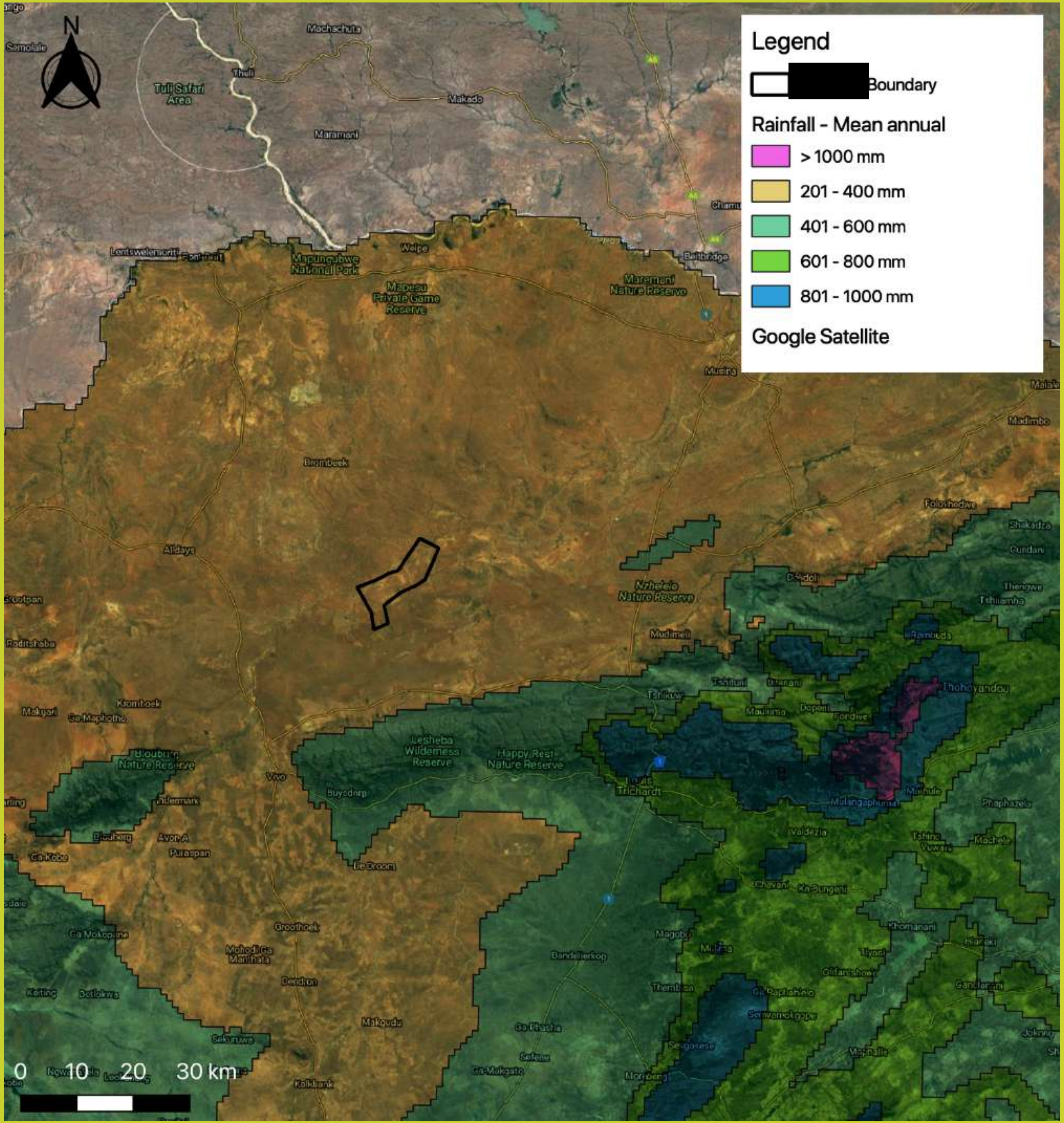
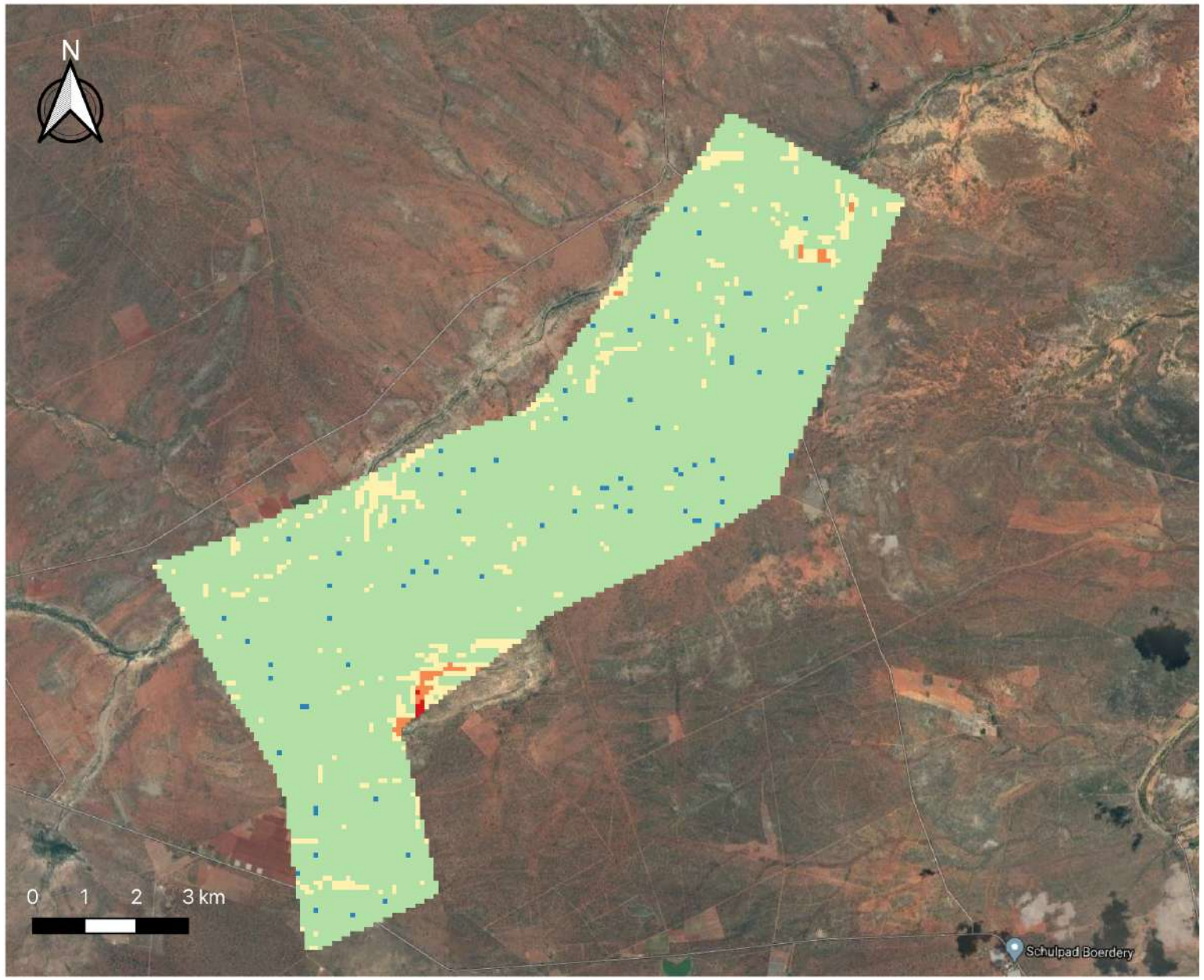
Map description

The geological map of the survey area (Council for Geosciences, 2007)


N
Legend
[redacted] Boundary
Rainfall - Mean annual
> 1000 mm
201 - 400 mm
401 - 600 mm
601 - 800 mm
801 - 1000 mm
Google Satellite
0 10 20 30 km



[redacted]

Hydropedology Project

Legend

Slope (degree)

- <= 0
- 0 – 1.5
- 1.5 – 3
- 3 – 4.5
- 4.5 – 6

Google Satellite

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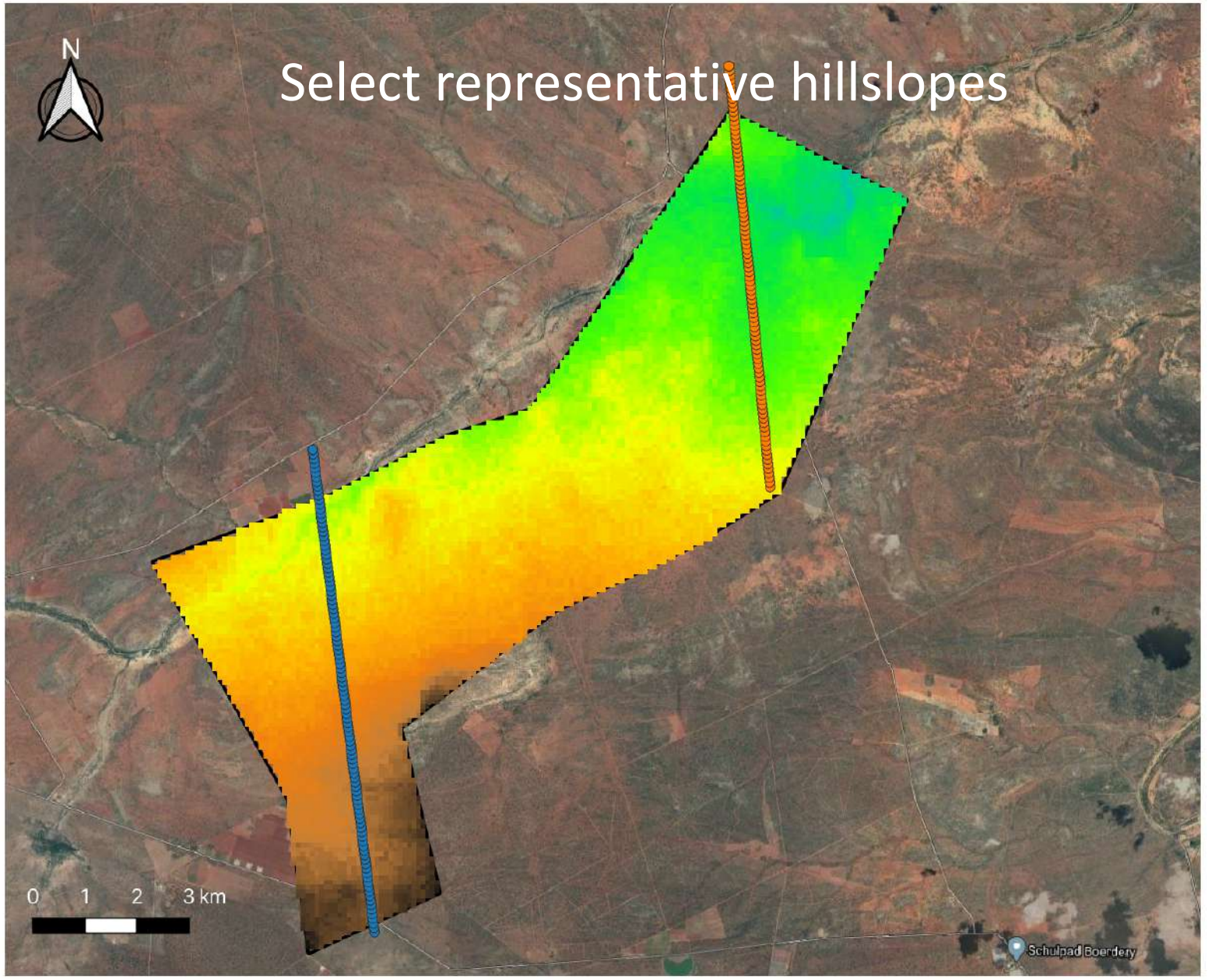
Map description

Slope map given in degrees of the site.

Select representative hillslopes



Hydropedology Project

Legend

- Transect B
- Transect A

Elevation

- 677
- 690.26
- 703.52
- 716.78
- 730.04
- 743.3
- 756.56
- 768.8
- 779

Google Satellite

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Map description

Elevation map of the site and the position of Transect A and B for the profile of the site.

Thank you

South African Journal of Plant and Soil 2020, 37(1): 23–33
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SOUTH AFRICAN JOURNAL OF PLANT AND SOIL
ISSN 0257-1862 EISSN 2167-034X
https://doi.org/10.1080/02571862.2019.1640300

Hydropedology in South Africa: Advances, applications and research opportunities

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The need to characterise and quantify hydrological processes in order to manage scarce water resources led to significant progress in the field of hydropedology in South Africa during the past decade. The adoption of hydropedological research by industry and government as part of water resource management strategies further facilitated the progress in the field. It is therefore timely to provide a comprehensive review of the developments in terms of the science and applications in the recent past. This paper start with an overview of the intimate link between soil classification and hydropedology, then focus on recent advances in hydrological interpretation of soil morphology and chemistry. The status of hydropedological classification of soils and hillslopes are then presented. This is followed by a discussion on how hydropedological assessments could be applied in groundwater/surface water interaction studies, pollution control and management, wetland protection and rehabilitation and hydrological modelling. The paper concludes by identifying three areas where hydropedology could be advanced in the future: 1) quantification of hydropedological interpretations 2) characterisation of the intermediate vadose zone and 3) hydropedological mapping of South Africa.

Keywords: hydrological modelling, soil genesis, soil morphology, water resource management

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