HYDROPEDOLOGICAL STUDY

PORTION 72 OF THE FARM BULTFONTEIN 533JQ, LANSERIA GAUTENG

INDEX (PTY) LTD

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August 2024

TABLE OF CONTENTS

DECLARATION

The observations, conclusions and recommendations made in this report are based on the best available data and on best scientific and professional knowledge of the directors of INDEX (Pty) Ltd. The report is based on GIS programming and corrected drome photogrammetry to map survey points. Survey points are normally accurate to within 3 metres.

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Dr Andries Gouws of INDEX (Pty) LTD conducted the survey. He is a registered member of SACNASP (Registration Number 400140/06).

General declaration:

- INDEX acted as the independent specialist in this application;
- 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;
- There were no circumstances that may compromise INDEX's objectivity in performing such work;
- INDEX have expertise in conducting the specialist report relevant to this application, including knowledge of NEMA and its regulations and any guidelines that have relevance to the proposed activity;
- Have no, and will not engage in, conflicting interests in the undertaking of the activity.

Signature of specialist for INDEX (PTY) LTD

August 2024

1 BACKGROUND

1.1 TERMS OF REFERENCE

Index was commissioned to do a hydropedological study of PORTION 72 OF THE FARM BULTFONTEIN 533JQ

The site is located just south of Lanseria Airport. The locality is indicated in Figure 1.

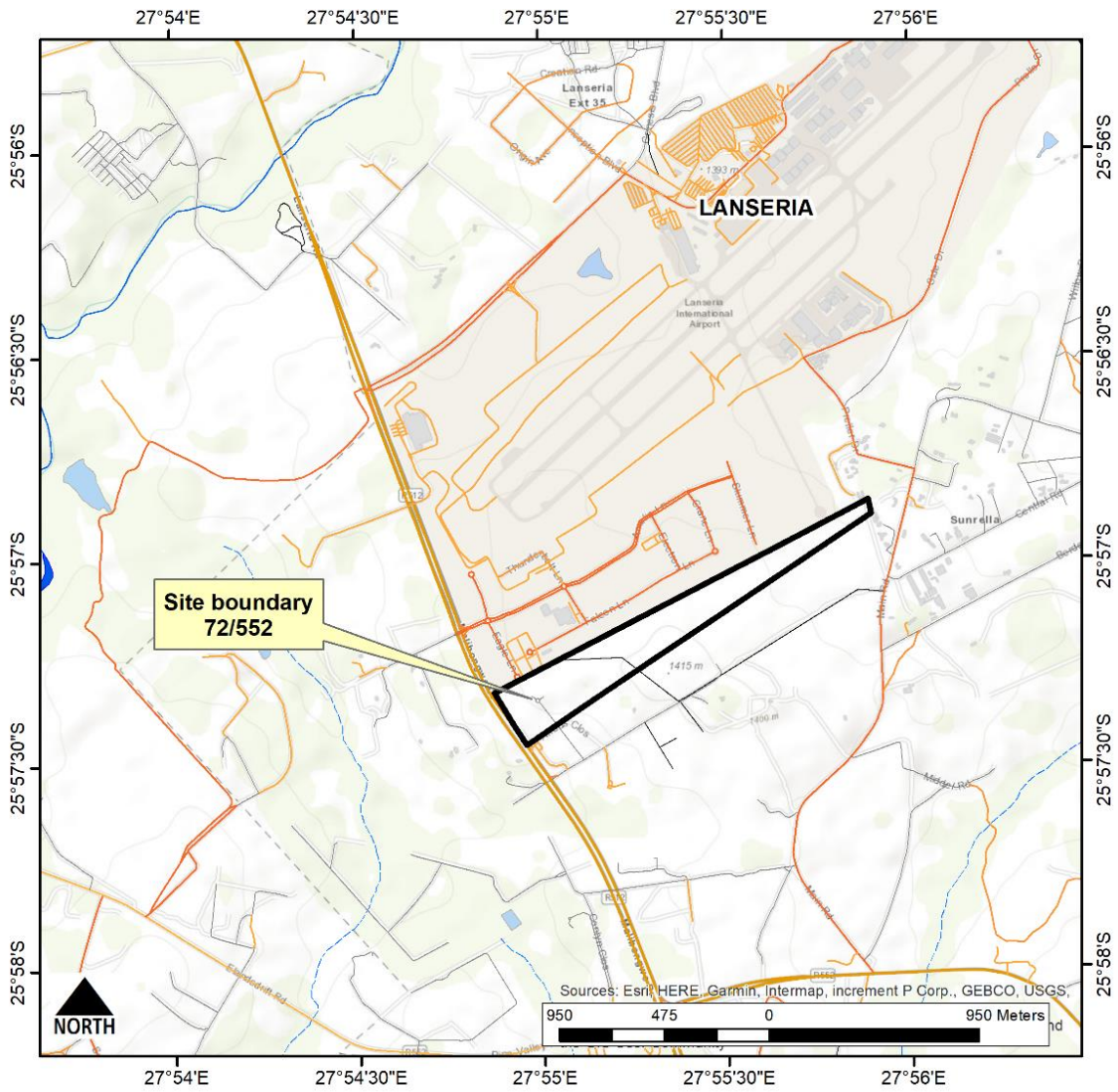


Figure 1 Locality

1.2 METHODOLOGY

A survey was done in 2024. A number of profiles were done by a backhoe excavator and investigated to determine lateral subsurface water flow. These as well as the photographs taken of each observation were used in this report.

Additional information was provided by the Geotechnical Investigation report (report no GGW/24/009) and a Freshwater Assessment.

2 SITE DESCRIPTION

2.1 TOPOGRAPHY

The site is located on the crest of the landscape with the northern section that drains east and north and the northern section towards the north. It is slightly convex for the major part and then concave when it reaches the wetland.

Hydropedological units are always closely related the topography. Lateral movement hardly ever occurs on the crest of landscapes; it is confined to the midslope and valley bottoms.

A section of the site is indicated below:

Figure 2. Section of the site to indicate topography

2.2 LAND USE ON THE PROPERTY

- The entire site is derelict land. It appears from the micro indentations on the northern part of the site, that sand was either mined or moved to Lanseria Industrial area to build platforms for construction.
- There are no fences which allows for informal grazing by lessees or landless people.

2.3 SURFACE HYDROLOGY

Drainage of stormwater mainly takes place as surface flow towards the lower laying portions to the east of the site. The subject site is too narrow to channel water lower down the landscape.

Runoff south of the crest is to along the Lanseria boundary. There are no wetlands in this portion of the site.

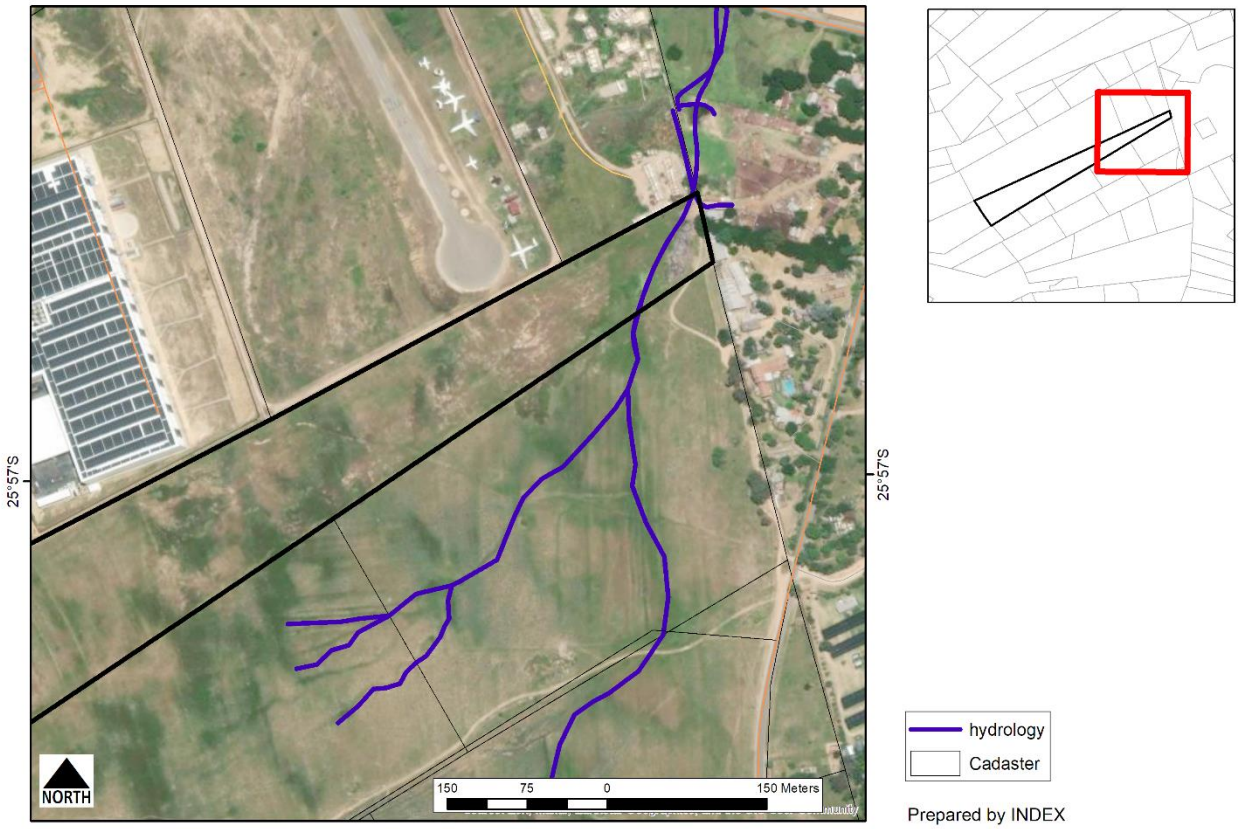


Figure 3. Stormwater flow

2.4 SOIL

The granites often have a pebble horizon that typically separates the transported and residual soil cover. The saprolite horizon shows various stages of ferruginization and due to fluctuating water tables develop ferricrete ('ouklip').

The dominant soils types that occur on the crest and midslope of the landscape are Glencoe, Avalon and Clovelly.

Granite normally weathers into shallow gravelly soil with poor water holding capacity. Most of the upland soils are fairly shallow with outcrops. Seeps may be found on midslopes where they occur downslope of areas where hard plinthite had developed.

Structured soils often occur along the streams. They may have a bleached e-horizon that is indicative of lateral water movement in the upper subsoil. These occur to the east of the site and can be classified as interflow soils. They need special consideration in the planning process, both because they can lead to perched water tables.

Four general soil types were observed:

- Crest and midslopes: shallow red and grey soils classified as Hutton and shallow rocky soils with a greyish brown colour classified as Glenrosa or Clovelly;
- The midslopes tend to be moderately deep and shallow, rocky yellow-brown soils classified as Glenrosa and Clovelly. However, on this specific site it was found that the topsoil was removed with only the underlaying granite or pebble layer that remained.

Portions occur that is indented where rainwater accumulates and over time, has created saturated conditions. They are not wetlands because they don't drain towards the lowlands. Water is mainly lost through evaporation.

- Granite outcrops were found on some of the midslope portions. It can either be actual outcrops or is what remains after the topsoil had been removed through a mining process. The dominant soils in this portion are Mispah, Glenrosa or Dresden. The latter is where to subsoil consists of hard ferricrete.
- The valley bottom is the concave portion of the site. This is either seep or wetland soils, which was also so identified by the Aquatic Assessment.

  Although much of the water is lost through surface flow, the floodplain soils can be seasonally wet, which lets it be classified as wetlands. The dominant soils in this dark waterlogged soil which was classified as Longlands or Katspruit.

The locality of the profiles or observations are indicated below:

Figure 4. Positions of observations

Profile 2
Orthic A horizon
Lithocutanic B
Classification: Glenrosa

Dry, with no signs of wetness. Free of bleached layers. Drainage occurs as surface flow as soon as the topsoil is water saturated.

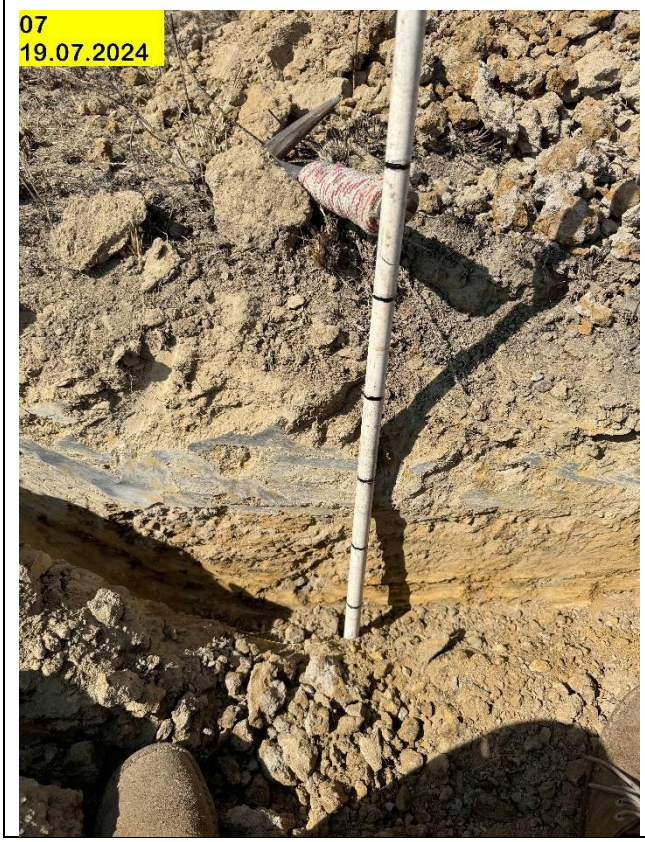
The profile makes no contribution to the base flow of the watercourse.

Classified as Recharge or Deep Interflow soil.

Profile 8
Orthic A horizon
Hard rock
Classification: Mispah / Rock outcrops

Dry, with no signs of wetness. Drainage occurs as surface flow as soon as the topsoil is water saturated.

The profile makes no contribution to the base flow of the watercourse.

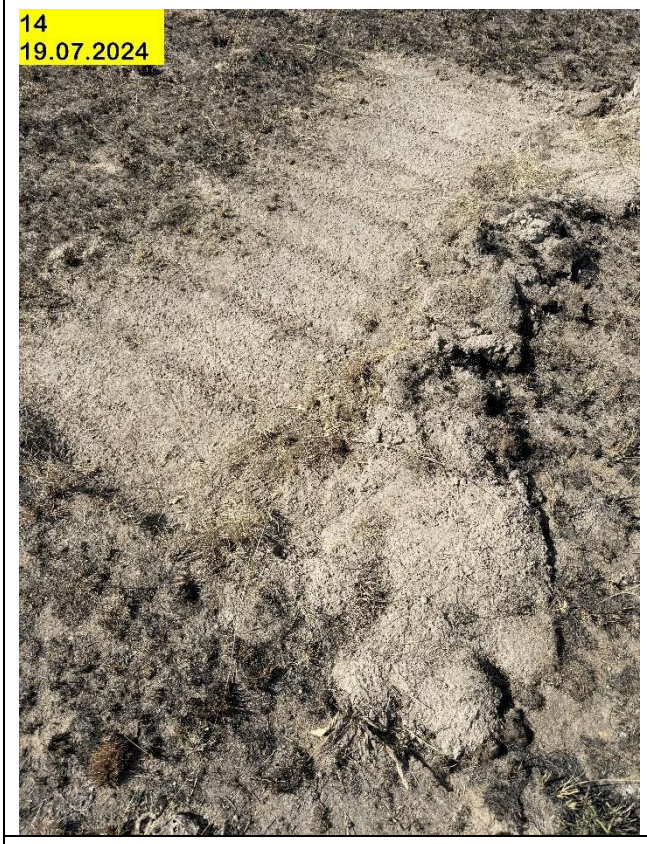


Profile 7
Orthic A horizon
Lithocutanic B
The lower subsoil is greyish brown with gleyed properties.
Classification: Glenrosa

Dry, with slight signs of wetness in the deeper subsoil. It is free of bleached layers. Drainage occurs as surface flow once the topsoil is water saturated.

The profile makes no contribution to the base flow of the watercourse.

Classified as Deep Interflow soil.



Profile 14
Orthic A horizon
Hard Rock
All the soil up the hard rock layer has been removed.
There is no soil present.
Classification: Mispah

Dry, with no signs of wetness. Drainage occurs as surface flow.

The profile makes no contribution to the base flow of the watercourse.

Occurs in the drainage basin outside of the subject site.

Profile 12
Orthic A horizon
Lithocutanic B

Classification: Glenrosa or Oakleaf.

The soil colour is light grey with a sandy loam structure. Although the soil profile is dry, there are signs of at least temporary saturated conditions. The B and C horizons are gleyed

Dry, with no signs of wetness. Drainage occurs as surface flow with small volumes that may drain laterally when the soil is water saturated for prolonged period.

The profile makes little contribution to the base flow of the watercourse.
Classified as Deep Interflow soil.

Profile 15
Orthic A horizon
Lithocutanic B / Soft plinthite / G
Classification: Glenrosa / Longlands / Avalon

Slightly moist, with no signs of a permanent perched water table. It is free of bleached layers that would indicate significant lateral subsurface water flow.
The profile occurs in a depression created where the topsoil was removed.

The profile makes no contribution to the base flow of the watercourse – the water is lost through evaporation.

Classified as Recharge soil.

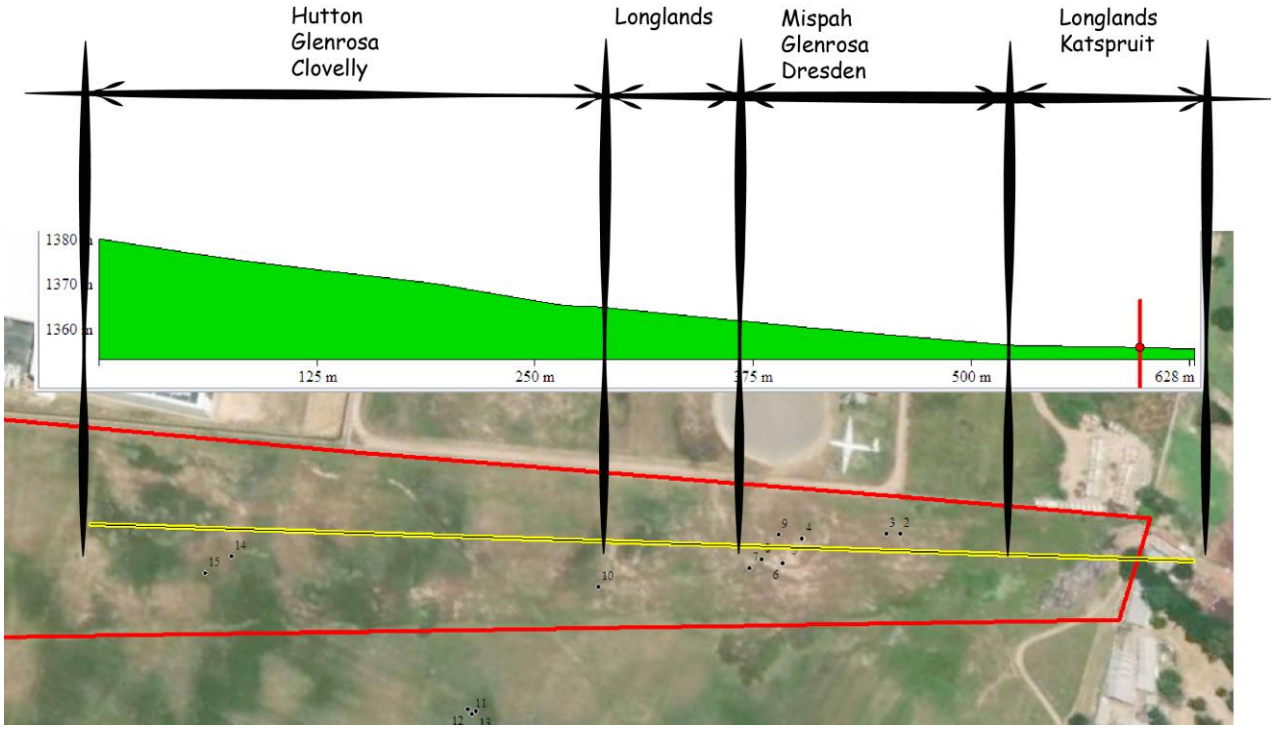


Figure 5. Soil map – Topography soil associations

3 HYDROPEDOLOGICAL BEHAVIOUR OF SOILS

Granite poses particular problems in terms of subsurface water flow and their effect on maintenance of wetlands.

Soil formation is a function of parent material, climate, topography, living organisms and time. Because of topographical differences, a wide range of different soils were formed. A main physical action is water movement onto, into, through and out of a soil profile. Water movement can be downwards as a result of gravity, lateral (normally above restrictive layers), or upwards through capillary forces and evapotranspiration.

When soil is waterlogged or under chemically reduced conditions, Fe and Mn become more mobile and are depleted to form in E-horizon. Oxidizing conditions, in turn, causes precipitation of Fe and Mn to form yellow or red coatings on the soil particles or when the water saturation fluctuates, can precipitate to form nodules (ferricrete).

Reddish and brown soils are normally found on the crests of the landscape. These fall into the category of '*Recharge Soils*'. Yellowish and greyish soils with impervious layers in the deeper subsoil usually occur on the midslopes. They are interflow soils. The valley floor is where responsive soils or wetlands occur.

BEHAVIOUR OF SOIL TYPES

There are three broad groups of soils in relation to their reaction to rainwater. They are as follows:

- Recharge soils

Red colours of the top- and subsoil are typically associated with freely drained soils that are found higher in the landscape. Here rainfall flows into and through the profile. These soils are termed recharge soils, as they are likely to recharge groundwater, to again emerge via the bedrock at lower lying topography. The dominant flow direction in the recharge zone is vertical through the soil and into the fractured rock, from where it can recharge groundwater in downslope positions in the hillslope soils.

In the case of the Halfway House Granites, the soils have a high infiltration rate and have a vertically downward flow that exceeds rainfall intensity. As soon as the soil is either saturated or the precipitation exceeds infiltration, then surface flow occurs.

The common soil types are Hutton, Clovelly, Glenrosa, Mispah and Glencoe.

- Interflow soils

The second group of soils favours lateral flow. Lateral flow occurs due to differences in the conductivity of horizons where a subsoil layer prevents or restricts downward movement. This is manifest by lighter colour chroma of the B horizon. Mottles (red, yellow and grey colours) in the B horizon are the result of a fluctuating water table. The dominant flow direction in the interflow zone is lateral and takes place in or above the B horizon.

The dominant soil types in this group are Avalon, Wasbank, Glenrosa, Longlands and Glencoe.

- Responsive soils

These are true wetland soils. There are two types of soil that qualifies as responsive soils.

a) Soils characterised by grey colours of the lower B and C horizons and dark colours of the topsoil horizon. These properties are indications that this profile is saturated for prolong periods. Because they are close to saturation, especially during peak rainy seasons, it is found that additional rainfall is unlikely to infiltrate the soils but will flow as surface runoff.

b) Very shallow soils where small amounts of rain can easily exceed saturation point. Any more than that will drain away as surface runoff. Included in this group would be highly structured soils. The responsive zone is fed by lateral flowing water from the interflow zone as well as via the bedrock from the recharge zone or as surface flow where the soil is saturated.

Responsive soils generally have a very slow saturated hydraulic conductivity, implying they need a long time to saturate. Due to high evapotranspiration rates, surface water soon evaporates. Responsive soils are wetted via deep interflow terrestrial flowpaths, from the bottom upwards. Responsive wetland soils should be excluded from all development. Terrestrial responsive soils (or seeps) may be temporarily saturated following rains and has to be incorporated into the site development plan.

Morphological indicators of this hydrological response, are the darkening and increases in consistency of the topsoil. Structure greater than medium and a gleyed character in the subsoil, also are indicators.

Soil colour is often of low value and low chroma. Bleached character is also associated with these soils in the dry and moist state. Gley colours range from blue, green to yellow. These soils also show mottles mostly in the bleached colours. Grey and olive-coloured mottles are very common.

Figure 6 indicates the hydrological flow path of rainwater.

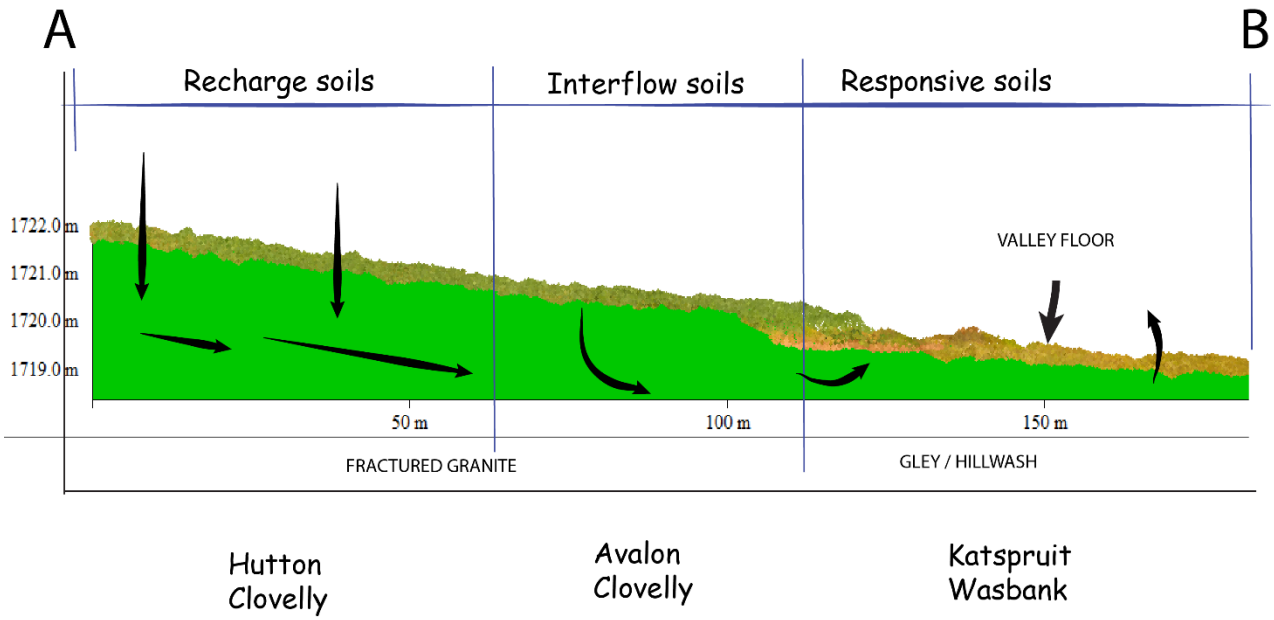


Figure 6. Hydropedological process of the site

4 LAND MODIFIERS

The site occurs on the crest of the landscape. Construction of the industrial area has modified the groundwater profile with the result that the only contribution that this site makes to the baseflow of groundwater is generated on the site itself.

The land is very uneven with many small excavations. This is the result of previous mining activities, likely from sand and gravel borrowing when the platforms for the adjoining industrial area ware built. Much of the northern section is shallow soil that also lost its topsoil through mining.

The land is vacant and has never been cultivated.

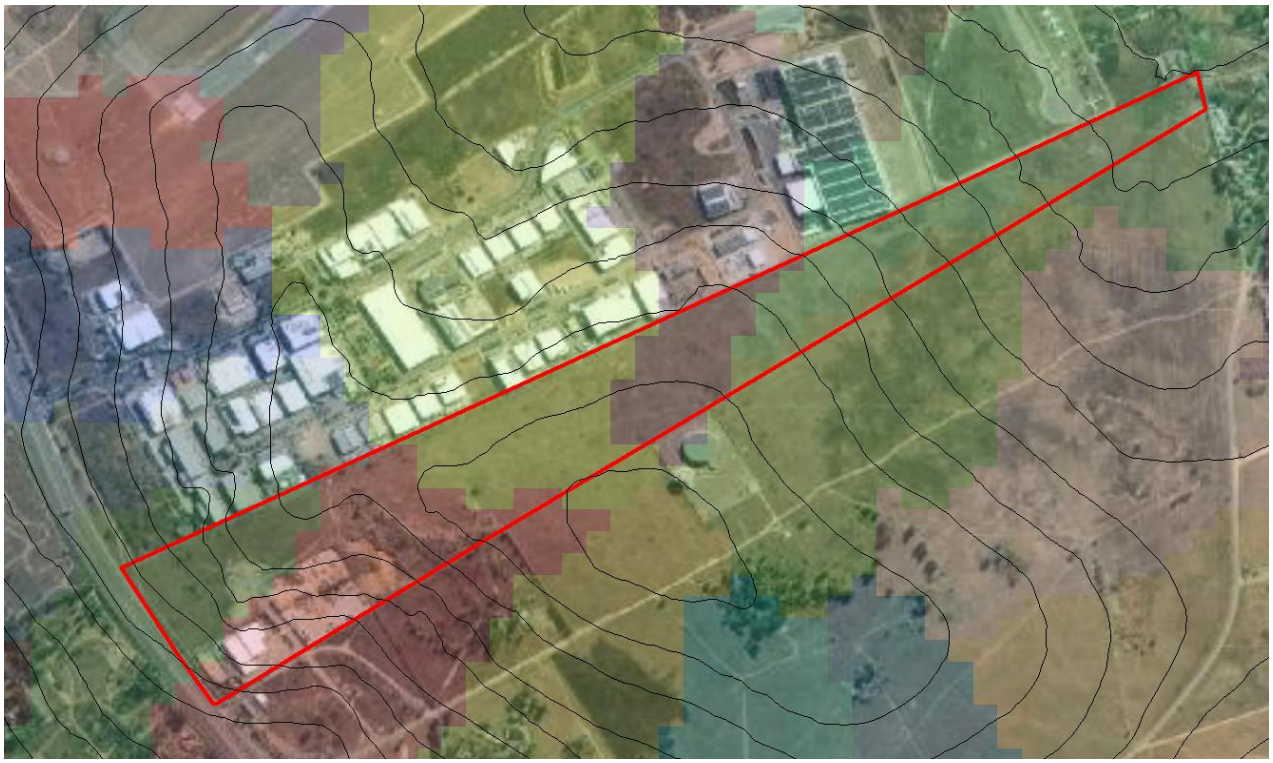


Figure 7. Map indicating drainage areas and the industrial area to the north-west

5 CONCLUSION

There are no clear drainage lines on Portion 72 of the site. The site is on the plateau of the landscape and sloped south and north from the centre.

There is a small portion of land in the northern corner of the site that is a wetland, and which should be retained and maintained. This contains responsive soils, which was also identified as wetlands in the Terrestrial Specialist Study.

The uneven previously mined area should be rehabilitated and levelled out to prevent pockets of water saturated soils, which could potentially damage the foundations of small structures.

The soils found on the northwestern portion has been modified through stripping of the topsoil and borrowing of gravel for construction purposes. These soils are now greyish and brown soil on hard rock or partially weathered granite.

Construction of the industrial area has modified the groundwater profile with the result that the only contribution that this site makes to the baseflow of groundwater is generated on the site itself.

The mining effectively removed horizons that could act as a permeable layer in which lateral subsurface water can flow and which can contribute to maintain a wetland.

From both hydropedological and geotechnical investigations it is clear that there is little lateral movement of water towards the watercourse.

6 RECOMMENDATIONS

There is a common understanding among pedologists on the behaviour of soils on the crest of the landscape (reddish and yellow brown soils) and the soil that occur on the valley floor (hydromorphic soils with a perched water table). These soils have properties that's behaviour is predictable.

The purpose of a hydropedological investigation is to present hydrological soil flow path and storage mechanism information to engineers and planners.

To sustain the wetland;

a) the inflow of water into the soil (recharge) must be maintained by limiting or mitigating sealing of the soil surface, or at least, to encourage water infiltration into deeper rock layers;
b) discharge into the wetland must be controlled by a Stormwater Management Plan.
c) Hydromorphic soils were identified towards the eastern site of the site. This is within the headlands of the watercourse. Construction on the site should not prevent any lateral water movement towards the watercourse.

These measures will help ensure that development structures will not be affected by excess water in the rainy season.

Hydraulic connectivity of soils on the site should be taken into consideration by the geotechnical engineer or engineering geologist to address and incorporate any ecological constraints into the site development plan.

7 ADDENDA

Figure 8. Soil profiles investigated for the wetland delineation

7.1 REFERENCES

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7.2 OBSERVATIONS

The soil profiled and description of the soil profiles investigated for the wetland delineation are described below.

PHOTOS


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11
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12
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13
19.07.2024


14
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