AGRICULTURAL POTENTIAL OF OLIFANTSFONTEIN 410 JR CLAYVILLE X50;

REMAINDER EXTENT OF PORTION 7 (A PORTION OF PORTION 1), REMAINDER EXTENT OF PORTION 15 (A PORTION OF PORTION 7) PORTION 41 (A PORTION OF PORTION 7)

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SPECIALIST REPORT ON AGRICULTURAL POTENTIAL

SUMMARY AND CONCLUSIONS

Index was requested by AfricanEPA to do a soil survey on the farm Olifantsfontein 410 JR: Remainder extent of Portion 7 (A Portion of Portion 1), Remainder extent of Portion 15 (a portion of Portion 7) and Portion 41 (a Portion of Portion 7) for the purpose of rezoning and subdividing the land. The property is located west of Clayville. The property is vacant or used only for residential purposes.

Rainfall can be expected throughout the year at an average of approximately 623 mm. The average daily maximum temperature is 28,5°C with the daily minimum at 4,8°C, averaging out to 18°C per day throughout the year. Wind speeds can reach a mean of 8,3km/h. The most intense wind occurs during spring. This may adversely affect certain crops.

The average yield of boreholes is estimated at 0,5 to 2,0 lt per second. The normal expected borehole yield is not sufficient for irrigated crop production. The total dissolved solids are expected to be between 200 and 600 mg/kg. The levels where crops and animals start being influenced are at 1 200 and 4 000 mg/l respectively. There is no surface water available on the property.

The area is mainly grassland with small portions encroached with black wattle. Most land on the farm is natural or disturbed veld with a grazing capacity of 6 hectares per large stock unit. Taking the quarry and eroded areas into consideration the farm can accommodate approximately 40 LSUs. According NDA criteria, a viable farm should be able to carry at least 60.

The property is underlain by granite and gneiss, a rock that generally weathers into shallow course-grained sandy soils.

Five soil types were found, (1) deep and moderately deep red soils classified as Hutton. (2) moderately deep yellow and greyish brown colour soils classified as Avalon, (3) shallow greyish brown soils on partially weathered granite, classified as Glenrosa, (4) deep, dark waterlogged soil along the river classified as Longlands and Escourt; and (5) excavations.

A detailed soil and land analysis found that none of the soil types found can be described as high or medium potential.

Agricultural potential assumes that the property would sustain the commercial farmer and that the net farm income is positive. The following were found:

- Most crops fail to yield a positive margin.
- The preferred land use would be livestock, which can provide the farmer with a gross farming income of R143 076 before overheads and repayment of land. This is not sufficient to cover overheads or repay a bond if the land had to be bought. A farming loss of R57 648 is projected if this was a farming unit.

Conclusion and findings

The following conclusions can be made:

No land is presently under irrigation, there is also no water available.

The property has only 21 hectare medium to high potential soil. Further, no land was found to be high potential for rainfed cropping according to the departmental guidelines.

The site is suitable for livestock, but the income that can be derived from the number of cattle that the property can keep, is not high enough to cover overhead costs if the farm was managed as a financial venture.

In conclusion, the property is not a viable farming unit.

Declaration

This is to declare that the survey was done and the report written by Dr. Andries Gouws, a registered scientist with the South African Council for Natural Scientist in the category of Agricultural Sciences.

Dr. J A Gouws

1. INTRODUCTION

Index was requested by AfricanEPA to do a soil survey on the farm Olifantsfontein 410 JR: Remainder extent of Portion 7 (A Portion of Portion 1), Remainder extent of Portion 15 (a portion of Portion 7) and Portion 41 (a Portion of Portion 7) for the purpose of rezoning and subdividing the land.

Agricultural potential is determined by a number of factors, notably the soil properties (soil depth, texture, structure and course fragments) and climatic conditions. These will determine crop yield and then combined with management and produces price, will determine if it is a viable farming unit.

The study will indicate the following:

- Present land use;
- Soil description;
- Water availability;
- Climatic conditions;
- Vegetation status and livestock carrying capacity.
- The agricultural potential of the land will be indicated for various farming enterprises.

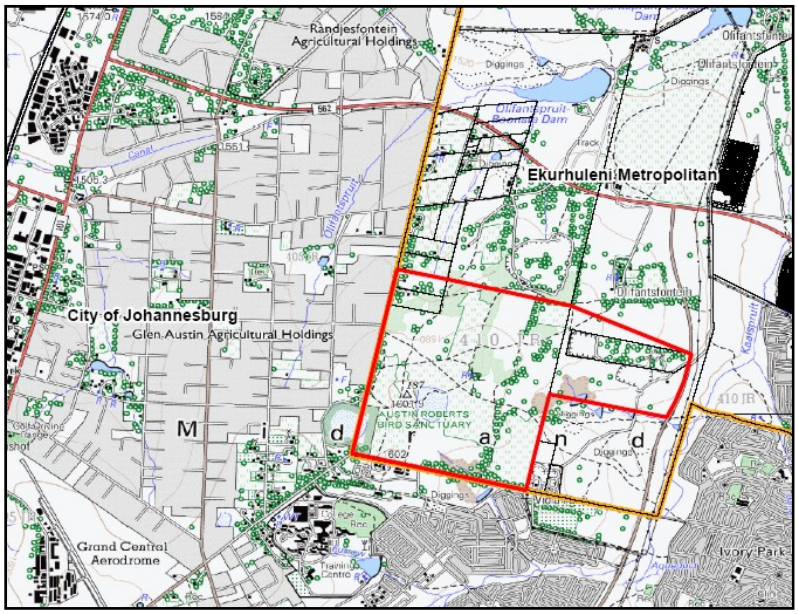


Figure 1. Locality map

2. SITE DESCRIPTION

2.1 SITE DATA

Site description: Olifantsfontein 410 JR: Remainder extent of Portion 7 (A Portion of Portion 1), Remainder extent of Portion 15 (a portion of Portion 7) and Portion 41 (a Portion of Portion 7)

Size: 373 hectares

The property is located west of Clayville.

2.2 PRESENT LAND USE

The property is vacant or used only for residential purposes.

2.3 NATURAL ENVIRONMENT

Rainfall

Rainfall can be expected throughout the year, but this is mainly a summer rainfall region. Thunderstorms occur frequently in summer, especially in the afternoons. The mean monthly precipitation is 56 mm/month and an average annual precipitation of approximately 623 mm (see Table 1).

It is a fairly dry area with a mean monthly potential evapotranspiration (PET) of 120 mm/month with the highest occurring during the summer months.

Hail can occur and is to be expected in the spring months.

Table 1. Rainfall data

Station Name	Distance (km)	Record (Years)	Latitude (°) (')	Longitude (°) (')	MAP (mm)	Altitude (m)
Olifantsfontein	5.7	53	25 57	28 14	623	1515
Doomkloof	10.5	57	25 53	28 14	675	1440
Irene	11.4	83	25 52	28 13	688	1470
Zwartkop	14.5	44	25 50	28 10	662	1400
Kempton Park (Sar)	14.8	92	26 06	28 13	697	1660
Pretoria-Wierda Park	14.8	25	25 50	28 09	699	1390

Temperature

- The daily maximum temperatures are 28,5°C with the daily minimum at 4,8°C, averaging out to 18°C per day throughout the year. The highest temperatures occur during the summer months in December & January.
- Frost may occur from as early as May to as late as August. The mean day length is 12 hours.

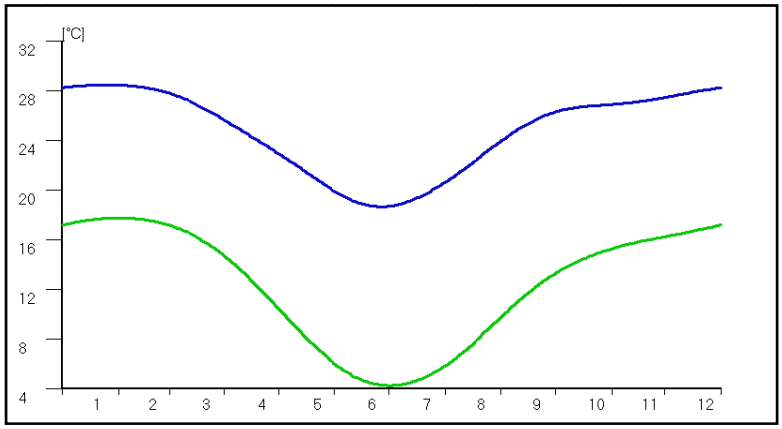


Figure 2. Average daily minimum and maximum temperatures

Wind and water vapour pressure

- Wind speeds can reach a mean of 8,3km/h. The most intense wind occurs during spring. This may adversely affect certain crops.
- A mean water vapour pressure of 12 hPa can be expected, the highest occurring during late spring and summer. In combination with the wind speed this determines the evaporation rate.

Hail

- Hail can be expected 3 to 5 times per year and may cause damage to crops. It normally occurs during thunderstorms in the early part of the rainy season.

Water

- Groundwater

  Boreholes monitored by the Department of Water Affairs were taken as representing the status of the region.

  From this dataset, the following could be deduced:

  - Borehole yield
    - The average yield of boreholes is estimated at 0,5 to 2,0 lt per second.
    - The normal expected borehole yield is not sufficient for irrigated crop production.

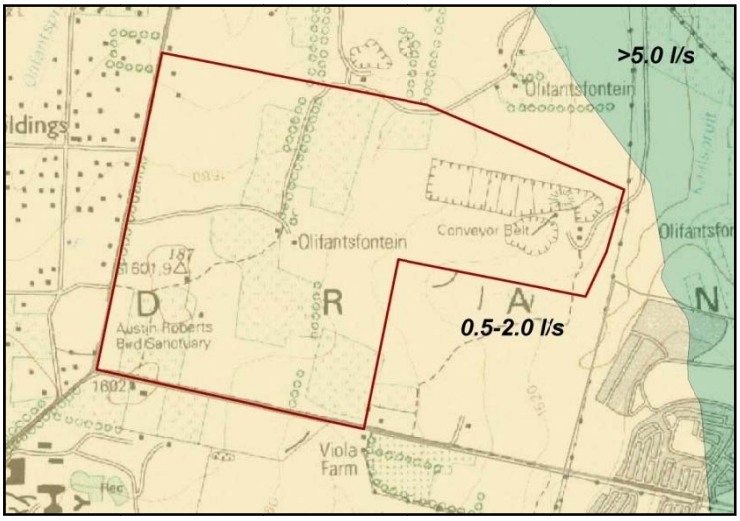


Figure 3. Expected groundwater yield

- Quality
  - The total dissolved solids (TDS) are between 200 and 600 mg/kg. The levels where crops and animals start being influenced are at 1 200 and 4 000 mg/l respectively.

❖ Surface water

There is no surface water available on the property.

2.3.1 Vegetation

The area is mainly grassland with small portions encroached with black wattle.

Most land on the farm is natural or disturbed veld.

❖ The average grazing capacity [1] of the veld is 6 hectares per large stock unit (LSU [2]).

❖ The farm can accommodate approximately 40 LSUs, taking the quarry and eroded areas into consideration. According NDA criteria, a viable farm should be able to carry at least 60.

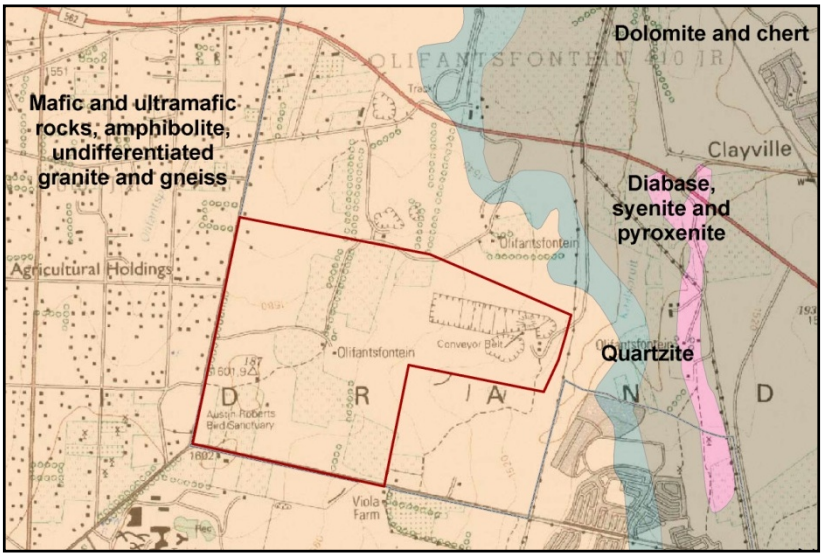


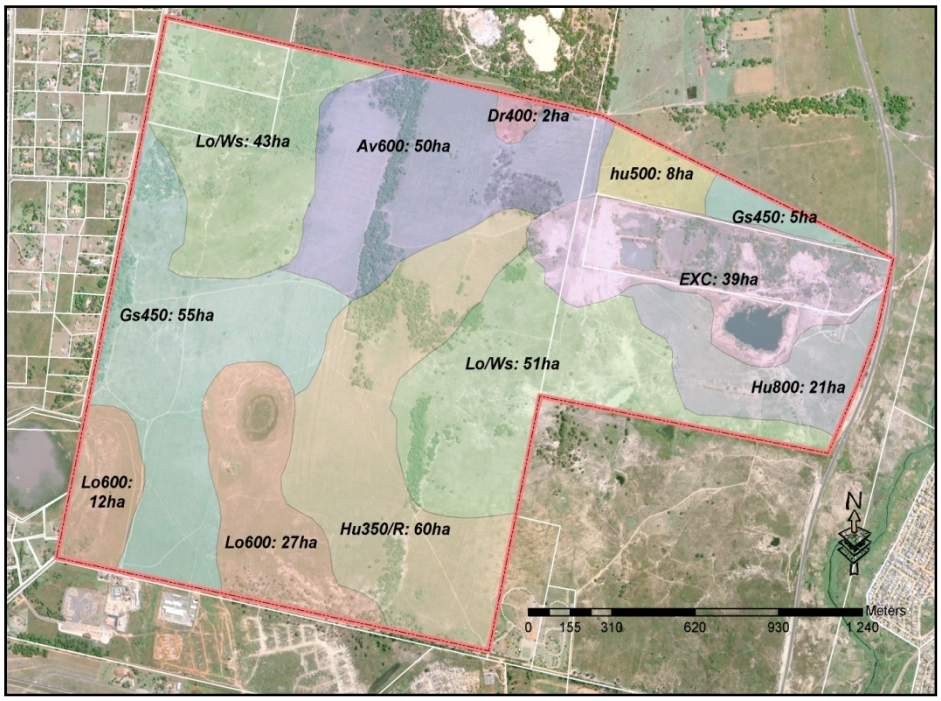
Figure 4. Geology

2.3.2 Soils

The property is underlain by granite and gneiss, a rock that generally weathers into shallow course-grained sandy soils.

The investigated study site has an area of 373 hectare. More than 60 observations were made by soil auger or probe, and the soil then classified according to the Binomial Classification System for Southern Africa. The observation points were taken by GPS and transferred to a base map.

Minor watercourses occur in the western portion and in the south eastern part. The soils close to the river tend to consist of either shallow duplex soil or deep sands that are waterlogged.



Five soil types were found:

❖ Deep and moderately deep red soils classified as Hutton. The soil in this group that is in the southern portion of the property is has many rock outcrops and is not arable;

❖ Moderately deep yellow and greyish brown colour soils classified as Avalon;

[1] Source: Department of Agriculture: Grazing capacity Maps. 1993. Directorate Resource Conservation. Private Bag x120. Pretoria 0001

[2] Medium framed animals

- Shallow greyish brown soils on partially weathered granite, classified as Glenrosa;
- Deep, dark waterlogged soil along the river classified as Longlands and Escourt; and
- Excavations.

Table 2. Soil descriptions

Soil unit	Description	Area
Hu800	Orthic A overlying a red apedal B horizon. The profile consists of deep red soils with moderate clay content and sandy loam texture. Soil depth ranges from 800 to 1200mm. The unit has moderate amounts of loose stones throughout the profile. The underlying rock is granite and quartzite. The soil form present is Hutton.	21ha
Hu500	Orthic A overlying a red apedal B horizon. The profile consists of shallow red soils with moderate clay content and sandy clay loam texture. Soil depth ranges from 400 to 600mm. The unit has moderate amounts of loose stones throughout the profile. The underlying rock is granite and quartzite. The soil form present is Hutton.	8ha
Av600	Orthic A overlying yellow-brown subsoil of which the deeper portion is soft plintite. The profile consists of shallow grey-brown to yellowish soil with a sandy to sandy loam texture. It has a low clay content and weak structure. The soil depth varies between 500 mm to 650 mm. Loose stones were found on most of the mapping unit. The underlying rock is granite and quartzite The main soil forms present are Avalon and Clovelly.	50ha
Gs450	Orthic A underlain by a lithocutanic B horizon. The profile consists of shallow grey-brown to yellowish rocky soil with a sandy to sandy loam texture. It has a very low clay content and weak structure. The soil depth varies considerably over short distance and can be from 200 mm to 500 mm. Loose stones were found on most of the mapping unit. The underlying rock is granite and quartzite The main soil forms present are Glenrosa.	55ha
Hu350/R	Orthic A overlying a red apedal B horizon. The profile consists of shallow red soils with moderate clay content and sandy clay loam texture. Soil depth ranges from 300 to 500mm, and has many outcrops and loose stones throughout the profile. The underlying rock is granite and quartzite. Rocky Hutton and Glenrosa soils.	60ha
Lo600	Orthic A over an E horizon over a lithocutanic or gleyed B horizon. Included are some watercourses and pans. Shallow washed out rocky soils close to the watercourse. It has sandy loam texture with a low clay content and weak structure. The lower horizon has a greyish-brown colour. Depth varies from 400 mm to 600 mm. The main soil forms are Longlands, Kroonstad and Oakleaf.	39ha
Lo/We	Duplex soils along the watercourse. Soils found in this area included Escourt, Kroonstad, Longlands and Westleigh.	94ha
Dr400	Orthic A underlain by hard plintite. The profile consists of shallow grey-brown to yellowish sandy to sandy loam texture. It has a low clay content and weak structure. The soil depth is 250 mm to 500 mm. The underlying rock is hard plintite and granite. The main soil forms present are Dresden and Glenrosa.	2ha
Exc	Excavations where sand is mined	39ha

- Arable potential: The Hu800, Hu500 and Av600 are arable, and has moderate potential.

3. LAND USE POTENTIAL FOR AGRICULTURE

- GAPA classification (land use potential)

  GAPA found that the higher lying ridge has high potential, the balance has a low potential for arable agriculture. In general trend this was found to correct in a detailed soils survey done by Index.

- NDA classification

  Soil of the Avalon, Bainsvlei, Bloemdal, Clovelly, Glencoe, Hutton, Oakleaf, Pinedene, Shortlands and Tukulu deeper than 800mm and soil under irrigation has high potential. Only Hu800 meets these criteria.

- Reviewed classification

  From a more detailed soil and land analysis than GAPA, but based on their criteria, that of the NDA and by criteria of STK[3], we found that none of the soil types found can be described as high or medium potential.

  The rating in land use capability classes are as follows:

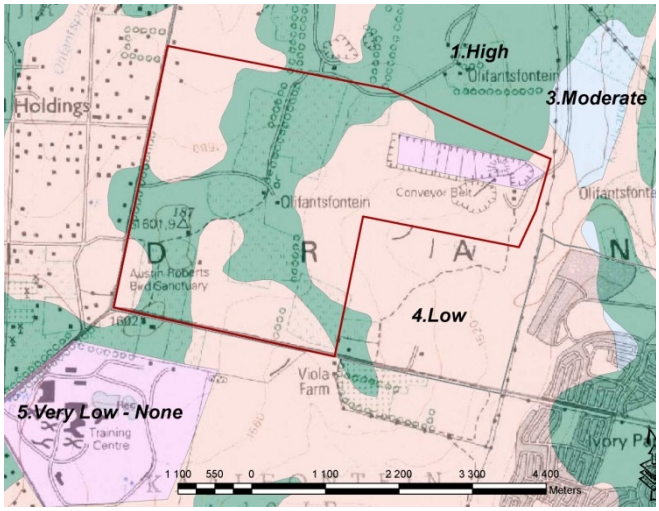


Figure 5. Agricultural potential (GAPA)

Table 3. Potential rating

Potential rating	General description	Map units	Size
Arable classes			
Class i - High potential	The soil in this climatic zone is deeper than 900 mm. It has a granular structure with a clay content of around 25%. The NDA criteria include land with permanent irrigation infrastructure and land with unique value. There is no irrigation on the property.	-	-
Class ii – High / Medium potential	These soils are moderately deep and have a clay content of between 18% and 28% with a granular structure. Nodules and stone fragments in the subsoil may impede root development.	Hu800	21
Class iii – Medium potential	Consists of soils that experience moderate drainage, has a depth between 500 and 800 mm and may have rock outcrops. As a group, they are moderately suitable for agricultural development.	Av600 Hu500	58
Non-arable classes			
Class vi – Low potential	Class IV occurs on soil that is shallow (<500 mm) that are moderate to poorly drained with prevalent rock outcrops. However, their poor water retention properties and poor natural fertility renders them only marginally suitable for crop production. As a group, they are moderately to poorly suitable for agricultural development.	Hu350/R Gs450	120
Class v – Very low potential	This group consists of highly erodible soils. They should remain undisturbed and only used for grazing. This is also in line with protection measures required by legislation regarding wetland environments. It also includes building and road infrastructure.	Dr400 Lo/We, Exc Lo	194

[3] South African Development Trust Corporation. A parastatal development agency for the former Department of Development Aid.

Figure 6. Agricultural potential

4. ENTERPRISE ANALYSIS BASED ON LAND USE POTENTIAL

4.1 BACKGROUND

The unique interaction between the different components that constitute land use potential, which are soil properties, water availability and climate, will determine enterprise yield. Farming potential is determined by this yield and the resulting income from crops and sale of animal products. It is further impacted on by prevailing socio-economic conditions and management skills of the practitioner.

The following analysis for rainfed crops is based on yield models of Crafford and Not (Department of Agriculture).

4.2 CROP YIELD AND GROSS FARM INCOME

The projected long-term yield for the major crops is indicated in Table 4.

Table 4. Projected yield for major crops

TEXTURE CLASSES	
Sandy loam	1
Sandy clay loam	2
Clay loam	3
Clay	4
Sandy clay	5

Rainfall (mm/y)	**682**
Effective rainfall	**580**

Soil description	Texture	Soil depth	Yield t/ha)			
	Class	(mm)	Maize	Grain sorghum	Sunflower	Sugar beans
Hu800	2	800	2.6	3.2	1.2	0.7
Hu500	2	500	1.8	2.3	0.8	0.6
Av600	2	600	2.2	2.7	1.0	0.7
Hu350/R	2	0	0.0	0.0	0.0	0.0
Gs450	1	0	0.0	0.0	0.0	0.0
Lo600	1	0	0.0	0.0	0.0	0.0
Lo/We	3	0	0.0	0.0	0.0	0.0
Dr400	1	0	0.0	0.0	0.0	0.0
Exc	1	0	0.0	0.0	0.0	0.0

85% of in-season rain (mm/y)

- Producer prices
  - Maize R1 400/t
  - Beef: R18,00/kg

4.3 FARM INCOME

Agricultural potential assumes that the property would sustain the commercial farmer and that the net farm income is positive. It further implies that the gross farm income should be able to cover all overhead costs. In this analysis, net farm income excludes repayment of land, but includes repayment of loans of mechanisation and equipment. The following were found:

- Crop production fails to yield a positive margin.
- The preferred land use would be livestock, which can provide the farmer with a gross farming income of R143 076 before overheads and repayment of land. This is not sufficient to cover overheads or repay a bond if the land had to be bought. A farming loss of R57 648 is projected if this was a farming unit.

Table 5. Projected net farm income

	Grazing capacity (ha/gve)	Area (hectare)	GROSS FARM INCOME Maize	Grain sorghum	Sunflower	Sugar beans	beef cattle
Hu800	6	21	R6 930	R7 871	-R18 669	-R42 000	R7 871
Hu500	6	8	-R17 089	-R4 600	-R11 904	-R14 052	R2 998
Av600	6	50	-R16 700	R16 500	-R106 805	R 0	R18 739
Hu350/R	6	60	R 0	R 0	R 0	R 0	R22 487
Gs450	6	55	R 0	R 0	R 0	R 0	R20 613
Lo600	6	39	R 0	R 0	R 0	R 0	R14 617
Lo/We	6	94	R 0	R 0	R 0	R 0	R35 230
Dr400	6	2	R 0	R 0	R 0	R 0	R 750
Exc	0	39	R 0	R 0	R 0	R 0	R 0
TOTAL		368	-R26 859	R19 771	-R137 378	-R56 052	R123 305

Net farm income

Gross income	Average Rand	Preferred Rand
Field crops (average)	-R50 130	R19 771
Cattle	R123 305	R123 305
TOTAL INCOME	R73 175	R143 076
Less:		
Overheads		
Labour (365 days @ R60)	R21 900	R21 900
Management (part time) - R10000/m	R130 000	R130 000
Repayment of loans		
Mechanisation & equipment (R300 000)	R48 824	R48 824
TOTAL EXPENSES	R200 724	R200 724
Net farm income	**-R127 548**	**-R57 648**

The preferred land use is maize or sorghum production on the deep soils and cattle on the balance. Stover from the maize is used as winter feed.

5. ANALYSIS OF AGRICULTURAL POTENTIAL

5.1 ANALYSIS OF LAND FOR DIFFERENT LAND USES

- An analysis was done for irrigated crops, rainfed crops and for livestock. The analysis is indicated in Table 6. The most constraining factor normally determines the land use potential.

Table 6. Land use potential analysis

Land unit	Agricultural potential: Irrigated crops	Rainfed crops	Grazing	Area Ha
Hu800	Low potential The soil is arable but there is no water available for irrigation.	Medium potential The soil is arable and has medium / high potential according to NDA criteria	Medium potential The property is suitable for livestock production. Stock theft and vandalism is problematic in this general area	21
Hu500	Low potential The soil is arable but there is no water available for irrigation.	Low potential The soil is arable but has low potential	Medium potential The property is suitable for livestock production.	8
Av600	Low potential The soil is not arable and there is no water available for irrigation.	Low potential The soil is arable but has a moderate to low arable potential	Low potential The property is suitable for livestock production.	50

Land unit	Agricultural potential			Area Ha
	Irrigated crops	Rainfed crops	Grazing	
Gs450	Low potential The soil is not arable and there is no water available for irrigation.	Low potential The soil is not arable.	Low potential The property is suitable for livestock production.	55
Hu350/R	Low potential The soil is not arable and there is no water available for irrigation.	Low potential The soil is not arable.	Low potential The property is suitable for livestock production.	60
Lo600	Low potential The soil is not arable and there is no water available for irrigation.	Low potential The soil is not arable.	Low potential The property is suitable for livestock production.	39
Lo/We	Low potential The soil is not arable and there is no water available for irrigation.	Low potential The soil is not arable.	Low potential The property is suitable for livestock production.	94
Dr400	Low potential Soil is too shallow with restrictive rock layers.	Low potential Land is not arable.	Low potential The property is suitable for livestock production.	2
Exc	No potential No cultivation is possible these area	No potential No cultivation is possible in these areas	No potential No grazing is possible in these areas	39

6. CONCLUSION AND FINDINGS

The following conclusions can be made:

- Irrigated crops

  No land is presently under irrigation, there is also no water available.

- Rainfed crops

  The property has only 21 hectare medium to high potential soil. Further, no land was found to be high potential for rainfed cropping according to the departmental guidelines. The main constrains to viable crop farming are the soil properties.

- Livestock

  The site is suitable for livestock, but the income that can be derived from the number of cattle that the property can keep, is not high enough to cover overhead costs if the farm was managed as a financial venture.

The financial analysis indicates that the gross farm income before overheads and payment of loans, is at best R134 076 per year, and the net farm income is a loss of R57 648.

In conclusion, the property is not a viable farming unit.

7. ADDENDA

7.1 CRITERIA FOR THE DETERMINATION OF AGRICULTURAL DEVELOPMENT POTENTIAL

Below is a checklist that needs consideration in determining the agricultural potential (opportunities and constraints) of an area.

- Soil properties (types and classes) and their implications on enterprise selection.
- Availability of water: cost, quality and quantity.
- Climatic conditions and their influence on enterprise selection and production costs.
- Markets and their influence on enterprise selection and profitability.
- Land value/cost.
- Farm security.
- Support structures; technical support and funding mechanisms.
- Skills levels and production preferences of the producers.
- Ownership of land.

Land use potential describes the land's capacity to accommodate different agricultural enterprises as well as for housing construction. Each agricultural enterprise requires different soil and land conditions to produce optimally. For example, crop production under irrigation requires a soil that is deep and free of impediments for root development. It should also be freely drained to allow for the removal of salts that may accumulate in the soil through irrigation practices and by applications of fertiliser. Rainfed crops, on the other hand, produce better on soil with moderately restrictive layers for drainage. This allows water retention and may allow crops to overcome short periods of drought that periodically occurs.

An assessment was made of the land's potential for different enterprises. Factors that are taken into consideration in rating land for different land uses are slope, soil depth, soil structure, texture, drainage conditions and occurrence of rock.

Rock outcrops in an otherwise deep well-drained soil may be more suitable for horticulture than for field crops, because mechanisation problems are less severe than with field crops (where the total area is cultivated). These soils are moderately to well suited to hand cultivation.

The following criteria applied in determining the land use suitability for agricultural use of which the most limiting will dictate the suitability class:

Table 7. Criteria for general land use suitability.

	I	II	III	IV	V
	Arable classes			Non arable classes	
Criteria	High	High / Medium	Medium	Low	Very Low
Slope (%)	<4		<8	>12	
Soil depth (mm)	>1000	1000-800	800-500	500-300	<300
Structure in the subsoil				Moderate to strong	Strong
Texture	20-35%			>55 or <10	>55
Drainage	Red, freely drained.	Red, yellow, well drained, few mottles.	Moderately restrictive, soft plintite in deeper subsoil.	Poorly drained. Soft plintite in subsoil.	Gleyed subsoil.
Rock	None	None/few	Moderate	Many	Many

Land capability classes: General description of land capability:

Five suitability classes, ranging from highly suitable to unsuitable, are normally used for the different groups of enterprises. This will allow planners to decide on the optimal land uses for the different soil units as well as for the farm as a whole.

- Arable classes
  - Class I – High potential land

  This class consists of moderately structured, well-drained soils that are free of rocks and other impediments that could either restrict root development or drainage. The soil is deeper than 1200mm to any impeding layer. This class is suitable for all agricultural activities and can be used without constraint. Even moderately poor quality irrigation water can be used without detrimentally affecting the soil's productivity.

  - Class II – High / Medium potential land

  Deep to moderately deep (800mm to 1200mm) brown, red and yellow soils, with properties that imposes moderate restrictions on root development and drainage. Clay layers in the soil profile may cause drainage problems. This unit is well suited for irrigated crop production under irrigation as well as for rainfed crops.

  - Class III – Medium potential land

  Consists of soils that experience moderate drainage, has a depth between 500 and 800 mm, and which may have rock outcrops. As a group, they are moderately suitable for agricultural development.

- Non arable classes
  - Class IV

  Class IV occurs on soil that is shallow (<500 mm) that are moderate to poorly drained with prevalent rock outcrops. However, their poor water retention properties and poor natural fertility renders them only marginally suitable for crop production.

  As a group, they are moderately to poorly suitable for agricultural development.

  - Class V

  This group consists of highly erodible soils. They should remain undisturbed and only used for grazing. This is also in line with protection measures required by legislation regarding wetland environments.