TOWNSHIP ESTABLISHMENT

PORTION OF THE REMAINING EXTENT OF THE FARM BERGENDAL 981 JT & REMAINING PORTION OF THE FARM WEMMERSHUIS 379-JT

AGRICULTURAL POTENTIAL SURVEY

For and on Behalf of

Korsman & Associates

September 2015

DRAFT REPORT

Sustaining the Environment

Stonecap Trading 14 (Pty) Ltd

Our Ref:
Your Ref:

20th November 2012

Korsman & Associates
Private Bag X7294
Postnet Suite 59
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Attention: Laurette Swarts

Dear Laurette,

Attached herewith please find our draft report detailing the findings of our Soil and Land Capability studies undertaken in consideration of the "Agricultural Potential" for the Bergendal Township establishment project.
Earth Science Solutions (ESS) (Pty) Ltd. was commissioned to undertake the work based on the proposal submitted and the order received.

Should you have any queries in this regard, please do not hesitate to contact us.

Yours faithfully,
Earth Science Solutions (Pty) Ltd

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AGRICULTURAL POTENTIAL ASSESSMENT REPORT
TOWNSHIP DEVELOPMENT –
PORTION OF THE REMAINING EXTENT OF THE FARM BERGENDAL 981-JT
&
REMAINDER OF PORTION 12 OF THE FARM WEMMERSHUIS 379-JT

Compiled for
KORSMAN & ASSOCIATES

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Client: **KORSMAN & ASSOCIATES**
WITBANK
SOUTH AFRICA

Attention: Ms. Laurette Swarts

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EXECUTIVE SUMMARY

Based on the Terms of Reference and our understanding of the process to be followed, the Township Development being considered for the Berg-en-dal project requires that the agricultural potential of the area is considered as part of the application.

The identification and classification of the soil profiles will be carried out using the South African Taxonomic Soil Classification System (Mac Vicar *et al*, 2nd edition 1991) and the land capability rating in conjunction with the Department of Agriculture and Forestry's "Criteria for Prime or Unique Agricultural Land" guideline document. In addition, but outside of the requirements for this study, the irrigation potential of the soil has been used to obtain a soil suitability code and irrigation suitability rating for the site.

Applying these criteria, the soils were mapped, the land capability was rated and a scale of agricultural potential/suitability was determined using the soil and geomorphological aspects of the study area.

The majority of the site returned soils that classify as poorly productive agricultural land use, with various depth limiting materials from saprolite and ferricrete to wetness hazards. The soils are considered shallow and the surface roughness too rocky for practical cultivation.

The soils effective rooting depths are on average between 400mm and 600mm, with surface rock an added hindrance to any form of mechanised agriculture of large portions of the site.

Other problems, which render these soils as marginal to poor, are the inherently low macro- and micro-nutrient supply characteristics, de-nitrification problems and the leaching hazard in the shallower soils, while erosion is a hazard that will need to be well managed.

In conclusion it is noted that:

- There are very limited areas of good productive soils (physical and chemical) that render the site of good agricultural production under dryland conditions.
- Approximately 51ha or 44% of the area is considered to be poor or unsuitable for agricultural production of any sort and should be left to conservation (conservation) or as wetland status as applicable.
- Only 59ha or 51% of the study area is considered to be of a land capability rating of "moderate grazing" potential that could be cropped to grasses for animal food production, while a mere 4ha or 3,6% is of a quality that could potentially be used for "moderate arable" production. This rule-of-thumb sequence should only be used as a guideline and is subject to the relative economic merits of the different cropping systems with respect to the limited size of the area.
- Soil salinity/sodicity is considered a potential problem. It is recommended that selected sites proven to have restricted drainage be monitored on a regular basis, particularly on the grey/pale and darker clay rich soils if they are to be developed.

It is considered important that all sensitive sites should be excluded as far as possible from any development being planned.

Additional work needs to undertake to better define the sensitive sites of wetland status.

1. INTRODUCTION AND TERMS OF REFERENCE

In line with the Terms of Reference (ToR) received from Korsman & Associates (K&A) Earth Science Solutions (ESS) (Pty) Ltd were commissioned to undertake the specialist Agricultural Potential studies for the Township Development being considered for the Berg-en-dal site

Having discussed the project at some length and with the ToR at hand, it is our understanding that the area of interest being proposed for development requires that the agricultural potential is considered as part of the authorisations required in terms of the application for a township development.

Based on these facts, it was our opinion, that the proposed project be tackled using a phased approach, as this would allow for better project management, and costing of each subsequent phase based on the scientific findings of the previous phase if required.

The soils were classified according to South African Taxonomic System of Classification.

2. METHODOLOGY

2.1 Soils Investigation

The soils investigation involved the traversing of the area on a grid base using a conventional 1.5m-bucket auger to examine, classify and log the soil profiles. Selected geomorphological (terrain information, topography and any other infield data of significance) data was used in conjunction with the pedological investigation, and was recorded and stored in an electronic format (data base), and the information mapped on a recognised CAD system.

The identification and classification of the soil profiles will be carried out using the **South African Taxonomic Soil Classification System** (Mac Vicar *et al*, 2nd edition 1991).

In this way, standardised soil identification and communication is allowed by use of the names and numbers given to both Form and Family. The procedure adopted when classifying the soil auger profiles will be as follows:

I. Demarcate master horizon

II. Identify applicable diagnostic horizons by visually noting the physical properties such as:

- √Depth
- √Texture
- √Structure
- √Mottling
- √Visible pores
- √Concretions
- √Compaction

iii Determine from i. and ii. the appropriate Soil Form

iv Establishing provisionally the most likely Soil Family (pending the outcome of the laboratory tests)

Sampling of representative areas of the differing Soil Forms (PLU's) was carried out and submitted for analysis to a recognised agricultural laboratory.

Factors that considered in the laboratory included:

- Determination of the pH
- Exchangeable bases
- C.E.C. (cation exchange capacity) cmol +/kg
- Texture (% clay) and
- Nutrient status mg/kg
- Organic carbon content of topsoil
- General chemistry of the soils
- Specific analysis for nitrates and related chemistry associated with the effluent sprayed onto the pastures

The methods employed in the determination of the above variables are:

- The Spectro Atomic Analyser for the determination of the basic elements
- The titration method for the determination of Organic Carbon contents, and
- The use of a density meter for the determination of the clay contents.

The reconnaissance survey was carried out on a grid base.

2.2 Land Capability Plan

Data Collection

The land capability of the study area was classified into four classes (wetland, arable land, grazing land and conservation) based on a combination of the Department of Agriculture Guidelines, and the internationally recognised CLI (Canadian Land Inventory) methodology. The land capability is based on the soils mapped and the geomorphology (climate, terrain, aspect etc) of the site.

The modified criteria for this classification are set out in Table 2.2.1.

Table 2.2.1: Criteria for pre-mining land capability (Chamber of Mines 1991)

Criteria for Wetland – Should not be used under any circumstance

- ***Land with organic soils or supporting hygrophilous vegetation where soil and vegetation processes are water determined.***

Criteria for Arable/Productive land with no limitations

- ***Land, which does not qualify as a wetland.***
- ***The soil is readily permeable to a depth of 750 mm.***
- ***The soil has a pH value of between 4.0 and 8.4.***
- ***The soil has a low salinity and SAR***
- ***The soil has less than 10% (by volume) rocks or pedocrete fragments larger than 100 mm in the upper 750 mm.***
- ***Has a slope (in %) and erodibility factor (K) such that their product is <2.0***
- ***Occurs under a climate of crop yields that are at least equal to the current national average for these crops.***

Criteria for Grazing land or Productive land that require special conservation practices

- ***Land, which does not qualify as wetland or arable land.***
- ***Has soil, or soil-like material, permeable to roots of native plants, that is more than 250 mm thick and contains less than 50 % by volume of rocks or pedocrete fragments larger than 100 mm.***
- ***Supports, or is capable of supporting, a stand of native or introduced grass species, or other forage plants utilisable by domesticated livestock or game animals on a commercial basis.***

Criteria for Conservation land that requires special management if it is to be utilized for any practice

- ***Land, which does not qualify as wetland, arable land or grazing land.***

In addition to the land capability rating, the soils were rated according to their ability to be irrigated, or "their irrigatability" was assessed. The irrigation potential of a soil and its capability, combined with the NDA system of soil evaluation has been used to obtain a soil suitability code for the site.

Ideally, soils used for economic agricultural production under irrigation should satisfy the following requirements:

- Moderate uniformity
- Good rooting depth (>500mm)
- Low rockiness hazard (<20%)
- Moderate permeability
- Good supply of available moisture (T.A.M.C. >70mm/m)
- Satisfactory aeration and infiltration rates (>8mm/hr)
- Moderate resistance to erosion
- Salinity and exchangeable sodium levels should be less than 200 milli-Siemens per meter (mS/m) and 2 milli-equivalents per hundred grams (me/100g).

Applying these criteria where possible to the soils that were mapped, a scale of irrigation suitability based on the limitations of the above factors has been defined for the varying soil groups, thus assisting in the determination of the agricultural potential of the soils. The system used is shown Table 2.2.2 below.

Table 2.2.2: Suitability Ratings

Suitability Unit	Rating No.	Soil depth & Soil Forms	Degree of Limitation	Management Needs
AO; BO	Very good (1)	>10Hu, Cv, Gf	None	Very good irrigation
BO; A1; B3:4	Good (2)	>8Hu, Cv, Sd, Gf, Oa	Slight Moist Limit Slight Erosion Hazard.	Good Irrigation Soils Good Conservation
A2; B1, B2; B3:4; CO:2	Moderate (3)	>6Hu, Cv, Gf, Oa, Sd, Pn, Va, Se	Moderate depth Low T.A.M.C. Erosion Hazard = Moderate	Irrigation. Small amounts of water more frequent
C2: D1x1: D1x:4, D2;3	Poor (4)	<600 but >400mm of any soil form	Severe, depth erosion, with signs of wetness	Not good. Unsuitable to Irrigation Dryland Pastures
D2; C1 x D3: 4E	Unsuitable (5)	All wet and very shallow soils	Very severe depth limit, wetness and erosion	Dryland Pastures Not Recommended for Irrigation

Highlighted area = excluded from irrigation development

Suitability Grades

A - Excellent	0 - No major limitations
B – Good	1 - Slight salinity or water logging hazard
C – Fair	1x - Marked salinity or water logging
D – Poor	2 - Shallow soil depth
E - Unsuitable	3 - Surface capping / rusting
	4 - Severe erosion hazard

The ratings vary from very good to unsuitable as the degree of limitation progressively becomes more severe.

3. DESCRIPTION OF THE AREA

3.1 Locality – Physiography

The proposed Bergendal Township Development Project is situated approximately four kilometres outside the country town of Belfast, a small agricultural and forestry support centre on the Mpumalanga Highveld. The proposed development is (Bergendal Township Development) is approximately 29ha in extent and covers an area to the south of the N4 highway that connects Johannesburg with the Mozambique boarder.

The study area comprises moderately flat to undulating terrain, with ensized and open drainage lines for the most part and a southerly aspect. The area of interest hosts a number of sensitive and in places highly sensitive sites, with both shallow soils and wetness aspects that will need to be considered if development is to be undertaken on this area.

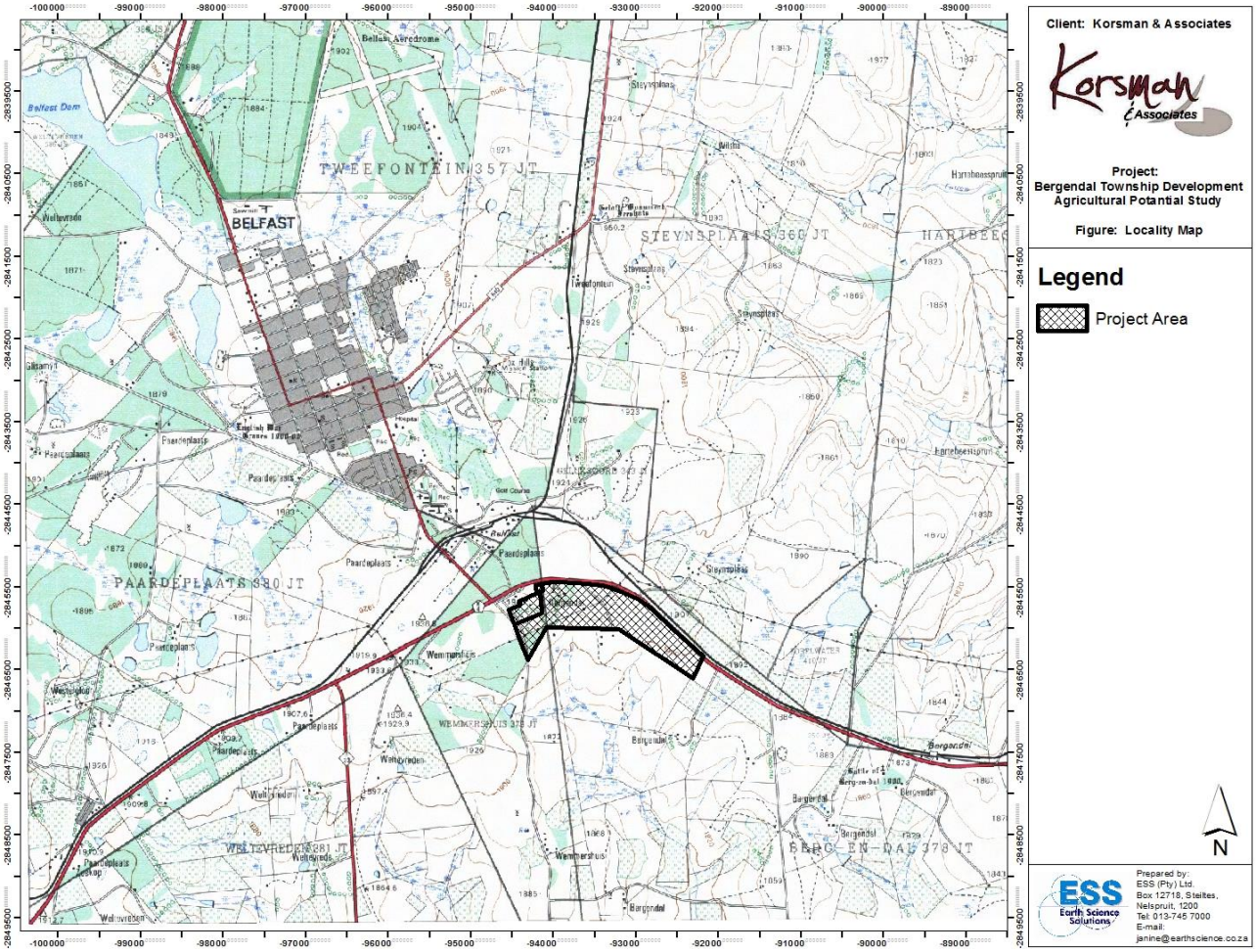


Figure 3.1.1: Locality Map

3.2 Existing Land Use Pattern

The area has historically been used for dryland grazing with a significant portion of the western portion of the study area having been rented to contractors associated with either power generation or light industry.

4. DESCRIPTION OF THE SOIL PROPERTIES

4.1 General

The study returned varying results for the soil and geomorphology of the site, with both physical and chemical variations across the site. The soil depths vary from a few millimetres (<100mm) to rocky areas of dolomite outcrop, to moderately sandy and sandy clay loams with depths of between 600mm and 800mm. The soils are intricately related to the parent materials from which they are derived, and by their relative position in the topography.

In terms of the Agricultural Potential Rating (Refer to Table 4.1) approximately 59.28ha or 51.54% of the study area rates as moderate agricultural potential land (C2, D1x1) with a moderate to poor quality grazing land capability, while 21.17% or 24.35ha is considered to have a poor Agricultural Potential Rating (D2) and wilderness land capability rating. Approximately 13.64% or 15.69ha is underlain by wet based soils, areas considered to be Unsuitable (D2, D3 and E4) and/or of a wetland land capability (refer to Table 4.1a and 2.2.2 for details).

Table 4.1a – Land Capability Rating

Soil_code	Land_Cap	Dom_soil	Sensitivit	Suitability Unit	Agri_Pot	Area (ha)	% Area
8-10 Cv	Arable	Moderately deep	Non sensitive	B1, B2	Moderate Arable	4.13	3.59
4-6 Cv	Grazing	Shallow sacllm	Moderately sensitive	C2, D1x1	Moderate Grazing	59.28	51.54
2 Ms/Gs	Wilderness	Shallow rocky	Sensitive	D2	Poor	20.22	17.58
2-4 Dr/Gc	Wet Based	Wet Based cllm	Highly sensitive	D2, D3	Unsuitable	15.69	13.64
Dam	Dam	Dam	Man Made	Man Made	Man made	1.82	1.58
Wb	Man Made	Man made	Man Made	Man Made	Man made	13.87	12.06
						115.01	

4.2 Soil Descriptions

In the course of the soil survey a number of differing soil forms were mapped (Refer to Table 4.1b). These included:

Clovelly (Cv), Hutton (Hu), Shortlands (Sd), Valsrivier (Va), Glencoe (Gc), Dresden (Dr) and Glenrosa (Gs), so well as the more hydromorphic Forms, namely **Avalon (Av)**, and **Sepane(Se).**

The distribution of the dominant soils mapped/classified is shown graphically below in Figure 4.2, with the Land Capability and Agricultural Potential/Suitability depicted in Figure 5.2 and 5.3 respectively.

The dominant soil mapped and classified have been described below in more detail, with consideration of the soil physical and chemical properties and the overall geomorphology (climate, topography, ground roughness and geology) being included in better understanding the agricultural potential and spatial distribution across the area of study.

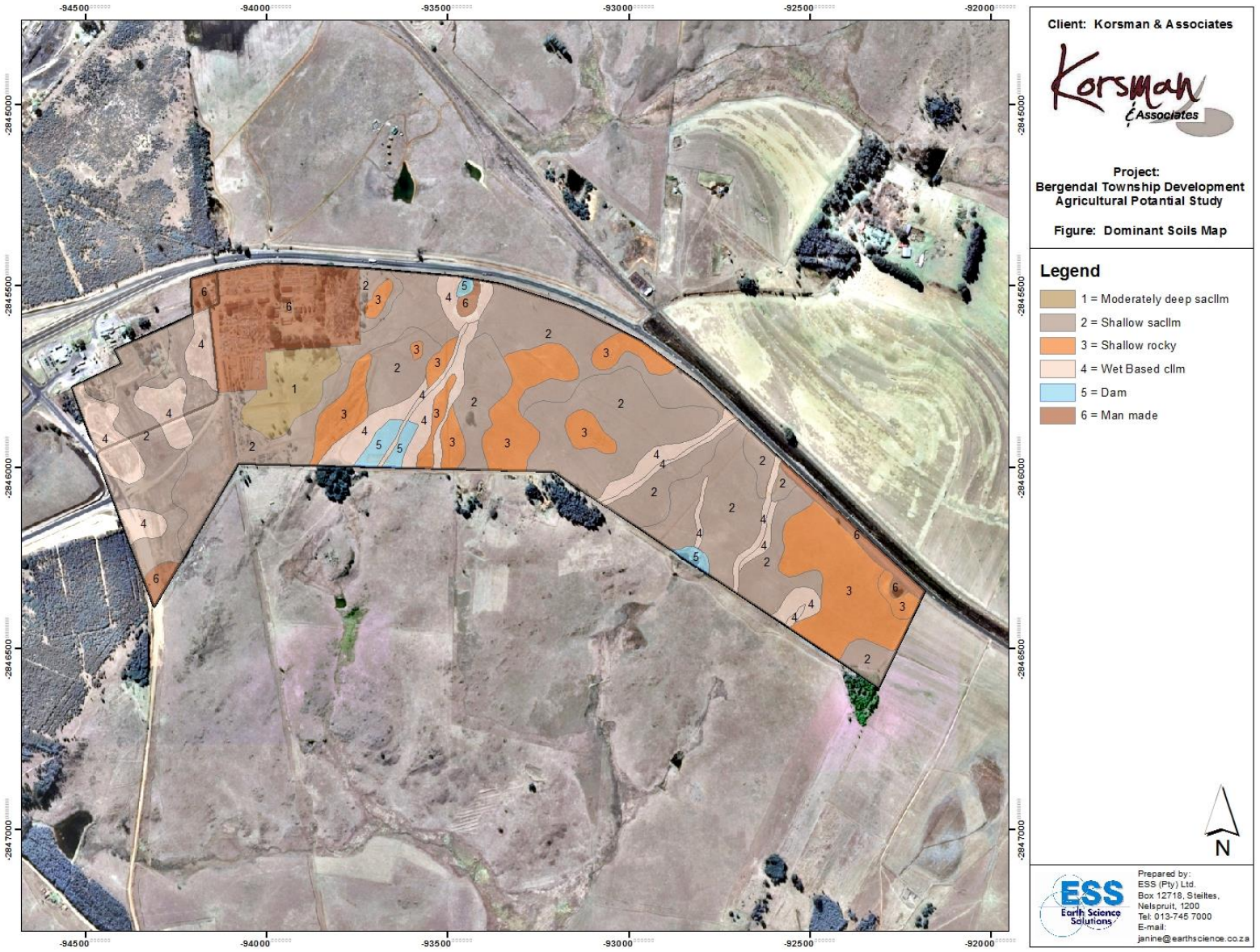


Figure 4.3.2.1 Dominant Soil Map

Clovelly (Cv) and Hutton (Hu)

The Clovelly and Hutton soil Forms returned results that have an average rooting depth (ERD) of between 400mm and 800mm on average, generally have a fine to medium grained texture and sand fraction, and in the majority of cases mapped they exhibit structure that is apedal to weak crumby.

These soils are generally confined to the middle and lower-mid slope positions adjacent to and up slope of the Avalon and Pinedene Forms.

The physical characteristics of these soils are fairly well drained. Overall they returned moderate to high intake rates (10 to 13mm/hr), coupled with moderate to low TAM. (ranging from 36mm/m on the shallower sandy soils to over 95mm/m on the heavier deeper soils), moderate to high internal drainage and moderate to high compactability. With these characteristics the soils can be described as fair on the irrigation suitability rating (I.S.R.) scale namely C-2 and are of the better agricultural soils mapped in the area. Erosion is generally not a problem, but needs to be monitored with respect to the relief of the site, with a significant increase in the erosion index if the vegetative cover is disturbed or removed.

Chemically, these soils returned lower than average amounts of the essential nutrients needed for adequate growth regimes, albeit that the Ca/Mg ratio is good, and the levels of Zinc (Zn), iron (Fe) and Aluminium (Al) are adequate. The pH readings of between 4.0 and 4.8 render these soils acid in character.

RECOMMENDATION: Suitable for some agricultural development if sufficient water was made available. Good irrigation/water management would be needed if these lands were to be considered for irrigated pastures or economic cropping. The depth of rooting is considered moderate to poor in terms of commercial agricultural, with grazing or the production of grass feed being the preferred option.

Shortlands (Sd) and Valsrivier (Va)

The Shortlands and Valsrivier Forms mapped can be divided into two sub-categories, based on their colour and degree of structure. Those with a predominantly red colour (Shortlands) are on average less structured and can be grouped with the Hutton Form with regards to their land capability, irrigation potential and general workability.

In contrast, the more brown Valsrivier Form has a stronger structure verging on strong blocky, and is more closely aligned to the Swartland Form soils in character.

Chemically, both soil families are similar, returning moderate to good levels of most nutrients (Ca, Mg and K) and more than adequate reserves of Iron (Fe), Aluminum (Al) and Zinc (Zn). The brown Valsrivier returning higher levels of Sodium (Na) (in the updated areas), resulting in a greater potential for salinity/sodicity problems.

Structurally the brown Valsrivier forms are more difficult to work, and they are generally shallower (400-600mm).

These soils (Shortlands and Valsrivier) are often associated with the dolerite derived parent materials.

Better than average management of both erosion as well as compaction will be needed to retain the agricultural potential of these soils.

RECOMMENDATION: Moderate to poor agricultural suitability, and then only for selective crops and/or grass production if sufficient water is available. Better than average water management would be needed if these lands are to be considered for agricultural development as the structure and availability of soil water is restrictive. In addition, these soils are considered sensitive to erosion, particularly if the vegetative cover is removed and/or the topsoil's are disturbed.

Glenrosa (Gs) and Mispah (Ms)

The Glenrosa and Mispah soil Forms returned effective rooting depths (ERD) of between 100mm and 400mm. The major hazards encountered with these soil types is erosion and loss of the eco system services due to the shallow ERD and poor vegetative cover, the rockiness of some of the areas.

A layer of trash or grass should be left covering the surface and the minimum tillage system should be employed if these soils are to be cultivated. Tillage constraints are moderate due to machine wear and subsurface hindrance (rocks etc. in the profile).

Geophysical, the soils returned moderate clay percentages (15 28%), moderate intake rates (6 to 10mm/hr), low available moisture holding capacities (<40mm/m) and better than average drainage.

RECOMMENDATION: Unsuitable for any commercial agriculture due to the shallow and/or varying soil depth.

Avalon (Av) and Sepane (Se)

The Avalon and Sepane soil Forms are associated with the lower lying areas and midslope seeps that are often associated with the local geological formation (dolerite dykes etc.), and where vertical flow has been impeded.

These soils returned moderate to poor intake rates (4 to 8mm/hr), have a lower than average moisture holding capability, are generally moderate to poorly drained, especially in lower horizons and are prone to erosion on the steeper slopes.

On average, these soils tend to be low in available nutrients and may show signs of aluminium toxicity.

RECOMMENDATION: Poor to Unsuitable Agricultural Potential Lands.

Cultivation for dryland crop production. Under irrigation these soils become wetter for prolonged periods resulting in waterlogged conditions.

Glencoe (Gc) and Dresden (Dr)

The Glencoe and Dresden (Dr) soil Forms are associated with the more iron rich lithologies and sites with impaired drainage, the underlying ferruginous/hard pan ferricrete layer forming a barrier to the vertical movement of soil water.

These soils are considered sensitive to disturbance, with the storage of soil water within the vadose zone considered a positive contributor to the biodiversity and ecological functioning of the environment.

These soils are often associate with historical land surfaces in the region, particularly where they are derived from horizontally bedded sediments.

These soils returned poor to very poor intake rates (2 to 4mm/hr), have a low available moisture holding capability, are low in available nutrients and are considered sensitive to the removal of vegetative cover and topsoil disturbance with resultant increases in the erosion index if they are not well managed. These soil forms classify as "transitional" soils under the wetland delineation system.

Detailed sampling is recommended if they are to be planted and a high degree of irrigation management would be needed if they are to be considered for irrigated cropping.

RECOMMENDATION: Poor to Unsuitable Agricultural Potential Lands.

Cultivation for dryland grazing at best. Under irrigation these soils become wetter for prolonged periods, increase the level of the groundwater table, resulting in waterlogged conditions. These are of the more sensitive materials mapped and are considered of the poorer agricultural soils mapped.

Table 4.2.1: Analytical Results – Soils

Soil Standard Analysis

Sample No	Block	pH (Water)	Res (ohms)	Ca (mg/kg)	Mg (mg/kg)	K (mg/kg)	Na (mg/kg)	P (Bray1)	Al (mg/kg)	Ca/Mg	Ca+Mg/K	CEC cmol(-)/kg
3164	B27	4.15	3700	101	31	32	2	5.4	110	3.26	4.13	2.07
3165	B38	5.17	3900	272	90	25	3	3	26	3.02	14.48	2.46
3166	B14	4.96	2400	161	33	30	5	4.5	142	4.88	6.47	2.75
3167	B12	4.99	4000	135	41	54	3	4.1	68	3.29	3.26	1.92

Micro-Elements and Physical Analysis

Sample No	Block	Zn (mg/kg)	Fe (mg/kg)	C %	Org Mat %	Sand %	Silt %	Clay %
3164	B27	0.18	99.2	1.73	2.97	84	5	11
3165	B38	0.34	47.8	2.3	3.96	74	9	17
3166	B14	1.26	622.5	3.74	6.44	86	3	11
3167	B12	0.33	78.9	1.51	2.6	74	5	21

4.3 Total Available Moisture Capability (T.A.M.C.)

The survey and the resulting T.A.M.C.'s as measured, are confined to selected auger sites, while the chemistry has been assessed based on a suite of composite samples representative of the most dominant soils in the study area.

Table 4.3.1: Total Available Water Capacity for soil samples analysed

Soil Name	Soil Code	Soil Depth (mm)	Water Holding capability (mm/m)	ERD (m)	% Intake	Agricultural Suitability Rating	Irrigation Suitability	ISR
Avalon	Av	400~600	58	0.6	80	Moderate	Fair / Good	C-2
Clovelly	Cv	200~400	42	0.4	40	Moderate to Poor	Poor	C-2
Clovelly	Cv	400~600	48	0.6	60	Moderate	Fair	B-2
Glencoe	Gc	200~400	40	0.4	40	Moderate to Poor	Poor	C-2
Glencoe	Gc	200~400	42	0.4	40	Moderate to Poor	Fair	C-2
Glencoe/Clovelly	Gc/Cv	400~600	54	0.6	65	Moderate to Poor	Fair	C-2
Glenrosa	Gs	200~400	38	0.4	50	Poor/Unsuitable	Fair	C-2
Glenrosa/Clovelly	Gs/Cv	200~400	36	0.4	65	Moderate to Poor	Fair	C-2
Sepane	Se	200~400	60	0.4	45	Poor/Unsuitable	Poor	E1x
Mispah	Ms	0~200	32	0.2	50	Unsuitable	Poor	E1x
Hutton	Hu	500~700	64	0.7	90	Good	Fair	B2
TOTAL								

I.S.R. Explanation

A	Very high potential, well suited to irrigation	**0**	No major limitations
B	Generally well suited with high potential under irrigation	**1**	Slight salinity of water
C	Not as well suited owing to soil depth, drainage limitations – have a fair to moderate potential under drip irrigation.	**2**	Shallow soil depth
D	Generally not recommended, as soil limitations such as depth, drainage and or moisture retention may be severe – exceptionally good management is required if to be planted.	**3**	Surface crusting/capping
E	Should be avoided completely.	**4**	Severe erosion hazard

5. INTERPRETATION OF THE SOILS DATA FOR AGRICULTURAL POTENTIAL/SUITABILITY

5.1 Need for Interpretation

The foregoing chapters have focussed on aspects such as soil survey procedure, soil classification and mapping, and a general description of soils in the area. A survey however, is more than just an exercise in fieldwork. To be beneficial, soil data has to be interpreted and translated into management terms.

Any estate manager needs to know what the important soil limitations are, as well as their degree of severity and how they will influence land use decisions, irrigation control, planting and irrigation practices, drainage etc.

A large number of interpretations are possible, since there are many different soils with widely varying limitations and with alternative uses. In addition, it has become imperative that the lands capability is well understood before any development is considered for an area, and a change of land use is considered.

In this investigation, the agricultural potential was considered as the focus for the study in determining the usability of the land. Using the agricultural/irrigation potential or I.S.R. (Irrigation Suitability Rating) as an easily measured management variable, an agricultural potential for the land was established. In determining the agricultural potential, the site has been rated on criteria such as unrestricted rooting depth (at least 500mm), a good supply of available water in the rooting zone (at least 700mm), satisfactory aeration and infiltration rate, no extremes of texture, low rockiness content and low levels of sodicity and salinity.

Reference has been made to these criteria in a previous section, and a five point scale of land use suitability for rating the agricultural/irrigation potential of soils was defined and presented in Table 2.2.2.

5.2 Proposed Land Capability Classes

5.2.1 Highly Productive Class (Arable)

This category comprises the deep (greater than 800mm), freely drained red and brown sandy soils with relatively low stone/gravel concentrations, low erosion and salinity hazards, and are characterised by very favourable water retention properties (T.A.M.C. ranging from 100mm to 190mm).

The combined influence of these properties ensures that typically these soils are well suited to dry land cropping, as well as overhead or micro irrigation systems, and a wide range of crops may be grown profitably. It is particularly evident from field observations of crop vigour in related areas that growth is at least that of the national average for crops grown, and this is not only because of favourable depth and drainage but also because of a moderately high level of fertility, coupled with slight acidity (pH range 4.0 to 6.0). Of the other crops, high quality grasses and animal feeds as well as most intensive market gardening will perform well on these soils, requiring slightly greater clay percentages to meet with ideal conditions. However, because of the moderate to high T.A.M.C. values and favourable infiltration rates for these soil forms, extended irrigation cycles with higher application rates could be practised

CONCLUSIONS: The site has no area that could potentially rate in this category.

5.2.2 Moderately Productive Class (Arable - Dryland Feeds/Grazing)

Included in this category are the intermediate depth (600-800mm), red-brown loams of the Hutton Form and yellow brown loams of the Clovelly Form. They have a similar irrigation potential rating as the more productive group of soils. It is however recommended that for irrigation control purposes, an average T.A.M.C. value of 700mm be used for both the red and yellow/brown soils.

Infiltration may also be somewhat restricted in the lower lying areas.

A better than average degree of management input will be needed to avoid over irrigation, and smaller amounts of water will have to be applied more frequently if agricultural development was to be considered.

The main limitations to these soils are,

- variable depth;
- erodibility on the sandy loams;
- only moderate T.A.M.C.'s and
- marginal levels of most nutrients.

Only limited areas of this class are noted on the area of study.

CONCLUSIONS: Commercial grasslands (dryland or irrigated) market gardening and some selective cultivars of tree crops.

5.2.3 Marginal Productive Class (Natural Grassland - Grazing)

Potential growth limitations in these soils tend to be moderate to severe, and vary depending on soil depth, excessive permeability in the lighter textured soils, limiting rooting due to structure and possibly chemical hindrances or excessive moisture and topographical limits.

The majority of the site is considered to fall into this class.

These soils require irrigation management of the highest order with emphasis on frequent light applications of water if they are to be considered for any form of commercial agriculture. Poor irrigation control (e.g. over-irrigation) will result in the occurrence of waterlogging on lower slopes. The passage of excess water through the underlying weathering horizons will also promote the solution of salts leading to possible brack development in lower slope positions. Surface hardening or capping may also be a problem on these soils.

Other problems, which render these soils as marginal include the inherently low macro- and micro-nutrient supply characteristics, de-nitrification problems and the leaching hazard in the shallower soils. These soils will respond to the use of higher rates of nitrogen and potassium fertilisers, applied preferably in split application.

This group of soils are also more prone to erosion and have a high erosion index, particularly where the vegetative cover is removed (development) and if the topsoil is exposed and disturbed.

Despite these limitations it is considered that vegetables and good quality animal feeds and grazing may be profitably produced under high quality management.

CONCLUSIONS: Mainly cultivation of animal feeds and vegetables.

5.2.4 Poorly productive class (Wilderness) and Unsuitable areas (Wet Based)

A significant proportion of the study area falls within this class of land capability rating, with various depth limiting materials from saprolite and ferricrete to wetness hazards. This group comprises Land Use Units ranging from very shallow (less than 400mm), and in places rocky soils of the Mispah and Glenrosa forms (Lithosols with very poor T.A.M.C. values under 500mm), to very poorly drained soils in the wetlands areas. Erosion is considered an issue that will need to be actively managed, and no development should be considered on these areas without additional in-depth investigations being undertaken.

CONCLUSIONS: These soils are definitely not recommended for the production of any agricultural crop and should be left undeveloped and noted as areas that will need to be conservation or controlled under strict conservation measures (wetlands).

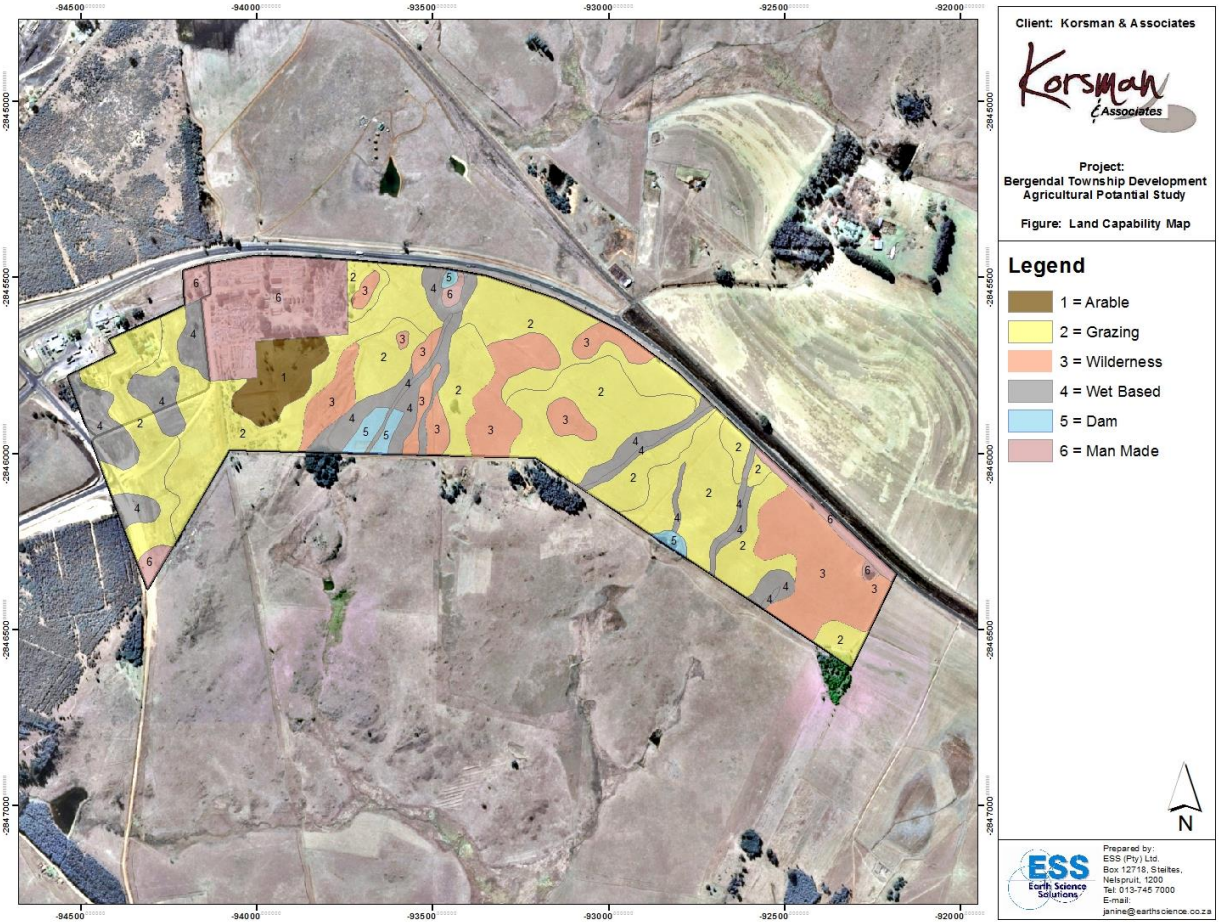


Figure 5.2 – Land Capability Map

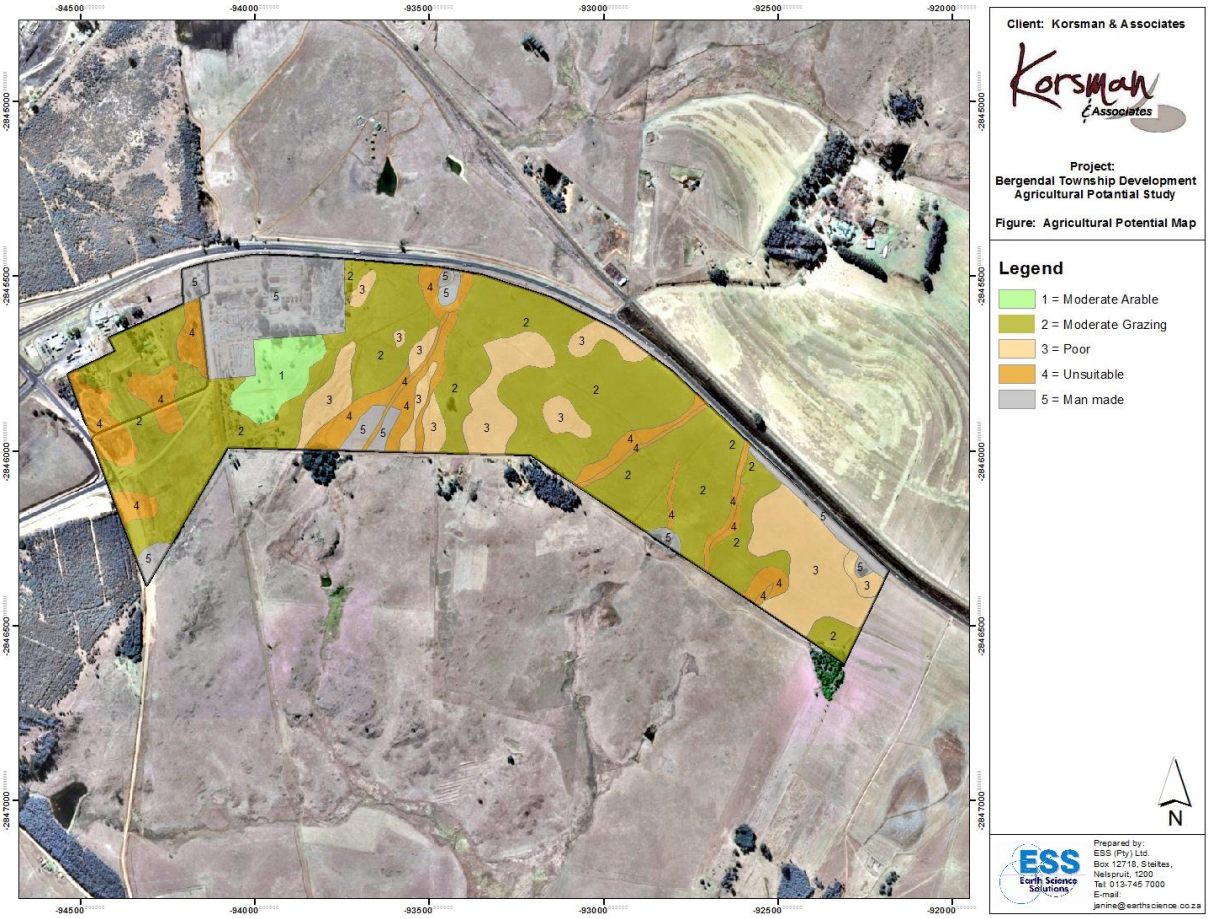


Figure 4.3.2 – Agricultural Potential Map

6. CONCLUSIONS

The Bergendal Project is considered to be an important economic initiative for the area, whether it is developed to agriculture, residential or industrial usage.

Based on this study, it is noted that sites with an agricultural potential greater than “moderate” are not present in this study area and thus the area is not economically viable for the production of anything other than low intensity grazing, and there is good evidence to believe that an economically successful agricultural development would not be a viable under dryland cultivation.

In conclusion it is noted that:

- There are very limited areas (<4ha) of good productive soils (physical and chemical) that render the site of good agricultural production under dryland conditions.
- Approximately 51ha or 44% of the area is considered to be poor or unsuitable for agricultural production of any sort and should be left to conservation (conservation) or as wetland status as applicable.
- Only 59ha or 51% of the study area is considered to be of a land capability rating of “moderate grazing” potential that could be cropped to grasses for animal food production, while a mere 4ha or 3,6% is of a quality that could potentially be used for “moderate arable” production.

This rule-of-thumb sequence should only be used as a guideline and is subject to the relative economic merits of the different cropping systems with respect to the limited size of the area.

- Soil salinity/sodicity is considered a potential problem. It is recommended that selected sites proven to have restricted drainage be monitored on a regular basis, particularly on the grey/pale and darker clay rich soils if they are to be developed.

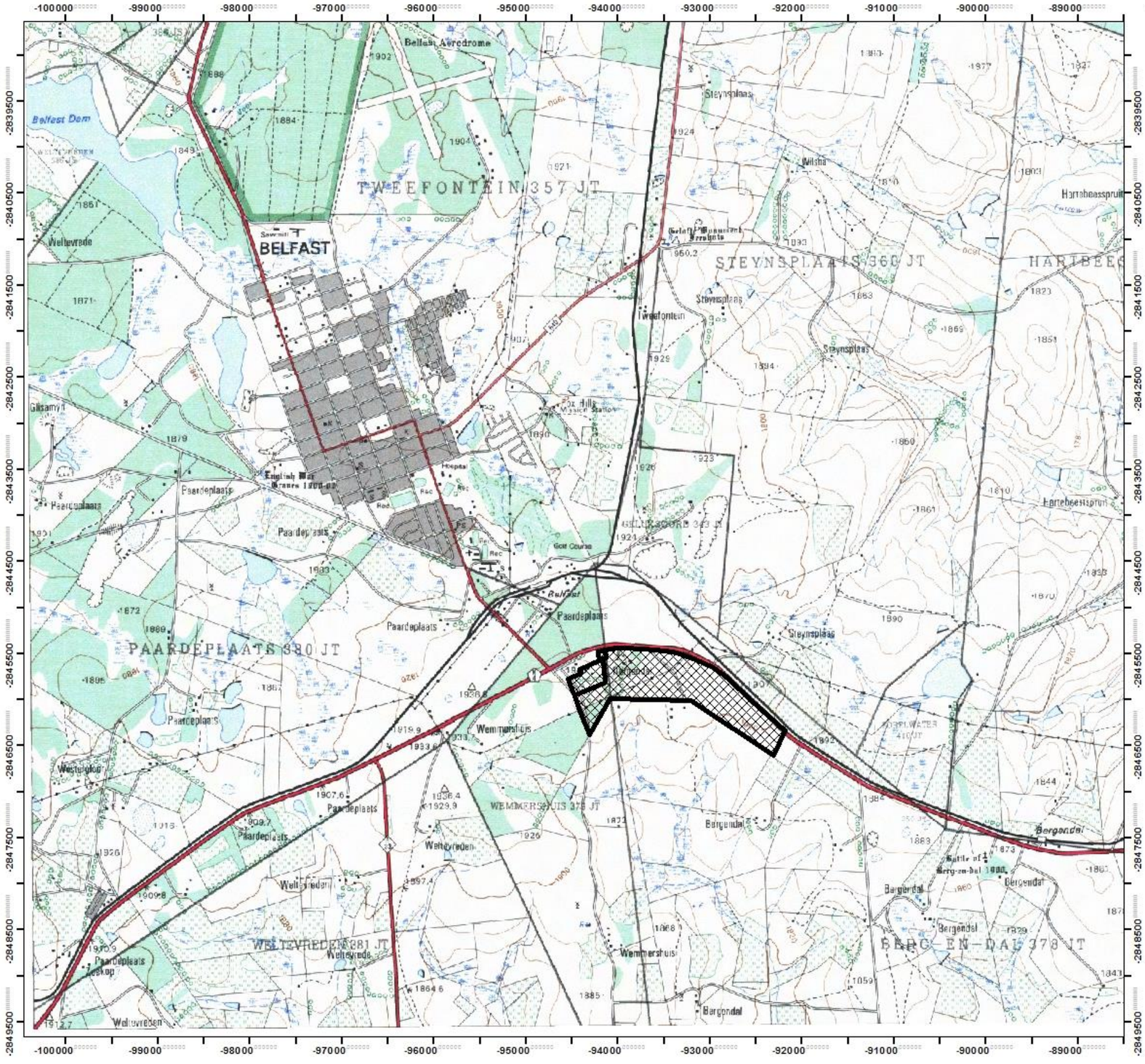
All sensitive and/or hazardous soils must be excluded as far as possible from the development planning.

Apart from the value of this survey for planning future development, it also provides an opportunity for a better understanding of the soils and their economic potential in the developed areas.

These results recorded are based on a reconnaissance survey and an understanding of the complex inter-relationships involved. ESS (Pty) Ltd reserve the right to modify the recommendations if and when new evidence may become available from on going research, and no guarantees are provided either explicitly or by implication.

APPENDIX A

Maps (A3 size)



Client: Korsman & Associates

Korsman & Associates

Project:
Bergendal Township Development
Agricultural Potantial Study

Figure: Locality Map

Legend

Project Area

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Figure: Agricultural Potential Map

Legend

- 1 = Moderate Arable
- 2 = Moderate Grazing
- 3 = Poor
- 4 = Unsuitable
- 5 = Man made

N

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Figure: Dominant Soils Map

Legend

- 1 = Moderately deep sacllm
- 2 = Shallow sacllm
- 3 = Shallow rocky
- 4 = Wet Based cllm
- 5 = Dam
- 6 = Man made

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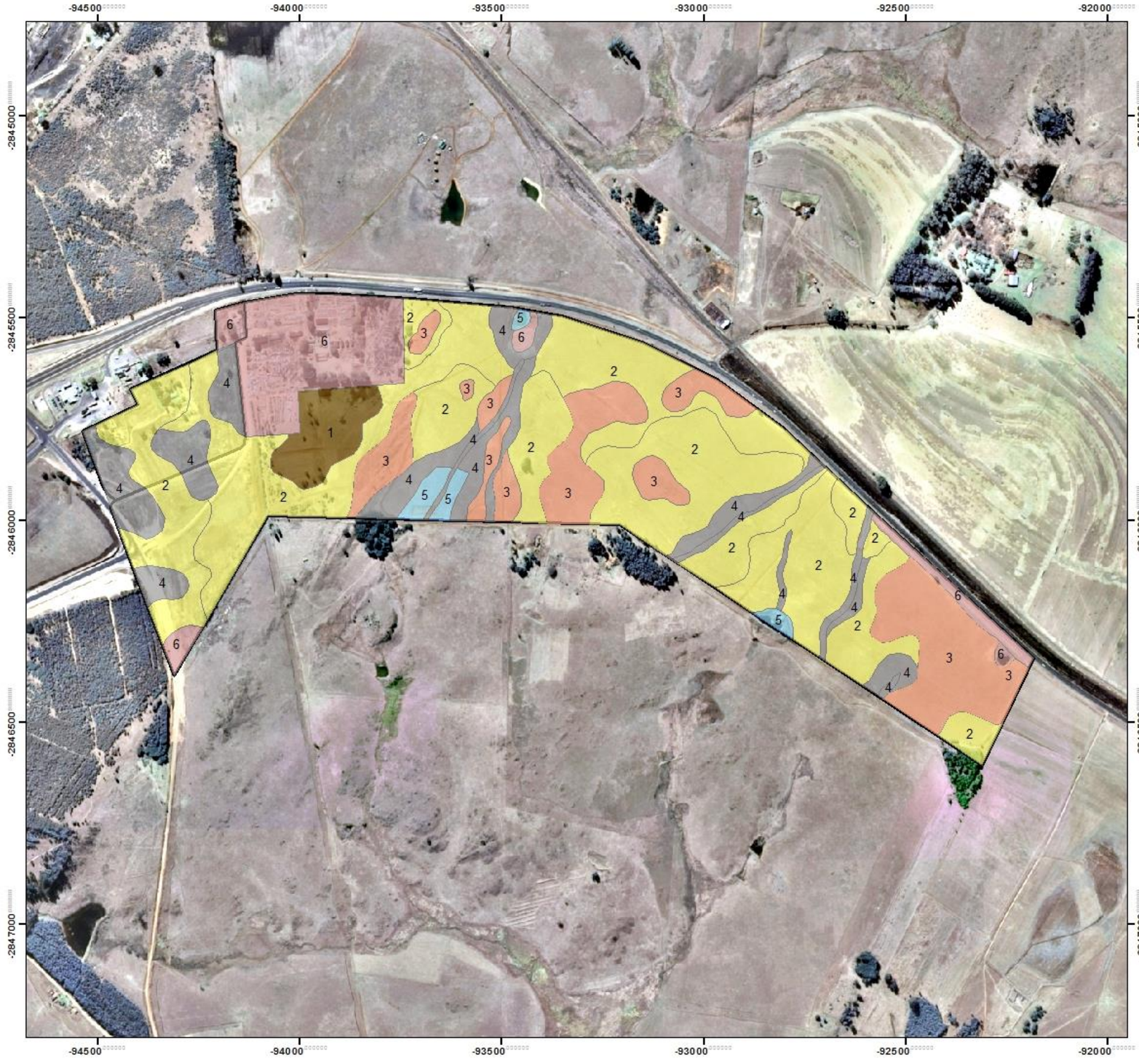

Client: Korsman & Associates

Project:
Bergendal Township Development
Agricultural Potantial Study

Figure: Land Capability Map

Legend

- 1 = Arable
- 2 = Grazing
- 3 = Wilderness
- 4 = Wet Based
- 5 = Dam
- 6 = Man Made

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