Appendix 6:

Soil and Agricultural specialist report

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Assessment of the impact of sand mining on agricultural potential on the Farm Woodlands no. 874

1 Introduction and brief

Johann Lanz was appointed to conduct a soil survey on Portion 2 of the farm Woodlands 874, south of Malmesbury. This assessment report uses data from the soil survey to determine sand depths for suitability of mining and rehabilitation, to determine agricultural potential, to assess the impact of mining on that potential, and to provide recommended mitigation measures and rehabilitation guidelines for all the identified impacts caused by mining.

The soil investigation was conducted on 26 May 2015. A total of 49 test pits were investigated (there is no number 35). Data from the test pits is provided in Appendix 1, and the positions of all test pits are shown in Figure 1. The farmer, who was present at the time of the field investigation, indicated that all the sand in the narrow western camp is shallow, and so test pits were not excavated in this camp.

2 Soils and agricultural potential

The geology of the site is Quaternary quartz sand of the Springfontein Formation, covering greywacke and phyllite of the Moorreesburg Formation, Malmesbury Group. The soils are generally deep sands overlying clay. They have a slightly darker topsoil horizon underlain by bleached light coloured or yellow sand, and are predominantly of the Fernwood soil form, as classified by the South African soil classification system. There is podzolisation in certain profiles. This gives a fairly dark brown horizon in the subsoil, and such soils are classified as Lamotte soil form. Where the clay is shallower, the soil form is classified as Kroonstad. The depth to the clay below surface is generaly 3 metres but is shallower in some places.

The soils are limited by the low clay content and leaching of the upper soil horizons and therefore have a low water and nutrient holding capacity. As a result they have a low to medium agricultural potential, and are rated as >3 - ≤5 out of 10 according to the system used by Western Cape soil scientists. The area is classified on Cape Farm Mapper as having a Dryland Potential Index of high and a land capability of Class III, moderate potential arable land. However the sandy soils of the specific site decrease its agricultural potential.

3 Agricultural land use

According to the 2013 crop census on Cape Farm Mapper, two of the camps within the proposed mining area (indicted with green boundaries in Figure 1) have been cultivated with planted pastures. The other two camps have been fallow for several years.

There is an old, open sand mining pit in the centre of the eastern camp, which is visible in Figure 1.

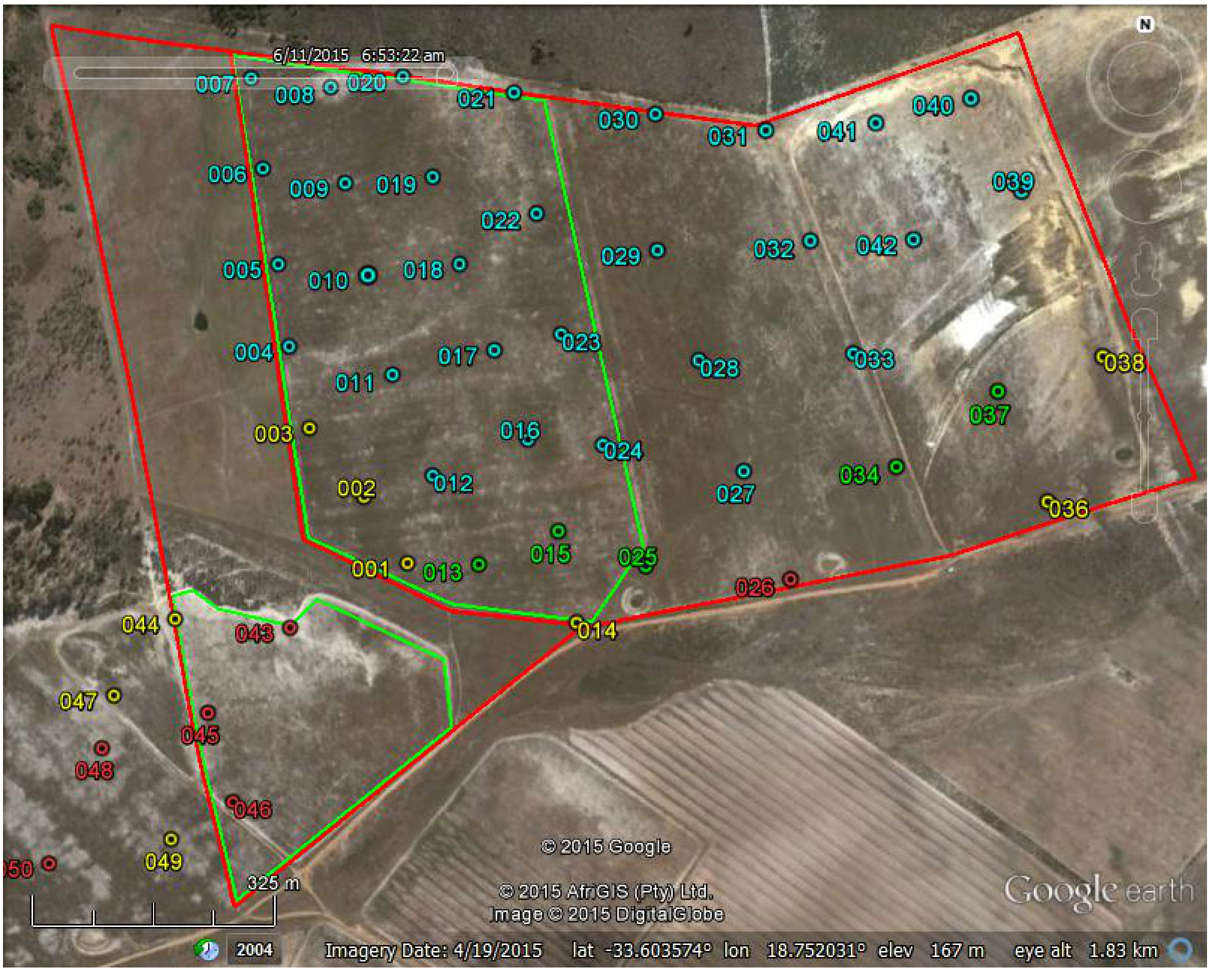

Figure 1. *Satellite image of the investigated area, showing all investigated test pits. Pits are colour coded according to total sand depth: Blue >250cm; Green 160-250cm; Yellow 100-150cm; Red <100cm. The outer red boundary was the proposed mining area. However based on available sand, the suitable area is confined to the inner red boundary.*

4 Identification and assessment of the impacts of mining on agricultural resources and production

Mining will change the existing soil profile through the removal of the E horizon. The impact of mining occurs by way of eight different identified mechanisms, listed below. All these mechanisms impact on the agricultural potential. For the purposes of this report, the overall impact, namely reduction in agricultural potential, as a result of the interaction of these different mechanisms, is assessed. The significance of the impact is influenced by the fact that the agricultural potential of the area is low to medium prior to disturbance. Each mechanism is discussed below. Details of mitigation measures are provided in the following section.

4.1 Loss of agricultural land for duration of mining

All mining areas will be lost to agricultural production for the duration of mining activity on them. Given the low to medium agricultural potential of the land and the fact that more than half of it is not currently utilized for agriculture, the significance of this impact is low.

4.2 Reduction in soil depth

Removal of sand from the soil profile will decrease the depth of suitable rooting material above a depth limiting cay layer in the sub soil. The retention of at least 50cm depth of rooting material (as recommended under mitigation) will mean that the loss of rooting depth is not significant to agricultural use.

4.3 Impaired soil drainage resulting in water logging in potential root zone

Reduction in the elevation of the surface above a water table, or the creation of surface depressions that are not free draining, has the potential to cause water logging in the potential root zone. The retention of at least 50cm depth of rooting material above the clay and ensuring that depressions are free draining (as recommended under mitigation) will keep this impact of low significance.

4.4 Loss of topsoil and of topsoil fertility during mining and stockpiling

Poor topsoil management during mining may result in the loss of topsoil for rehabilitation through burial or erosion from stockpiles. Also disturbance and dilution of topsoil can cause loss of fertility as a result of reduced organic carbon and biological activity. The natural topsoil has low natural fertility and therefore a reduction of this is of low significance for agricultural use.

4.5 Erosion of returned topsoil after rehabilitation

When topsoil is re-spread, on completion of mining, the newly rehabilitated land will be prone to erosion. Depending on the severity of erosion that may occur, the significance of this impact can vary.

4.6 The creation of uneven surfaces or steep slopes

Mining excavations can create an uneven surface or slopes that would prevent or hinder future cultivation. This can be completely mitigated with effective rehabilitation.

4.7 Alien vegetation encroachment

Soil disturbance is likely to result in alien vegetation encroachment after rehabilitation. This can be controlled with effective environmental management.

4.8 Soil contamination due to fuel spills

The presence of heavy machinery in the mining area may result in contamination from fuel spills. This can be prevented with effective environmental management.

5 Recommended mitigation and rehabilitation plan

The highest risk of rehabilitation failure is as a result of erosion of and / or loss of topsoil, both as a result of stripping and stockpiling, as well as after topsoil spreading. These aspects must therefore be well managed in order for rehabilitation to be successful.

1. The upper 50 cm of the soil must be stripped and stockpiled before mining. Mining can then be done down to the clay layer (or other depth limiting layer).

2. Topsoil is a valuable and essential resource for rehabilitation and it should therefore be managed carefully to conserve and maintain it throughout the stockpiling and rehabilitation processes.
3. Topsoil stripping, stockpiling and re-spreading must be done in a systematic way. The mining plan should be such that topsoil is stockpiled for the minimum possible time by rehabilitating different mining blocks progressively as the mining process continues.
4. Topsoil stockpiles should be protected against losses by water and wind erosion. The establishment of plants (weeds or a cover crop) on the stockpiles will help to prevent erosion.
5. To ensure minimum impact on drainage, it is important that no depressions are left in the mining floor. A surface slope (even if minimal) must be maintained across the mining floor in the drainage direction, so that all excavations are free draining.
6. Run-off water must be controlled via temporary banks during mining, where necessary on the slopes, to ensure that accumulation of run-off does not cause down-slope erosion.
7. After mining, any steep slopes at the edges of excavations, must be reduced to a minimum and profiled to blend with the surrounding topography.
8. The stockpiled topsoil must then be evenly spread over the entire mining area, so that there is a depth of 50cm of sandy topsoil above the underlying clay. The depth should be monitored during spreading to ensure that coverage is adequate and even.
9. Topsoil spreading should only be done at a time of year when vegetation cover can be established as quickly as possible afterwards, so that erosion of returned topsoil by both rain and wind, before vegetation is established, is minimised. The best time of year is at the end of the rainy season, when there is moisture in the soil for vegetation establishment and the risk of heavy rainfall events is minimal.
10. A cover crop must be planted and established immediately after spreading of topsoil, to stabilise the soil and protect it from erosion. The cover crop should be fertilized for optimum production. It is important that rehabilitation is taken up to the point of cover crop stabilisation. Rehabilitation cannot be considered to be complete until the first cover crop is well established.
11. The rehabilitated area must be monitored for erosion, and appropriately stabilised if any erosion occurs.
12. On-going alien vegetation control must keep the area free of alien vegetation after mining.

6 Conclusions

This assessment has found that there are adequate reserves of sand on site for mining and rehabilitation. Soils are sandy and the agricultural potential across the site is low to medium. Due to soil conditions, the land is fairly marginal for cultivation.

The potential impact of mining on the land is to reduce its agricultural potential by way of eight different identified mechanisms:

1. Loss of agricultural land for duration of mining
2. Reduction in soil depth
3. Impaired soil drainage
4. Loss of topsoil and fertility during mining and stockpiling
5. Erosion of returned topsoil after rehabilitation
6. The creation of steep slopes and uneven surfaces
7. Alien vegetation encroachment

8. Soil contamination from fuel spills

Mitigation measures and a rehabilitation plan are provided. With mitigation, the reduction in agricultural potential is assessed as having low significance. Without mitigation it is assessed as having medium significance. Mining of this site can proceed, subject to the recommended mitigation measures provided. If these measures are followed and effectively implemented, the agricultural potential of the land can be successfully rehabilitated to allow ongoing production.

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Appendix 1: Measured depths in all investigated test pits. The sequence of different layers within the test pits are as follows: 1 = light coloured sand; 2 = dark brown sand; 3 = distinctly yellow sand; 4 = light coloured sand; Tot = total sand depth; G = gravel.

Test pit no.	GPS Position Lat/Lon hddd.ddddd° WGS84		Thickness of different layers in cm					
	latitude	longitude	1	2	3	4	Tot	G
1	-33.6045060027	18.7492659688	120	0	0	0	120	0
2	-33.6037419923	18.7486329675	110	0	0	0	110	0
3	-33.6029420234	18.7478459906	150	0	0	0	150	0
4	-33.6019910127	18.7475470081	150	0	150	0	300	0
5	-33.6010369845	18.7473849859	150	0	150	0	300	0
6	-33.5999289807	18.7471600156	160	0	140	0	300	0
7	-33.5988870263	18.7469860073	110	60	0	130	300	0
8	-33.5989939794	18.7481139600	90	130	0	80	300	0
9	-33.6001019832	18.7483319733	150	70	0	80	300	0
10	-33.6011629645	18.7486720271	170	0	130	0	300	0
11	-33.6023159791	18.7490389869	70	0	230	0	300	0
12	-33.6034750286	18.7496139854	110	70	0	120	300	0
13	-33.6045019794	18.7502810173	180	0	0	0	180	0
14	-33.6051519960	18.7516569905	110	0	0	0	110	0
15	-33.6040940322	18.7513900269	240	0	0	0	240	0
16	-33.6030420195	18.7509440258	200	0	100	0	300	0
17	-33.6020230316	18.7504639942	100	80	0	120	300	0
18	-33.6010410078	18.7499640137	300	0	0	0	300	0
19	-33.6000330001	18.7495620176	0	130	0	170	300	0
20	-33.5988929775	18.7491340376	0	140	160	0	300	0
21	-33.5990779661	18.7506850250	0	300	0	0	300	0
22	-33.6004629917	18.7510209717	300	0	0	0	300	0
23	-33.6018249672	18.7513809744	300	0	0	0	300	0
24	-33.6030939873	18.7519839685	140	0	160	0	300	0
25	-33.6044810247	18.7526019663	180	0	0	0	180	0
26	-33.6045980360	18.7545869686	90	0	0	0	90	0
27	-33.6033689976	18.7539170031	300	0	0	0	300	0
28	-33.6021179985	18.7532740273	300	0	0	0	300	0
29	-33.6008710228	18.7526860368	300	0	0	0	300	0
30	-33.5993419960	18.7526250165	300	0	0	0	300	0
31	-33.5995439999	18.7541149836	0	0	300	0	300	0

Test pit no.	GPS Position Lat/Lon hddd.ddddd° WGS84		Thickness of different layers in cm					
	latitude	longitude	1	2	3	4	Tot	G
32	-33.6007749662	18.7547410280	0	0	300	0	300	0
33	-33.6020269711	18.7553550024	0	0	300	0	300	0
34	-33.6032929737	18.7559620198	200	0	0	0	200	0
36	-33.6036640406	18.7579350360	110	0	0	0	110	0
37	-33.6024380196	18.7572580297	160	0	0	0	160	0
38	-33.6020569783	18.7585559674	130	0	0	0	130	0
39	-33.6002500076	18.7574580219	0	0	300	0	300	0
40	-33.5992349591	18.7567719631	0	0	300	0	300	0
41	-33.5994870029	18.7555539887	0	0	300	0	300	0
42	-33.6007670034	18.7560959626	0	0	300	0	300	0
43	-33.6052870285	18.7476190086	80	0	0	0	80	80
44	-33.6052160338	18.7459670193	100	0	0	0	100	60
45	-33.6063050106	18.7464740407	80	0	0	0	80	0
46	-33.6073499825	18.7468399946	80	0	0	0	80	0
47	-33.6061210278	18.7451300025	100	0	0	0	100	0
48	-33.6067520175	18.7449549884	90	0	0	0	90	0
49	-33.6078200396	18.7459560391	130	0	0	0	130	0
50	-33.6081689782	18.7441589590	60	0	0	0	60	0

Note:

- The mine-able thickness of sand must subtract 50cm from the total sand thickness in order to leave 50cm of sand for rehabilitation.