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**STRATEGIC ENVIRONMENTAL
ASSESSMENT (SEA) TO INFORM THE
SITE SELECTION PROCESS AT
HARMONY GOLD MINES, WELKOM**

Report No: 8788/10160/12/E

Submitted to:

Harmony Gold Ltd
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03 July 2007

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EXECUTIVE SUMMARY

Harmony Gold Ltd (Harmony) is undertaking a pre-feasibility study to re-mine 56 of their existing tailings facilities in three regions located in Evander (Mpumalanga), Randfontein (Gauteng), and Welkom (Free State). The re-mining of these tailings dams presents an ideal opportunity to consolidate tailings facilities, spread across the three regions, into three Mega-Tailings Facilities (MTF). This SEA report focuses on the Welkom region, as part of an overarching pre-feasibility study, with the intended result being to guide site selection of the MTF

The Welkom site has 43 existing tailings dams being considered for potential re-mining. The size of the proposed footprint required to deposit the tailings generated during re-mining is approximately 10 km² (1,000ha) in extent. The strategic approach (SEA), to determine the site for the MTF, included an analysis of environmental, social and economic spatial data, complimented by the most recent and relevant contextual data sets. This resulted in preferential areas identified for consideration and ultimately the suggestion of four potential sites.

Site 1: Rietpan (farm Rietpan 17)

Site 2: St Helena (farm St Helena 42)

Site 3: Stuurmanspan (farm Stuurmanspan 92)

Site 4: La Riviera (farm La Riviera 289).

The available information was then used as a basis to evaluate these sites against predetermined and ranked objectives. Thereby ensuring that sustainability issues were highlighted, and considered during the site assessment. Where possible, those sites that contributed positively towards sustainability were identified. Conversely, where the sites may have potential adverse impacts, these were highlighted and used to inform the subsequent Environmental Impact Assessment (EIA) where mitigating measures to counter those impacts would be suggested.

Stuurmanspan (Site 3) was the preferred site for the MTF. It is a brownfield site, which has already been impacted by tailings facilities. Additionally there will be no resultant impact on agricultural productivity. Previously a drainage canal passed through this site, however this is now heavily impacted by mining and has resulted in polluted water ponding. The availability of this dirty water will support the tailings reprocessing, and may provide an opportunity to improve its quality through treatment and re-use. Information gathered during the site selection process will inform the EIA and highlight areas for consideration and mitigation. The other potential sites in order of preference were 4, 2 and finally 1.

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1 INTRODUCTION

Harmony Gold Ltd (Harmony) is undertaking a pre-feasibility study to re-mine 56 of their existing tailings facilities in three regions located in Evander (Mpumalanga), Randfontein (Gauteng), and Welkom (Free State). The estimated tonnage throughput of the tailings material intended to be reclaimed is estimated as:

- Randfontein: 420 million tonnes
- Evander: 420 million tonnes
- Welkom: 750 million tonnes.

The re-mining of the tailings dams presents an ideal opportunity to consolidate tailings facilities, spread across the three regions, into three Mega-Tailings Facilities (MTF). The process will facilitate better management of the tailings and allow for the implementation of tighter controls on environmental management, which are unlikely to have been taken into account during initial design. During the reprocessing of tailings, to extract gold, it may also be possible to extract other constituents such as cyanide and sulphides, thus reducing toxicity of the tailings materials. This SEA report focuses on the Welkom region, as part of an overarching pre-feasibility study, with the intended result being to guide site selection of the MTF

The Welkom region has 43 existing tailings dams being considered for potential re-mining resulting in a footprint of approximately 10km² (1 000ha) required to deposit the tailings generated during re-mining. The environmental authorisation process for the Welkom MTF was initiated in February 2007 and is firstly subject to the approval of the pre-feasibility study. Should the project proceed it would include the following phases:

- Pre-Feasibility and Site Identification Study (guided for the Welkom region by the SEA - this report)
- Scoping Phase – to identify issues and suggestions to focus the Environmental Impact Assessment (EIA) and inform the Environmental Management Programme (EMP)
- Impact Assessment Phase – detailed studies of both the positive and negative impacts of the proposed MTF
- Environmental Impact Report – development of the EIA/EMP Report
- Decision-Making Phase – the proponent uses the EIA/EMP findings to decide whether the project should go ahead.

1.1 Background

As part of the overarching pre-feasibility study a site selection process has been undertaken for Randfontein, Evander and Welkom. However, due to the number of tailings facilities to be reclaimed within Welkom, and following governmental guidance (Department of Minerals and Energy), a strategic approach to site selection was suggested for this site. It was decided that an Strategic Environmental Assessment (SEA) would be 'best practice' in that it provides a broad based approach to site selection, within a framework that considers the three pillars of sustainability; environment, society and economy.

This report outlines the findings of the SEA, resulting in site options for the proposed Welkom Mega Tailings Facility (MTF) and the ranking of these options based on best available information. The preparation of this report follows guidance issued by the Government on the implementation of the SEA (Strategic Environmental Assessment in South Africa, 2000, Guideline Document updated 2006). Although, not a pre-requisite for environmental authorisation this approach is seen as 'best practice' to facilitate decision making. In addition, the report dovetails with the Golder Sustainable Development Report which guides Harmony's suggested approach to sustainable development.

1.2 Purpose of this report

This report presents a site selection process, based on an SEA, used to inform the preferential site for the MTF. The strategic approach (SEA), included an analysis of environmental, social and economic spatial data, complimented by the most recent and relevant contextual data sets. This resulted in preferential areas identified for consideration and ultimately the suggestion of four potential sites.

The available information was then used as a basis to evaluate these sites against predetermined and ranked objectives. Thereby ensuring that sustainability issues were highlighted, and considered during the site assessment. Where possible, those sites that contribute positively towards sustainability have been identified. Conversely, where the sites may have potential adverse impacts, these have been highlighted and will be used to inform the subsequent Environmental Impact Assessment (EIA) where mitigating measures to counter those impacts will be suggested.

1.3 Structure of this report

The structure of this report is:

- **Section 2 - outlines the approach to site selection.**
- **Section 3 - summarises the key results of the assessment.**
- **Section 4 – a conclusion.**

2 APPROACH

The approach to the assessment process has been tailored to meet the specific needs of site selection for the Welkom MTF. The process needs to consider a number of aspects including; environmental, social and economic within a spatial context to minimise potentially adverse impacts upon receptors. Where possible locally relevant and sufficiently detailed information has been gathered to inform decision making. This was then supplemented through workshops and the active involvement of a Steering Committee (SC). A Steering Committee was established to guide the SEA process, encourage key stakeholder involvement and ensure decisions based on information gathered, were locally relevant. Participation was invited from government departments, designated consultation bodies and local organisations. The Steering Committee provided input at each of the main stages of the assessment process, including analysis of baseline data, identification of options and the options assessment. The Steering Committee included:

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Department of Minerals and Energy	Ms Jacqueline Mashamba Alistair le Grange Gibson Tshisikhawe
Free State Department of Tourism, Environment and Economic Affairs	Mr David Mofokeng
Industrial Development Corporation	Adrian Stone
Matjhabeng Local Municipality	Mr Koos Duvenhage Mr Fanie Niewoudt Mr George Manzini
Sedibeng Water	Mr Deon Dippenaar
Free State Farmer's Union	Mr Jaco Minnaar
Agri24: Welkom	Mr Lennert Long
Eskom	Mr Anton Coetzee Ernest Zulu
Chamber of Mines of South Africa	Mr Nikisi Lesufi
Chamber of Business: Goldfields	Mr I H Auret
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SEA consultants, Golder Associates Africa	Mr Nigel Beck Mr Pieter de Villiers Ms Mari Prinsloo

2.1 The Site Assessment Process

The Golder team undertook the assessment in a phased approach outlined below.

2.1.1 Background information review and objectives development

Relevant plans, programmes and policy documents were reviewed to aid the determination of the scope of the site assessment. A number of these documents, which were predominantly local, regional, and national, include baseline information which was assessed and reviewed (Appendix D).

The development of objectives, towards which sustainable development aspires, was a crucial step as they form the structure around which the potential MTF sites were assessed. Objectives covered themes within the categories; social, environmental and economic (Appendix A) and provide the context to focus information gathering of the various datasets that are necessary for informed site selection. Draft objectives were presented to the Steering Committee for comment and ranking. The comments made were noted and considered, and the feedback highlighted the 10 'key themes' with local relevance to Welkom (see Table 1).

Table 1: Key Themes (in order of importance)

Theme	Theme
1. Economic performance	6. Water quality
2. Agriculture	7. Climate change
3. Air quality	8. Waste and energy use
4. Water quantity	9. Poverty
5. Biodiversity – ecosystems	10. Living conditions

2.1.2 Collection of Baseline Data

The objectives were used to direct the collection of social, economic and environmental information necessary for the completion of the baseline assessment. This was supported by datasets identified from the review of plans and programmes (Appendix D). The information was presented in tabular format. Where information existed in a spatial form, a GIS approach in the presentation of that data was adopted. Despite significant effort, there were objectives where little or no information was available. These data gaps were identified.

A set of grey scale maps, using ENPAT, SANBI and NSBA datasets, were developed and used to preclude areas on the basis of a number of factors. Each new map, subsequently adding another shade of grey linked to a specific criterion, ultimately resulting in a map highlighting a swath of land (not in grey) upon which to focus the site selection exercise and the latter stages of the process (Appendix B).

The grey scale maps included the following criteria (each with the current tailings facilities marked):

1. Urban areas
2. Sand River
3. Sensitive geological areas (dolerites and andesites)
4. Areas with population density of over 200 people/km²
5. Inland water bodies
6. Fauna – flamingo habitats
7. Land cover.

These maps were presented within a workshop to the SC, which was asked to comment and provide greater insight and guidance. Where the SC felt that sites should be considered within the grey scale area, these were evaluated and included on merit. In completion of the baseline information gathering, the key sustainability issues facing the region were identified.

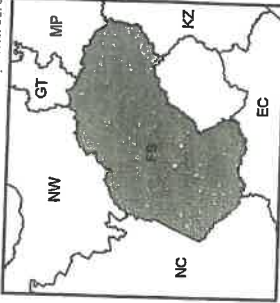
2.1.3 Collection and Analysis of Baseline Data for site options

Using information gathered during the first SC workshop (30th May 2007) and a more detailed review of reports and databases, a number of sites were assessed in greater detail. Baseline data around each site were gathered using aerial photos and the interrogation of available information in order to populate a table with detailed site specific information where possible.

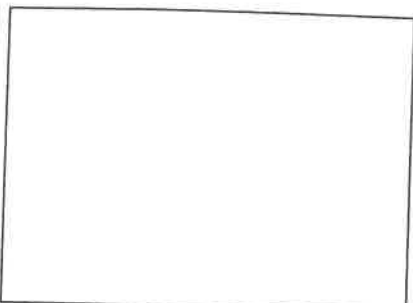
Baseline data was gathered around four sites (see Figure 1 and Table 2):

Table 2: Site names and co-ordinates for selected sites

Site #	Farm Name	Suggested	Coordinates	
		Site Name	Latitude	Longitude
Site 1	falls mainly on Rietpan 17	Rietpan	27°55'13.40"S	26°40'25.48"E
Site 2	falls mainly on St Helena 42	St Helena	28° 2'33.38"S	26°42'36.64"E
Site 3	falls mainly on Stuurmanspan 92	Stuurmanspan	28° 2'47.93"S	26°46'27.65"E
Site 4	falls mainly on La Riviera 289	La Riviera	28° 2'24.90"S	26°51'29.49"E



Coordinate System
Projection: Geographic
WGS 84



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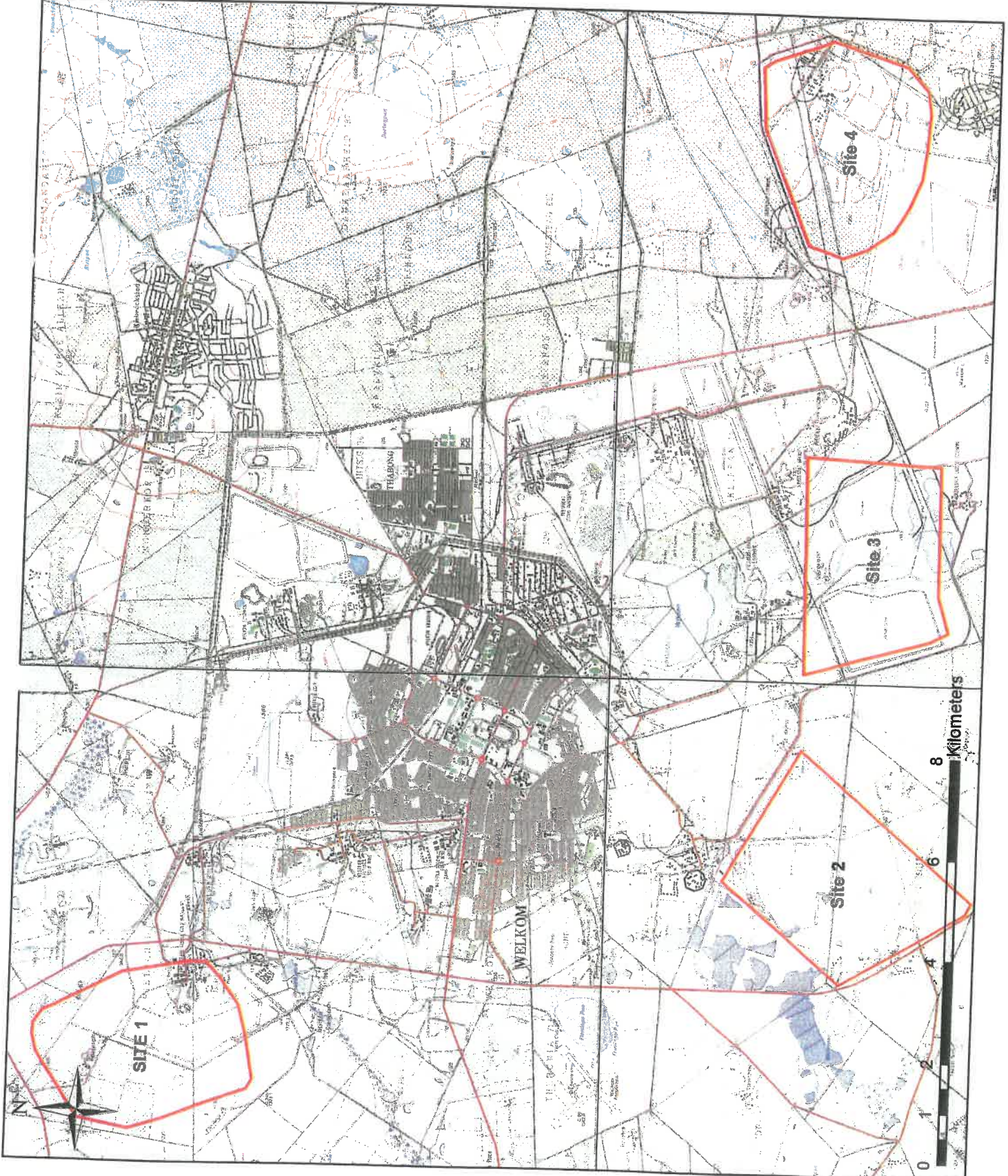
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Harmony Free State EMF

**Site Selection -
Farm boundaries**

Date: July 2007

Figure 1: Locality map



2.1.4 Assessment of Site Options

The preferred site options (1 – 4), were assessed for their likely effects upon the sustainability objectives developed for Welkom. The assessment followed a workshop format over a day, involving the SC, client and consultants. This collective involvement was mutually beneficial, with the client/SC providing necessary background information on the area and proposed sites (e.g geography, development history, urban planning). The baseline information (environmental, economic and social) was used to determine the likely effects of the options.

The Golder team mapped and provided context to the four preferred sites during the second SC workshop (19th June 2007) . Using a strategic assessment framework (Appendix C), the workshop attendees discussed and debated how far each option contributed towards or against the sustainability objectives. This ensured that sustainability was central to the decision-making process, and informed the preferential choice of sites. Each site option was assessed for its performance against each objective and the results recorded in the framework. Comments were included to improve the performance of options where this was considered appropriate. The final result culminating in a ranking of each site against each objective, with respect to potential impacts. The cumulative effect of these rankings against each objective being used to determine the preferred site (professional judgement was used in determining the site but not all objectives were considered equal, those with the potential to result in a fatal flaw were given higher priority e.g. impacts to water).

3 RESULTS OF ASSESSMENT

The results of the assessment include; the strategic assessment and the site options assessment. These are detailed below.

3.1 Strategic Assessment

The grey scale mapping sequentially adds layers of grey to the maps, such that the darker the tone of grey the less suitable the site is for the MTF. The sequence of maps shown in Appendix B, resulting in the composite Figure 2, suggests that the best swath of land to take forward to the site selection process for the MTF would be South of Welkom and north of the Sand River and Virginia. The Welkom Spatial Development Framework indicates that industrial development should be encouraged to the south of Welkom, which does not preclude other areas to the north from consideration. Therefore, other areas to the North West of Welkom were also considered on merit.

Following input from the SC, the Strategic Assessment resulted in four potential sites being taken forward to the site options assessment

3.2 Site Options Assessment

Each of the four sites were assessed in relation to its specific location and likely impacts, as well as its position in relation to the tailings processing plant (see Figure 3).



Coordinate System
Projection: Geographic
WGS 84

Legend

- ▲ Freestate Harmony fallings Points
- Grey scale showing:
 - Population >200
 - Urban areas
 - Inland water
 - Fauna
 - Geology
 - Land cover (urban, commercial & industrial)
 - SDF
 - Sand river

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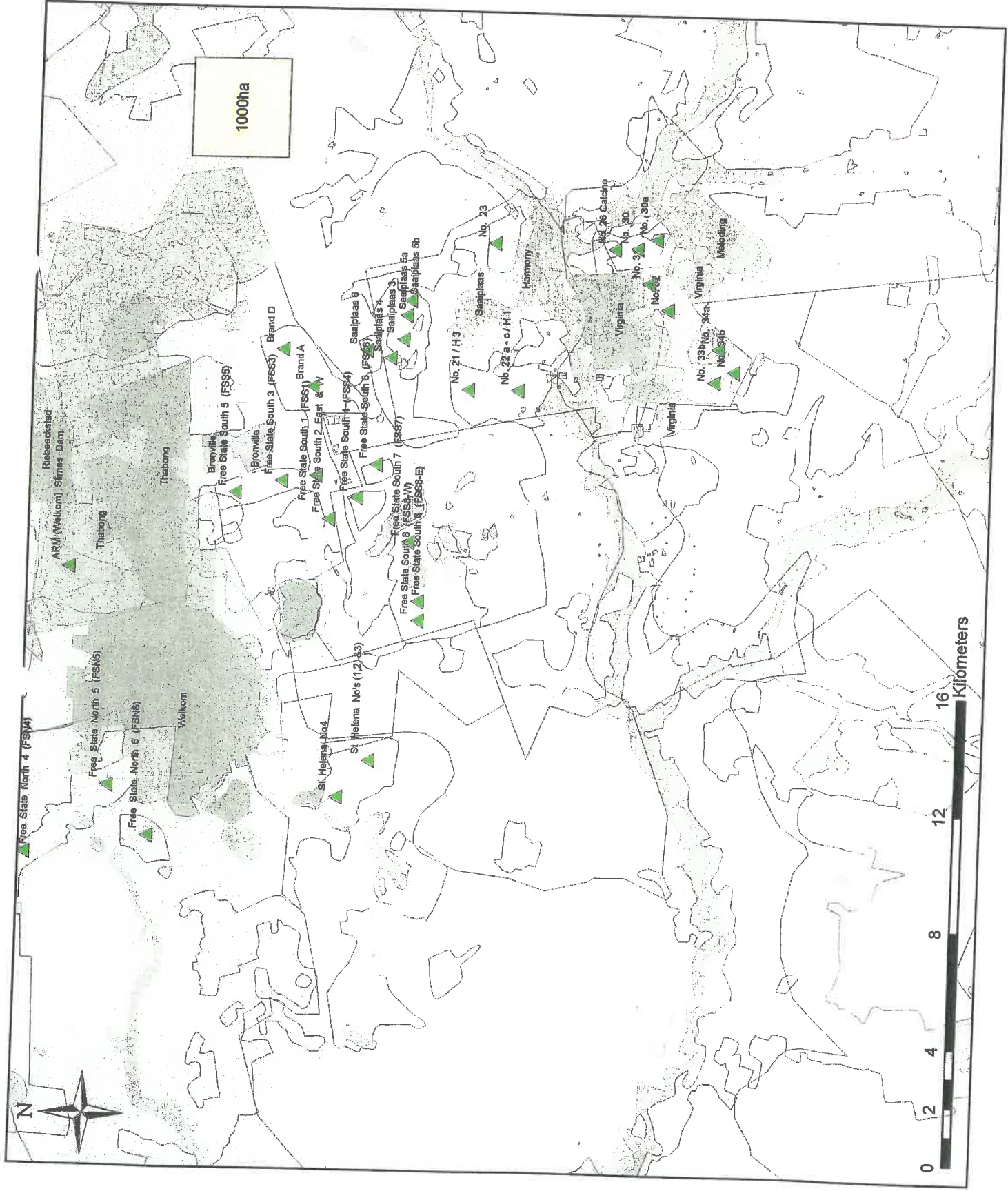
Harmony

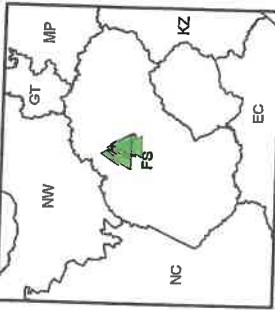
Harmony Free State EMF

9. Zoom

Date: July 2007

Figure 2: Composite grey scale showing area of focus





Coordinate System
Projection: Geographic
WGS 84

Legend

- FreeStateHarmonyVillingsPoints
 - site4
 - site3
 - site2
 - site1
- South_african_communities
- Grey Scale

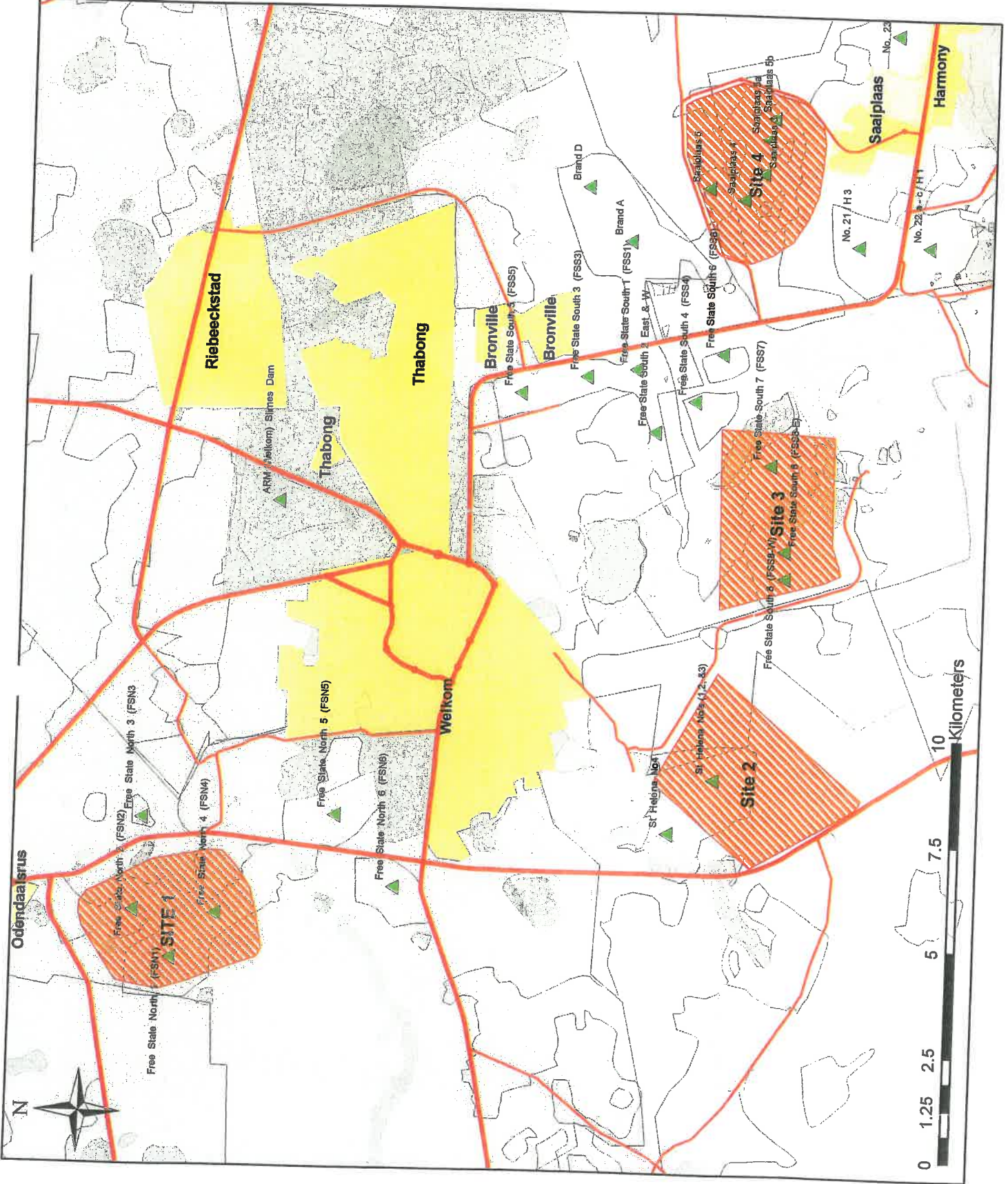
Roads

FEAT_TYPE

- MAIN ROAD
- SECONDARY ROAD

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Harmony
Harmony Free State EMF
Site Selection
Date: June 2007
Figure 3. Site options



The sustainability issues and potential impacts that were identified through the workshop process, are attached as Appendix C. The detailed assessments have been summarised and are presented in Table 3, which highlights the preferred option (i.e. that with the least negative impact or most positive impact – highlighted in green) for each criteria/objective. It should be noted that this approach is not quantitative and consequently the ratio of green to red ‘blocks’ does not qualify an option as being more sustainable, and therefore preferential, to the next. However, the method used for presenting the summary of assessment findings provides for easy visual interpretation of the likely effects of each option in relation to each other. This information serves to inform the selection of site options, and where appropriate highlight criteria to be addressed within the impact assessment.

Table 3: Overview of assessment of site options against sustainability criteria

 Preferred site (least - impact)
  Intermediate site
  Worst performing site (most - impact)

Sustainability Criteria	Sites			
	Site 1: Rietpan	Site 2: St Helena	Site 3: Stuurmanspan	Site 4: La Riviera
Biophysical				
Air Quality	Red	Orange	Orange	Green
Agricultural Productivity	Green	Orange	Orange	Red
Water Quantity	Red	Orange	Green	Orange
Water Quality	Red	Orange	Green	Orange
Ecosystem Productivity	Green	Red	Orange	Orange
Species Diversity	Red	Orange	Orange	Orange
Social				
Poverty Levels	Red	Orange	Orange	Orange
Equal Opportunity	Red	Orange	Orange	Orange
Living Conditions	Red	Orange	Green	Red
Health	Red	Orange	Green	Orange
Health & safety at work	Red	Orange	Orange	Orange
Education	Red	Orange	Orange	Orange
Infrastructure use	Red	Green	Orange	Orange
Crime	Red	Orange	Orange	Orange
Cultural Heritage	Green	Red	Green	Green
Economic				

Sustainability Criteria	Sites			
	Site 1: Rietpan	Site 2: St Helena	Site 3: Stuurmanspan	Site 4: La Riviera
Economic Performance				
Level of trade				
SMME Status				
Energy efficiency & waste management				

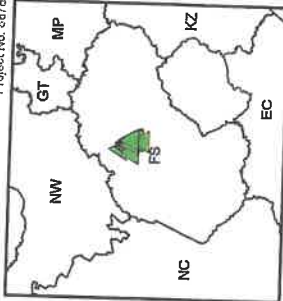
In differentiating the sites, the outcomes from a socio-economic perspective were largely equal. Consequently, the ultimate selection of the sites was primarily influenced by the potential impacts on the environment, however living conditions, community health and cultural heritage did contribute to the selection process. In line with the 10 key objectives (Table 1); wind direction was taken into account as an influence on air quality, as well as brownfield sites to limit greenfield land take, which may impact on agriculture or ecosystem function. Proximity to the Sand River and clean water systems, were considered for potential impacts on water quality and quantity.

It is apparent from the above that the preferred site is site 3, followed by 4, 2 and 1. The outcomes of the detailed site assessment is summarised for each site below.

3.2.1 Site option 3: Stuurmanspan

This site (see Figure 4) is the top ranked site, having a number of positive attributes that lend the site to the construction of the MTF. Stuurmanspan is a brownfield site, which has already been impacted by tailings facilities (namely Free State South 6, 7 and 8). There will be no resultant impact on agricultural productivity. Previously a drainage canal passed through this site, this is now heavily impacted by mining and has resulted in polluted water ponding. The availability of this dirty water will support the tailings reprocessing, and may provide an opportunity to improve its quality through treatment and re-use. Site 3 is in close proximity to water resources from which water management will take place (the so called 12 ABC system). This site is the closest to the proposed processing plant and, therefore, energy use, associated with pumping tailings and water, will be the least of the sites. Stuurmanspan has limited residential areas surrounding it, thus reducing the potential impacts on health and associated living conditions (dust, noise, visual) of the surrounding population.

The site performs poorly from an ecosystem productivity perspective, because it is in close proximity to the mine induced artificial wetland. However, this wetland is not of high value, since it is anthropogenic and due to the polluted nature of the surroundings and the water quality itself. Site 3 has a predominantly north-east wind direction with high winds in a north westerly direction which may blow dust across the northern parts of Virginia. The impact assessment will need to address these aspects in more detail and suggest mitigation measures.



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Harmony Free State EMF

Site Selection - Site 3

Date: July 2007

Figure 4: Site 3 - Stuurmanspan



3.2.2 Site option 4: La Riviera

Site 4 (see Figure 5) situated to the South East of Welkom is likely to have the least impact on air quality, particularly wind blown dust. Prevalent wind directions are likely to blow dust to the West and away from the main residential areas.

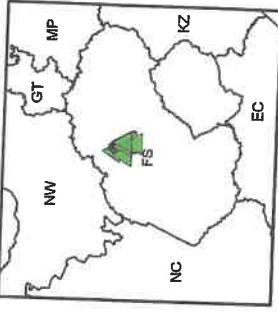
The majority of the site is brownfields (approximately 50%), however land take will include a portion of agricultural land to the south west used for grazing and crop farming. La Riviera is in close proximity to the urban areas of Saaiplaas and Harmony and the resultant impacts on living conditions of these areas will need to be addressed in any subsequent EA process.

3.2.3 Site option 2: St Helena

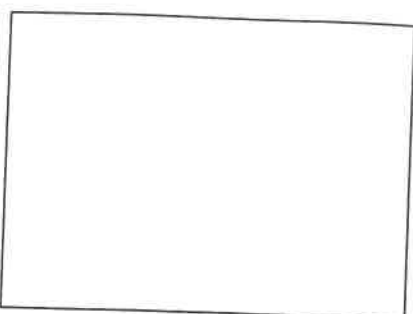
Site 2 (see Figure 6) has approximately only 40% of the proposed footprint impacted and therefore the site scores poorly from an ecosystem perspective due to Greenfield land take. Additionally certain areas are developing wetland characteristics due to the impoundment of water, which may increase the ecosystem potential in the future. Historically the area was used for grazing and cropping, and the remaining 60% of the site is used for agriculture, which would be lost should this be the selected site for the MTF. St Helena has cultural/historical importance in that it was the first gold mine in the Free State area (Eerstemyn), the area has been earmarked for a tourism development associated with these historical aspects.

3.2.4 Site option 1: Rietpan

Rietpan (see Figure 7) is the least favoured of the four sites. Situated to the North West of Welkom the prevalent winds are likely to transport dust across the main residential areas affecting living conditions and health. Additionally, the area to the east of the site has been proposed for future urban expansion and the above impact will be exacerbated by such urban growth. The entire site is brownfield and the resultant impacts on agriculture and ecosystem are considered to be negligible. The Sungazer Lizard (*Cordylus giganteus*) a red data species, is known to reside in close proximity to the existing tailings dams and activities associated with the proposed MTF are likely to impact upon this species. This site also performs badly from a water quantity perspective in that water will be managed from the 12 ABC system to the South and thus energy consumption will be high in pumping the required water to site. This site drains to the clean catchment to the West, thus any failure or leakage is likely to have a greater impact upon the quality of this catchment.



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Projection: Geographic
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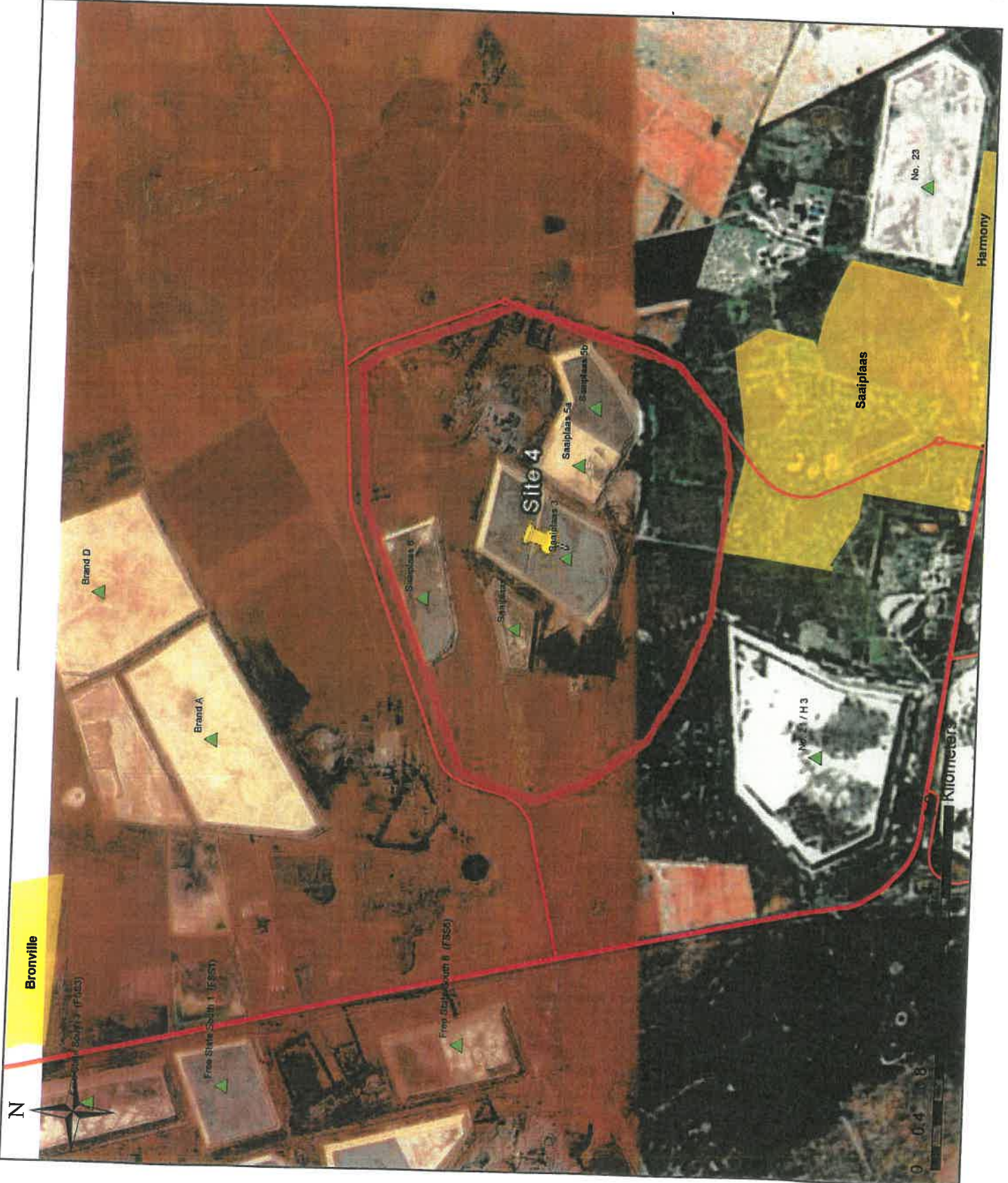
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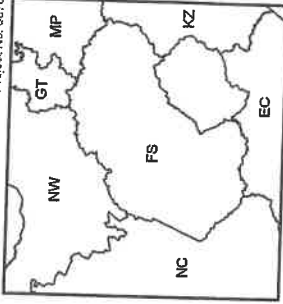
Harmony Free State EMF

Site Selection - Site 4

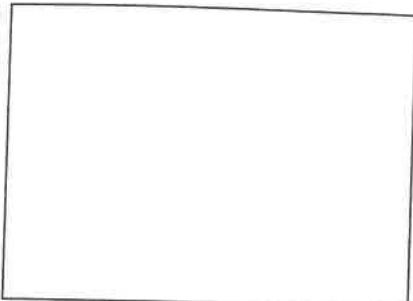
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Figure 5: Site 4 - La Riviera





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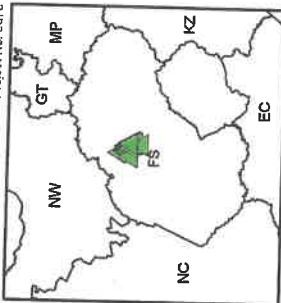
Harmony Free State EMF

Site Selection - Site 2

Date: July 2007

Figure 6: Site 2 - St Helena





Coordinate System
Projection: Geographic
WGS 84

Legend

- Harmony tailings dams
- South African Communities

Roads

FEAT_TYPE

- MAIN ROAD
- SECONDARY ROAD

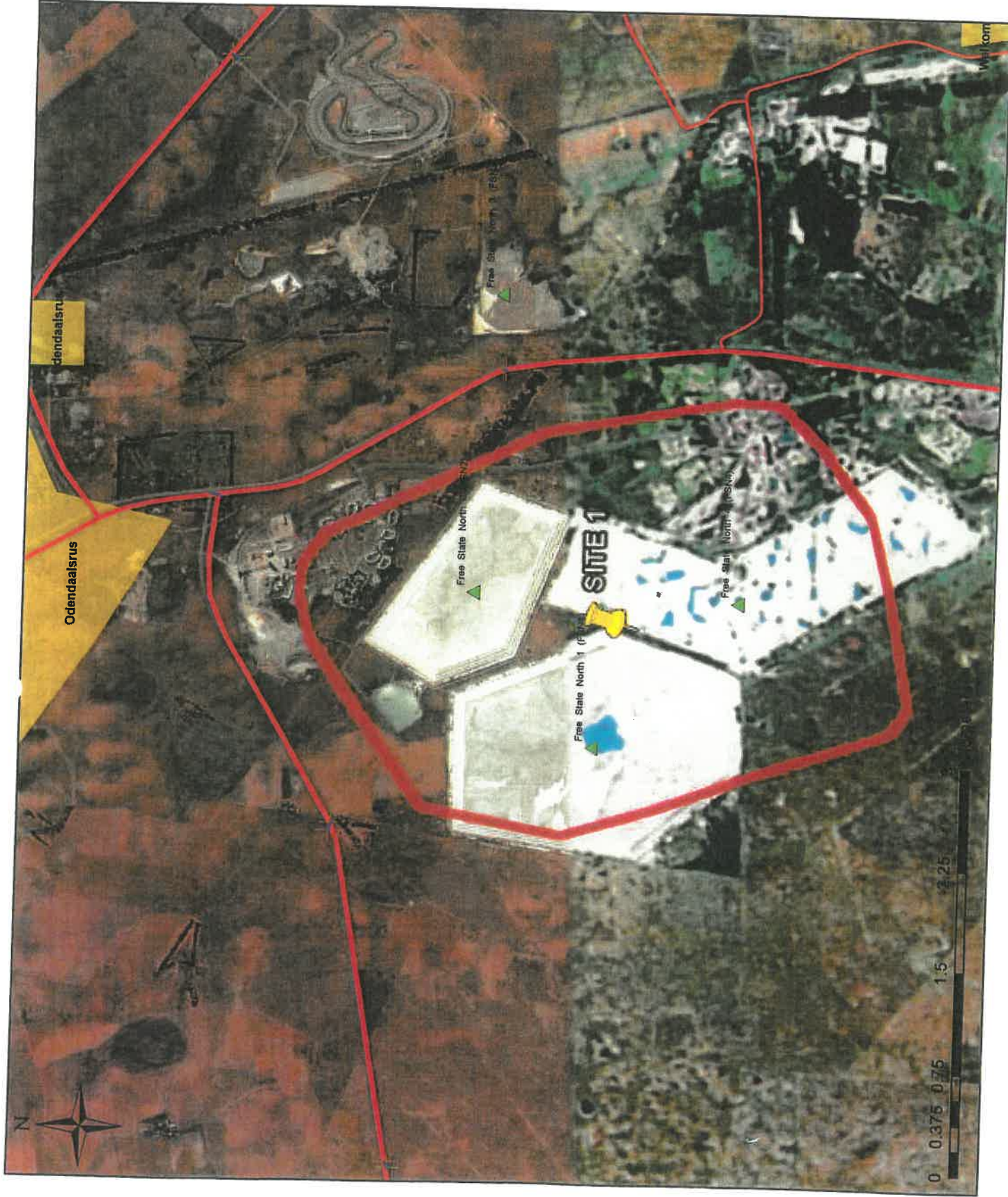
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Harmony Free State EMF

Site Selection - Site 1

Date: June 2007



4 CONCLUSION

The quality of surface and ground water is a contentious issue in all 4 areas under consideration. At Sites 2, 3 & 4 the Sand River flows to the south and the Mahemspruit which is already heavily polluted flows to the south of Site 1. Further studies need to be done on water quality and the impacts the selected site might have on the water regime. It is a prerequisite of Department of Water Affairs and Forestry (DWAF) that any new tailings facility have a liner system before they give permission for construction.


The site selection process, although limited by available information, provides the basis upon which the preferred site can be reasonably determined. Stuurmanspan (Site 3) site will be further assessed during the subsequent environmental impact assessment (EIA) to ascertain if any fatal flaws exist, should this be the case this site selection process will be revisited and the next best option taken forward. Information gathered during the site selection process will inform the EIA and highlight areas for consideration and mitigation.

GOLDER ASSOCIATES AFRICA (PTY) LTD



Nigel Beck

G:\PROJECTS\8788 - HARMONY MEGA SLIMES DAMS\WELKOM SEA-EMF\SEA REPORT\FINAL REPORT ISSUED TO CLIENT\8788-HARMONY MTF-SEA-EMF REPORT-WELKOM-FINAL 20-07.DOC



Rob Hounsome

APPENDIX A

BIOPHYSICAL OBJECTIVES

Theme	Sub-theme	Strategic Objective	Detailed Objectives	Source	Rank
Atmosphere	Climate Change	To limit climate change impacts and to reduce the potential impacts	To reduce CO2 levels and emissions	Proposed Harmony Steer Com. 30/05/2007 (from National)	
			To minimise emissions of greenhouse gases (GHG)	Proposed Harmony Steer Com. 30/05/2007	
			To encourage use of renewable energy sources (bio-fuels)	Proposed Harmony Steer Com. 30/05/2007	
Atmosphere	Ozone Layer Depletion	To reduce the depletion of the ozone layer	To encourage research into climate change	Proposed Harmony Steer Com. 30/05/2007	
			To minimise ozone depleting gases	Proposed Harmony Steer Com. 30/05/2007	
			To encourage research into ozone layer depletion	Proposed Harmony Steer Com. 30/05/2007	
Atmosphere	Air Quality	To improve air quality	To reduce dust emissions	Proposed Harmony Steer Com. 30/05/2007	
			To minimise the exposure of surrounding communities to harmful air substances & pollution	Matjhabeng IDP 2007 / 2011 (Local)	
			To reduce the emissions of PM10 and NOx	Matjhabeng IDP 2007 / 2011 (Local)	
Land	Agriculture	To improve agricultural productivity	To effectively monitor air pollution levels	Proposed Harmony Steer Com. 30/05/2007	
			To minimise the exposure of the surrounding communities to environmental harms & hazardous substances	Matjhabeng IDP 2007/2011	
			To enhance environmental health on adjacent land to mining operations through monitoring	Matjhabeng IDP 2007/2011	
			To implement a strategy to maintain the open spaces and ensure the rehabilitation during and post mining operations	Free State Growth and Development Strategy 2005- 2014	
			To support BEE based agriculture	Proposed Harmony Steer Com. 30/05/2007	
Fresh Water	Water Quantity	To improve water quantity and usage	To align support services and partnerships between Government and farmer organisations	Proposed Harmony Steer Com. 30/05/2007	
			To optimise water treatment and the re-use of process water	Free State Growth and Development Strategy 2005- 2014	
			To achieve wise management and sustainable use of water resources	Proposed Harmony Steer Com. 30/05/2007	
Fresh Water	Water Quality	To improve the quality of surface and groundwater	To implement monitoring strategies for surface and groundwater quality	Free State Growth and Development Strategy 2005- 2014	
			To allow for ongoing mitigation, remediation & rehabilitation efforts	Proposed Harmony Steer Com. 30/05/2007	
Biodiversity	Ecosystem	To improve ecosystem productivity and functioning	To ensure that mining developments do not infringe on planned urban greening programs	Matjhabeng IDP 2007/2011	
			To conserve and enhance habitats	National Environmental Management Act (National)	
Biodiversity	Species	To improve species diversity	To conserve rare and endangered species	Proposed Harmony Steer Com. 30/05/2007	

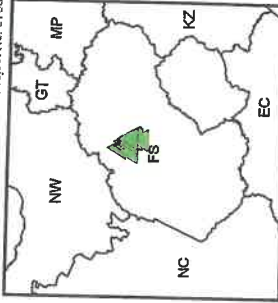
SOCIAL OBJECTIVES

Theme	Sub-theme	Strategic Objective	Details Objectives	Source	Rank
Equity	Poverty	To reduce levels of poverty	To ensure initiatives are aimed at fighting poverty through different projects which involve reaching out to the community	Harmony SD report 2006	
			To provide employment in the mining sector, and promote employment from within the area of mining operations	Harmony SD report 2006	
Equity		To improve equal opportunities	To ensure there is an employment equity policy which allows for women to be included into the workforce	Harmony SD report 2006	
Health	Living Conditions	To improve living conditions and service provision	To ensure there is an employment equity policy which allows for the historically disadvantaged to be included into the workforce	Harmony SD report 2006	
			To increase the standard of the housing and living conditions	Proposed Harmony Steer Com. 30/05/2007	
Health	Healthcare Delivery	To maximise the health and well-being of the population	To improve the sanitation facilities of the community households	Proposed Harmony Steer Com. 30/05/2007	
			To improve the provision of drinking water	Proposed Harmony Steer Com. 30/05/2007	
Health			To improve health care facilities both within mining operations and in the local communities to address occupational diseases such as silicosis, TB and noise-induced hearing loss.	Proposed Harmony Steer Com. 30/05/2007	
			To organise and encourage voluntary testing of HIV status at mining operations	Free State Growth and Development Strategy 2008-2014	
Health	Occupational safety and health	To improve the health and safety working conditions	To develop an HIV/Aids prevention and awareness programme which will educate, and promote healthy lifestyle principles to try to manage HIV/Aids in the workplace and the community	Majthabeng IDP 2007/2011	
			To ensure employees are part of an assistance program to deal with issues of employee psycho-social problems (e.g. alcohol dependence, work, family & stress)	Majthabeng IDP 2007/2011	
Education	Education Level	To improve the education levels of the community and workforce	To provide safe and healthy living and eating conditions to all employees	Harmony SD report 2006	
			To develop a skills development programme for employees to develop skills for both mining and post mining opportunities	Harmony SD report 2006	
Sport and Recreations	Facilities	To improve the use of facilities	To invest in the training and development, specifically focusing on employees and people from labour-sending communities	Majthabeng IDP 2007 / 2011 and Harmony SD Report 2006	
			To improve the literacy levels and level of knowledge	Harmony SD report 2006	
Security	Crime	To decrease crime in the community	To assess the redundant mining facilities in terms of social needs	Proposed Harmony Steer Com. 30/05/2007	
			To promote initiatives that are focused on the arts, sports and recreation	Free State Growth and Development Strategy 2005-2014	
Culture	Cultural Heritage	To improve the cultural heritage status	To promote strategies focussing on crime prevention	Harmony SD report 2006	
			To ensure aspects of cultural importance are preserved	Proposed Harmony Steer Com. 30/05/2007	

ECONOMIC OBJECTIVES

ECONOMIC OBJECTIVES					
Theme	Sub-theme	Strategic Objective	Detailed Objectives	Source	Rank
Economic Structure	Economic Performance	To improve economic performance	To generate economic growth at local and international levels	Harmony SD report 2006	
			To assess the redundant mining facilities in terms of future economic development	Free State Growth and Development Strategy 2005- 2014	
			To develop an incentive scheme to attract investors in the mining sector	Matjhabeng IDP 2007/2011	
			To promote a mining tourism sector in an old redundant mine	Matjhabeng IDP 2007/2011	
Economic Structure	Trade	To improve the level of trade in the area	To encourage local business development and trade	Proposed Harmony Steer Com. 30/05/2007	
Economic Structure	SMMIEs	To improve SMME status in the community	To ensure that mining operations promote procurement expenditure on SMME's within Mathabeng Municipality	Matjhabeng IDP 2007/2011	
			To assist in the creation of local business support infrastructure for SMME development	Matjhabeng IDP 2007/2011	
Consumption and Production Patterns	Waste and energy Use	To promote efficient energy use and waste management	To promote energy efficiency systems and the use of renewable energy resources	Free State Growth and Development Strategy 2005- 2014	
			To reduce the amount of hazardous waste sent to licensed disposal facilities and implement an integrated waste management system	Harmony SD report 2006	

APPENDIX B



Coordinate System
Projection: Geographic
WGS 84

Legend

- ▲ Freestate/Harmony/Vallings/Points

Grey scale showing:
Urban areas

Golden A
P.O. Box 6001
Halfway House
1685
Tel: (011) 254 4800
Fax: (011) 315 0317

Harmony

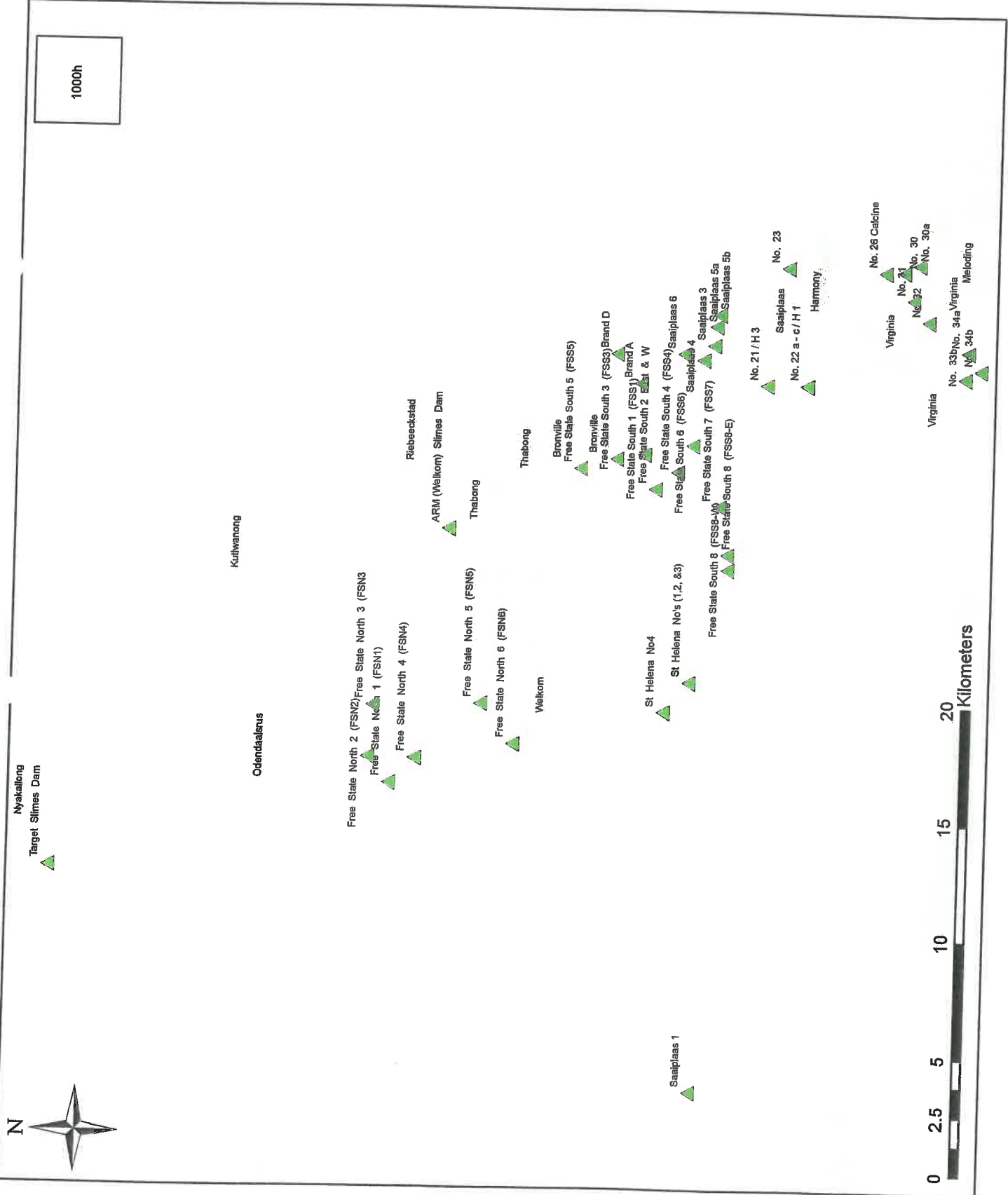
Harmony Free State EMF

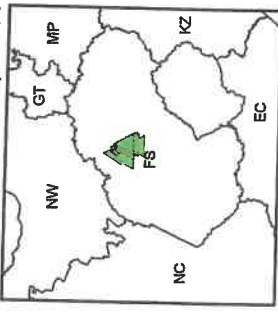
1. Urban areas

Date: July 2007

Grey scale

1000h





Coordinate System
Projection: Geographic
WGS 84

Legend

- ▲ Freestate/Harmony tailings points

Grey scale showing:

- Urban areas
- Sand river

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Harmony

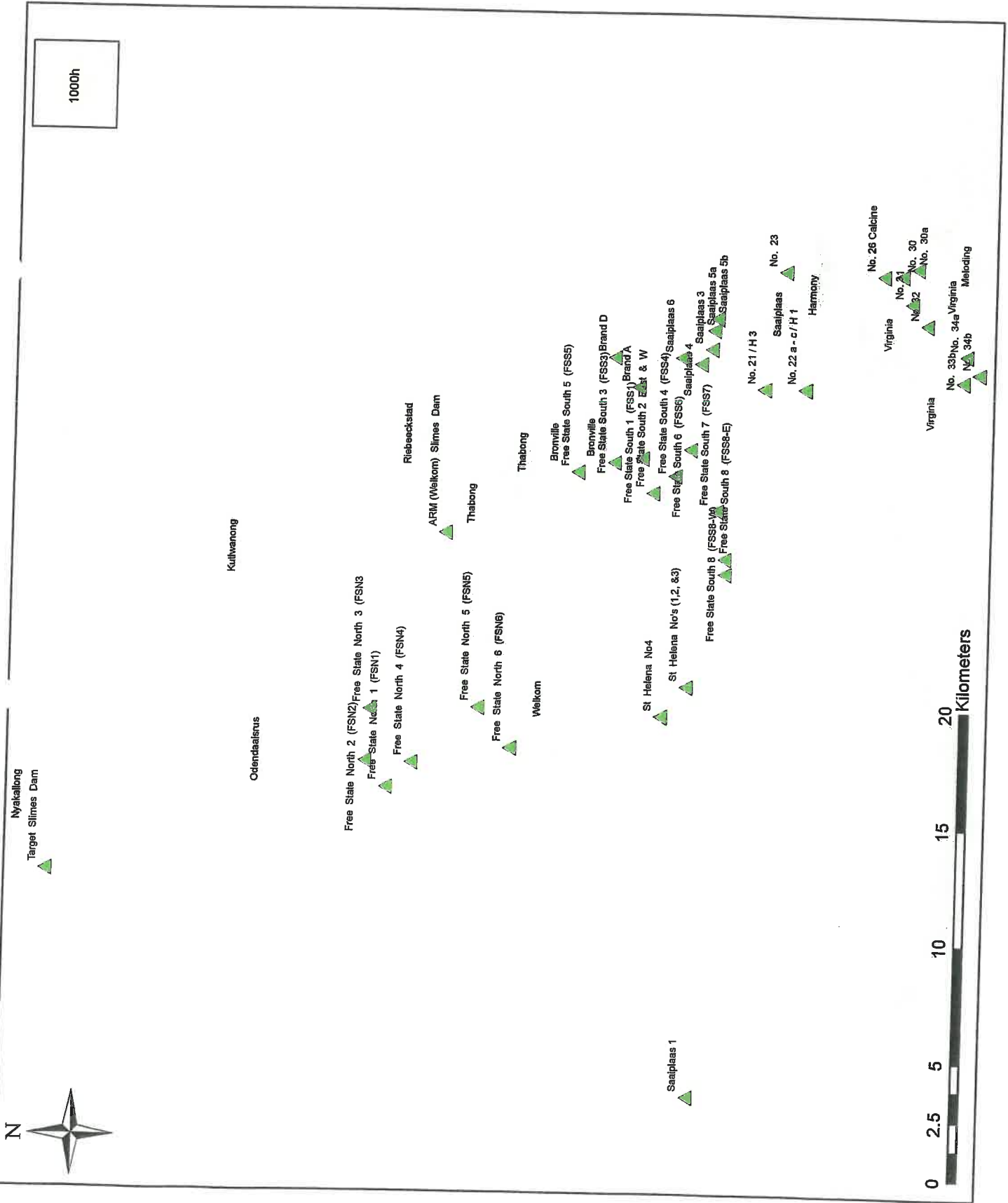
Harmony Free State EMF

2. Sand river

Date: July 2007

Grey scale

1000h





Coordinate System
Projection: Geographic
WGS 84

Legend

- ▲ Freestate-HarmonyTailingsPoints

Grey scale showing:

- Urban areas
- Sand river
- Geology
- dolerite & andesite

Golden Associates
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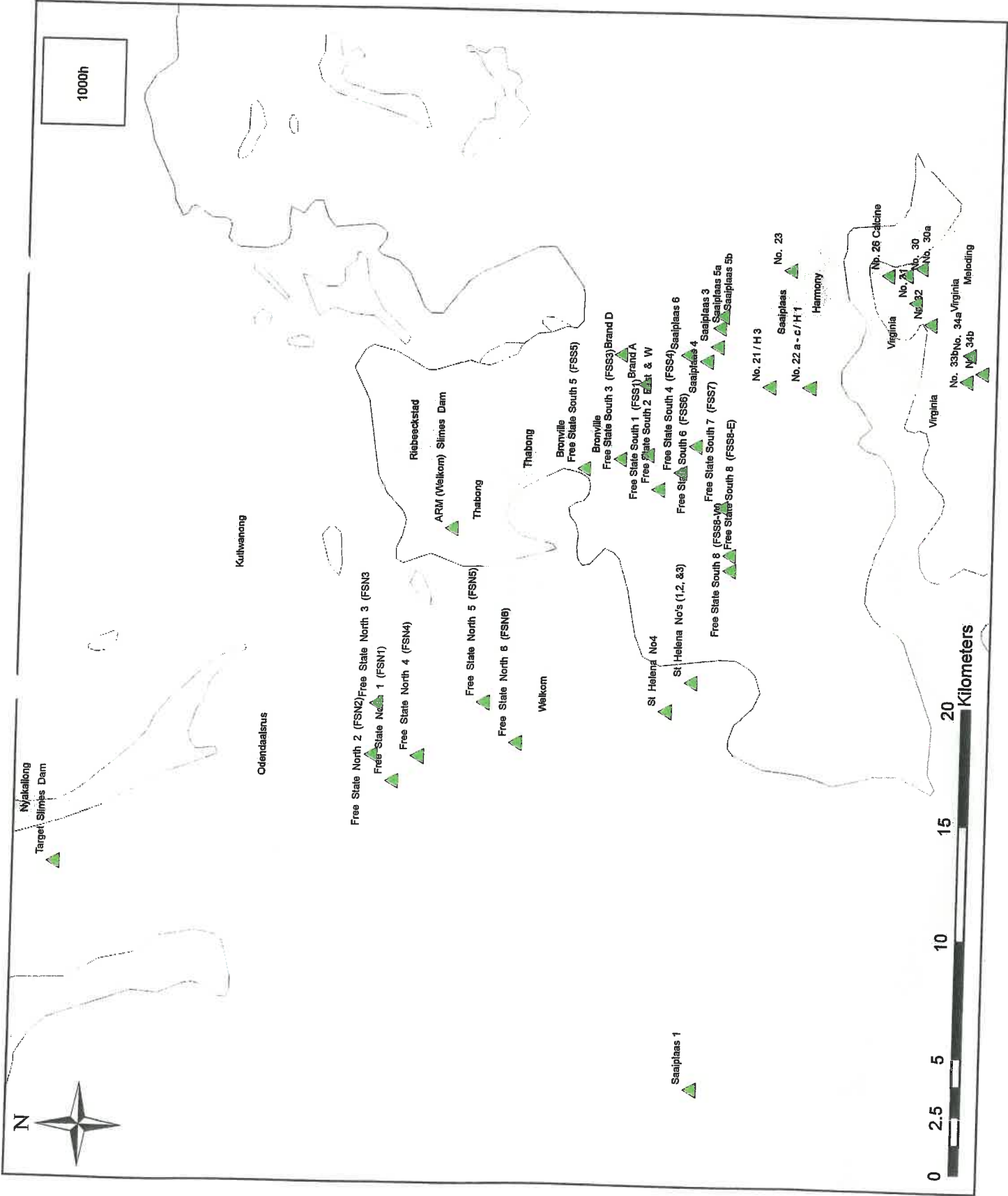
Harmony

Harmony Free State EMF

3. Geology

Date: July 2007

Grey scale





Coordinate System
Projection: Geographic
WGS 84

Legend

- ▲ Freestate Harmony villages/points

Grey scale showing:

- Population >200
- Urban areas
- Geology
- Sand river

Grindor Associates
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Fax: (011) 315 0317

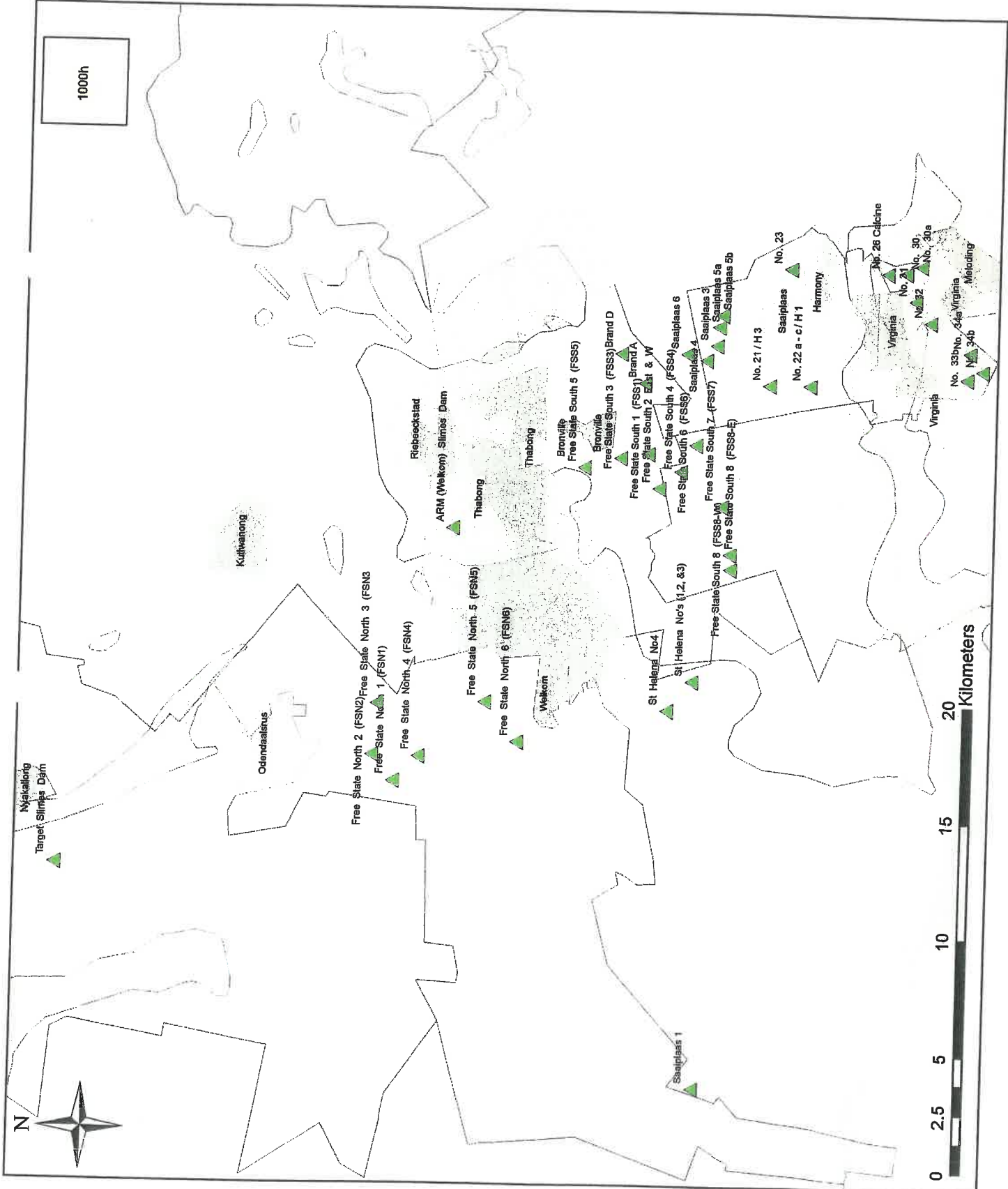
Harmony

Harmony Free State EMF

4. Population Density <200 people / km²

Date: July 2007

Grey scale





Coordinate System
Projection: Geographic
WGS 84

Legend

Freestate-Harmony/airings/Points

Grey scale showing:

- Population >200
- Urban areas
- Inland water
- Geology
- Sand river



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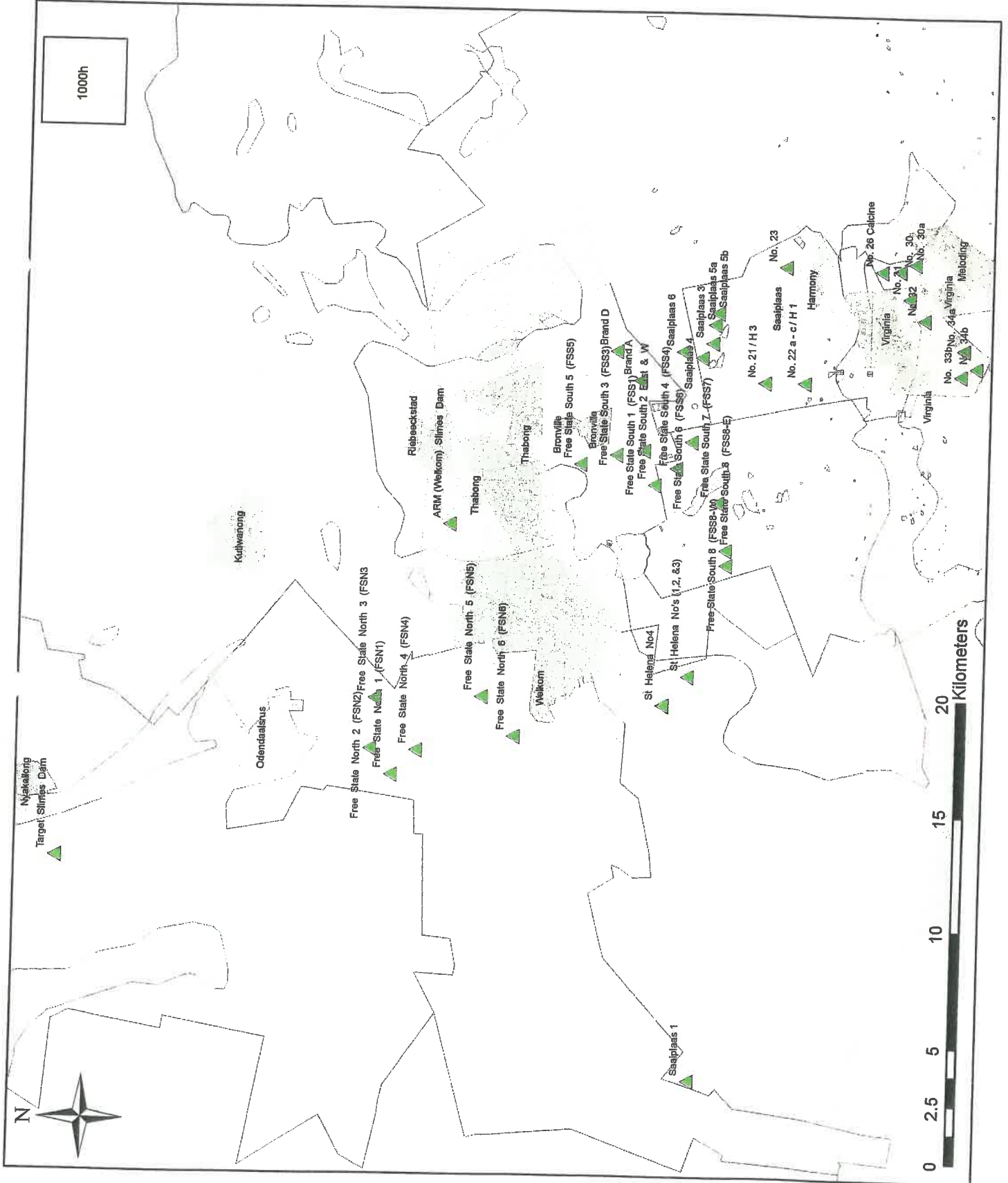
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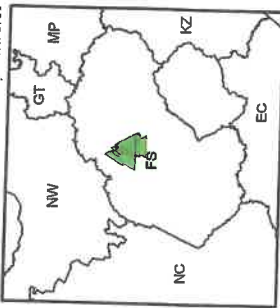
Harmony Free State EMF

5. Inland water

Date: July 2007

Grey scale





Coordinate System
Projection: Geographic
WGS 84

Legend

- Freestate/Harmony/Vallings/Points

Grey scale showing:

- Population >200
- Urban areas
- Inland water
- Fauna
- Geology
- Sand river

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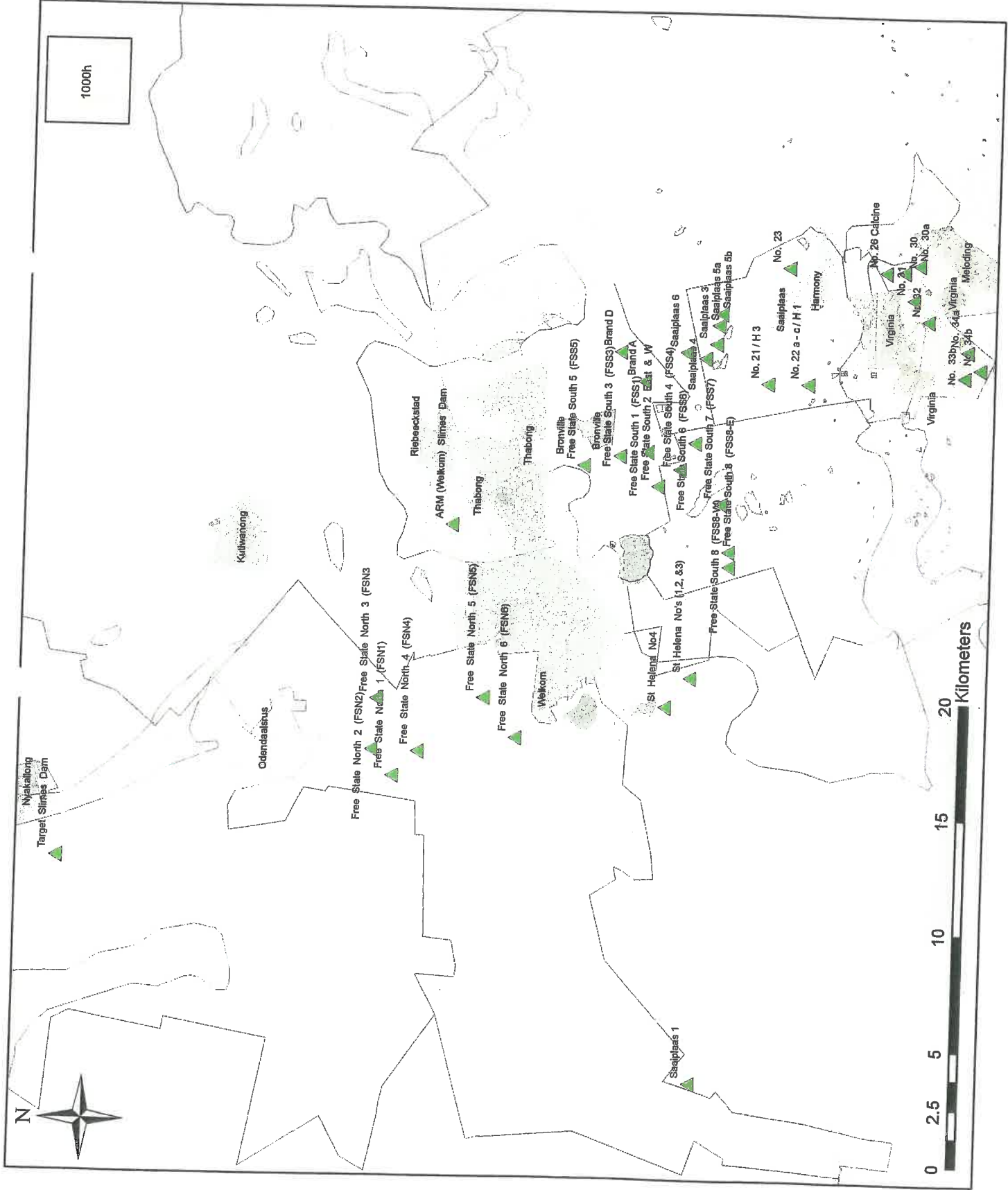
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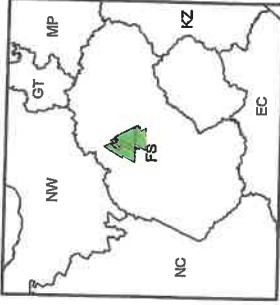
Harmony Free State EMF

6. Fauna (flamingos)

Date: July 2007

Grey scale





Coordinate System
Projection: Geographic
WGS 84

Legend

- Freestate/Harmony/Vallings/Points

Grey scale showing:

- Population >200
- Urban areas
- Inland water
- Fauna
- Geology
- Land cover (urban, commercial & industrial)
- Sand river

Galaxy Associates
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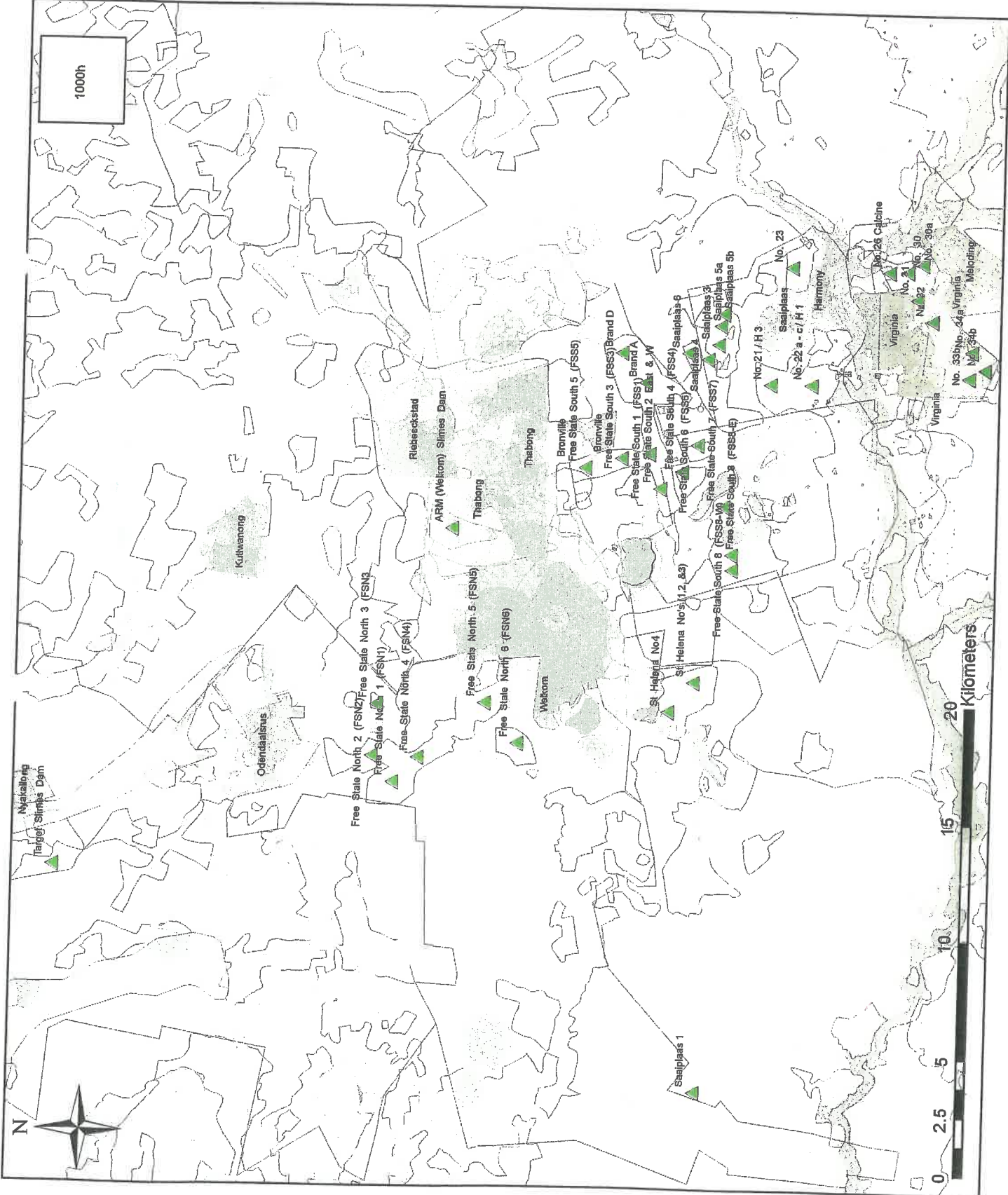
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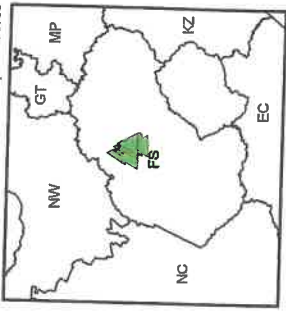
Harmony Free State EMF

7. land cover

Date: July 2007

Grey scale





Coordinate System
Projection: Geographic
WGS 84

Legend

- Freestate/Harmony/Points
- Grey scale showing:
 - Population >200
 - Urban areas
 - Inland water
 - Fauna
 - Geology
 - Land cover (urban, commercial & industrial)
 - SDF
 - Sand river

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Harmony

Harmony Free State EMF

8. SDF

Date: July 2007

Grey scale



APPENDIX C

EMF/SEA/SA appraisal framework for Harmony sites

Sustainable Development Objectives	Baseline Information Summary	Potential Impact (Rank)				Commentary	
		Least Negative	↑	Most Negative			
Biophysical							
To limit climate change and to reduce the potential impacts	<p>Generic:</p> <p>The emission of greenhouse gases, and the resultant climate change, is increasing in line with development. There is a growing emphasis to increase the energy efficiency of new developments.</p> <p>Site 1:</p> <ul style="list-style-type: none"> ± 3km north-west of Welkom and ± 2.5 km south of Odendaalsrus Dust is expected to blow towards Welkom Predominant wind direction is NE, but high winds W and NW (monthly) Might impact Welkom Future township development between Odendaalsrus and Welkom <p>Site 2:</p> <ul style="list-style-type: none"> ± 2km south of Welkom and ± 10 km NW of Virginia Dust is expected to blow away from Welkom Predominant wind direction is NE, but high winds W and NW (monthly) Might impact Virginia Average wind speeds do not exceed 6m/s Possibility of tourist development – mixed type <p>Site 3:</p> <ul style="list-style-type: none"> ± 4km south of Welkom, between sites 2 and 4. Predominant wind direction is NE, but high winds NW (monthly) Might impact Virginia Average wind speeds do not exceed 6m/s Golf estate development platform – to the north 	All equal	4	3	2	1	<p>Site 1 - Future township development between Odendaalsrus and Welkom which is directly east of the proposed site. Direct impact on urban development (Kooos Duvenhage).</p> <p>Not a lot of dust to the north of the FS North TSF – Flamingo Park area (Tommy Barnard)</p> <p>Site 3 - A residential golf estate development is planned towards the north of the area (Ferdie Jordaan)</p> <p>Site 2 - A possible mixed tourism development is in the pipeline for this area (Ferdie Jordaan)</p> <p>Health issue - From Allan Ridge side.</p>
To improve air quality							

EMF/SE/ISA appraisal framework for Harmony sites

Sustainable Development Objectives	Baseline Information Summary	Potential Impact (Rank)			Commentary
		Least Negative	↑	Most Negative	
To improve agricultural productivity	<p>Site 4:</p> <ul style="list-style-type: none"> ± 8km east-south-east of Welkom and ± 5 km north of Virginia. Predominant wind direction is NE, but high winds NW (monthly) Might impact Virginia. 				
	<ul style="list-style-type: none"> The present land use is solely mining and associated activities Unfeasible to improve the agricultural potential Site is contaminated by 3 existing tailings dams which make up ± 80% of the site Adjacent areas are used for agriculture <p>Site 1:</p> <ul style="list-style-type: none"> Future industrial development towards this area (SDF) Majority of area earmarked for urban extension – St Helena Gold Mines – EMPR (pg 10) Historically area was used for grazing and crop planting (maize in summer & wheat in winter) 2 tailings dams making up ± 40 % , but agriculture adjacent to site - ± 50% of proposed area Impermeable soils & poor nutrient status <p>Site 2:</p> <ul style="list-style-type: none"> Future industrial development towards this area (SDF) The present land use is solely mining and associated activities <p>Site 3:</p> <ul style="list-style-type: none"> Unfeasible to improve the agricultural potential Site is contaminated by 2 existing tailings dams , which make up ± 60% of the site ± 30% of the site is made up of return water dams Adjacent areas are used for mining and ± 10 % is previously farmed land 	3	1	2	4

Sites 2 & 4 - high agricultural potential (Jaco Minnaar)

Sites 1 & 3 - ground already polluted (Jaco Minnaar)

Site 3 -- No impact on agriculture - no agriculture surrounding this area (Ferdie Jordaan)

TSF will be lined thus no contamination, if any ± 100m zone of influence

Sites 2, 3 & 4 – topography should be taken into account as could have runoff into Sand River

EMF/SEA/SA appraisal framework for Harmony sites

Sustainable Development Objectives	Baseline Information Summary	Potential Impact (Rank)			Commentary
		Least Negative	↑	Most Negative	
To improve water quantity and usage	<ul style="list-style-type: none"> Impermeable soils Contaminated soils Site 4: The land surrounding the mining area is used for agricultural purposes with both grazing and crop farming being practised 4 tailings dams on proposed footprint - ± 50 % of proposed area Land capability in the Welkom District as a % of mine property: Arable land = 52.4%, Grazing = 28.1%, Area unavailable for agriculture = 19.4% Sandy to clay soils (impermeable) 				
	<ul style="list-style-type: none"> Site 1: ± 3 km NNE of Mahemspruit Proposed footprint over 3 existing TSF Site 2: ± 8 km north of Sand River No well defined water courses near mine property, except for natural pans, constructed water courses and evaporation dams (Wolwepan is approximately 0,75 km west) Area situated on a very wide, flat watershed – difficult to define Defined as an ineffective/enclosed drainage basin, with no runoff reaching the river system Maximum borehole yield – 2 litres/second – low potential for exploitation of groundwater for irrigation purposes Site 3: ± 7 km north of Sand River Area drains south into the Sand River 	3	2	4	1

EMF/SEA/SA appraisal framework for Harmony sites					
Sustainable Development Objectives	Baseline Information Summary	Potential Impact (Rank)		Commentary	
		Least Negative	Most Negative		
To improve the quality of surface and groundwater	<p>Site 4:</p> <ul style="list-style-type: none"> ± 4 km north of Sand River This area is located in draining area C340 according to DWAF's numbering system and drains south into the Sand River 	↑	Most Negative		
	<p>Site 1:</p> <ul style="list-style-type: none"> ± 3 km NNE of Mahemspruit Potential of contamination of Mahemspruit to the south <p>Site 2:</p> <ul style="list-style-type: none"> Sand River ± 8km to the south Surface water (SW) - Run off would flow W towards Rietpan/Wolwepan where it is contained – very poor water quality in this pan complex Impacts on surface water are limited to the contamination of water in pans and artificially created evaporation areas Groundwater (GW) movement restricted to vleis and pan systems & follows surface topography, however large potential for groundwater to be contaminated by polluted seepage from evaporation facilities <p>Site 3:</p> <ul style="list-style-type: none"> ± 7 km north of Sand River SW – Site 3 has an impact on the water quality in the catchment areas because of recycling of water during mining operations GW – movement restricted to vleis and pan systems & follows surface topography, however large potential for groundwater to be contaminated by polluted seepage from evaporation facilities <p>Site 4:</p> <ul style="list-style-type: none"> SW – Site 4 has an impact on the water quality in the catchment areas because of recycling of water during mining operations. High TDS concentrations GW – Mining activities had a greater effect on the shallow groundwater system than on the deep aquifer 	3	4	1	
			2		
					Suggest to go for a highly impacted area in order to obtain improvement (Willem Grobler)

EMF/SEA/SA appraisal framework for Harmony sites

Sustainable Development Objectives	Baseline Information Summary	Potential Impact (Rank)				Commentary
		Least Negative	↑	Most Negative		
To improve ecosystem productivity and functioning	<ul style="list-style-type: none"> Water quality varies from "background" to "contaminated" water quality 	1	4	3	2	Suggestion to rank all equal (Willem Grobler) Sites 1 & 3 - are natural catchment area used as mine water facilities. Therefore it could be viewed as higher risk areas (Debbie Benson).
		<ul style="list-style-type: none"> Site 1: <ul style="list-style-type: none"> Dominant species is <i>Themeda triandra</i> (Red grass) Karoo bush type veld Ecosystems have been impacted by mining and surrounding activities - ± 80% of proposed area is impacted Site 2: <ul style="list-style-type: none"> Dominant species is <i>Themeda triandra</i> Ecosystems have been impacted by development and surrounding activities - 40% of proposed area is impacted Certain areas are developing wetland characteristics due to impoundment of water (negligible) Site 3: <ul style="list-style-type: none"> In terms of natural vegetation the dominant species is <i>Themeda triandra</i> No endangered or rare species recorded Ecosystems have been impacted by mining and surrounding activities - ± 60% of proposed area is impacted Site 4: <ul style="list-style-type: none"> Dominant species of veld type in this area is <i>Themeda triandra</i> Ecosystems have been impacted by mining and surrounding activities - ± 50% of proposed area is impacted Reduced habitat for wildlife, but indigenous species will re-establish themselves in their natural habitat as mining activities reduce in each area 				

EMF/SEA/SA appraisal framework for Harmony sites			Potential Impact (Rank)	Commentary
Sustainable Development Objectives	Baseline Information Summary			
		Least Negative	Most Negative	
		↑		
		2,3,4 all equal, 1		
	<p>Site 1:</p> <ul style="list-style-type: none"> Sungazer lizards (<i>Cordylus giganteus</i>) are present nearby Animal life limited – meerkat (<i>Suricata suricatta</i>), guinea-fowl (<i>Numeda Meleagris</i>) <p>Site 2:</p> <ul style="list-style-type: none"> No rare or endangered species recorded Most of natural vegetation has been destroyed and alien vegetation introduced Dominant species – Highveld grassland Animal life limited – meerkat(<i>Suricata suricatta</i>), guinea-fowl (<i>Numeda Meleagris</i>) <p>Site 3:</p> <ul style="list-style-type: none"> No endangered or rare species recorded <p>Site 4:</p> <ul style="list-style-type: none"> Animal life limited – meerkat (<i>Suricata suricatta</i>), guinea-fowl (<i>Numeda Meleagris</i>) Most of the large mammal species do not occur in the area Animal life limited – meerkat (<i>Suricata suricatta</i>), guinea-fowl(<i>Numeda Meleagris</i>) No endangered or rare species resident in the area, according to CITES lists 		<p>Site 1 - Sungazer lizards (<i>Cordylus giganteus</i>) near site (Sungazers are a CITES species, listed in the South African Red Data Book - Reptiles and Amphibians - http://www.nasmus.co.za/HERPETOL%5CSungazer.html)</p> <p>Site 3 - Was natural vle area/catchment area (Tommie Barnard)</p>	
To improve species diversity				
Social				
To reduce levels of poverty	<p>Generic:</p> <ul style="list-style-type: none"> African youths are the largest population group and the most disadvantaged. There is an inherent lack of skills particularly amongst the African and coloured youth, which leads to high unemployment amongst these groups. 		All equal	
To improve equal opportunities	<p>Generic:</p> <ul style="list-style-type: none"> In 2001, 36% of all males in Matjhabeng LM were employed, while only 17% of females were employed. 		All equal	

EMF/SEA/SA appraisals framework for Harmony sites						
Sustainable Development Objectives	Baseline Information Summary	Potential Impact (Rank)			Commentary	
		Least Negative	↑	Most Negative		
To improve living conditions	<p>Site 2:</p> <ul style="list-style-type: none"> Hostels available for labourers and rental houses for the public <p>Generic:</p> <ul style="list-style-type: none"> In 2001, 62.35% (80 255) of the population in the Matjhabeng LM had a flush toilet sewer, 10.2% (13 189) of the population used a pit latrine, and 16.18% (20 826) used a bucket latrine. Approximately 36.89% of the population are living in informal settlements. Some mines supply a limited amount of housing facilities and hostels for accommodation. The mining townships of Allanridge and Nyakallong are permanently established and declared by ordinance, and will remain after mine closure. In 1997, housing in the Welkom area included 12 208 houses/dwellings, 236 blocks of flats/hostels, 3 896 flats/hostel units. Most of Freegold's mine's hostels have closed down, only are 3 estimated to be operational. Freegold's facilities and infrastructure that can be reused by other users after the mine's closure will not be demolished. Saaiplaas in Ward 11 is planned to expand to the east 	3	2	1	4	Site 3 - Least residential
	<p>Site 2:</p> <ul style="list-style-type: none"> Hospital in proximity on mine property The urban mining population of Welkom, Odendaalsrus and Virginia is approximately 263 082 with a rural population of 1 644 487 (according to 1995 statistics). The population growth rate is approximately 4.6%. In 2001, 12.96% (33 383) of the population in Matjhabeng local municipality had pipe water in their dwelling, 46.56% (119 868) had access to water from their regional or local school, and 22.74% (58 548) 	3	4	2	1	<p>Link to air quality (4,3,2,1) Groundwater for domestic use (Debbie Benson)</p> <p>Look at areas where people are reliant on groundwater – e.g. no people in Site 3 area who's dependant on groundwater for domestic use (Debbie Benson)</p>

EMF/SE/SA appraisal framework for Harmony sites				
Sustainable Development Objectives	Baseline Information Summary	Potential Impact (Rank)		Commentary
		Least Negative	Most Negative	
To improve the health and safety working conditions	<p>had access to piped water in their yard.</p> <ul style="list-style-type: none"> Site 2: <ul style="list-style-type: none"> Hospital in proximity of mine property Site 2: <ul style="list-style-type: none"> Training centre and primary school on mine property Generic: <ul style="list-style-type: none"> 1.1% 14 year olds and 11% of 35 year olds without formal education. 71% of 14-year-olds and 50% of 35-year-olds had attained primary education 43.7% youths had some secondary education 19.4% of youths obtained matric 6.4% of all African and Coloured youths in the Free State have not received any schooling 	All equal		
To improve the education levels of the community and workforce	<ul style="list-style-type: none"> Generic: <ul style="list-style-type: none"> All sites have same infrastructure Between 15% and 20% of the Free State population makes use of library facilities St Helena gold mine has sporting facilities, clubs and a primary school – approx. 5km away. Welkom also provides recreation clubs with sporting facilities Facilities are in close proximity to mines Generic: <ul style="list-style-type: none"> Security facilities on mine property Generic: <ul style="list-style-type: none"> No known sites of archaeological and cultural interest Site 2 – Post Office, tourism potential, first gold mine and shaft in Goldfields (St Helena EMPR). 	All equal		<p>Site 2 & 3 - might have more use of infrastructure. Closer to existing facilities such as office blocks etc. (Ferdie Jordaan)</p> <p>Site 2 – might assist with regeneration of existing facilities at mine.</p>
To decrease crime in the community	<ul style="list-style-type: none"> Generic: <ul style="list-style-type: none"> Security facilities on mine property 	All equal		
To improve the cultural heritage status	<ul style="list-style-type: none"> Generic: <ul style="list-style-type: none"> No known sites of archaeological and cultural interest Site 2 – Post Office, tourism potential, first gold mine and shaft in Goldfields (St Helena EMPR). 	1, 3, 4 (All equal), 2		<p>Site 2 – Sensitive area; 1st gold mine in the Goldfields area (Eerstemyn) see St Helena EMPR.</p>
Economic				
To improve economic performance	<ul style="list-style-type: none"> Generic: <ul style="list-style-type: none"> No known sites of archaeological and cultural interest Site 2 – Post Office, tourism potential, first gold mine and shaft in Goldfields (St Helena EMPR). 	All equal		

EMF/SE/ISA appraisal framework for Harmony sites				
Sustainable Development Objectives	Baseline Information Summary	Potential Impact (Rank)		Commentary
		Least Negative	Most Negative	
	<ul style="list-style-type: none"> • Mining activities largest source of employment • Population growth rate has declined • Level of unemployment has decreased due to cut-backs and lack of growth on mines • The support industries for mining comprises the major field of economic activity in the area • Mining comprises 67.1% of the economic activity in the Goldfields area • The economy of the entire Free State is underperforming when compared to the national average – contributing only 5% in 2002. This can be attributed to the negative growth in mining. • The Mathjibeng LM economy is centered on mining activities, with 52% of the population working in the mining industry. • Welkom's economy is 53% based on mining, Odendaalsrus' 38% and Virginia 78%. Henneman is dominated by manufacturing 41%, agriculture 17%, trade 10% and finance 10%. • The economic over-reliance on the mining sector needs to be investigated and strategies are to be put in place by the municipality to address this issue. • Regional socio-economic structure highly dependent on mining. • Operational phases of mines have positive impacts on socio-economic structure of the areas, but are linked to the predicted life-span of the mine. • Closure of mine will have major impacts on regional economy. 	↑	Most Negative	
To improve the level of trade in the area	<p>Generic:</p> <ul style="list-style-type: none"> • Sites 2, 3 and 4 are situated approximately 4km south of Welkom and will thus create further jobs, which will increase trade in the area. • Only 10% of Welkom's economy is made up out of trade. 		All equal	
To improve SMME status in the	<p>Generic:</p>		All equal	

EMF/SEA/SA appraisal framework for Harmony sites						
Sustainable Development Objectives	Baseline Information Summary	Potential Impact (Rank)			Commentary	
		Least Negative	↑	Most Negative		
community	<ul style="list-style-type: none"> In 2007, Matjhabeng LM is set to implement a number of interventions to build the capacity of SMMEs, especially small-scale farmers (align with Comprehensive Agricultural Support Programme – CASP). 					
To promote efficient energy use and waste management	<p>Generic:</p> <ul style="list-style-type: none"> In 2001, 69 805 (54%) of the Matjhabeng local municipality use electricity for cooking, while paraffin is used second most by 39.6855% (51 080). In 2001, electricity is used by 65 915 (51.2%) of the Matjhabeng local municipality to cook, whereas paraffin is used by 41 749 (32.4%). In 2001, 89 956 (69.8%) of the Matjhabeng local municipality residents use electricity for lighting with 24 943 (19.37%) using candles for lighting. In 2001 most of the Matjhabeng LM residents have their refuse removed once per week (76.6%). 	3	2	4	1	<p>Will be the same for the water transportation.</p> <p>Site 3 is the closest to the proposed plant therefore less energy used in transporting water.</p>

APPENDIX D

TITLE	AUTHOR	DATE
Environmental Management Programme Report – St Helena Gold Mines	St Helena Gold Mines Limited	November 1994
Preliminary Report on detailed Rehabilitation Plan for the 1, 2 & 3 Tailings Dam Complex - St Helena Gold Mines	SRK Consulting	April 1999
Phase 2: Design of Detailed Rehabilitation Measures for Area G - St Helena Gold Mines	SRK Consulting	December 1999
Development of a Decision-making Methodology for evaluating Tailings Dam Rehabilitation Options against Tailings Disposal Capacity Requirements	SRK Consulting	May 1997
Geohydrological Investigation – Saaiplaas/Masimong Area	Bokamoso	February 2004
Saaiplaas/Masimong Environmental Management Programme	Harmony Gold Mining Company Limited	March 2002
JMS Remediation Project – Draft Phase 2 Report	Anglogold	2001
Environmental Management Programme Report submitted to the Department of Minerals and Energy for the Mine known as ARM 4	African Rainbow Minerals and Exploration	November 1998
Freestate Goldfields and Lower Vet River Catchment: Development of a Water Management Plan	Department of Water Affairs and Forestry	January 1997
Assessment of the Impact of Agricultural Practices on the Quality of Groundwater Resources in South Africa	Water Research Commission	1999
Environmental Management Programme Report – Loraine Gold Mines	Avgold - Loraine Gold Mines	February 1997
Environmental Management Programme Report – Target Division	Avgold – Target Division	December 1998
Water Use License Application for Doringpan	IMBEWU Enviro-legal Specialists	September 2002
Environmental Management Programme Report – H J Joel Gold Mining Company Limited	H J Joel Gold Mining Company	October 1996
Environmental Management Programme Report – Unisel Gold Mines Limited	Unisel Gold Mines Limited	June 1994
Mining Authorization Application for properties situated in the magisterial district of Virginia and EMP	Harmony Gold Mining Company Limited	July 2002

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REPORT ON

FINAL SITE EVALUATION REPORT TO INFORM THE TAILINGS STORAGE FACILITY (TSF) SITE SELECTION PROCESS AT HARMONY GOLD MINES, WELKOM

Report No: 8788-8907-40

Submitted to:

Harmony Gold Ltd
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Randfontein
1760

DISTRIBUTION:

2 Copies - Harmony Gold Ltd
2 Copies - Golder Associates Africa (Pty) Ltd

31 January 2008

8788-8907-40

Directors : FR Sutherland, AM van Niekerk, SAP Brown, L Greyling, SM Manyaka



LOCAL OFFICES IN DURBAN, FLORIDA, JOHANNESBURG, KIMBERLEY, PIETERMARITZBURG AND PRETORIA
GOLDER COMPANIES LOCATED IN GHANA, MOZAMBIQUE, ASIA, OCEANIA, EUROPE, NORTH AMERICA, SOUTH AMERICA

EXECUTIVE SUMMARY

Harmony Gold Mining Company Limited commissioned Golder Associates Africa to undertake a site selection process to inform the Environmental Impact Assessment (EIA) of possible impacts and positioning of a new Tailings Storage Facility (TSF) within the Welkom region.

A Steering Committee with a diverse representation, including regulators, was established. The idea being that this committee would guide the site selection process, through the provision of relevant and updated information. Three Steering Committee meetings were held in total. At the first two meetings, four sites were selected as potential options upon which to construct the new tailings facility (report number 8788/10160/12/E):

Site 1: Rietpan (farm Rietpan 17) – now called Nooitgedacht

Site 2: St Helena (farm St Helena 42)

Site 3: Stuurmanspan (farm Stuurmanspan 92)

Site 4: La Riviera (farm La Riviera 289).

Additionally, following initial engineering design, it was requested that two potential sites favoured from an engineering perspective (Dankbaarpan and Free State North 5) also be evaluated as part of the site selection process.

Consequently, a third, and final, Steering Committee meeting was convened on the 25 October 2007 where the above six sites were revisited. During which the previous site selection findings were discussed and an optimal site selected.

Nooitgedacht was agreed upon as the preferred site for the TSF (as agreed by the Steering Committee). The proposed footprint is largely brownfields with a partial greenfields take. There are existing tailings facilities in the vicinity which may provide the opportunity for additional disposal. The resultant negative impacts on agriculture and ecosystems are considered to be negligible, but outweighed by the positive attributes of the site.

Stuurmanspan is the next preferred site. It is a brownfields site, which has already been impacted on by tailings facilities (namely Free State South 6, 7 and 8). There is also expected to be no additional impact on agricultural productivity.

Dankbaarpan was considered by the Steering Committee as fatally flawed, due to the potential impacts on the pan. The Steering Committee also indicated that Free State North 5 was too close to residential areas to be considered as a potential Tailings Storage Facility (TSF) site. Therefore these two sites were excluded from further assessment.

Following discussions, in order of preference, the sites for the TSF are:

1. Nooitgedacht,
2. Stuurmanspan,
3. La Riviera,
4. St Helena,
5. North 5 (excluded from further assessment) and
6. Dankbaarpan (fatally flawed).

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1 INTRODUCTION

Harmony Gold Mining Company Limited commissioned Golder Associates Africa to undertake a site selection process to inform the Environmental Impact Assessment (EIA) of possible impacts associated with a new Tailings Storage Facility (TSF) within the Welkom region. This report is the follow-up report to the initial SEA report (with report number 8788/10160/12/E) which sets out the initial approach.

Three Steering Committee meetings were undertaken in total. At the first two meetings, four sites were selected as evident in report number 8788/10160/12/E. This resulted in preferential areas identified for consideration, and ultimately resulted in the selection of the four potential sites for further evaluation (in no preferential order):

Site 1: Rietpan (farm Rietpan 17) – now called Nooitgedacht

Site 2: St Helena (farm St Helena 42)

Site 3: Stuurmanspan (farm Stuurmanspan 92)

Site 4: La Riviera (farm La Riviera 289).

In addition, following initial engineering design, it was requested that two potential sites favoured from an engineering perspective (Dankbaarpan and Free State North 5) also be evaluated as part of the site selection process.

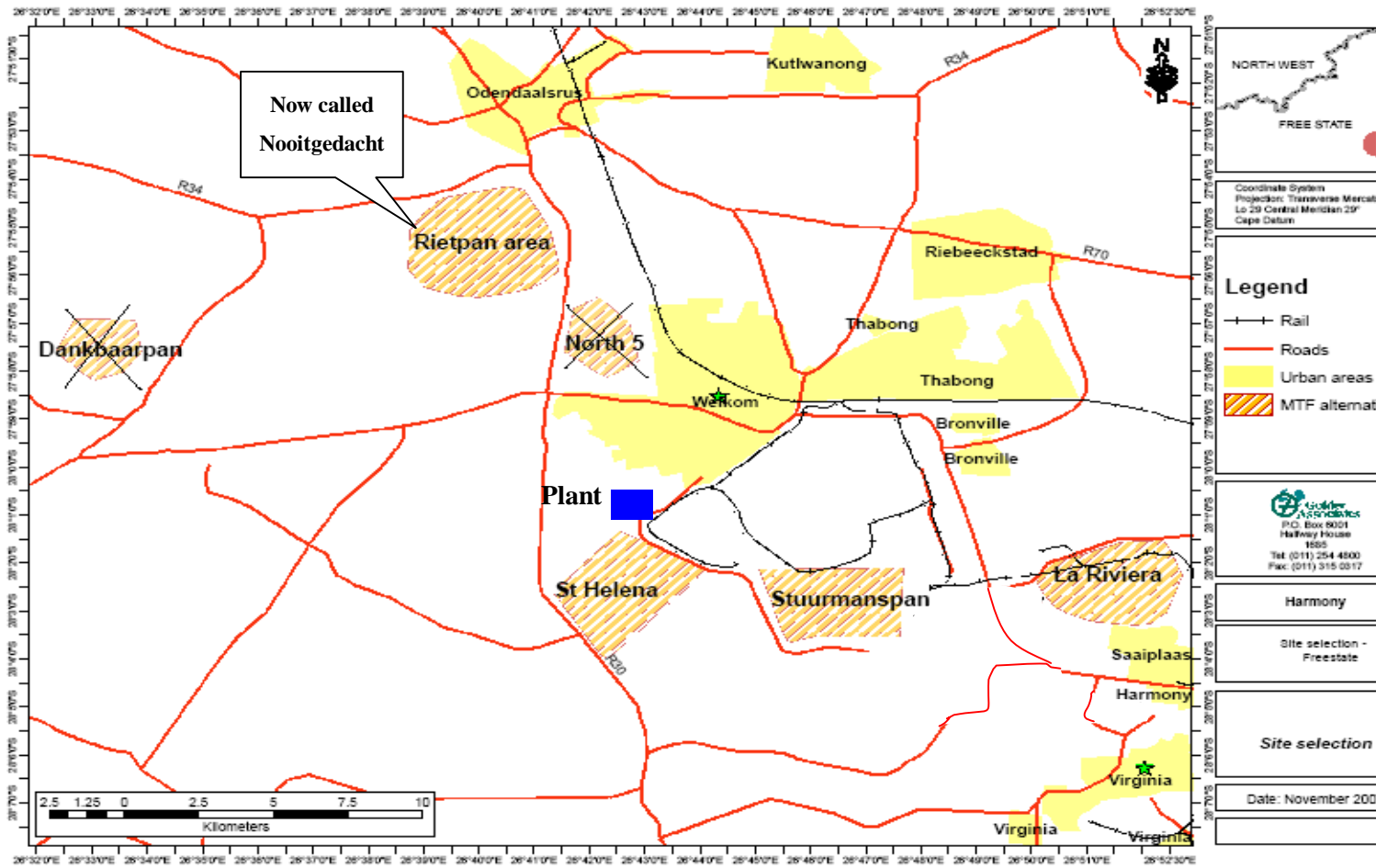
Therefore, a third, and final, Steering Committee meeting was convened on the 25 October 2007 through which the above six sites were revisited (see Figure 1), and during which the previous site selection findings were discussed and an optimal site selected.

1.1 Structure of this report

The structure of this report is as follows:

- **Section 2: Outline of the site selection approach**
- **Section 3: Summary of the key results of the assessment**
- **Section 4: Conclusion**

Figure 1: Locality map of the six sites



2 ASSESSMENT OF SITE OPTIONS

During the third Steering Committee meeting (25 October 2007) spatial and contextual information pertaining to the six sites was presented to the Committee. Using background knowledge from the previous Steering Committee meetings, and personal expertise, the committee discussed the suitability of each site to accommodate a tailings facility against a number of previously determined themes (Report 8788/10160/12/E). Professional judgement was used in determining the site, but not all themes were considered equal, those with the potential to result in a fatal flaw or significant impact were given higher priority (e.g. impacts to water). Where sites were considered fatally flawed by the Steering Committee, these were no longer considered as an option.

3 RESULTS OF ASSESSMENT

The final results of the site selection process, following the third Steering Committee meeting, included the strategic assessment and the site options assessment. The results in this report differs from the original SEA report as more information came to light as additional steer committee members attended the 3rd meeting. These are detailed below.

Table 1: Overview of assessment of site options against sustainability criteria

Preferred site (least - impact)

Intermediate site

Worst performing site (most - impact)

Sustainability	Sites						
	Nooitgedacht	St Helena	Stuurmanspan	La Riviera	Dankbaarpan		
Biophysical							
Air Quality	C	B	B	A	Fatally Flawed	Site excluded from further assessment	
Agricultural Productivity	A	B	B	C			
Water Quantity	A	B	A	B			
Water Quality	A	B	A	B			
Ecosystem Productivity	A	C	B	B			
Species Diversity	A	B	B	B			
Social							
Poverty Levels	A	B	B	B	Fatally Flawed	Site excluded from further assessment	
Equal Opportunity	A	A	A	A			
Living Conditions	A	B	B	B			
Health	B	B	B	B			
Health & safety at work	B	B	B	B			
Education	B	B	B	B			
Infrastructure use	A	A	A	A			
Crime	B	B	B	B			
Cultural Heritage	A	C	A	A			
Economic							
Economic	B	B	B	B	Fatally Flawed	Site excluded from further assessment	
Economic Performance	B	B	B	B			
Level of trade	B	B	B	B			
SMME Status	B	B	B	B			
Energy efficiency & waste management	B	A	A	B			
Ranking							
A	10	3	6	4			
B	9	15	14	15			
C	1	2	0	1			

In differentiating the sites, the outcomes from a socio-economic perspective were largely equal. Consequently, the ultimate selection of the sites was primarily influenced by the potential impacts on the environment. However, living conditions, community health and cultural heritage did contribute to the selection process.

In line with the 10 key themes (Table 1 from the SEA report), wind direction was taken into account as an influence on air quality, as well as brownfield sites to limit greenfield land take, which could impact on agriculture or ecosystem function. Proximity to the Sand River and clean water systems were also considered for potential impacts on water quality and quantity.

In order of preference, as apparent from Table 1, the selected sites for the TSF are:

1	2	3	4	5	6
Nooitgedacht	Stuurmanspan	La Riviera	St Helena	North 5 (Excluded for further assessment)	Dankbaarpan (Fatally flawed)

3.1 Site Options Assessment

Each of the six sites were assessed in relation to their location and likely impacts, as well as proximity to the tailings processing plant (see **Figure 1**). Engineering factors were also considered in the site selection process which influenced the final decision on a site location. The outcome of the detailed site assessment of each site is summarised below.

3.1.1 Site option 1: Nooitgedacht

Although Nooitgedacht (see **Figure 1**) was the fourth ranked site in the previous round of the site selection process, the Steering Committee was in favour of this site as the ideal position for a tailings facility. In terms of the water quantity and quality themes which were rated as “poor” in the SEA report, the DWAF mentioned that this site is actually more suitable for this purpose than the other candidate sites as it is not located close to a major water source.

The proposed footprint is largely brownfields with a partial greenfields take. There are existing tailings facilities in the vicinity of this site of which the footprints may be considered for disposal of tailings. It was indicated that this area has low agricultural potential resulting in a lower land value than elsewhere in the Welkom vicinity. Therefore resultant negative impacts on agriculture and ecosystem are considered to be negligible. The site performs favourably from a water quality perspective in that it is situated a significant distance from the Sand River and is unlikely to impact on any clean water systems. This option was also supported in terms of an engineering perspective.

Situated to the North West of Welkom, the prevalent winds may transport dust across the main residential areas, however mitigation measures to suppress dust will be identified in the EIA. The

Sungazer Lizard (*Cordylus giganteus*) a red data species, is known to reside in close proximity to the existing tailings facilities and activities associated with the proposed TSF are likely to impact upon this species. However, these lizards were previously re-located from another site and a similar process is expected to be followed to relocate them once more.

3.1.2 Site option 2: Stuurmanspan area

This site (see **Figure 1**) is the second choice site. Stuurmanspan is a brownfield site, which has already been impacted by tailings facilities (namely Free State South 6, 7 and 8). Therefore there is expected to be no additional impact on agricultural productivity. Previously a drainage canal passed through this site, which is now heavily impacted on by mining and has resulted in the ponding of polluted water. The availability of this dirty water will support the tailings re-processing and may provide an opportunity to improve its quality through treatment and re-use. The Stuurmanspan area is in close proximity to water resources from which water management will take place (the so called 12 ABC system) and the proposed processing plant. Energy use associated with pumping tailings and water to and from this site will therefore be relatively low in comparison to energy use at the other sites. Stuurmanspan has limited residential areas surrounding it, limiting the potential impacts of dust, noise and visual intrusion on the living conditions of neighbouring population.

The site performs poorly from an ecosystem productivity perspective, as it is in close proximity to a mine-induced artificial wetland. However, this wetland is not of high value, since it is anthropogenic and due to the polluted nature of the surroundings and the water quality itself. Local winds blow in a North-Westerly direction which may blow dust across the northern parts of Virginia. The impact assessment will need to address these aspects in more detail and suggest mitigation measures if this site is to be taken forward into the EIA.

3.1.3 Site option 3: La Riviera

La Riviera (see **Figure 1**) situated to the South East of Welkom/Thabong is likely to have the least impact on air quality, particularly wind blown dust. Prevalent wind directions are likely to blow dust to the West and away from the main residential areas.

The majority of the site is brownfields (approximately 50%); however land take will include a portion of prime agricultural land to the south west used for grazing and crop farming. La Riviera is in close proximity to the urban areas of Saaiplaas and Harmony, and the resultant impacts on living conditions of these areas will need to be addressed in any subsequent environmental assessment process.

3.1.4 Site option 4: St Helena

St Helena (see **Figure 1**) has approximately 40% of the proposed footprint impacted and therefore the site scores poorly from an ecosystem perspective due to Greenfield land take. Additionally, certain areas are developing wetland characteristics due to the impoundment of water, which may increase the ecosystem potential in the future. Historically the area was used for grazing and cropping, and the

remaining 60% of the site is used for agriculture, which would be lost should this be the selected site. St Helena has cultural/historical importance in that it was the first gold mine in the Free State area (Eerstemyn); the area has been earmarked for a tourism development associated with these historical aspects.

3.1.5 Site option 5: Free State North 5

North 5 (see **Figure 1**) was evaluated as a site for the TSF; however its proximity to residential areas (approximately 200m) excluded this site from the selection process.

3.1.6 Site option 6: Dankbaarpan

Dankbaarpan (see **Figure 1**) was immediately fatally flawed by the Department of Water Affairs and Forestry due to it being situated directly on a pan. This option was not evaluated further.

4 CONCLUSION

The quality of surface and ground water is a contentious issue in all six areas under consideration. At St. Helena, the Stuurmanspan area and La Riviera the Sand River flows to the south, and the Mahemspruit which is already heavily polluted flows to the south of Nooitgedacht. Further studies need to be undertaken on water quality and the impacts the selected site might have on the water regime. It is a prerequisite of Department of Water Affairs and Forestry (DWAF) that any new tailings facility have a liner system before they give permission for construction. However, in the Nooitgedacht area it was agreed that an alternative engineered option may be considered i.e. herring bone system, clay liner etc. and additional studies contained in the EIA should address these.

The site selection process, although limited by available information, provides the basis upon which the preferred site can be reasonably determined. Nooitgedacht site (the preferred option) will be further assessed during the subsequent environmental impact assessment (EIA) to ascertain if any fatal flaws exist, should this be the case this site selection process will be revisited and the next best option taken forward. Information gathered during the site selection process will inform the EIA and highlight areas for consideration and mitigation.

GOLDER ASSOCIATES AFRICA (PTY) LTD

Pieter de Villiers

Nigel Beck

G:\PROJECTS\8788 - HARMONY MEGA SLIMES DAMS\WELKOM SEA-EMF\SEA-STAGE III\SEAIII SITE SELECTION REPORT\8788-8907-40-HARMONY MTF-SITE SELECTION REPORT-WELKOM-FINAL-JANUARY 2008.DOC

APPENDIX A



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Harmony Gold Mining Ltd
SEA/EMF AS PART OF HARMONY WELKOM MEGA TAILINGS FACILITY (MTF)
SITE SELECTION PROCESS
THIRD PROJECT STEERING COMMITTEE MEETING
Date: 25 October 2007; Venue: Harmony Boardroom, Virginia
Project No : 8788

			ACTION
1.	Present		
	Nigel Beck	Golder Associates	NB
	Pieter de Villiers	Golder Associates	PdV
	Mari Prinsloo	Golder Associates	MP
	Phildrè Lotter	Golder Associates	
	Debbie Benson	Harmony Gold	DB
	Johann Mouton	Harmony Gold	
	Lebohang Shabe	Harmony Gold	
	Gerrit Weideman	Harmony: Property	GW
	Hennie Greyvenstein	Harmony: Radiation	
	Ross Cooper	Jones and Wagner	RC
	Stoney Steenkamp	Sedibeng Water	SS
	Willerm Grobler	DWAF: Free State	WG
	Gibson Tshisikhawe	DME: Welkom	
	Johan Zeelie	Department of Agriculture (National)	JZ
	Koos Duvenhage	Matjhabeng Local Municipality (Town Planning)	KD
	George Manzini:	Matjhabeng Local Municipality (Town Planning)	
	Ian Auret	FGF Business Chamber	IA
	Lennox Long	Agri 24: Welkom	LL
	Tranzer Mtebele	Lejweleputswa Development Agency (LDA)	
	Notes of Proceedings:		
2.	Welcome and Objectives		
	NB welcomed everyone present and explained the objectives of the meeting.		
	PdV provided feedback on the SEA process thus far.		
3.	Discussion		
3.1	Consideration of Dankbaar pan as MTF site alternative:		

		ACTION
	Dankbaar pan is a natural pan and a water resource. The proposal to construct the MTF on the pan is fatally flawed and the Department will not even consider it as an option. - WG, DWAF recommendation	
	NB and JM acknowledged this comment and indicated that Dankbaar pan will not be considered as a MTF option any more.	
3.2	Consideration of the SEA Site 1 as MTF site alternative:	
3.2	DB proposed that the <i>SEA Site 1 area and the farms to the west of it</i> , especially the Farms Jacobsdal, Goedgedacht and Nooigedacht, should be considered for the MTF site. 'Rietpan area' on attached map.	
	It will be possible to once more relocated the sungazer colony previously relocated from Dankbaar pan to Nooitgedacht. - DB	
	Future urban development is planned for the area east of the railway line between Odendaalsrus and Welkom. - KD	
	Future industrial development is also planned for the area west of the railway line between Welkom and Odendaalsrus , i.e. between the railway line and the R30 public road. - KD	
	<p>Pro's of Site 1 / area to the west ('Rietpan area')</p> <ul style="list-style-type: none"> • Far from rivers such as Sand river - WG • Not good agricultural land, at best grazing land – LL, JZ, WG • Considered to have reasonable geology (Karoo) - WG • RC indicated that given limited information it could be technically feasible and that it is probably the technically preferred site • The farmers in this area will probably sell their farms for the right price - JZ • No water servitudes are located on this site. Pipelines follow the Wesselsbron road – SS • Located approximately 11 to 15 km from the St Helena plant, which counts in its favour – DB <p>Con's of Site 1 / area to the west ('Rietpan area')</p> <ul style="list-style-type: none"> • Wind direction • Some small pans in the area need to be considered - WG • Involves property purchase (so does current Sites 2 and 4) – DB, GW 	Technical feasibility to be confirmed in further work.
	An alternative site was suggested to the southwest of Site 1 and this was supported by all present. It could mean that Site 1 itself is moved or that the geometry is changed to fall within farm boundaries. 'Rietpan area' on attached map.	
	By moving the MTF site a little southwest from Site 1 ('Rietpan area'), it will be further away from the proposed residential and industrial developments. – WG	
3.3	RC identified <i>two alternative MTF sites</i> ('Merriespruit Dams 4A and 4B) on the farms Video and La Riviera, situated between the SEA Sites 3 ('Stuurmanspan') and 4 ('La Riviera').	
	This proposal was considered fatally flawed based on proximity and drainage to the Sand river. - WG	
3.4	Why don't Harmony consider <i>using previous tailing dam footprints</i> , in stead of creating a MTF? - WG	
	This is being considered as a motivation for the project, but more than one dams are more expensive than one big dam and are also more onerous to manage from an environmental and closure perspective. - RC	

		ACTION
	Tailings dams North 4, Free State North 1, Free State North 2 and Free State North 3 only provides adequate space for tailings from St Helena, but not from Saaiplaas and other current operations which will be out of tailings capacity in years to come. - RC	
	Harmony will need the capacity of a MTF in future. - JM	
	The option exists to split gold and uranium-rich tailings. Smaller footprints such as North 4, 5 and St Helena 1, 2 and 3 could be considered for storage of Uranium rich tailings in order to ensure that these tailings are not sterilised by mixing it with the barren gold tailings. This is part of the technical consideration. - RC	
	Another potentially viable alternative for technical consideration, with some further footprint expansion on this site, would be SEA Site 2. - RC	
3.6	Consideration of the North 5 tailings dam as MTF site alternative	
	<p>North 5</p> <p>Pro's</p> <ul style="list-style-type: none"> • Could consider as additional footprint if more deposition land is needed – DB • Reusing existing footprints is opportunity for mine to fund the rehabilitation of the footprint out of production costs – WG • This area has no agricultural potential – JZ • A well-managed slimes dam creates less dust than a open moonscape (i.e. reclaimed footprint) - WG <p>Con's</p> <ul style="list-style-type: none"> • Will have to be lined after area is cleaned and prior to new tailings deposition (a clay lining might be appropriate) – WG • Appropriate management (cut-off trenches etc.) to manage water run-off / drainage to Mahemspruit will have to be considered - WG • Possible sale of mine property in close proximity and impact of this - DB • Residential areas are located approximately 200 m from this site – DB, RC • Reusing existing footprints is not an economically feasible option – JM 	
3.3	Harmony should stay away from areas with high agricultural potential, since this is where land is more expensive. - IA	
	<p>Cost of land in the area (LL, JZ)</p> <ul style="list-style-type: none"> • Arable land – R 27,000.00 / ha (eg. Near Bultfontein) • Grazing – R 12,000.00 / ha (eg. Near SEA Site 1) 	Note
3.4	It was proposed that the SEA Site 3 ('Stuurmanspan') should be considered as an option 2. - MP	
	Stuurmans pan is not technically feasible. - RC	
3.5	DWAF's best practice guidelines for tailings dams is now available (not officially published yet). WG will forward it to DB.	Note
4	Conclusion	
4.1	All present indicated they are comfortable with the 'Rietpan area' (or the area to the west / south-west of this site) as the new preferred MTF site. This site will be taken forward in the technical investigations. - NB	

		ACTION
	All agreed that a site visit should be arranged to the SEA Site 1 with all present as soon as further technical work has confirmed suitability of this site.	Golder to arrange after technical outcome

DATE: 25 October 2007

SIGNATURE:

GOLDER ASSOCIATES AFRICA (PTY) LTD

MP

G:\Projects\8788 - Harmony Mega Slimes Dams\Meetings and Minutes\8788-SEA-Project Steering Committee Meetings\8788-SEA-PSC Meeting 3-25 October 2007\8788-Minutes-Welkom PSC Meeting III-25 Oct 2007.doc



Coordinate System
 Projection: Geographic
 MGRS: 34

Legend

- Site alternatives
- Free State Harmony fallings dams.

Grey scale showing:

- Population >200
- Urban areas
- Inland water
- Fauna
- Geology
- Land cover (urban, commercial & industrial)
- Sand river

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Harmony

Harmony Free State EMF

Date: November 2007

Grey scale

