A WIN-WIN SOLUTION FOR MINE WASTE CLEAN-UP:

The remediation of mine contaminated sites, the recovery of metals, prevention of water pollution and job creation

Report to the
Water Research Commission

by

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Mr Lucas Moloto	West Rand Community representative
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Mr John-Mark Killian and Mr Lerato Molefe	Umsizi Pty Ltd
Dr Christo Marais and Dr Guy Preston	Department of Environmental Affairs

Executive Summary

Over 120 km of the Witwatersrand is affected by the legacy of gold mining. Many dumps have been reprocessed and are being reprocessed but the roots of the dumps are left behind causing continuous pollution. The mine dump residue continually drips acidic water into the Witwatersrand catchments impacting on the Vaal- and Crocodile River systems. The underlying and adjacent soil is contaminated with heavy metals and the dust from the mine dump residue impacts on the people living next to the dumps. Most of the mining companies that created the dumps have closed and the responsibility for clean up is now with the Department of Mineral Resources (DMR). The cost of clean up of all mine dumps using conventional methods has been estimated by the United Nations as US$6bn.

To stop the continual pollution of the waterways and to improve the health of the people affected by the dump residue, the WIN-WIN team approached the WRC to fund a feasibility study for the clean-up of the dump areas by a women-headed and women-driven team. A leading objective was to create employment and opportunities for entrepreneurship. At first the project aimed to obtain funding from government but as the project developed, it discovered that there are enough remnant metals in the residue to enable sale of the clean-up materials to a mineral processing company. Often the biggest cost of clean up is disposal of the waste. The mineral processing company would process the residue and then dispose of the residue in a licensed and regulated mine dump at no cost to the WIN-WIN project.

The sale of the residue enables self-funding of the project and investment in the training and development of the communities driving the clean-up. The model used for Working for Water (WfW) has been imitated and WIN-WIN builds on its experience in providing training, family planning support, income management support, health management and advice on creating small businesses. The WIN-WIN project concluded with an income forecast for the clean-up of a typical site.

An added advantage to clean up would be the possible ownership of the cleaned-up land by the people doing the clean-up. This can also create more opportunities for income generation and meets the government directives for land redistribution.

The conclusion of the WIN-WIN feasibility study is that it is economically viable for local communities to clean up mine residue with the creation of the following benefits:

- Air, water and soil pollution is reduced, and land made available for further rehabilitation
- Catchments are cleaned up and acid rock drainage arrested
- Employment is created and training is self-funded for the local communities
- Opportunities created for women and women-led development projects
- Health of nearby communities improves
- Land ownership offers opportunity for further community development
- A new model for clean up is created with the possibility of extension throughout Southern Africa.

The next step is to obtain seed funding to do the first clean up. There is already an agreement in principle for a mineral processing company to buy the mine residue at R50/t. Once the first site for clean up has been identified and evaluated the cost estimate and cash flow forecast will be reworked, seed capital obtained, and the site cleaned up.

Ten sites have been identified and will be evaluated for:

- Ease of access to a mineral processing plant and logistics
- Environmental assessment specific to each site
- Ease of clean up, accessibility of water and power
- Opportunity to acquire the land prior to clean up
- Ease of permit issue

- Accurate costing for the specific site
- Availability of funding for the first three months until cash flow is positive

Once a first site is cleaned up, the lessons learned will be used to design subsequent clean ups. A WIN-WIN model has been created to ensure as many people as possible benefit from the women-driven initiative to clean up each site. The success of the methodology can be expanded to other gold mining areas and aim to employ some 40 to 60 people per site and tackle 50 sites per year creating up to 3000 new jobs each year plus opportunities for entrepreneurship in newly cleaned-up areas.

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1 INTRODUCTION

The WIN-WIN project aimed to research the feasibility of a women-driven self-help initiative to clean up mine dump residue areas and remove the sources of pollution to streams, soils and air in the Witwatersrand. The Witwatersrand has over 100 years of mine dumps in various states of neglect. The companies responsible for the pollution are often long closed and neither the local municipalities nor government bodies have the resources required to move the dumps or rehabilitate polluted areas. This self-help project has been designed by women living in the area to plan and implement a strategy to remove mine dump residue where possible thus improving the environment and benefitting the health of local people. The improvement of the environment and reduction in ongoing pollution also benefits all South Africans using the downstream water and is therefore called the WIN-WIN strategy.

The project was divided into four tasks with specific objectives and deliverables. The tasks comprised:
1. Desk study
2. Liaison with stakeholders
3. Development of strategy
4. Reporting and Presentation

The aims of the project are:
1. Investigate feasibility of cleaning up soils and mine dump residue using community and private participation.
2. Determine interest, establish health and safety guidelines and get feedback from stakeholders. Investigate feasibility of the partnership.
3. Plan roll out of the pilot project.

The WRC became interested in the project because it met all the social and environmental objectives for research knowledge generated by the WRC including:
1. Human Capital Development in Water and Science Sectors
2. Empowerment of Communities
3. Transformation and Redress
4. Sustainable Development Solutions
5. Inform Policy and Decision Making
6. New Products and Services for Economic Development

There has been a ground-swell of interest in the project. All the stakeholder departments and those concerned with the environmental health of South Africa have been positive and excited about the possibilities of the WIN-WIN solution to cleaning up mine residue pollution

The focus of WIN-WIN is on people helping themselves to create employment and opportunities by cleaning up and owning land that has been polluted by mine dump residue. Figure 1 shows the extent of the mine waste dump areas and the proximity of the informal settlements. This illustrates a significant problem but one that is twinned with great resources of a willing workforce and desire to improve the environment.

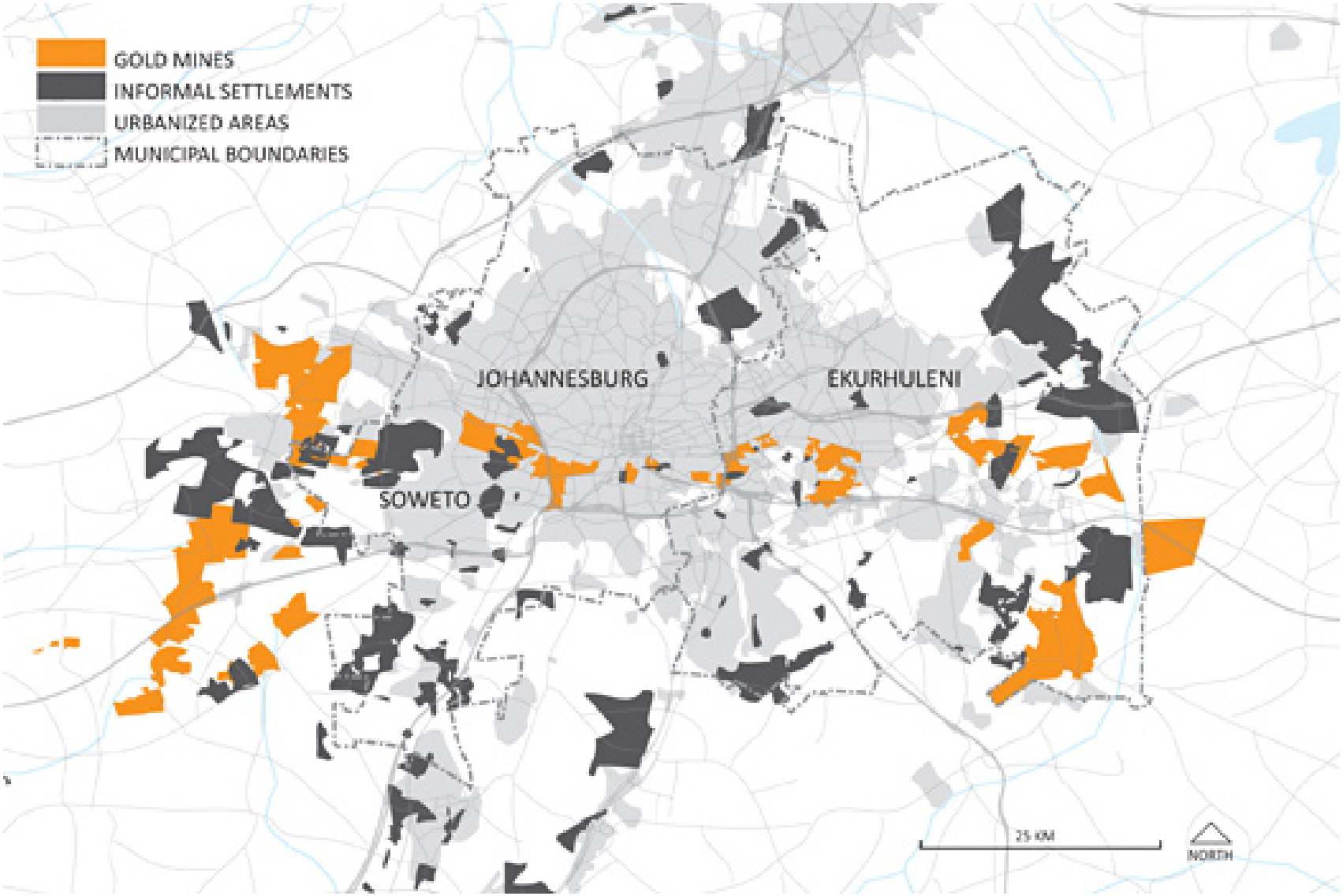

Figure 1: Gold mine areas and informal settlements (Tang and Watkins, 2011)

The dumps continually pollute the soils, surface water and ground water through seepage. This pollution affects all users of the land and drinking water. Until the land is cleaned up the pollution continually affects the local people through dust and acidic water. Mrs Mariette Liefferink of the Federation for Sustainable Environment (FSE) has been encouraging the government and mining companies to clean up the dump sites for over 20 years. The FSE has specifically highlighted the high levels of contamination and radioactivity levels in areas such as Tudor Shaft and Robinson Lake. This project aims to evaluate the feasibility of self help clean up and at the same time generate employment.

The mine dumps were created by gold mining and range in age from over 100 years to recent. Modern dumps have been regulated and are designed to minimise pollution. Since 1970 some dumps have been re-mined and are in various states of abandonment. About 33 of the very old dumps have been reprocessed by MINTAILS, an Australian listed mineral processing company. MINTAILS were given the rights to reprocess the dumps conditional that the land beneath the dumps was rehabilitated. MINTAILS used hydraulic mining and pipelines to remove the bulk of the mine dumps leaving the bottom of the dumps behind and no rehabilitation. MINTAILS is now no longer operating and has left behind many sites of partially cleared mine dumps.

Prior to re-mining, the dumps had been mostly stable and some were vegetated. The partial removal of the dumps has increased the pollution of the surface water and aquifers by acid rock drainage. Wind action creates dust pollution spreading the mine residue downwind and making it difficult for people to breathe. Each time rainfall occurs on the mine dump residue the metals and salts in the dumps are remobilised and pollute the downstream aquifers and streams.

Figure 2: shows the creation of acid rock drainage and equation 1 shows the reaction that continually occurs with each rainfall event.

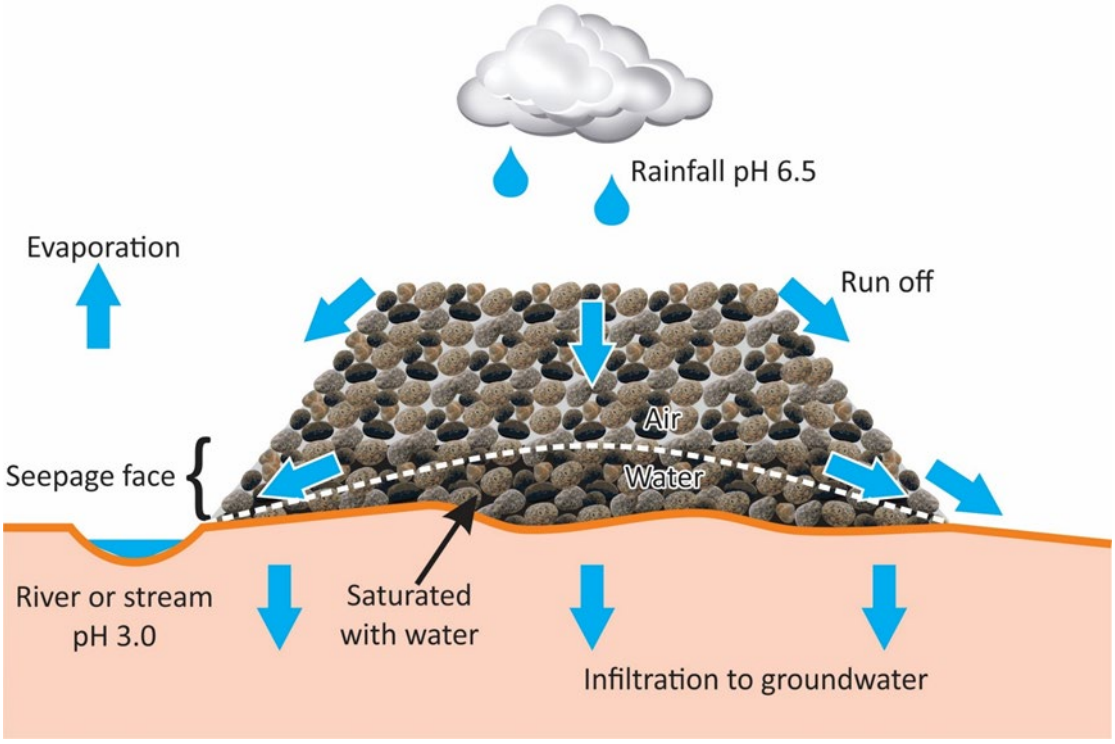

Figure 2: Acid rock drainage

Equation 1

Oxidation of Pyrite in the dumps

$$FeS_{2(s)} + \frac{7}{2}O_2 + H_2O \rightarrow 2SO_4^{2-} + Fe^{2+} + 2H^+$$

Pyrite + Oxygen +Water →Sulphuric Acid + Iron² + Hydrogen

The West Rand has a very high concentration of areas contaminated by the residue from reprocessed mine dumps. Typical metals are Arsenic, Cobalt, Copper, Gold, Manganese, Silver and sulphates. Figure 3 shows a typical area where a thick skin of mine dump residue has been left behind after the main mine dump has been removed.

Figure 3: Chamdor mine dump residue (Credit: Federation for a Sustainable Environment)

This mine dump residue is difficult to clean up, so has been left behind by large-scale commercial mining. Its removal and clean up of the site requires small scale planning and lots of muscle power. The local communities are enthusiastic to use their energy to clean up the areas. The area has very high unemployment and there is opportunity to train and employ enthusiastic people to clean up and at the same time empower women to create wealth and entrepreneurial opportunities. The WIN-WIN team is formed of ladies from the Tudor Shaft area who are very keen to drive this initiative.

The focus of the WIN-WIN research was to investigate the feasibility of a self-help clean up. The project addressed:

- The scale of the opportunity
- Appetite in the community to clean up
- Opportunities and risks
- Legal and permit requirements
- Land ownership
- Financial constraints and possible sources of revenue

The research was inspired by the success of the Working for Water Programme (WfW), a 20-year success story, initiated by the Department of Water Affairs and Forestry, that creates employment for over 20 000 people countrywide to control invasive alien plants. The removal of these plants species improves the health of catchments. By using a similar model, WIN-WIN plans to clean up polluted areas. WfW is a government programme with an annual budget of ZAR2 billion. WIN-WIN explored the opportunity to fund the clean-up of mine residue using the sale of the residue to a mineral processing company.

2 WORK DONE

The project started with an understanding of the extent of the pollution created by mine tailings residue. Over 39 reports were obtained and sifted through for information, the bibliography lists the reports and includes reports done by the WRC on the magnitude of the problem (Hattingh et al., 2003 and Rosner et al., 2001). There are over 320 dumps in the Witwatersrand with at least 30 partially mined dumps in the West Rand available for labour-intensive clean up. The West Rand has some of the oldest dumps and pollutes both North- and South-flowing catchments. The FSE work has highlighted this area as very polluting and, in most need, of clean up. The ladies driving this initiative live in the West Rand and logistically it is the easiest place to start cleaning up. The reports on the mine dumps and water pollution have little information on specific sites and there are no epidemiological studies available to highlight the impact on people. However, many of the residents in the area complain about chest infections and ill-health. This is evident by standing on the dump areas and is well reported in the 2019 documentary *Jozi Gold*[1] by Sylvia Vollenhoven featuring Mariette Liefferink.

Table 1 lists results from a soil sampling programme done at Robinson Mine tailings by the Institute for Soil Climate and Water (Institute of Soil Climate and Water, 2018)

Table 1: Soil chemistry on West Rand – 27 Mar 2018, Robinson Mine Tailings

Elements		SANS	Sandy soil	Soil
	Units	LIMIT	F421	F422
Li	mg/kg		1.05	2.41
Be	mg/kg		0.06	5.14
B	mg/kg		0.52	0.69
Ti	mg/kg		17.7	19.8
V	mg/kg	150	4.79	8.79
Cr	mg/kg	6.5	19.24	150.18
Mn	mg/kg	740	40.14	220.9
Co	mg/kg	300	0.72	41.07
Ni	mg/kg	91	3.01	853.26
Cu	mg/kg	16	2.56	707.23

Elements		SANS	Sandy soil	Soil
	Units	LIMIT	F421	F422
Zn	mg/kg	240	3.83	351.32
As	mg/kg	5.8	17.06	1696.49
Se	mg/kg		0.21	0.9
Rb	mg/kg		0.67	2.66
Sr	mg/kg		1.56	14.8
Mo	mg/kg		0.41	1.82
Cd	mg/kg	7.5	0.01	0.93
Sn	mg/kg		0.12	2
Sb	mg/kg		0.06	0.43
Te	mg/kg		0.03	0.17

Elements		SANS	Sandy soil	Soil
	Units	LIMIT	F421	F422
Ba	mg/kg		7.51	1.49
La	mg/kg		4.95	33.07
W	mg/kg		0.01	29.06
Pt	mg/kg		0.01	0.19
Tl	mg/kg		0.01	0.04
Pb	mg/kg	20	4.08	22.52
Bi	mg/kg		0.26	0.86
U	mg/kg	10	0.57	35.43

[1] https://vimeo.com/338674319 (Password – Jozi123)

Although reporting on only three samples, the chemistry table reveals the high levels of Chrome, Nickel, Copper, Zinc, Arsenic, Lead and Uranium that can be found associated with mine residue. The high level of Uranium is associated with high levels of radioactivity (Liefferink, 2012).

All these metals can cause damage to health. The dust from the loose material is unpleasant to inhale and have been linked to respiratory disease (Liefferink, 2012). Not all the dumps will have the same concentration of metals. Over 100 years the techniques used to process ore have changed many times with modern methods extracting significantly more metals. Many of the dumps have been added too and the residue left at the base of the dump has been enriched with leached metals. The older residue dumps may have been leaching of the more toxic chemicals which have a short half-life. Therefore, each dump will have a unique chemistry requiring detailed sampling and evaluation of the specific dump prior to the design and implementation of any clean up.

WIN-WIN specifically targets clean up those dumps that have been reprocessed, leaving a skin of mine dump residue behind. Over 30 dumps have recently been reprocessed, leaving a skin of 1-2 m thick residue as well as spillage from pipeline leakages. Other dumps are being recycled, leaving some 150 sites suitable for hand clean up.

Figure 4 shows the mine dump residue from pipelines left behind by MINTAILS.

Figure 4: Tailings residue from pipelines on the West Rand.

From the research it became clear that over 120 km of Johannesburg/Witwatersrand is affected by pollution from tailings residue as shown in Figure 5. The biggest concentration is in the West Rand. Figure 5 shows the proximity of the municipalities to the goldfields and rivers. The colours show the levels of radiation measured by Du Toit et al. in 2007. The radiation highlights the location of the main dumps with the older dumps having more concentration of Uranium.

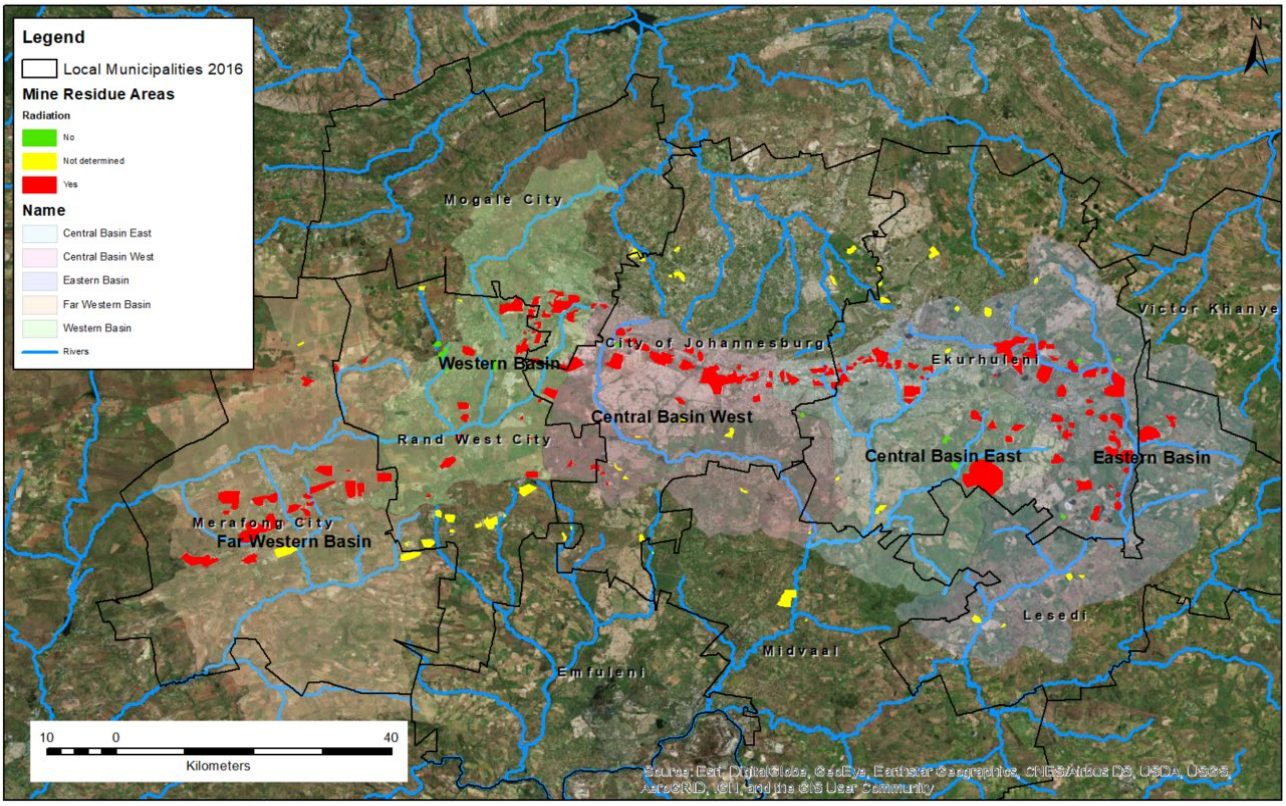

Figure 5: Proximity of municipalities to the Goldfields, rivers and basins (Adapted from Du Toit, 2007).

Radiation decays with time, however this will be proportionate, so 2017 figure will still be representative of the dump distribution in 2019.

Figure 6 is an orthogonal image of the dumps and residential areas around Tudor Shaft near Krugersdorp.

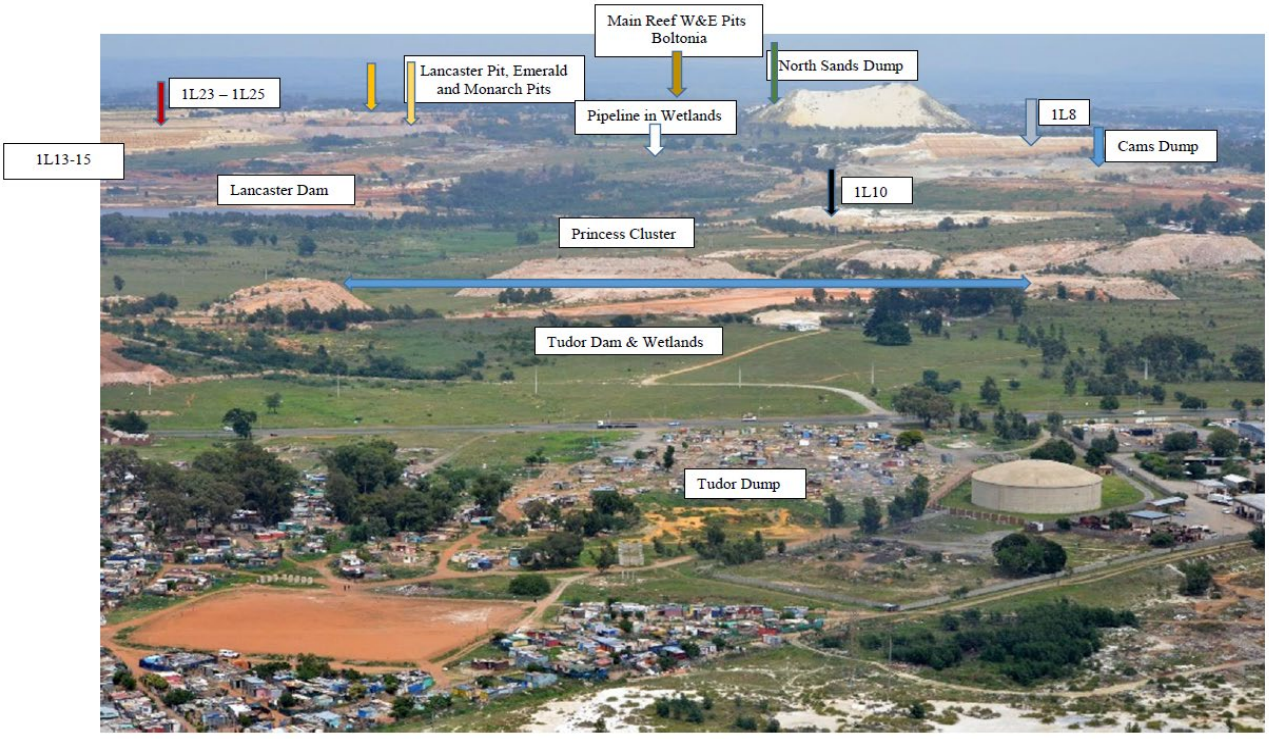

Figure 6: Tudor Shaft and mine dump areas (Federation for a Sustainable Environment)

Figure 7 shows the homes of people living on top of the old mine dump roots at Tudor Shaft informal settlement.

Figure 7: Tudor Shaft settlement (M Krog, 2007).

The United Nations estimated that to clean up all the mine dumps and mine dump residue along the Witwatersrand would cost US$6Bn (Verbal communication M Liefferink, FSE). The WIN-WIN project originally believed that clean up could be done by copying the Working for Water (WFW) programme and requesting funding from government. Research into the assay values available from mine dump residue showed that some of the tailings contain metals that can be extracted and therefore of interest to mineral processing companies operating in the West Rand.

The gold content in slimes is around 0.32 g/t and in sand between 0.6 to 0.8 g/t. Recoveries are approximately 45% to 50%, which means that about roughly 0.15 g/t could be recovered from slimes and around 0.4 g/t from the sand fraction (personal communication Chief Metallurgist, DRD Gold). The distribution of the grades is not uniform.

Because of the low yields in slimes, these are typically only viably mined or re-processed by way of high-pressure water jets and pumped for processing in slurry format to the plants. Coarser sand materials on the other hand are often mechanically moved, by way of loaders and trucks. Assuming a recovery of 50% from slimes with a concentration of 0.4 g/t, the revenue yield per tonne is around R105 per tonne of material processed if a gold price of R517,000 per kilogram is assumed.

Using the desk study information, we obtained an offer to purchase the cleaned-up tailings residue at R50/t from a mineral processing company based in the West Rand. This is now our recommended source of finance to fund the clean-up of land covered with tailings dump residue.

The advantage of processing by a registered minerals company is that the waste then becomes part of a new, formally registered and licensed tailings dam facility that will be managed, monitored and licensed correctly for many years without cost to WIN-WIN. The mineral processing company obtains points from the Department of Mineral Resources (DMR) for assisting new business start-ups, particularly women-led initiatives, therefore the mineral processing company is keen to help WIN-WIN establish and they will take on the liability of re-

depositing and maintaining the new slimes dams following reprocessing of the WIN-WIN collected mine dump residue.

WIN-WIN identified all the stakeholder and discussed opportunities and risks for clean up with:

- Residents
- Legal advisors
- Municipalities (Mogale city)
- Mineral processing companies
- NGOs and activists
- National Nuclear Regulator (NNR)
- Department of Mineral Resources
- Department of Environment
- Department of Water and Sanitation
- Possible investors
- Women's Development Bank
- Umsizi provided training in land management and entrepreneurial skills to the WIN-WIN team

Advice was obtained from the DMR, Department of Environment, lawyers and environmental specialists and the National Nuclear Regulator (NNR) on legal issues and permits required. The response was that each site must be evaluated case by case for its specific needs. The NNR explained there is a range of radioactivity levels throughout the West Rand and not all mine residue dumps need NNR authorisation. The issue of permits will require about R300 000 in legal and environmental assessment. For some sites requiring urgent clean up exemptions may be available which will then reduce the cost of permitting and authorisation. Once sites have been chosen the NNR and Municipality offered their help with listing specific requirements and guiding the permitting procedures.

3 OUTCOMES OF THE MEETINGS AND TRAINING

Every meeting was positive with everyone approached, without exception, agreeing that the community-driven clean up would be a WIN-WIN for everyone by:

- Creating employment
- Empowering women
- Alleviating poverty
- Employment of up to 5 000 people per year (based on 40 to 60 new jobs per site and 50 sites a year), opportunities for entrepreneurship and improved livelihoods
- Reduction in pollution of water, predominantly on the Wits watershed
- Clean up polluted land for the benefit of all
- Reduction in cost of water treatment in the Vaal system
- Civil society participation
- Emphasis on work for women and disabled
- Improvement in health of all living in the area

At the WIN-WIN workshop at the WRC the FSE raised the issue that when the slimes were removed the land would still require remediation. The WIN-WIN mine residue clean up is aimed at removing the slimes which causes the pollution. The type of remediation required for each site to remove pollution from ground, surface water and soils depends on the planned use for the land. For example; planned use as a landfill site requires a different remediation strategy than land planned for residential or market gardening. Planning for the West Rand is primarily managed by the municipalities. The clean-up for each site will require discussion with the municipalities including the type of rehabilitation available for each specific site. No new land use is possible

without the removal of the mine residue, therefore WIN-WIN addresses this first step towards improving the environment. Once cleaned up, the rehabilitation can be planned by the relevant stakeholders.

4 OPPORTUNITIES

From the discussions and research undertaken during the WIN-WIN project the main opportunities have been identified as:

- Imitate the success of the WfW programme by using their contract experience and providing the same support in training, social and health issues
- Use the value in the waste and create an economic motivation for clean up
- Develop women-led project teams for each project site
- Use willing general workers to collect and bag mine residue
- Provide skills training for contaminant clean up
- Use existing permitting and clean up expertise
- Use the increase in land value on the urban fringes to generate income
- Re-invest income into more training and employment
- Use pilot scheme success to expand to other mining areas – East and West

The main opportunity that was identified from the research is that the sale of the mine residue to a mineral processing company will generate enough income to pay for the clean-up. This has a significant advantage over requesting funding from an already over-stretched government purse. The mineral processing company also offered support for small businesses that would like to establish nurseries to grow plants for the vegetation and stabilisation of mine dumps that will not be re-processed.

The additional opportunity that had not been foreseen was the possibility of additional revenue from the sale of the cleaned-up land. Whilst the land is occupied with mine residue, it has minimal value. Because the land is close to urban areas which are under pressure to expand once the residue is removed, the land then becomes more valuable. This highlights the opportunity for the WIN-WIN team to obtain ownership of the land prior to clean up. Once cleaned up, the land can be used for the community or resold to raise equity for further investments and fund more clean up projects. Ownership implies liabilities and these will be addressed case-by-case during the evaluation of each site for clean up and future use.

The logical extension of WIN-WIN is the replication of the clean-up strategy for other polluted areas, including the balance of the mine-polluted areas of the Witwatersrand, other mineral-producing areas in South Africa with mine legacy pollution and further afield, other mining legacy countries such as Ghana.

5 RISKS

The WIN-WIN project was originally planned to emulate the successful Working for Water (WfW) programme and has benefitted from their experience in managing community projects for over 20 years. The use of WfW legal documents and training experience helps ameliorate risk for the WIN-WIN project. Risk assessment for the aspects of the WIN-WIN project, which do not overlap with WfW, have been addressed through discussion with the stakeholders listed under the Work done heading.

The key components of high-level risk assessment for the overall WIN-WIN project are given in Table 2 using the Institute of Project Management categories. A more detailed risk assessment is planned for each specific site chosen for clean up using the Mitre Risk Amelioration Strategy. (https://www.mitre.org/publications/systems-engineering-guide/acquisition-systems-engineering/risk-management/risk-mitigation-planning-implementation-and-progress-monitoring).

Table 2 summarises the risks.

Table 2: High level Risks and amelioration

High level risk	Amelioration	Comment
Financial	Agreement with minerals processing company to buy slimes. Detailed accounting according to(Pty) Ltd regulations and required auditing	Agreement in principle, site specific agreements to be signed
Compliance	All legal and environmental compliance will be listed and addressed prior to clean up	Each site will be reviewed and relevant compliance issues addressed
Social	Community involvement and consultation is seen as central to the success of each clean up	Full transparency is planned
Operational	The logistics for each clean up will be planned in detail and implemented according to health and safety guidelines under the direction of the appointed officers	
Reputational	Transparency in operations and engagement with all affected and interested parties maintaining the dignity and respect for all	
Political	The project will be independent of any hijacking by a political party	

The mineral processing company is concerned that their purchase of the collected slimes will be perceived as exploitation of vulnerable people to create profit for processing companies. Full transparency on the management and employment of all general workers will mitigate this concern.

In the current political background, it is of concern that there will be an inability to get all the stakeholders to co-operate. The WIN-WIN team plan to ameliorate this risk through consultation and engagement with decision makers at all levels.

The above are like risks faced by WfW which were overcome by good communication strategies and detailed planning. By choosing a first area for clean up that has simple requirements and permitting the WIN-WIN team plans to fine tune the business model, improve the concept and then expand into multiple sites.

6 PLAN

The outcome of the discussions and research is a clean up model comprising a WIN-WIN holding-company that will fund and manage the clean-up of contaminated land starting in the West Rand. From discussions it is possible that land ownership could be an additional benefit to the model. The specifics of land ownership was not addressed in this research but highlighted as a possible major benefit. Some of the land belongs to government and municipalities and could therefore be transferred to communities at minimal cost. Each parcel of land could be owned and cleaned up by a separate entity called Basadi Phahamang (BP).

Figure 8 illustrates the company organisation.

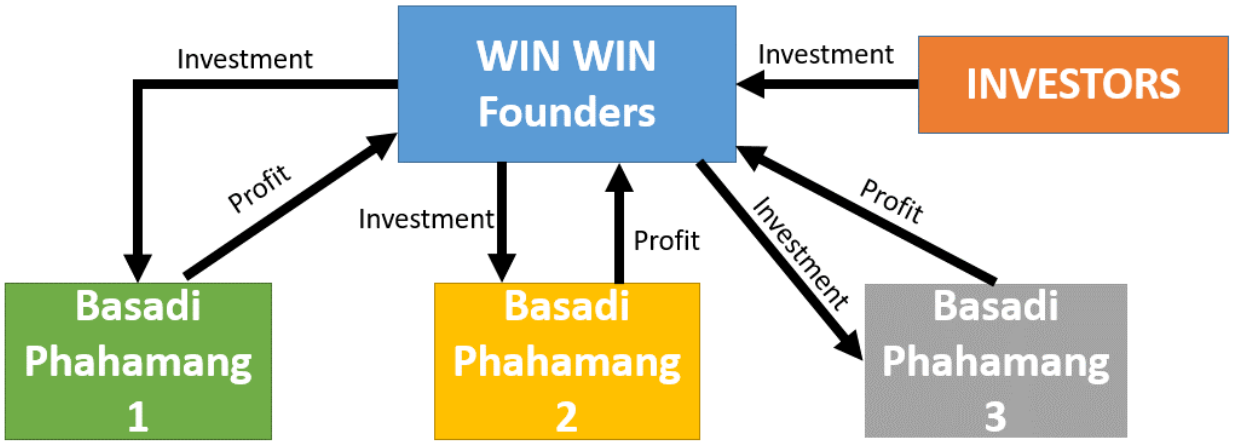

Figure 8: BP Company Organisation

The BP will use the same contract format and HR organisation as WfW and provide during implementation

- Training in Hazardous waste clean up
- Training in business practices
- Money management advice
- Family planning advice
- HIV and AIDS management advice
- NICRO Ex-offender Re-integration
- Saving schemes
- Opportunity to build on Broad Based Livelihood programme (Umsizi)

As well as meet the government directives on the redistribution of land, where possible.

The work organisation will be in teams of ten supported by the WIN-WIN management team, Figure 9 shows the planned work organisation set-up.

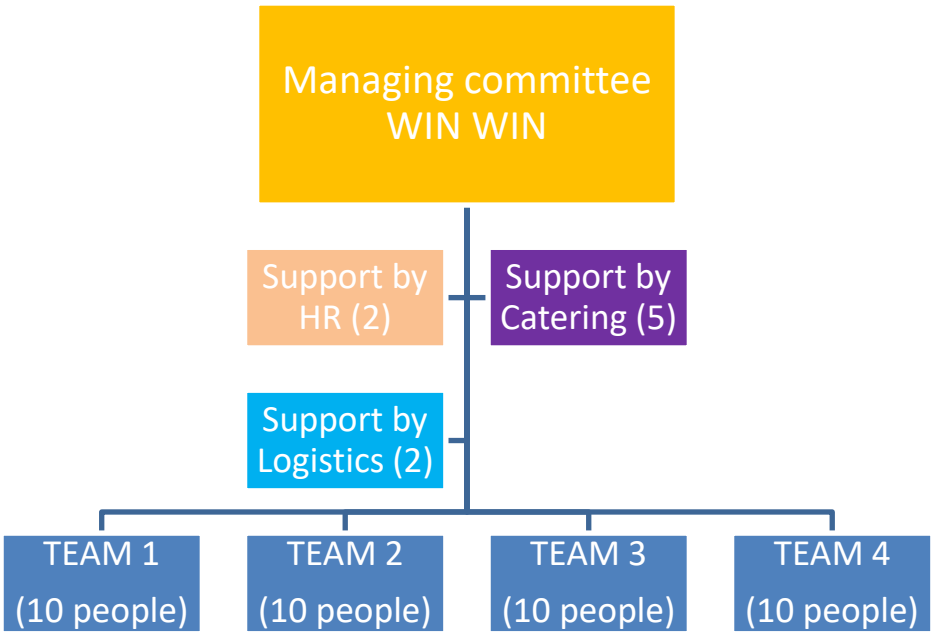

Figure 9: Work organisation

The organogram will be different for each site, however we believe four to six teams of ten workers will be needed for each site, supported by logistics, catering, HR, training, accounting and earthmoving expertise. Once the first site has been selected for clean up, the work organisation will be planned in detail. At this stage the forecast is for 40 to 60 jobs to be created for each clean up. Once the land is cleaned, there is opportunity to encourage entrepreneurship such as market gardening and land development. At this stage the planning has focussed on clean up without a specific remediation design. The type of remediation required depends on the final land use for the site. This decision depends on many variables including land use-planning. For example, a site that is earmarked for use as a landfill site will have a different remediation requirement than a site earmarked for housing. The type of remediation will also provide opportunities for employment. The mineral processing company that would like to buy the mine residue is interested in land use for vegetation nurseries with the aim to revegetate some of the older dumps that are not suitable for recycling.

7 COSTING SUMMARY

Key to the success of the WIN-WIN solution to mine residue clean up is the sourcing of funds for the clean-up. Initially the WIN-WIN team had planned on asking government for a similar type of funding to that received by WfW, however a mineral processing company has offered to contribute R50/t for the mine residue irrespective of the grade of saleable metals in the slimes.

This has four benefits:

1. WIN-WIN obtains income for the clean-up
2. WIN-WIN can use funds from the first clean up to clean up other sites
3. WIN-WIN is relieved of the cost of disposal of the mine residue
4. Because there is an income from the clean-up, WIN-WIN can obtain seed money for the first clean up from ethical investors interested in sustainability. The Women's Development Bank has offered to put up 90% of the seed money and Sustainability investors from Switzerland and Sweden are also interested in providing start-up capital.

To evaluate the potential for self-funding of clean up, WIN-WIN assembled a work programme and a cash flow balance sheet.

Table 3 shows the cash flow predictions for a typical slimes residue area, we chose an erf called Luipaardsvlei in the West Rand which has a slimes residue if some 530,000 tonnes and Figure 10 shows the site.

The cash flow assumes the slimes are sold at R50/t and collected at the site. R350/day is assumed for General Worker's wages and all other costs including legal and permit requirements have been included.

Table 3: Cash flow for typical area assumed similar to Luipaardsvlei

	PROJECTION Win Win	YEAR 1	ZAR							INTEREST/MONTH		0		
	MONTH	March	April	May	June	July	August	September	October	November	December	January	February	TOTAL
	INCOME													
	R50/tonne (Total 530,000 tonnes)	0	0	0	0	4,416,667	4,416,667	4,416,667	4,416,667	4,416,667	4,416,667	0	0	26,500,000
(A)	**TOTAL SALES**	**0**	**0**	**0**	**0**	**4,416,667**	**4,416,667**	**4,416,667**	**4,416,667**	**4,416,667**	**4,416,667**	**0**	**0**	**26,500,000**
	EXPENDITURE													
	Project Management	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	2,160,000
	Environmental Consultant			160,000	160,000									320,000
	Legal support	100,000	100,000											200,000
	Team administrator a)	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	240,000
	Team administrator b)	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	240,000
	CAD/GIS support	8,000	8,000	8,000	8,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000	160,000
	HR manager					3,250	3,250	3,250	3,250	3,250	3,250	3,250	3,250	26,000
	Training expert and equipment					6,667	6,667	6,667	6,667	6,667	6,667			40,000
	Surveyor					140,000	140,000					190,000	190,000	660,000
	40 General Workers at R350/day					294,000	294,000	294,000	294,000	294,000	294,000	294,000	294,000	2,352,000
	Land Registration fees	25,000												25,000
	Transfer Fees	30,000												30,000
	Office Rental	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	180,000
	Travel expenses	6,500	6,500	6,500	6,500	3,792	3,792	3,792	3,792	3,792	3,792	6,500	6,500	61,750
	4 Earth moving operatives					22,667	22,667	22,667	22,667	22,667	22,667			136,000
	PPE					30,000								30,000
	Fuel					36,667	36,667	36,667	36,667	36,667	36,667			220,000
	Rental 4 Earth moving machines.					1,600,000	1,600,000	1,600,000	1,600,000	1,600,000	1,600,000			9,600,000
	Hire of latrines and canvas awnings for shade					6,750	6,750	6,750	6,750	6,750	6,750			40,500
	Provision of drinks and hot lunches					42,000	42,000	42,000	42,000	42,000	42,000			252,000
	Insurance & UIF	9,840	9,840	11,640	11,640	21,078	21,078	16,878	16,878	16,878	16,878	21,698	21,698	196,020
	Office costs (Printing and communications)	4,000	4,000	4,000	4,000	6,500	6,500	6,500	6,500	6,500	6,500	6,500	6,500	68,000
(B)	**TOTAL**	**418,340**	**363,340**	**425,140**	**425,140**	**2,464,369**	**2,434,369**	**2,290,169**	**2,290,169**	**2,290,169**	**2,290,169**	**772,948**	**772,948**	**17,237,270**
(C)	Monthly Working Capital (A-B)	-418,340	-363,340	-425,140	-425,140	1,952,298	1,982,298	2,126,498	2,126,498	2,126,498	2,126,498	-772,948	-772,948	9,262,730
(D)	CUM Working Capital	-418,340	-781,680	-1,206,820	-1,631,960	320,338	2,302,635	4,429,133	6,555,630	8,682,128	10,808,625	10,035,678	9,262,730	0
	CASH INTRODUCED													
	Owners Input Cash	1,000,000												
	Vehicles	.												
	Bank													
	Loans - Others													
	Grants													
(E)	**TOTAL**	**1,000,000**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	CAPITAL EXPENDITURE													
	Premises													
	Machinery / Equipment													
	Capital Repayments													
	Vehicles													
	Fixtures & Fittings													
	HP/Loan Repayments Investor					183,333	183,333	183,333	183,333	183,333	183,333			
(F)	**TOTAL**	**0**	**0**	**0**	**0**	**183,333**	**183,333**	**183,333**	**183,333**	**183,333**	**183,333**	**0**	**0**	**0**
(G)	**MONTHLY BALANCE C+E-F**	581,660	-363,340	-425,140	-425,140	1,768,964	1,798,964	1,943,164	1,943,164	1,943,164	1,943,164	-772,948	-772,948	
(H)	**OPENING BALANCE J**	**0**	581,660	218,320	-206,820	-631,960	1,137,004	2,935,968	4,879,133	6,822,297	8,765,461	10,708,625	9,935,678	
(J)	**CLOSING BALANCE G+H**	581,660	218,320	-206,820	-631,960	1,137,004	2,935,968	4,879,133	6,822,297	8,765,461	10,708,625	9,935,678	9,162,730	
	Interest Calculations												**Net Profit**	**9,162,730**

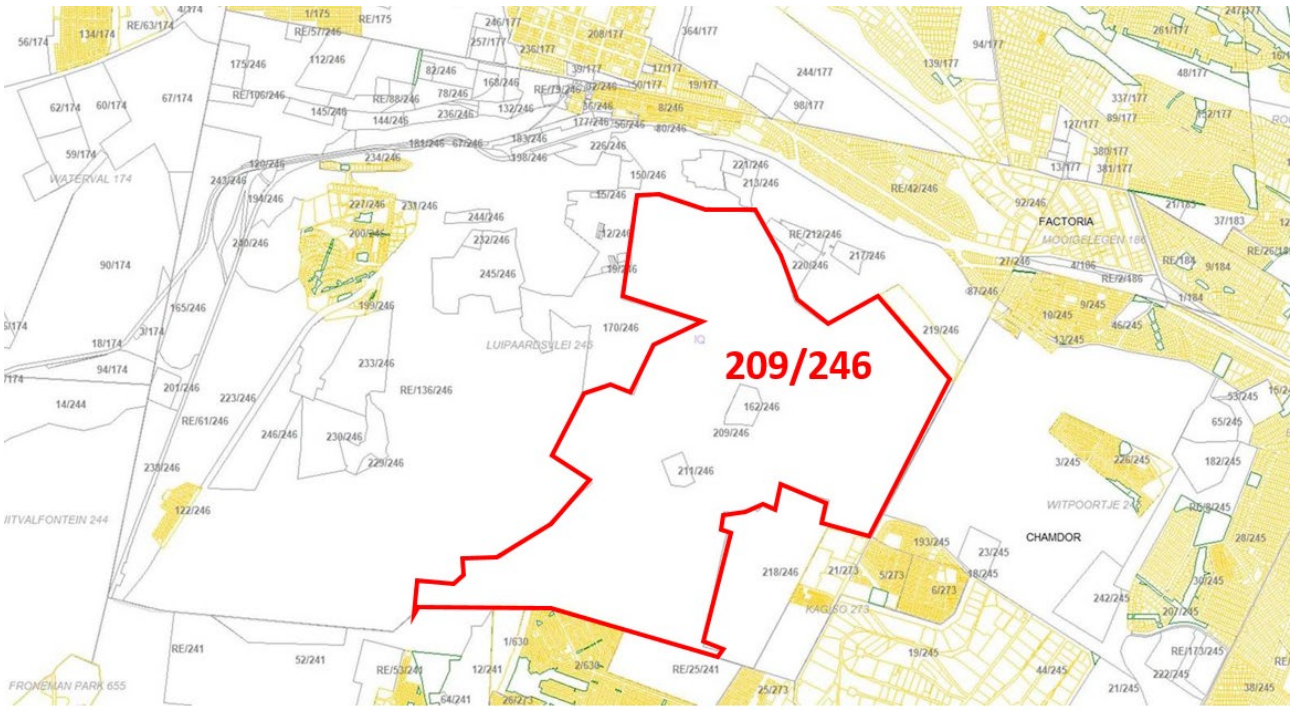

Figure 10: Luipaardsvlei 209/246

Table 4 summarises the expenditure for the clean up

Table 4: Initial Summary of draft clean up costs

Task	Task Description	Total per task
1	Set up legal framework and New company for ownership and operation, set up management team and confirm costing	ZAR580 000
2	Obtain permit compliance for clean up	ZAR440 000
3	Training of people and implementation clean up Assume 40 workers	ZAR17 237 000
4	Registration for services and land transfer	ZAR246 000
Total		ZAR18 503 000

For this assessment we assumed the portion of land has no value and may be one of the portions that has no known owner and is therefore available for transfer to the community at no purchase price.

We understand that the cash flow approach is very simplistic, however it has been used to show the WIN-WIN model is feasible. Many of the costs are site-specific. There are over 50 dump areas in the West Rand that require clean up, with more becoming available as large dumps are reprocessed by mining companies. The next step is to choose the first site for clean up and confirm the costs for each aspect of the work.

WIN-WIN plans to cover the costs of training and the clean up by the sale of the slimes. Once the land is cleaned-up, it has a value. Therefore, we have allocated funds for the legal fees for the acquisition of the land so that once cleaned-up, the land can be used by the community to create opportunities either in development, space for housing or businesses. This is in line with the government focus on land redistribution. Land ownership empowers previously disadvantaged people to create business opportunities. The cost and implementation of the final rehabilitation of the land will depend on the type of land use planned for the land.

The WIN-WIN project aims to create opportunity by implementing the first step of clean up which is the removal of the mine dump residue

8 HEALTH AND SAFETY CONSIDERATIONS

Health and safety considerations have been included in the planning of the WIN-WIN approach and are integral to the training and implementation component of the clean-up. A budget for training in hazardous waste management as well as purchase and training in the use of Personal Protective Equipment (PPE) has been included. All sites will be cleaned in compliance with relevant regulations for worker safety. Under the WfW programme, there has been success in educating people in health management issues and WIN-WIN plans to emulate this.

Each site will be assessed for the risks and hazardous waste management requirements and managed to a very high standard. There is opportunity to obtain funding from an Australian-based NGO for the training of workers in hazardous waste management skills and a local company has offered use of their training facilities. Pure Earth, a New York-based NGO (Pureearth.org) has shared their training materials with WIN-WIN. Once WIN-WIN has a sufficient pool of skilled people in health and safety, they can also be deployed to clean up other sites, both South African and across border. We have had interest from Ghana on the WIN-WIN model as they face similar challenges in mine residue clean up.

Security is also an important aspect of WIN-WIN. The team has surveyed the areas of the West Rand for illegal mining activities. The artisanal miners have interest in the gold-bearing rocks that are found close to shaft areas. The gold from the rocks is extracted by crushing and panning or using mercury to extract the metal by hand. The artisanal miners are not interested in the slimes as removing metals from slimes requires a sophisticated and expensive mineral processing plant. WIN-WIN plans to engage with the illegal miners on a site-by-site basis and, where possible, include them in the WIN-WIN mine residue clean up. We believe inclusion and discussion will have a safer outcome than policing or confrontation.

9 STRATEGY FOR SUCCESS

The WIN-WIN research has identified the feasibility of self-help clean up of mine dump residue contaminated land. Every person and organisation that has heard the WIN-WIN strategy is enthusiastic and has identified more WIN-WIN opportunities. Cleaning up land benefits the environment and everyone’s health.

The strategy developed during the research is:

1. Identify a buyer for the mine dump residue
2. Plan and cost the removal of the residue using a community-driven women-led team
3. Obtain seed funding from the Women’s Development Bank or other sustainable investors
4. Obtain permitting and legal compliance
5. Clean up the site
6. Re-invest profit to clean up subsequent sites

The objective of the clean-up is to benefit the environment therefore sites that are not profitable to clean up can also be cleaned up under the overall umbrella of total income. There are over 1 000 sites requiring clean up along the Witwatersrand, with more becoming available. Our model assumes four teams of ten workers plus 20 team leaders and managers. Sixty new jobs could be created per site. Assuming 50 sites a year can be cleaned up we estimate 5 000 new jobs each year could be created

The research has outlined the benefits of the WIN-WIN programme and potential pitfalls. Key to the success of the clean-up is:

1. Sale of the slimes/mine dump residue
2. Willingness of the ladies of the communities around the sites to drive the employment and clean up
3. Institutional will of the regulators to assist with permit issue
4. Will of the municipality to guide and support the clean up
5. Investment by the Women's Development Bank or other sustainable investors and their guidance on financial matters

The next step is to choose the first site for clean up. We understand that there will be mistakes made in the first clean up and cite Nelson Mandela's mantra "We either WIN or we Learn'. The appetite for learning is great and we have short-listed ten sites for evaluation.

10 SOCIAL BENEFITS

The social development is an integral part of WIN-WIN, affecting all operations of the programme. The Social Development thrust is aimed principally at poverty relief, but it also seeks to optimise benefits in general for the women-driven project teams. The WIN-WIN programme social development targets are the same as the very successful WfW programme which includes:

1. Creation of 5 000 new jobs per annum (based on 40 to 60 jobs per site and 50 sites per year) for previously unemployed individuals.
2. Allocate 60% of these jobs to women.
3. Allocate 20% of the jobs to youth (under the age of 23).
4. Allocate 2% (minimum amount) of the jobs to disabled persons.
5. Ensure every worker receives a minimum average of two days of training per month.
6. Ensure every project has a functional steering committee.
7. Ensure every worker receives an hour of HIV-AIDS awareness training per quarter.
8. Ensure every project allows for access to childcare facilities.
9. Within the social development function are specific projects including:
    a) Partnership with the Planned Parenthood Association of SA (PPPASA).
    b) Childcare
    Childcare for the children of workers is critical both in terms of protecting the safety of children and releasing women into the workforce.
    c) HIV/AIDS
    The employment of an HIV/AIDS coordinator.
    d) Reproductive Health
    Combining the resources of the PPPSS and UNFPA to provide reproductive health care training and support to workers.
    e) NICRO Ex-offender Re-integration
    f) A pilot project that aims to facilitate savings schemes by, and for, workers in the WIN-WIN programme and uses Saving schemes and assistance with setting up vegetable growing self-help scheme Umsizi to train in market gardening skills.

These are achieved by WfW using ZAR2 billion annually from government. The WIN-WIN project will start with one clean up site employing 40 to 60 people and then expand to clean up more areas exponentially with the aim of the employment of up to 5 000 people per year as well as opportunities for entrepreneurship in the newly cleaned up areas. Key to this expansion is the success of the first clean up where lessons will be learned and strategy improved. Emulation of the social investment of the WfW programme and copying their

success in supporting general labour-intensive projects will help short cut the learning experience and drive a self-funded and more efficient project with no government funding.

11 CONCLUSIONS

The project was divided into four tasks with specific objectives and deliverables.
The tasks comprised:

1. Desk study
2. Liaison with stakeholders
3. Development of strategy
4. Reporting and Presentation

The aims of the project are:

1. Investigate feasibility of cleaning up soils and mine residue using community and private process plant participation.
2. Determine interest, establish health and safety guidelines and get feedback from stakeholders. Investigate feasibility of partnerships.
3. Plan roll out of pilot project.

The mineral processing company will pay R50/t generating an income of about R9 million, realised within 6-12 months. The profit from the first clean up can provide the seed money for clean up for the next areas and training for the clean-up of the next areas. Start-up capital of ZAR1M will be required to fund the first three months and The Women's Development bank has expressed interest. Once cleaned the land value is about R500 000/ha. It may be possible for the land to be acquired by the community prior to clean up and then post clean up used for further investment. Once the model is proven, the strategy and seed capital can be extended for additional pieces of land with the objective to clean up the whole of the West Rand.

As each site has specific needs for clean up and remediation, they will be tackled as separate entities based on accurate site assessment and site-specific planning. The DMR is very interested in using the opportunity to clean up for a sustainable environment rather than supporting commercial enterprises based on profit.

Ten sites have been identified for clean up assessment; the evaluation of each site will include:

- Access to a mineral processing plant
- Environmental assessment specific to each site
- Ease of clean up, accessibility of water and power
- Opportunity to acquire the land prior to clean up
- Ease of permit issue
- Accurate costing for the specific site
- Availability of funding for the first three months

Once a first site is cleaned up the lessons learned will be used to design subsequent clean ups. A WIN-WIN model has been created to ensure as many people as possible benefit from the women-driven initiative to clean up each site.

The WIN-WIN methodology is a WIN-WIN for all because:

- Unemployed, particularly women become trained, employed and empowered to start businesses
- Contaminated land is cleaned up
- Living areas become habitable
- Land becomes valuable and sales can pay for rehousing and further clean up

- The minerals processing company gains recognition for supporting a community and women-driven initiative, the sale of metals can fund further clean ups
- Government and municipalities are relieved of some of the cost of clean up and legal liability
- Water-board costs of water treatment are reduced
- Health care costs reduce
- A healthier work force and healthier children boost South Africa's economy

Next step

- Decide on best site for pilot clean up (WIN-WIN has identified ten)
- Obtain agreement for purchase of mine residue slimes (done)
- Link communities, trainers, permit experts, landowners, process plant owners, DE and DWS to plan and accurately cost the WIN-WIN solution for the chosen site
- Obtain seed funding
- Implement clean up of the pilot site

The WRC project supporting the WIN-WIN assessment has confirmed that the women-driven self-help clean up strategy is feasible for the West Rand. Discussion with stakeholders has identified that there is enthusiasm from all sectors for the implementation. The research and discussions revealed that the slimes can be sold for R50/t and the income used to pay for the clean-up. Once cleaned up, the land has value and this may be useful for further investment in the communities and rehabilitation of the land for future use according to local planning objectives. The main cost of any clean up operation is often the sustainable disposal of the waste. For the WIN-WIN strategy, the mineral processing company will dispose of the slimes in their regulated, licensed and monitored disposal facility at no cost to the WIN-WIN project. The mineral processing company benefits by supporting the women-led initiative.

The research has also shown that, once the model for clean up is perfected, the strategy can be used to benefit other communities throughout South Africa and beyond.

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