the DEDECT

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North West Provincial Government

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	(For official use only)
File Reference Number:	
Application Number:	
Date Received:	

Basic assessment report in terms of the Environmental Impact Assessment Regulations, 2010, promulgated in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended.

Kindly note that:

1. This basic assessment report is a standard report that may be required by a competent authority in terms of the EIA Regulations, 2010 and is meant to streamline applications. Please make sure that it is the report used by the particular competent authority for the activity that is being applied for.

2. The report must be typed within the spaces provided in the form. The size of the spaces provided is not necessarily indicative of the amount of information to be provided. The report is in the form of a table that can extend itself as each space is filled with typing.

3. Where applicable tick the boxes that are applicable in the report.

4. An incomplete report may be returned to the applicant for revision.

5. The use of "not applicable" in the report must be done with circumspection because if it is used in respect of material information that is required by the competent authority for assessing the application, it may result in the rejection of the application as provided for in the regulations.

6. This report must be handed in at offices of the relevant competent authority as determined by each authority.

7. No faxed or e-mailed reports will be accepted.

8. The report must be compiled by an independent environmental assessment practitioner.

9. Unless protected by law, all information in the report will become public information on receipt by the competent authority. Any interested and affected party should be provided with the information contained in this report on request, during any stage of the application process.

10. A competent authority may require that for specified types of activities in defined situations only parts of this report need to be completed.

SECTION A: ACTIVITY INFORMATION

Has a specialist been consulted to assist with the completion of this section?	YES ✓	NO

If YES, please complete the form entitled "Details of specialist and declaration of interest" for appointment of a specialist for each specialist thus appointed:

Specialist studies have been conducted in the past which do not fall within WSP's scope of work.

Specialist studies conducted include: Air Emissions Assessment, Soil Assessment, Groundwater Monitoring, and Surface Water Monitoring.

Any specialist reports must be contained in Appendix D.

1. ACTIVITY DESCRIPTION

Describe the activity, which is being applied for, in detail[1]:

Introduction:

Anglo American Limited: Rustenburg Platinum Mines Limited (RPM) has four existing empty Tar Dams within their mine lease area near Rustenburg, North West Province. The empty Tar Dams contained legacy residues that were generated from the gas fired smelter at Klipfontein, which existed more than 60 years ago. The tar residue from the smelter was stored in four separate clay-lined, soil compartments. Each empty tar dam is approximately 1600m^2 in size and contained an estimated 3200m^3 of tar residue. Tar Dam footprints A and B (referred to as the Bleskop Tar Dams) are located between the Bleskop Stadium and the RPM Hospital, while Tar Dam footprints C and D (referred to as the TEMSO Tar Dams) are located north of the Klipfontein Concentrator, adjacent to the road to TEMSO. Locality maps are included in Appendix A.

History:

Due to the hazardous waste classification of the tar in the dams, a decision was taken in 2003 to recover the material out of Tar Dam D (3,703 tonnes) closest to the road to TEMSO for combustion at a cement kiln in Lichtenburg after all the necessary legal permits were obtained. The tar was transferred in a liquid form to the cement plant to be used as an alternative fuel and resource (AFR). However, as the melted tar was fed into the furnace, it solidified (transfer lines were not heated) and the project was stopped as a result. A decision was then taken in March 2003 to move the rest of the content of the same Tar Dam D to Holfontein H:H hazardous waste landfill site.

Activities Undertaken in 2011 and 2012:

Due to the potential environmental, health and safety risk associated with the Tar Dams, RPM decided to decommission the Tar Dams and remove the remaining tar residues (in dams A, B and C) to a permitted hazardous waste landfill site (Holfontein). The activity was deemed to be a 'reasonable measure' as defined in the National Environmental Management Act (No. 107 of 1998) (NEMA) and environmental authorisation was not required for the removal of the tar residues and underlying contaminated soils. Subsequent remediation of the underlying and surrounding contaminated soil may be required. It is proposed that the potentially contaminated soil be remediated to a predetermined standard prior to being backfilled, shaped and grassed with indigenous self-sustaining grasses. Furthermore, as part of the project, the facilities (Tar Dams) will be decommissioned.

[1] Please note that this description should not be a verbatim repetition of the listed activity as contained in the relevant Government Notice, but should be a brief description of activities to be undertaken as per the project description.

The risks related to the Tar Dams were investigated in detail to ensure that all necessary steps are taken in order to minimise harm to the environment and to ensure legal compliance and best practice. To this effect, numerous specialist studies were undertaken to assess the potential impact on air quality, hydrology and geohydrology and soils (underlying and surrounding). Furthermore, RPM appointed WSP Environment and Energy (WSP) to undertake the environmental authorisation process for the decommissioning project as well as a geo-environmental risk assessment to evaluate the extent of potential contamination (if any). WSP has also been appointed to undertake the necessary waste management license application for the remediation of contaminated land which will be authorised by Department of Environmental Affairs.

Geo-environmental Risk Assessment and Remediation Strategy

The full geo-environmental report undertaken by WSP is available in Appendix D.

In summary, an intrusive investigation has identified sites that are underlain by clay resting upon Norite. It appears that the tar dams were formed by excavating into the underlying clay to create pits with the remnant clay material forming the sides of the dams. The upper side material was exposed and subject to the weathering which allowed for small cracks to form which subsequently allowed for some shallow penetration of waste tar into the nearby soils. However, the extent of this penetration is limited therefore the clay is considered an extremely effective medium in containing the tar residues.

The investigation focused upon identifying the possible extent of hydrocarbon contamination in the areas surrounding the tar dams footprint and assessing whether such contamination could be remediated through bio-remediation.

The investigation identified that any spread of hydrocarbon contamination outside of the footprint of the former tar dams is extremely limited and that the sidewalls and base of the tar dams were effective in limiting the potential loss of hydrocarbons into the surrounding soils. In this regard only two hot spots with elevated levels of total oil and grease were identified. The investigation confirmed that hydrocarbons are present in the soil in the most part as a heavy tar fraction but also that elevated levels of hydrocarbons in the C6 to C35 range are also present. With regards to the latter the samples obtained did not exhibit concentrations above industrial acceptable standards but were useful in determining the probable distribution of hydrocarbon chains within any more concentrated soils that are stockpiled onsite.

WSP is currently developing a remediation strategy for the project which will be submitted to DEA for authorisation.

Tar Dam Decommissioning

Although the tar residues have been removed from each of the tar dams, the dams require environmental authorisation in accordance with the NEMA Government Notice Regulation (GNR) 544 of 2010 for the following listed activities:

- Activity 27(iv)
  - Activities, where the facility or land on which it is located is contaminated; and
- Activity 27(v)
  - Storage, or storage and handling, of dangerous good of more than 80 cubic metres.

WSP was appointed by RPM to undertake the environmental authorisation required to decommission and remediate the area associated with the tar dams. A comprehensive BA process was undertaken that included a transparent stakeholder engagement process. The potential environmental and social impacts associated with the decommissioning activities were assessed and mitigation measures developed in order to minimise the risks associated with the project. Please note that as the geo-environmental assessment undertaken by WSP indicated that all tar residues were contained within the clay layer, no contamination assessment to downstream uses was deemed necessary. A BA and EMP report was developed in accordance with the requirements of NEMA.

The draft report was placed on public review for a period of 60 days prior to being finalised and submitted to the NW DEDECT for authorisation.

2. FEASIBLE AND REASONABLE ALTERNATIVES

"alternatives", in relation to a proposed activity, means different means of meeting the general purpose and requirements of the activity, which may include alternatives to—

(a) the property on which or location where it is proposed to undertake the activity;

(b) the type of activity to be undertaken;

(c) the design or layout of the activity;

(d) the technology to be used in the activity;

(e) the operational aspects of the activity; and

(f) the option of not implementing the activity.

Describe alternatives that are considered in this application. Alternatives should include a consideration of all possible means by which the purpose and need of the proposed activity could be accomplished in the specific instance taking account of the interest of the applicant in the activity. The no-go alternative must in all cases be included in the assessment phase as the baseline against which the impacts of the other alternatives are assessed. The determination of whether site or activity (including different processes etc.) or both is appropriate needs to be informed by the specific circumstances of the activity and its environment. After receipt of this report the competent authority may also request the applicant to assess additional alternatives that could possibly accomplish the purpose and need of the proposed activity if it is clear that realistic alternatives have not been considered to a reasonable extent.

Paragraphs 3 – 13 below should be completed for each alternative.

Please note: As this project entails the remediation and decommissioning of existing empty Tar Dams, no site alternatives were assessed. Treatment and Disposal alternatives / options, however, have been included in this document.

3.

Activity POSITION

Indicate the position of the activity using the latitude and longitude of the centre point of the site for each alternative site. The co-ordinates should be in degrees and decimal minutes. The minutes should have at least three decimals to ensure adequate accuracy. The projection that must be used in all cases is the WGS84 spheroid in a national or local projection.

List alternative sites, if applicable.

Alternative:	Latitude (S):		Longitude (E):	
Alternative S1 (preferred or only site alternative) Dam A	25°	41‘ 50.94”	27°	21’ 30.45”
Alternative S1 (preferred or only site alternative) Dam B	25°	41’ 51.09”	27°	21’ 31.95”
Alternative S1 (preferred or only site alternative) Dam C	25°	41’ 55.05”	27°	22’ 05.36”
Alternative S1 (preferred or only site alternative) Dam D	25°	41’ 56.35”	27°	22’ 05.22”

In the case of linear activities:

Alternative:	Latitude (S):		Longitude (E):	
Alternative S1 (preferred or only route alternative)				
• Starting point of the activity	°	'	°	'
• Middle/Additional point of the activity	°	'	°	'
• End point of the activity	°	'	°	'
Alternative S2 (if any)				
• Starting point of the activity	°	'	°	'
• Middle/Additional point of the activity	°	'	°	'
• End point of the activity	°	'	°	'
Alternative S3 (if any)				
• Starting point of the activity	°	'	°	'
• Middle/Additional point of the activity	°	'	°	'
• End point of the activity	°	'	°	'

For route alternatives that are longer than 500m, please provide an addendum with co-ordinates taken every 250 meters along the route for each alternative alignment.

4. PHYSICAL SIZE OF THE ACTIVITY

Indicate the physical size of the preferred activity/technology as well as alternative activities/technologies (footprints):

Alternative:	Size of the activity:
Alternative A1[2] (preferred activity alternative) – Dam A	1600 m^2
Alternative A1 (preferred activity alternative) – Dam B	1600 m^2
Alternative A1 (preferred activity alternative) – Dam C	1600 m^2
Alternative A1 (preferred activity alternative) – Dam D	1600 m^2

or, for linear activities:

Alternative:	Length of the activity:
Alternative A1 (preferred activity alternative)	m
Alternative A2 (if any)	m
Alternative A3 (if any)	m

Indicate the size of the alternative sites or servitudes (within which the above footprints will occur):

Alternative:	Size of the site/servitude:
Alternative A1 (preferred activity alternative)	m^2
Alternative A2 (if any)	m^2
Alternative A3 (if any)	m^2

5. SITE ACCESS

Does ready access to the site exist?

If NO, what is the distance over which a new access road will be built

YES ✓	*NO*
m	

Describe the type of access road planned:

Include the position of the access road on the site plan and required map, as well as an indication of the road in relation to the site.

FIGURE 1: Tar Dams A and B (Source: Google Earth 2012)

FIGURE 2: Tar Dams C and D (Source: Google Earth 2012)

6. SITE OR ROUTE PLAN

A detailed site or route plan(s) must be prepared for each alternative site or alternative activity. It must be attached as Appendix A to this document.

The site or route plans must indicate the following:

6.1 the scale of the plan which must be at least a scale of 1:500;
6.2 the property boundaries and numbers of all the properties within 50 metres of the site;
6.3 the current land use as well as the land use zoning of each of the properties adjoining the site or sites;
6.4 the exact position of each element of the application as well as any other structures on the site;
6.5 the position of services, including electricity supply cables (indicate above or underground), water supply pipelines, boreholes, street lights, sewage pipelines, storm water infrastructure and telecommunication infrastructure;
6.6 all trees and shrubs taller than 1.8 metres;
6.7 walls and fencing including details of the height and construction material;

6.8 servitudes indicating the purpose of the servitude;
6.9 sensitive environmental elements within 100 metres of the site or sites including (but not limited thereto):
- rivers;
- the 1:100 year flood line (where available or where it is required by DWA);
- ridges;
- cultural and historical features;
- areas with indigenous vegetation (even if it is degraded or invested with alien species);

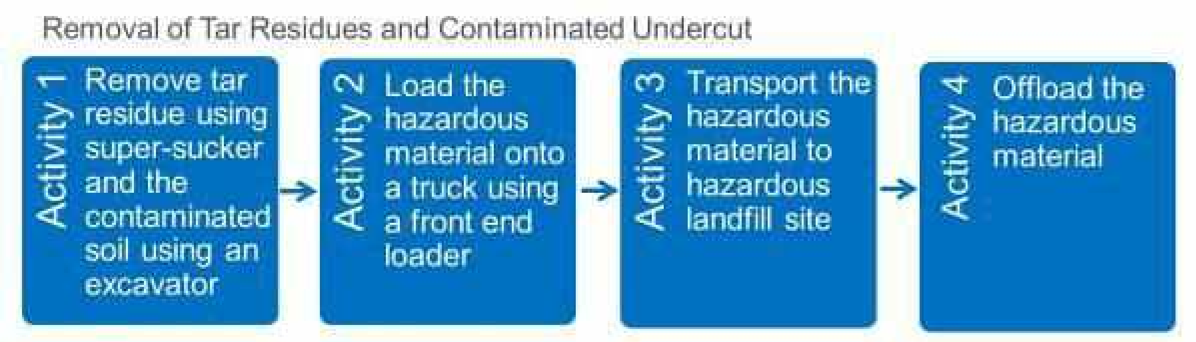
6.10 for gentle slopes the 1 metre contour intervals must be indicated on the plan and whenever the slope of the site exceeds 1:10, the 500mm contours must be indicated on the plan; and
6.11 the positions from where photographs of the site were taken.

7. SITE PHOTOGRAPHS

Colour photographs from the centre of the site must be taken in at least the eight major compass directions with a description of each photograph. Photographs must be attached under Appendix B to this form. It must be supplemented with additional photographs of relevant features on the site, if applicable.

8. FACILITY ILLUSTRATION

A detailed illustration of the activity must be provided at a scale of 1:200 as Appendix C for activities that include structures. The illustrations must be to scale and must represent a realistic image of the planned activity. The illustration must give a representative view of the activity.



9. ACTIVITY MOTIVATION

9(a) Socio-economic value of the activity

Section 9(a) is not applicable as the project is temporary and as a result will create temporary employment on a small scale (through appointing contractors).

What is the expected capital value of the activity on completion?	R	
What is the expected yearly income that will be generated by or as a result of the activity?	R	
Will the activity contribute to service infrastructure?	YES	NO
Is the activity a public amenity?	YES	NO
How many new employment opportunities will be created in the development phase of the activity?		
What is the expected value of the employment opportunities during the development phase?	R	
What percentage of this will accrue to previously disadvantaged individuals?	%	
How many permanent new employment opportunities will be created during the operational phase of the activity?		

What is the expected current value of the employment opportunities during the first 10 years?	R
What percentage of this will accrue to previously disadvantaged individuals?	%

9(b) Need and desirability of the activity

Motivate and explain the need and desirability of the activity (including demand for the activity):

NEED:			
1.	Was the relevant provincial planning department involved in the application?	YES	NO ✓
2.	Does the proposed land use fall within the relevant provincial planning framework?	YES	NO ✓
3.	If the answer to questions 1 and / or 2 was NO, please provide further motivation / explanation:		
	The dams fall within RPM's mine lease area. The dams will be remediated and rehabilitated to fit the surrounding environment.		

DESIRABILITY:			
1.	Does the proposed land use / development fit the surrounding area?	YES ✓	NO
2.	Does the proposed land use / development conform to the relevant structure plans, SDF and planning visions for the area?	YES ✓	NO
3.	Will the benefits of the proposed land use / development outweigh the negative impacts of it?	YES ✓	NO
4.	If the answer to any of the questions 1-3 was NO, please provide further motivation / explanation:		
5.	Will the proposed land use / development impact on the sense of place?	YES ✓	NO
6.	Will the proposed land use / development set a precedent?	YES ✓	NO
7.	Will any person's rights be affected by the proposed land use / development?	YES	NO ✓
8.	Will the proposed land use / development compromise the "urban edge"?	YES	NO ✓
9.	If the answer to any of the question 5-8 was YES, please provide further motivation / explanation.		
	Currently, approximately 90% of the tar residue has been removed from the tar dams, and a minor risk remains although due to the viscosity of the residual tar residue, this risk is deemed to be low. Once environmental authorisation has been received, and remediation activities completed (following authorisation from DEA), the dams will be backfilled, levelled and revegetated to fit the topography of the surrounding area. The proposed activity will improve the sense of place and will set the precedent for future environmental remediation activities.		

BENEFITS:			
1.	Will the land use / development have any benefits for society in general?	YES ✓	NO
2.	Explain: The remediation activity will remove any remaining environmental, health and safety risk / hazard in the immediate surrounding area hence benefiting society.		
3.	Will the land use / development have any benefits for the local communities where it will be located?	YES ✓	NO
4.	Explain: The removal of the tar residues has minimised the potential environmental, health and safety risk associated with the tar dam. Once environmental authorisation has been received from NW DEDECT, the empty dams will be backfilled, levelled and revegetated thereby ensuring that no potential surface water, groundwater, air, and soil contamination will occur in the future thus improving the land use potential. Reduced environmental risks and improved land use opportunities will be made as a result of the project.		

10. APPLICABLE LEGISLATION, POLICIES AND/OR GUIDELINES

List all legislation, policies and/or guidelines of any sphere of government that are applicable to the application as contemplated in the EIA regulations, if applicable:

Title of legislation, policy or guideline:	Administering authority:	Date:
NEMA GNR 544, 27 (iv and v)	NW DEDECT	2010
NEM: WA GNR 718, Category A, Activity 12	DEA	2010

11. WASTE, EFFLUENT, EMISSION AND NOISE MANAGEMENT

11(a) Solid waste management

Will the activity produce solid construction waste during the construction/initiation phase?	YES ✓	NO
If yes, what estimated quantity will be produced per month?	3200 m^3	

How will the construction solid waste be disposed of (describe)?

The tar residue in the dams was removed using 'super sucker equipment' by an independent waste contractor. The material from the dams was then placed in a 5 m^3 vacuum tank before being fed into a heating skip system. The heating system comprised of flue (pipe for conveying exhaust gases from a furnace, to the outdoors), which was heated using LPG gas. A strainer system and a positive displacement pump enabled the transfer of filtered material from the heating system to a 30 m^3 heated storage tank. Once the heated storage tank had been filled, the material was transferred to a bitumen tanker and subsequently transported to the Holfontein Hazardous Landfill (H:H) site. The remaining undercut (depth of approximately 300mm) and the semi-solid tar left in the dam was mixed using a grader and loaded into tipper trucks for transportation to the H:H site.

The remaining undercut (300mm to clay liner) has been excavated and stockpiled onsite. The remaining contaminated soils will be screened to remove the viscous tar residues; thereafter the soil will be sampled to identify the concentration of contaminants. The tar residues will be disposed of as hazardus waste. Following the results of the soil analysis, the soil may be tilled until an acceptable standard has been reached (included in a separate BA process of which NE DEDECT has been identified as a commenting authority). Once the dams have been successfully remediated, the empty voids may be filled with backfill (inert) material, covered with topsoil and seeded with an indigenous grass mixture.

Where will the construction solid waste be disposed of (describe)?

Holfontein Hazardous Landfill site (H:H)

Will the activity produce solid waste during its operational phase?	YES	NO ✓
If yes, what estimated quantity will be produced per month?	m^3	

How will the solid waste be disposed of (describe)?

N/A

Where will the solid waste be disposed if it does not feed into a municipal waste stream (describe)?

N/A

If the solid waste (construction or operational phases) will not be disposed of in a registered landfill site or be taken up in a municipal waste stream, then the applicant should consult with the competent authority to determine whether it is necessary to change to an application for scoping and EIA.

Can any part of the solid waste be classified as hazardous in terms of the relevant legislation?	YES ✓	NO

If yes, inform the competent authority and request a change to an application for scoping and EIA.

The tar residues have been identified as hazardous waste, although the waste has been removed from site and disposed of at a permitted hazardous landfill site by an independent waste contractor. Proof of disposal is available upon request. WSP does not deem the removal, transportation and disposal of tar residues requiring a full scoping and EIA. The decommissioning activity falls under the NEMA GNR.544 of 2010 requiring a BA process which is considered sufficient for this process.

Is the activity that is being applied for a solid waste handling or treatment facility?	YES	NO ✓

If yes, then the applicant should consult with the competent authority to determine whether it is necessary to change to an application for scoping and EIA.

11(b) Liquid effluent

Will the activity produce effluent, other than normal sewage, that will be disposed of in a municipal sewage system?	YES	NO ✓
If yes, what estimated quantity will be produced per month?	m^3	
Will the activity produce any effluent that will be treated and/or disposed of on site?	Yes	NO ✓

If yes, the applicant should consult with the competent authority to determine whether it is necessary to change to an application for scoping and EIA.

Will the activity produce effluent that will be treated and/or disposed of at another facility?	YES ✓	NO

If yes, provide the particulars of the facility:

Facility name:	Holfontein, managed by EnvironServ Waste Management (Pty) Ltd
Contact person:	Lynn van der Linde
Postal address:	PO Box 1547, Bedfordview
Postal code:	2008

Telephone:	011 456 5400	Cell:	-
E-mail:	lynnv@enviroserv.co.za	Fax:	0114531797

Describe the measures that will be taken to ensure the optimal reuse or recycling of waste water, if any:

N/A

11(c) Emissions into the atmosphere

Will the activity release emissions into the atmosphere?	YES ✓	NO
If yes, is it controlled by any legislation of any sphere of government?	YES	NO ✓

If yes, the applicant should consult with the competent authority to determine whether it is necessary to change to an application for scoping and EIA.

If no, describe the emissions in terms of type and concentration:

The results obtained during the Baseline ambient air quality assessment (Appendix D) conducted at the tar dam site (during the tar removal stage of the project) revealed that ambient concentrations of Benzene, Toluene, Ethylbenzene, Xylene, Trimethylbenzenes, Phenol, Ammonia, Cyanide and PAHs at all three of the sampling locations were *well below* the relevant South African Ambient Air Quality Standard and/or the equivalent UK Environmental Assessment Levels (UK EALs). Ambient concentrations of Phenol and Ammonia downwind of the Tar Dams were marginally higher than those recorded at the upwind sampling location, suggesting that tar dam emissions contributed (marginally) to ambient concentrations of these contaminants. Worker exposure to airborne concentrations of Benzene, Toluene, Ethylbenzene, Xylene, Trimethylbenzenes, Phenol, Cresol and Ammonia *was minimal* during the survey period.

11(d) Generation of noise

Will the activity generate noise?	YES ✓	NO
If yes, is it controlled by any legislation of any sphere of government?	YES	NO ✓

If yes, the applicant should consult with the competent authority to determine whether it is necessary to change to an application for scoping and EIA.

If no, describe the noise in terms of type and level:

General machinery in the form of an excavator/s and tipper trucks will be used onsite which create a certain degree of noise pollution although the noise produced onsite is within the Occupational Health and Safety Act (OHSA) limits. PPE will be worn onsite when working with noise producing machinery.

12. WATER USE

Please indicate the source(s) of water that will be used for the activity by ticking the appropriate box(es)

municipal	water board	groundwater	river, stream, dam or lake	other	the activity will not use water

If water is to be extracted from groundwater, river, stream, dam, lake or any other natural feature, please indicate

the volume that will be extracted per month:	litres	
Does the activity require a water use permit from the Department of Water Affairs?	YES	NO

If yes, please submit the necessary application to the Department of Water Affairs and attach proof thereof to this application if it has been submitted.

13. ENERGY EFFICIENCY

Describe the design measures, if any, that have been taken to ensure that the activity is energy efficient:

N/A

Describe how alternative energy sources have been taken into account or been built into the design of the activity, if any:

N/A

SECTION B: SITE/AREA/PROPERTY DESCRIPTION

Important notes:

1. For linear activities (pipelines, etc) as well as activities that cover very large sites, it may be necessary to complete this section for each part of the site that has a significantly different environment. In such cases please complete copies of Section C and indicate the area, which is covered by each copy No. on the Site Plan.

Section C Copy No. (e.g. A):

2. Paragraphs 1 - 6 below must be completed for each alternative.

3. Has a specialist been consulted to assist with the completion of this section?

YES	NO ✓

Please note: Specialist studies have been conducted on the Tar Dams in the past. The relevant specialist studies will be included in Appendix D.

If YES, please complete the form entitled "Details of specialist and declaration of interest" for each specialist thus appointed:

All specialist reports must be contained in Appendix D.

Property description/physical address: (Tar Dams A & B):	Portion 170 of the farm Kroondal 304 JQ
Property description/physical address: (Tar Dams C & D)	Portion 2 (Remaining Extent) of the farm Klipfontein 300 JQ
	(Farm name, portion etc.) Where a large number of properties are involved (e.g. linear activities), please attach a full list to this application.
	In instances where there is more than one town or district involved, please attach a list of towns or districts to this application.
Current land-use zoning:	Grazing
	In instances where there is more than one current land-use zoning, please attach a list of current land use zonings that also indicate which portions each use pertains to , to this application.

Is a change of land-use or a consent use application required?	YES	NO ✓
Must a building plan be submitted to the local authority?	YES	NO ✓

Locality map:

An A3 locality map must be attached to the back of this document, as Appendix A. The scale of the locality map must be relevant to the size of the development (at least 1:50 000. For linear activities of more than 25 kilometres, a smaller scale e.g. 1:250 000 can be used. The scale must be indicated on the map.) The map must indicate the following:

- an indication of the project site position as well as the positions of the alternative sites, if any;
- road access from all major roads in the area;
- road names or numbers of all major roads as well as the roads that provide access to the site(s);
- all roads within a 1km radius of the site or alternative sites; and
- a north arrow;
- a legend; and
- locality GPS co-ordinates (Indicate the position of the activity using the latitude and longitude of the centre point of the site for each alternative site. The co-ordinates should be in degrees and decimal minutes. The minutes should have at least three decimals to ensure adequate accuracy. The projection that must be used in all cases is the WGS84 spheroid in a national or local projection)

1. GRADIENT OF THE SITE

Indicate the general gradient of the site.

Alternative S1:

Dam A

Flat	1:50 – 1:20	1:20 – 1:15	1:15 – 1:10	1:10 – 1:7,5	1:7,5 – 1:5	Steeper than 1:5

Dam B

Flat	1:50 – 1:20	1:20 – 1:15	1:15 – 1:10	1:10 – 1:7,5	1:7,5 – 1:5	Steeper than 1:5

Dam C

Flat	1:50 – 1:20	1:20 – 1:15	1:15 – 1:10	1:10 – 1:7,5	1:7,5 – 1:5	Steeper than 1:5

Dam D

Flat	1:50 – 1:20	1:20 – 1:15	1:15 – 1:10	1:10 – 1:7,5	1:7,5 – 1:5	Steeper than 1:5

Alternative S2 (if any):

Flat	1:50 – 1:20	1:20 – 1:15	1:15 – 1:10	1:10 – 1:7,5	1:7,5 – 1:5	Steeper than 1:5

Alternative S3 (if any):

Flat	1:50 – 1:20	1:20 – 1:15	1:15 – 1:10	1:10 – 1:7,5	1:7,5 – 1:5	Steeper than 1:5

2. LOCATION IN LANDSCAPE

Indicate the landform(s) that best describes the site:

NB: Indicate by highlighting/ticking

2.1 Ridgeline

2.2 Plateau

2.3 Side slope of hill/mountain

2.4 Closed valley

2.5 Open valley

2.6 Plain

2.7 Undulating plain / low hills

2.8 Dune

2.9 Seafront

3. GROUNDWATER, SOIL AND GEOLOGICAL STABILITY OF THE SITE

DAMS A AND B*

Is the site(s) located on any of the following (tick the appropriate boxes)?

	Alternative S1:		Alternative S2 (if any):		Alternative S3 (if any):	
Shallow water table (less than 1.5m deep)	YES	NO ✓	YES	NO	YES	NO
Dolomite, sinkhole or doline areas	YES	NO ✓	YES	NO	YES	NO
Seasonally wet soils (often close to water bodies)	YES	NO ✓	YES	NO	YES	NO
Unstable rocky slopes or steep slopes with loose soil	YES	NO ✓	YES	NO	YES	NO
Dispersive soils (soils that dissolve in water)	YES	NO ✓	YES	NO	YES	NO
Soils with high clay content (clay fraction more than 40%)	YES ✓	NO	YES	NO	YES	NO
Any other unstable soil or geological feature	YES	NO ✓	YES	NO	YES	NO
An area sensitive to erosion	YES	NO ✓	YES	NO	YES	NO

DAMS C AND D*

	Alternative S1:		Alternative S2 (if any):		Alternative S3 (if any):	
Shallow water table (less than 1.5m deep)	YES	NO ✓	YES	NO	YES	NO
Dolomite, sinkhole or doline areas	YES	NO ✓	YES	NO	YES	NO
Seasonally wet soils (often close to water bodies)	YES	NO ✓	YES	NO	YES	NO
Unstable rocky slopes or steep slopes with loose soil	YES	NO ✓	YES	NO	YES	NO
Dispersive soils (soils that dissolve in water)	YES	NO ✓	YES	NO	YES	NO
Soils with high clay content (clay fraction more than 40%)	YES ✓	NO	YES	NO	YES	NO
Any other unstable soil or geological feature	YES	NO ✓	YES	NO	YES	NO
An area sensitive to erosion	YES	NO ✓	YES	NO	YES	NO

*Information obtained from a Geological Map of the Rustenburg region and from the maps provided on the DEA website.

If you are unsure about any of the above or if you are concerned that any of the above aspects may be an issue of concern in the application, an appropriate specialist should be appointed to assist in the completion of this section. (Information in respect of the above will often be available as part of the project information or at the planning sections of local authorities. Where it exists, the 1:50 000 scale Regional Geotechnical Maps prepared by the Council for Geo Science may also be consulted).

4. GROUNDCOVER

Indicate the types of groundcover present on the site:

The location of all identified rare or endangered species or other elements should be accurately indicated on the site plan(s).

Natural veld - good conditionE	Natural veld with scattered aliensE	Natural veld with heavy alien infestationE	Veld dominated by alien speciesE	Gardens
Sport field	Cultivated land	Paved surface	Building or other structure	Bare soil

The groundcover of the project areas comprise natural veld with scattered aliens, bare soil and tar residue.

If any of the boxes marked with an "E "is ticked, please consult an appropriate specialist to assist in the completion of this section if the environmental assessment practitioner doesn't have the necessary expertise.

5. LAND USE CHARACTER OF SURROUNDING AREA

Indicate land uses and/or prominent features that does currently occur within a 500m radius of the site and give description of how this influences the application or may be impacted upon by the application:

NB: Indicate by highlighting/ticking

Dam A and Dam B

5.1 Natural area

5.2 Low density residential

5.3 Medium density residential

5.4 High density residential

5.5 Informal residential[A]

5.6 Retail commercial & warehousing

5.7 Light industrial

5.8 Medium industrial [AN]

5.9 Heavy industrial [AN]

5.10 Power station

5.11 Office/consulting room

5.12 Military or police base/station/compound

5.13 Spoil heap or slimes dam[A]

5.14 Quarry, sand or borrow pit

5.15 Dam or reservoir

5.16 Hospital/medical centre

5.17 School

5.18 Tertiary education facility

5.19 Church

5.20 Old age home

5.21 Sewage treatment plant[A]

5.22 Train station or shunting yard [N]

5.23 Railway line [N]

5.24 Major road (4 lanes or more) [N]

5.25 Airport [N]

5.26 Harbour

5.27 Sport facilities

5.28 Golf course

5.29 Polo fields

5.30 Filling station [H]

5.31 Landfill or waste treatment site

5.32 Plantation

5.33 Agriculture

5.34 River, stream or wetland

5.35 Nature conservation area

5.36 Mountain, koppie or ridge

5.37 Museum

5.38 Historical building

5.39 Protected Area

5.40 Graveyard

5.41 Archaeological site

5.42 Other land uses (Mining activities)

Dam C and Dam D

5.1 Natural area

5.2 Low density residential

5.3 Medium density residential

5.4 High density residential

5.5 Informal residential[A]

5.6 Retail commercial & warehousing

5.7 Light industrial

5.8 Medium industrial [AN]

5.9 Heavy industrial [AN]

5.10 Power station

5.11 Office/consulting room

5.12 Military or police base/station/compound

5.13 Spoil heap or slimes dam[A]

5.14 Quarry, sand or borrow pit

5.15 Dam or reservoir

5.16 Hospital/medical centre

5.17 School

5.18 Tertiary education facility

5.19 Church

5.20 Old age home

5.21 Sewage treatment plant[A]

5.22 Train station or shunting yard [N]

5.23 Railway line [N]

5.24 Major road (4 lanes or more) [N]

5.25 Airport [N]

5.26 Harbour

5.27 Sport facilities

5.28 Golf course

5.29 Polo fields

5.30 Filling station [H]

5.31 Landfill or waste treatment site

5.32 Plantation

5.33 Agriculture

5.34 River, stream or wetland

5.35 Nature conservation area

5.36 Mountain, koppie or ridge

5.37 Museum

5.38 Historical building

5.39 Protected Area

5.40 Graveyard

5.41 Archaeological site

5.42 Other land uses (Mining activities)

If any of the features marked with an "N "are highlighted or ticked, how this impact will / be impacted upon by the proposed activity?

If any of the features marked with an "An" are highlighted or ticked, how will this impact / be impacted upon by the proposed activity?

If YES, specify and explain:
If YES, specify:

If any of the features marked with an "H" are highlighted or ticked, how will this impact / be impacted upon by the proposed activity.

If YES, specify and explain:
If YES, specify:

6. *CULTURAL/HISTORICAL FEATURES*

Are there any signs of culturally or historically significant elements, as defined in section 2 of the National Heritage Resources Act, 1999, (Act No. 25 of 1999), including	*YES* ✓	*NO*
Archaeological or palaeontological sites, on or close (within 20m) to the site?	NO	

If YES, explain:	Graveyards are in proximity of the Bleskop Tar Dams site (Dam A and B) but the grave sites are located further than 35 metres from the project activity.

If uncertain, conduct a specialist investigation by a recognised specialist in the field to establish whether there is such a feature(s) present on or close to the site.

Briefly explain the findings of the specialist:	N/A

Will any building or structure older than 60 years be affected in any way?	*YES*	*NO* ✓
Is it necessary to apply for a permit in terms of the National Heritage Resources Act, 1999 (Act 25 of 1999)?	*YES*	*NO* ✓

If yes, please submit or, make sure that the applicant or a specialist submits the necessary application to SAHRA or the relevant provincial heritage agency and attach proof thereof to this application if such application has been made.

SECTION C: PUBLIC PARTICIPATION

1. *ADVERTISEMENT*

The person conducting a public participation process must take into account any guidelines applicable to public participation as contemplated in section 24J of the Act and must give notice to all potential interested and affected parties of the application which is subjected to public participation by—

(a) fixing a notice board (of a size at least 60cm by 42cm; and must display the required information in lettering and in a format as may be determined by the competent authority) at a place conspicuous to the public at the boundary or on the fence of—

(i) the site where the activity to which the application relates is or is to be undertaken; and

(ii) any alternative site mentioned in the application;

(b) giving written notice to—

(i) the owner or person in control of that land if the applicant is not the owner or person in control of the land;

(ii) the occupiers of the site where the activity is or is to be undertaken or to any alternative site where the activity is to be undertaken;

(iii) owners and occupiers of land adjacent to the site where the activity is or is to be undertaken or to any alternative site where the activity is to be undertaken;

(iv) the municipal councillor of the ward in which the site or alternative site is situated and any organisation of ratepayers that represent the community in the area;

(v) the municipality which has jurisdiction in the area;

(vi) any organ of state having jurisdiction in respect of any aspect of the activity; and

(vii) any other party as required by the competent authority;

(c) placing an advertisement in—

(i) one local newspaper; or

(ii) any official *Gazette* that is published specifically for the purpose of providing public notice of applications or other submissions made in terms of these Regulations;

(d) placing an advertisement in at least one provincial newspaper or national newspaper, if the activity has or may have an impact that extends beyond the boundaries of the metropolitan or local municipality in which it is or will be undertaken: Provided that this paragraph need not be complied with if an advertisement has been placed in an official *Gazette* referred to in subregulation 54(c)(ii); and

(e) using reasonable alternative methods, as agreed to by the competent authority, in those instances where a person is desiring of but unable to participate in the process due to—

(i) illiteracy;

(ii) disability; or

(iii) any other disadvantage.

2. CONTENT OF ADVERTISEMENTS AND NOTICES

A notice board, advertisement or notices must:

(a) indicate the details of the application which is subjected to public participation; and

(b) state—

(i) that the application has been submitted to the competent authority in terms of these Regulations, as the case may be;

(ii) whether basic assessment or scoping procedures are beingapplied to the application, in the case of an application for environmental authorisation;

(iii) the nature and location of the activity to which the application relates;

(iv) where further information on the application or activity can be obtained; and

(iv) the manner in which and the person to whom representations in respect of the application may be made.

3. PLACEMENT OF ADVERTISEMENTS AND NOTICES

Where the proposed activity may have impacts that extend beyond the municipal area where it is located, a notice must be placed in at least one provincial newspaper or national newspaper, indicating that an application will be submitted to the competent authority in terms of these regulations, the nature and location of the activity, where further information on the proposed activity can be obtained and the manner in which representations in respect of the application can be made, unless a notice has been placed in any *Gazette* that is published specifically for the purpose of providing notice to the public of applications made in terms of the EIA regulations.

Advertisements and notices must make provision for all alternatives.

4. DETERMINATION OF APPROPRIATE MEASURES

The practitioner must ensure that the public participation is adequate and must determine whether a public meeting or any other additional measure is appropriate or not based on the particular nature of each case. Special attention should be given to the involvement of local community structures such as Ward Committees, ratepayers associations and traditional authorities where appropriate. Please note that public concerns that emerge at a later stage that should have been addressed may cause the competent authority to withdraw any authorisation it may have issued if it becomes apparent that the public participation process was inadequate.

5. COMMENTS AND RESPONSE REPORT

The practitioner must record all comments and respond to each comment of the public before the application is submitted. The comments and responses must be captured in a comments and response report as prescribed in the EIA regulations and be attached to this application. The comments and response report must be attached under Appendix E.

6. AUTHORITY PARTICIPATION

Please note that a complete list of all organs of state and or any other applicable authority with their contact details must be appended to the basic assessment report or scoping report, whichever is applicable.

Authorities are key interested and affected parties in each application and no decision on any application will be made before the relevant local authority is provided with the opportunity to give input.

List of authorities informed:

- Department of Environmental Affairs (DEA);
- Department of Water Affairs (DWA);
- North West Department of Economic Development, Environment, Conservation and Tourism (NW DEDECT);
- Department of Health (DOH);
- Bonjanala Platinum District Municipality;
- Rustenburg Local Municipality; and
- South African Heritage Resource Association (SAHRA).

List of authorities from whom comments have been received:

- NW DEDECT;
- DWA; and
- SAHRA.

7. CONSULTATION WITH OTHER STAKEHOLDERS

Note that, for linear activities, or where deviation from the public participation requirements may be appropriate, the person conducting the public participation process may deviate from the requirements of that subregulation to the extent and in the manner as may be agreed to by the competent authority.
Proof of any such agreement must be provided, where applicable.

Has any comment been received from stakeholders?

YES ✓	*NO*

If "YES", briefly describe the feedback below (also attach copies of any correspondence to and from the stakeholders to this application):

Please note that WSP had confirmations from two stakeholders that were to attend the public meeting, however, no stakeholder attended the public meeting despite adequate notification. There were no further comments received with reference to the project.

SECTION D: IMPACT ASSESSMENT

The assessment of impacts must adhere to the minimum requirements in the EIA Regulations, 2010, and should take applicable official guidelines into account. The issues raised by interested and affected parties should also be addressed in the assessment of impacts.

1. ISSUES RAISED BY INTERESTED AND AFFECTED PARTIES

List the main issues raised by interested and affected parties.

- The DWA questioned the proximity of the project to a water course.
- The Rustenburg Local Municipality (RLM) indicated that the Local Municipality would review and comment on the report once it is released for authority review. The RLM representative further emphasised that WSP should include all the identified impacts and appropriate mitigation measures in the BA report.
- Motshabi Mohlalisi from the NW DEDECT stated an individual from the waste department at the NW DEDECT should be invited to attend a site visit and should be included as a commenting authority for the project.

*(Please refer to Appendix E for further detail on the issues received thus far in the project and the corresponding responses issued).

Response from the practitioner to the issues raised by the interested and affected parties (A full response must be given in the Comments and Response Report that must be attached to this report as Annexure E):

- WSP responded to the DWA stating that the rivers would not be impacted upon, as WSP will formulate mitigation measures to prevent any foreseen impacts.
- WSP responded to RLM indicating that the report will be submitted to the Department for review once completed.
- Andre Britz indicated that he is willing to take the Waste individual from the DEDECT on a site visit.

*(Please refer to Appendix E for further detail on the issues received thus far in the project and the corresponding responses issued).

2. IMPACTS THAT MAY RESULT FROM THE PLANNING AND DESIGN, CONSTRUCTION, OPERATIONAL, DECOMMISSIONING AND CLOSURE PHASES AS WELL AS PROPOSED MANAGEMENT OF IDENTIFIED IMPACTS AND PROPOSED MITIGATION MEASURES

List the potential direct, indirect and cumulative property/activity/design/technology/operational alternative related impacts (as appropriate) that are likely to occur as a result of the planning and design phase, construction phase, operational phase, decommissioning and closure phase, including impacts relating to the choice of site/activity/technology alternatives as well as the mitigation measures that may eliminate or reduce the potential impacts listed.

Alternative (preferred alternative)

Direct impacts:

Environmental Aspect	Significance (+ve / -ve)
Topography	+
Surface Water	+
Ground Water	+
Soil	+
Air	+
Land use	+
Fauna	+
Flora	+
Noise	-
Visual Aspect	+
Health & Safety	+ and -

Refer to Appendix G5

Indirect impacts:

Environmental Aspect	Significance (+ve / -ve)
Waste Management	+
Traffic	+
Cultural & Heritage Impacts	-
Employment	+

Climate	+
Visual Aspect	+
Health & Safety	+ and -

Refer to Appendix G5

Cumulative impacts:

As the tar residues were contained within the clay liner, limited downstream impacts are anticipated. Cumulative impacts associated with air quality in the surrounding area of the tar dams may have occurred during 'operation' and residual removal activities although this is considered minimal.

3. ENVIRONMENTAL IMPACT STATEMENT

Taking the assessment of potential impacts into account, please provide an environmental impact statement that summarises the impact that the proposed activity and its alternatives may have on the environment after the management and mitigation of impacts have been taken into account, with specific reference to types of impact, duration of impacts, likelihood of potential impacts actually occurring and the significance of impacts.

The information contained in this basic assessment report provides a detailed description of the activities associated with the removal of the tar residue, decommissioning and future levelling and revegetation of the tar dams. Included are the relevant options considered and the stakeholder consultation process that was followed. The report also provides an environmental impact assessment that identified potential impacts associated with the decommissioning activities, and an environmental management programme that considers the impacts of the project.

Provided that the measures set out in the environmental management programme are adhered to, no significant negative biophysical or socio-economic impacts should arise going forward

It is the view of the Environmental Assessment Practitioner that this project should be authorised by the NW DEDECT to ensure the long-term health and safety of surrounding communities and the natural environment are maintained.

Alternative A (preferred alternative)

The tar residues and contaminated undercut has been removed by a registered waste contractor and transported to Holfontein for correct disposal. As the tar residues and contaminated undercut contain Benzene, Toluene, Ethylbenzene, Xylene, Trimethylbenzenes, Phenol, Ammonia, Cyanide and PAHs and other harmful constituents which are considered toxic, the material was removed and disposed of at a hazardous landfill site as a 'reasonable measure' contained under Section 28 of the NEMA.
The dig and dump process involved the excavation of the tar contaminated soil from the tar dam footprints into a side tipper truck which then transported the hazardous waste material to Holfontein where it was disposed of. Holfontein is classified as a H:H landfill and can therefore accept Category 1 and 2 hazardous waste.

The remaining contaminated soil (identified to be contaminated by WSPs geo-environmental assessment, but was concluded to be contained within the clay lined dam) is to be screened to remove the viscous tar residue from the soil/ clay matter. Thereafter, the tar will be disposed of as hazardous waste and the soils analysed. If required, the resultant soil will be tilled in order to remove soil contaminants. The void will then be filled, levelled and seeded with indigenous vegetation. This will contribute to restoring the impacted areas to a similar land use prior to the construction of the tar dams.

Alternative B (Incineration)

An alternative method for disposing of the tar residue was noted to be controlled incineration due to the presence of cyanide in the tar. An attempt was made to transfer the tar material to a cement kiln in 2003, where it would was to be co-combusted with other materials during the operations at Alpha Cement in Lichtenburg. However, complications were experienced while transferring the tar into the kiln from the transport tanker, as the tar residue could not be heated during delivery and the resultant tar coagulated thereby making the project unfeasible. The project was therefore aborted due to issues with the process which could not be resolved.

Alternative C (Recycling / Recovery)

It has been noted that the tar and pitch wastes can be blended with waste oils and other waste petroleum products to give a second grade fuel oil. However, this is not acceptable due to the presence of cyanide which poses a health risk to users. The alternative is therefore not considered a responsible/ feasible option and was not considered.

No-go alternative (compulsory)

The no-go alternative means that the existing tar residue contaminated soil will remain onsite, resulting in potential long-term risk of exposure through the soil, air and water contaminated. As previously stated, the tar dams contained harmful substances which had a potential to lead to biophysical and social health risks and impacts. Furthermore, should the area associated with the tar dams not be authorised for decommissioning, the void will not be filled, levelled and revegetated, thus contributing to the cumulative impact of the mine on the general socio-economic and biophysical environment. Therefore, this is not considered to be a feasible or responsible alternative by the EAP and should not be considered further.

SECTION E. RECOMMENDATION OF PRACTITIONER

Is the information contained in this report and the documentation attached hereto sufficient to make a decision in respect of the activity applied for (in the view of the environmental assessment practitioner)?	YES ✓	NO

If "NO", indicate the aspects that should be assessed further as part of a Scoping and EIA process before a decision can be made (list the aspects that require further assessment):

If "YES", please list any recommended conditions, including mitigation measures that should be considered for inclusion in any authorisation that may be granted by the competent authority in respect of the application:

The conditions are set out in the EMPr.

All the conditions in the EMPr must be implemented by the responsible parties.

Is an EMPr attached?	YES ✓	NO

The EMPr must be attached as Appendix F.

SECTION F: APPENDIXES

The following appendixes must be attached as appropriate:

Appendix A: Site plan(s)

Appendix B: Photographs

Appendix C: Facility illustration(s)

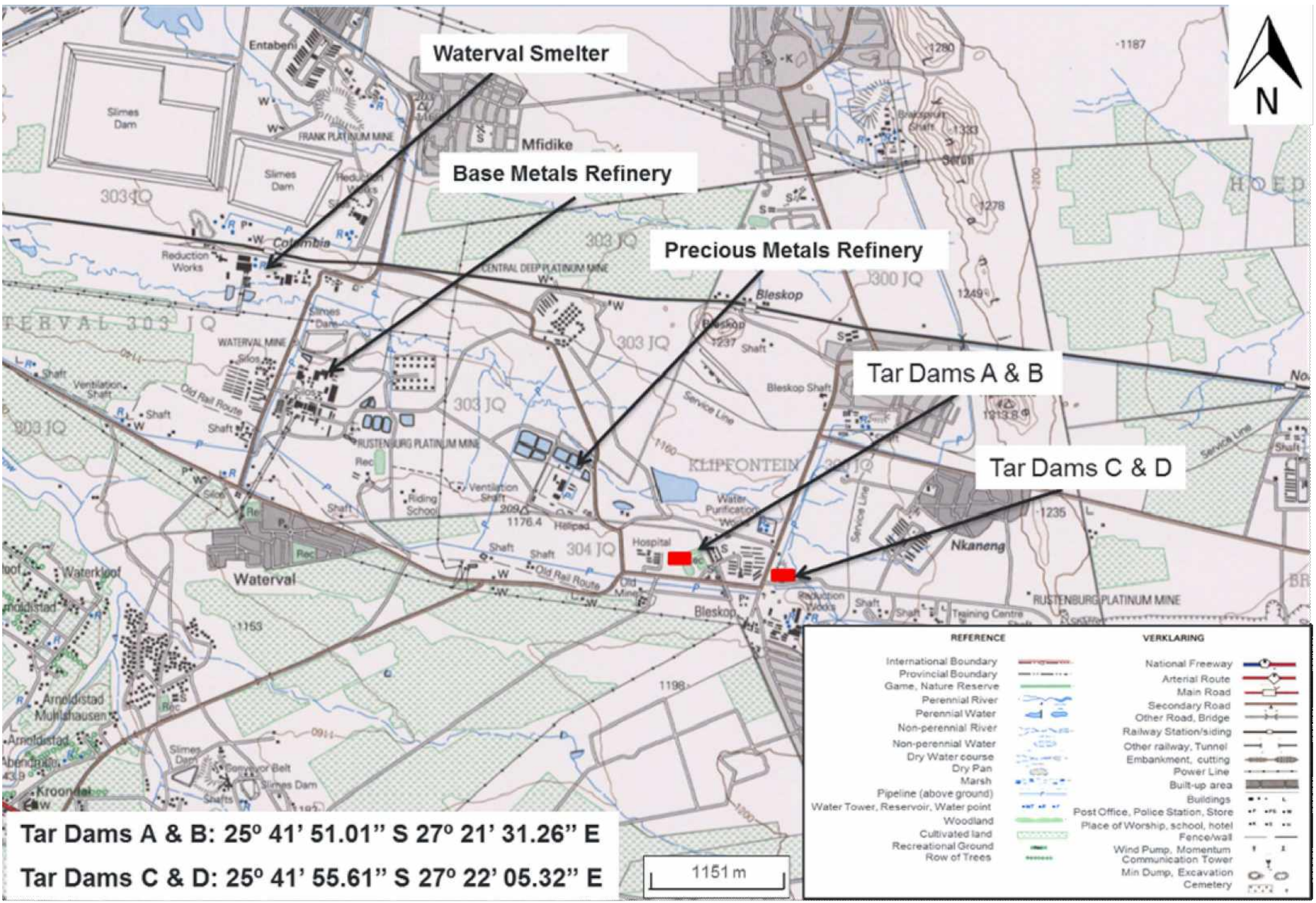
Appendix D: Specialist reports

Appendix E: Comments and responses report

Appendix F: Environmental Management Programme (EMPr)

Appendix G: Other information

Appendix A1: Topographical Locality Map


Waterval Smelter
Base Metals Refinery
Precious Metals Refinery
Tar Dams A & B
Tar Dams C & D
N
Tar Dams A & B: 25º 41' 51.01" S 27º 21' 31.26" E
Tar Dams C & D: 25º 41' 55.61" S 27º 22' 05.32" E
1151 m
REFERENCE
VERKLARING
International Boundary
Provincial Boundary
Game, Nature Reserve
Perennial River
Perennial Water
Non-perennial River
Non-perennial Water
Dry Water course
Dry Pan
Marsh
Pipeline (above ground)
Water Tower, Reservoir, Water point
Woodland
Cultivated land
Recreational Ground
Row of Trees
National Freeway
Arterial Route
Main Road
Secondary Road
Other Road, Bridge
Railway Station/siding
Other railway, Tunnel
Embankment, cutting
Power Line
Built-up area
Buildings
Post Office, Police Station, Store
Place of Worship, school, hotel
Fence/wall
Wind Pump, Momentum
Communication Tower
Min Dump, Excavation
Cemetery
Mfidike
Waterval
Bleskop
Nkaneng
Hospital
Slimes Dam
RUSTENBURG PLATINUM MINE
KLIPFONTEIN

Appendix A2: Google Earth Locality Maps


N
Bleskop Mine Residence
TEMSO Tar Dams
a
b
Klipfontein Concentrator
a = 40 metres
b = 40 metres
Area = 0.16 hectares
c = Tar Dam previously removed in 2003
Google earth

Appendix B: Site Photographs

TAR DAMS A AND B (BLESKOP TAR DAMS)


North East of Tar Dam A


South West of Tar Dam A


Looking North West of Tar Dam A


Looking North of Tar Dam A


Looking West of Tar Dam A


Looking North East of Tar Dam B

Looking North of Tar Dam B

Looking South East of Tar Dam B

Looking North West of Tar Dam B

Looking East of Tar Dam B

Looking East of Tar Dams A and B

Looking North of tar Dams A and B

Looking from West to East of Tar Dams A and B

Looking South of Tar Dams A and B

Looking from the West to the North East of Tar Dams A and B (Tar Dam B in foreground)

TAR DAMS C AND D (TEMSO TAR DAMS)

Looking South West of Tar Dam C

Looking West of Tar Dam C

Looking North West of Tar Dam C

Looking North of Tar Dam C

Looking from the North East to the West of Tar Dam C

Looking South of Tar Dam D

Looking South West of Tar Dam D

Looking West of Tar Dam D

Looking from South to West of Tar Dam D

Appendix C: Facility illustration(s)

Not applicable: as the project tis existing, and the authorisation pertains to the decommissioning of tar dams and the remediation thereof, no site facility illustrations are considered relevant.

Appendix D- Annexure A: Enviroserve Report (2003)

PLATINUM

Rustenburg Tar dams

Review and Status

2011

Compiled by Dr HB Prinsloo

Date: 30 September 2011

CONTENTS

1. INTRODUCTION

The "tar dams" at Rustenburg Section (Rusteburg Platinum Mines) are legacy residues from a gas fired smelter at Klipfontein (where the existing Klipfontein Concentrator is) that existed more than 60 years ago. These residues were deposited in 4 different soil compartments that are situated in what is now the Rustenburg Platinum Mine lease area. Tar dams A and B (approximately 1600m2 per dam) are between Bleskop Soccer Stadium and the Hospital (red circle on map below) while tar dams C and D (approximately 1600m2 per dam) can be found next to the road to TEMSO (right arrow on map below).

2. HISTORY

The history and sequence of events related to the tar dams in Rustenburg section can be summarized as follows:

1960

- 4 tar dams was generated as a result of residue from an old gas fired smelter at Klipfontein that existed more than 60 years ago

2003 (see detailed 2003 Enviroserve Report in Annexure A)

- Due to the hazardous waste classification of the tar in the dams, a decision was taken in 2003 to recover the material out of dam D (3703 tonnes) closest to the road to TEMSO for combustion at Alpha's cement kiln in Lichtenburg after all the necessary legal permits were obtained. The tar was transferred in a liquid form to the Alpha Cement Plant to be used as an alternative fuel and resource (AFR). However, as the melted tar was fed into the furnace, it solidified (transfer lines were not heated) and the project was stopped as a result.

- A decision was then taken in March 2003 to move the rest of the content of the same tar dam (dam D) to Holfontein H:H hazardous waste landfill site. The transfer of tar started immediately after the Alpha Cement project was terminated.
- Although safe disposal at Holfontein is a solution, alternative solutions like re-use or treatment, had to be considered for the tar in the dams.

2008

- A tender was therefore issued in 2008 to consider alternative treatment solutions, or as a last resort, to remove as a priority the tar at the two dams (A and B) between Bleskop Soccer Stadium and the Hospital (the intent was to remove the tar in the third dam (C) next to TEMSO at a later stage). Although quotes to remove the tar from the dams A and B have been received in reaction to the tender, no acceptable alternative treatment options could be agreed upon. Therefore no order to proceed with the work was issued.

2011 (see Enviroserve quotation in Annexure B)

- In 2011, a decision was taken to remove the residue in the dams to Holfontein and to rehabilitate the disturbed areas. The removal of the 3 tar dams is in progress and is expected to be finalized before the end of 2011.

3. SPECIALIST STUDIES

After the decision was taken in 2011 to remove all remaining residue in the tar dams to Holfontein and to rehabilitate the disturbed areas, the risk related to the tar dams were investigated in detail to ensure all necessary steps are taken to minimize harm to the environment and to ensure legal compliance.

As a result, the follow studies have been completed:

- Baseline Ambient Air Quality Assessment (6 Sep 2011) – Anglo Platinum Limited: Tar Dam site *by* Margot Saner & Associates (MS&A) (Pty) Ltd **(See Annexure C)**

- Follow-up Air Sampling Survey – Anglo Platinum Limited: Tar Dam site (7 Sep 2011) – Anglo Platinum Limited: Tar Dam site *by* Margot Saner & Associates (MS&A) (Pty) Ltd **(See Annexure D)**
- The Status of Soil, Surface Water and Groundwater at the Tar Dam (August 2011) by Cleanstream **(See Annexure E)**
- Tar dam rehabilitation status report (September 2011) *by* Enviroserve **(See Annexure F)**

A decision has also been take to obtain the independent opinion of a toxicologist the end of 2011 to cover the following scope:
The scope of work is to evaluate the existing processes and approach with regards to environmental and human health impacts associated with the tar dams by:

- *Undertaking an Environmental risk assessment on the Air and Water analysis conducted,*
- *Undertaking an Human Health risk assessment on the Air and Water analysis conducted,*
- *Evaluate the potential exposure pathways and risks between the air and water,*

Based on point 1-3, as well as the understanding of the physical chemistry and the environmental fate, this should result in:

- *Advice on the potential exposure pathways during remediation by removal of the contents of the tars to a hazardous waste management facility,*
- *Advise on the remediation and rehabilitation process.*
- *If the tar comprises material that fall within the dangerous goods classification advice on whether any "dangerous goods" as contemplated in the South African National Standard 10234 are contained in the tar in sufficient quantities in order to determine whether further environmental authorisation is required to proceed with the removal.*

4. FINDINGS FROM SPECIALIST STUDIES

Emissions:

Baseline Ambient Air Quality Assessment (6 Sep 2011) – Anglo Platinum Limited: Tar Dam site by Margot Saner & Associates (MS&A) (Pty) Ltd (See Annexure C)

CONCLUSION / EXECUTIVE SUMMARY

The results obtained during this Baseline ambient air quality assessment conducted at the tar dam site adjacent to the Anglo Plats Medical Centre revealed that ambient concentrations of Benzene, Toluene, Ethylbenzene, Xylene, Trimethylbenzenes, Phenol, Ammonia, Cyanide and PAHs at all three of the sampling locations were well below the relevant South African Ambient Air Quality Standard (Benzene) and/or the equivalent UK Environmental Assessment Levels (UK EALs).

Ambient concentrations of Phenol and Ammonia downwind of the tar dams were marginally higher than those recorded at the upwind sampling location, suggesting that tar dam emissions contributed (marginally) to ambient concentrations of these contaminants.

Based on the results of this baseline study, the health risks associated with acute and/or chronic inhalation exposure to the measured ambient contaminant concentrations at the tar dam site, are minimal.

Follow-up Air Sampling Survey – Anglo Platinum Limited: Tar Dam site (7 Sep 2011) – Anglo Platinum Limited: Tar Dam site by Margot Saner & Associates (MS&A) (Pty) Ltd (See Annexure D)

CONCLUSION / EXECUTIVE SUMMARY

The outcome of the follow-up air sampling surveys conducted at the tar dam site adjacent to the Anglo Plats Medical Centre, revealed the following:

- Ambient concentrations of Benzene, Toluene, Ethylbenzene, Xylene, Trimethylbenzenes, Phenol, Cresol and Ammonia at both of the sampling locations were well below the relevant South African Ambient Air Quality Standard (Benzene) and/or the equivalent UK Environmental Assessment Levels (UK EALs).
- Worker exposure to airborne concentrations of Benzene, Toluene, Ethylbenzene, Xylene, Trimethylbenzenes, Phenol, Cresol and Ammonia was minimal during the survey period – i.e. all results were well below the relevant Occupational Exposure Limits (OELs).

Based on these results it is evident that:

• The health risks associated with acute and/or chronic inhalation exposure to the measured ambient contaminant concentrations at the tar dam site remain minimal.

• The health risks associated with worker inhalation exposure to priority contaminant concentrations at the tar dam site were low.

RECOMMENDATIONS:

Based on the results obtained during both the baseline air sampling survey (MS&A Project No 02626) and this follow-up study, the following recommendations are made:

- Additional follow-up air sampling (ambient and worker) must be conducted during full-scale excavation of the tar dams using excavator equipment (set to replace the 'Super-sucker'). This will allow for informed comment on the risks of worker / off-site receptor exposure to priority airborne contaminants under *worst-case conditions*. *(Note: this additional sampling was conducted on 30 August 2011 and results are awaited).*

- Pending completion of this additional air sampling it is recommended that all workers required to engage in any activities within the demarcated operational area, continue to be issued with the following Personal Protective Equipment (PPE):
  - Cotton overalls
  - Safety boots / Rubber gum boots
  - Tyvek oversuits
  - Safety goggles
  - Rubber gloves (elbow length)
  - Type ABEK1 half mask respirators

- Use of the above PPE must be enforced, with special priority being given to ensuring that workers make diligent use of hand protection (gloves) so as to prevent direct skin contact with the tar mixture as far as practicably possible. Despite the low risk of exposure to excessive airborne concentrations of contaminant compounds, use of respiratory protective equipment (RPE) by workers should be encouraged when engaged within the demarcated operational area and enforced whenever workers are actively engaged in actual tar removal activities. Additional comment in this regard will follow once the recommended follow-up air sampling has been completed and the results are available for interpretation.

- Workers must be fully informed about the health risks associated with exposure to the tar dam contents as well as the likely routes of exposure – particularly direct skin/eye contact.

- All workers must remain subject to appropriate medical surveillance protocols. The structure and frequency of these protocols should be at the discretion of the company Occupational Medical Practitioner (OMP). Both this report and MS&A Project No 02626 must be made available to the OMP.

Soil, Surface- and groundwater:

The Status of Soil, Surface Water and Groundwater at the Tar Dam (August 2011) by Cleanstream

(See Annexure E)

CONCLUSION / EXECUTIVE SUMMARY

6.1 Surface water

Water in the tar dam

The organic and inorganic results from this study clearly indicate that the water in the **Klipfontein Tar Dam** is polluted. Pollutants identified in the water of the tar dam which exceeds guidelines for the protection of human health, and which could pose possible contamination of receiving ground and surface water environment include (drinking water guidelines shown in brackets):

- Aluminium 4.4 mg/l (0.15 mg/l)
- Arsenic 0.063 mg/l (0.010 mg/l)
- Chloride 1490 mg/l (100 mg/l)
- Cyanide 2.24 mg/l (0.20 mg/l)
- Fluoride 45.22 mg/l (1.0 mg/l)
- Lead 0.021 mg/l (0.020 mg/l)
- Manganese 5.07 mg/l (0.40 mg/l)
- Mercury 0.21 mg/l (0.006 mg/l)
- Nickel 0.91 mg/l (0.15 mg/l)
- Selenium 0.031 mg/l (0.010 mg/l)
- Sulphate 3790 mg/l (400 mg/l)
- Benzene 0.051 mg/l (0.010 mg/l)
- Phenol 500 mg/l (4.0 mg/l)

Other constituents, that recorded above detection limits, but are within health based guidelines, or for which no health based guideline are available include (where available drinking water guidelines are shown in brackets):

- Ethylbenzne 0.0048 mg/l (0.30 mg/l)
- Toluene 0.057 mg/l (0.70 mg/l)
- o-xylene 0.013 mg/l
- m,p, xylene 0.026 mg/l
- Trimethylbenzene 0.016 mg/l
- n-Butylbenzene 0.0048 mg/l
- Cresols 370 mg/l
- 2,4-Dimethylphenol 13.0 mg/l
- 2,5-Dimethylphenol 4.3 mg/l
- o-Ethylphenol 2.3 mg/l
- m-Ethylphenol 13.0 mg/l
- TPH (C10 – C40) 65.0 mg/l

Significant impacts are related to (risks to human health at the concentration recorded are shown in brackets):

• Chloride	(Medium)
• Sulphate	(Medium)
• Cyanide	(High)
• Mercury	(High)
• Fluoride	(High)
• Phenol	(High)
• Cresols	(High)
• Total petroleum hydrocarbons	(High)

<u>Surface water in adjacent streams</u>

The Central Services Workshop effluent (**K083**) located upstream from the tar dam including NB12 and NB12A was included in this pollution assessment. Although K083 did not record any organic or inorganic constituents above health based guidelines, it did contain volatile oragnic hydrocarbons, mercury, chrysene, trichloromethane, phenol and TPH above detection limits (some of which no health based guidelines are available). Parameters and concentrations include (where available guidelines are shown in brackets):

• Mercury	0.00043 mg/l	(0.001 mg/l)
• Benzene	0.0055 mg/l	(0.010 mg/l)
• Ethylbenzene	0.0019 mg/l	(0.30 mg/l)
• Toluene	0.013 mg/l	(700 mg/l)
• o-xylene	0.0057 mg/l	
• m,p, xylene	0.0054 mg/l	
• Xylenes (sum)	0.011 mg/l	(0.50 mg/l)
• Trimethylbenzene	0.0037 mg/l	
• p-Isopropyltoluene	0.0008 mg/l	
• Phenol	0.015 mg/l	
• Chrysene	0.00026 mg/l	
• Trichloromethane	0.0013 mg/l	(0.30 mg/l)
• TPH (C10-C40)	19.0 mg/l	

Significant impacts are related to risks to human health at the concentration recorded are shown in brackets):

- Total Petroleum Hydrocarbons

The organic and inorganic results for the Klipfontein Spruit, K110 and K058, situated downstream from K083 and upstream and downstream from the tar dam respectively, do not show any indication of impact from the the tar dam or the effluent from Central Services Workshop (K083).

Average TDS for the database period, as managed by Clean Stream Scientific Services relating to the routine RPM-RS monthly surface water monitoring programme, at K110 are 3361 mg/l and for K058 3463 mg/l. TDS in this section of the Klipfontein Spruit is a concern with the Resource Quality Objective (RQO) as per the Draft Water Use Licence (162/7/A220/C5) of 2007, set at 515 mg/l. Similarly, average NO_3 for the upstream locality K110 is 4% greater than for the downstream locality at K058. Average NO_3 for K110 is 56.3 mg N/l while for K058 it was calculated at 53.9 mg N/l. NO_3 also remain a concern with the bulk of the NO_3 is most probably introduced from the Klipfontein re-mining activities. The additional contributions at the downstream locality, K058, is most probably from other upstream sources, such as from Siphumelele 3 Mine or could be sewage related (Siyavuya informal settlement) as high *E.coli* is typically recorded for K058.

Significant impacts (non-tar dam related) are related to risks to human health at the concentration recorded are shown in brackets)::

- Salinity (medium)
- Nitrate (high)
- *E.coli* (high)

6.2 Groundwater

In terms of groundwater the Terratest results indicate tracers for both inorganic and organic constituents in the downstream groundwater regime as recorded at **NB12**.

Mercury (Hg) was recorded for NB12 downstream from the tar dam and K083 at a concentration of 0.000092 mg/l. Mercury (Hg) was also recorded for the tar dam and **K083** with concentrations of 0.210 mg/l and 0.00043 mg/l. Although the Hg concentration is well within the health based guideline of 0.006 mg/l, it is nevertheless significant, because no Hg has been recorded above detection limits for the other surface or groundwater localities. This could be indicative of leachate from the tar dam or seepage from K083 into the downstream groundwater regime.

No cyanide was recorded in any of the groundwater localities sampled.

Organic constituents recorded for NB12 above detection limits include (where available human health guidelines are shown in brackets):

- Benzene 0.0004 mg/l (0.010 mg/l)
- Ethylbenzene 0.01 mg/l (0.30 mg/l)
- Phenol 1.8 mg/l (4.0 mg/l)

- Cresols 4.1 mg/l
- TPH (C10 – C40) 0.20 mg/l

In terms of organic parameters, the less dense benzene and ethylbenzene, and equally dense phenols and cresols were identified as tracers in both the tar dam and downstream groundwater as recorded at borehole NB12. The total petroleum hydrocarbons (TPH) in borehole NB12 also recorded mostly in the lighter C10-C31 ranges. All of the above constituents, except for the cresols were also recorded for the Central Services Workshop (K083). These compounds, generally known as light-non-aqueous-phase-liquids (LNAPLs), will generally spread across the surface of the water table and form a layer on top of the water table. Soluble components will follow the direction of groundwater movement creating a typical pollution plume.

The potable water quality guideline for phenol is set at 4.0 mg/l with the concentration in NB12 recording significantly less at 1.8 mg/l. No drinking water quality guidelines exist for cresols or total TPH compounds but are regarded as toxic. Therefore, although the health risks at NB12 in terms of the organic tracers and available guidelines remain low, leachate from the tar dam and / or seepage from K083 are the most probable sources for the organic constituents.

The phenol concentration for NB12, recorded at 1.8 mg/l, is significantly greater than the concentration at K083 – 0.015 mg/l. Because a pollution plume decreases in concentration away from the source, K083 may contribute to the pollution but cannot be solely responsible. Furthermore, it is significant that cresols of 4.1 mg/l and 370 mg/l were recorded for NB12 and the tar dam, respectively, but was not detected for K083. *However, some phenols may be formed as a result of natural processes like the formation of phenol and p-cresol during decomposition of organic matter (Swarts et. al., 1998). Decomposed organic matter was noted to be present at NB12 during time of sampling as a result of the borehole being uncapped.*

A significant impact on the downgradient groundwater regime relative to the tar dam was calculated in terms of salinity, mostly contributed by chloride, bicarbonate, calcium, magnesium, sodium, potassium and saline ammonia (NH_4^+). Other parameters increasing significantly from NB12A (upstream) towards NB12 (downstream) include phosphate, iron and manganese.

Of significance is the increase in salinity, alkalinity and saline ammonia in NB12 (downstream) relative to NB12A (upstream). EC increased more than double to values exceeding acceptable drinking water standards as proposed by the DWA (DWAF, 1998). An EC increase from 63.2 mS/m to 158.8 mS/m was recorded with acceptable maximum ranges set at 70 mS/m. An alkalinity increase of 544.4 mg/l was recorded at NB12 relative to NB12A with concentrations of 742.7 mg/l and 198.3 mg/l recorded respectively. Although no drinking water guideline exist for alkalinity, this should nevertheless be seen as significant since a very high alkalinity concentration of 3483 mg/l was recorded for the tar dam.

A saline ammonia increase of 38.78 mg N/l was recorded at NB12 relative to NB12A with respective concentrations of 44.22 mg N/l and 5.44 mg N/l. No health based guideline exists for saline ammonia. It is significant to note that the tar dam did not record high saline ammonia or nitrate (both as N) which may indicate contamination from other sources. Other sources may include historic sewage pollution and organic matter degradation (borehole is uncapped and could result as a trap for small mammals and reptiles). Frequent theft of borehole caps is a concern at RPM-RS. Current measures of securing the caps are by Allen keys but new more effective measures should be revised.

The significant PO_4-P concentration at NB12 relative to NB12A are cause for concern. An increase of 2.92 mg P/l was recorded downstream from NB12A (0.98 mg P/l) towards NB12 (3.90 mg P/l). High PO_4 of 38.5 mg P/l was recorded for the tar dam with K083 averaging at 8.1 mg P/l for the database period. Leachate from the tar and / or seepage from K083 could be responsible for the increase in PO_4 concentrations although P from organic matter degradation is also highly probable. In addition, seepage from water at K083 into the subsurface may follow a preferential pathway to NB12 which may be why a similar distribution is not noted for NB12A. However, a specialist geohydrological investigation should confirm this.

Significant impacts are related to:

- Phenols (Low)
- Cresols (Low)
- Mercury (Low)

6.3 Soil

Metals recorded for soil-1 which exceeds soil quality guidelines for the protection of human health are Cr (500 mg/kg) and Ni (160 mg/kg). Guidelines set for Cr and Ni are 64 mg/kg and 50 mg/kg, respectively.

A wide range of phenolic compounds were recorded above detection limits in **soil-1** but only phenol and cresols (sum) have established health based guidelines of 0.33 mg/kg and 0.40 mg/kg, respectively. Phenol recorded a concentration of 3.44 mg/kg and the sum of cresols 22.0 mg/kg both of which significantly exceed the health based guidelines.

The health based guideline for the sum of PAH of 9.0 mg/kg is significantly exceeded in **soil-1** with a concentration of 450 mg/kg. Similarly, the health based guideline for the sum of TPH, 250 mg/kg are more than 165 times greater in soil-1 with a concentration of 42 000 mg/kg.

Other constituents which exceed soil quality health based guidelines in **soil-1** are the volatile chlorinated hydrocarbon monochlorophenol which at 1.1 mg/kg exceed the guideline set at 0.06 mg/kg.

Chromium (Cr) and benzene recorded concentrations of 86 mg/kg and 1.0 mg/kg in **soil-2** which are significantly greater compared to their respective guidelines of 64 mg/kg and 0.0095 mg/kg, respectively. A wide range of PAH and TPH constituents were recorded for soil-2 but with only guidelines available for the sum of total constituents recorded. The sum of PAH calculated for soil-1 are 4.5 mg/kg which is well within the health based guideline of 9.0 mg/kg. However, the sum of TPH constituents calculated to 720 mg/kg which is significantly greater than the health based guideline of 250 mg/kg. The organic chlorinated compound a-chlordan recorded a concentration of 0.003 mg/kg which is significantly greater than the health based guideline of 0.0004 mg/kg for the sum of chlordans. Chlordan was mostly used as a pesticide in the United States but due to the human and environmental concerns it was banned by the Environmental Protection Agency (EPA) in 1988.

Significant impacts are related to:

- Chromium
- Nickel
- Phenols
- Cresols
- Polycyclic aromatic hydrocarbons
- Total Petroleum Hydrocarbons

RECOMMENDATIONS

Based only on the results presented in this study it is clear that the Klipfontein Tar Dam are impacting on the downstream groundwater regime in terms of salinity and organic compounds. However other contributing sources, specifically related to nutrient enrichment, such as the effluent from the Central Services Workshop (K083) and / or organic matter decomposition, should not be excluded. Since the tracers identified in NB12 are below available drinking water standards for the protection of human health, no immediate risk remain towards the receiving surface or groundwater environment in terms of human health. However for many of the constituents which recorded above detection limits, no health based guidelines are available and it is therefore difficult to assign a human health risk towards it. The concentrations recorded at the possible sources (Klipfontein Tar Dam and effluent from General Services Workshop – K083) remain medium to high with some variables exceeding human health guidelines. ***It is therefore recommended that these probable sources of contamination, the tar dam and K083, be removed and that specialist soil and hydrogeological investigations follow this pollution status report to evaluate the radius and / or depth of influence of contamination.***

Groundwater pump-and-treat systems are probably the most common remediation option for addressing contaminated aquifers. This technology pumps groundwater out of contaminated zones to remove dissolved contaminants and, if present, to slowly dissolve any trapped NAPLs. The pumped water is then treated on the surface to remove or destroy the dissolved contaminants. However, the first option in remediation should always be source removal if possible (EPA, 1990). The residual NAPL that remains trapped in the soil matrix acts as a continuing source of dissolved contaminants to ground water, and effectively prevents the restoration of NAPL-affected aquifers for many years. The soil in this instance should therefore also be seen as a source and if possible, all polluted fractions should be removed by excavation.

Ongoing monitoring of the groundwater and soil, preferably stratified sampling in the case of soil, should be performed to assess the extent of and / or depth of pollution which should be extended until after source removal.

It is recommended that the borehole at NB12 be purged to remove all stagnant water and be re-tested for nutrients which could have been contaminated by organic matter. This will define the source of the high nutrients (N, P) recorded for NB12 more clearly, whether it be from organic matter degradation or indeed contamination by upstream sources.

5. REHABILITATION AND DECOMMISIONING

Based on the experience gain by Enviroserve in 2003 when they removed the tar in dan D and the fact that they have access to the H:H Landfill site at Holfontein, they were sub contracted by Anglo American Platinum to removed the tar in the remaining tar dams to Holfontein. A quotation of R21.2m was approved and the removal of the tar from the dams started at the beginning of September 2011. The intent is to have all tar removed before end of 2011.

A quote was also obtained from WSP to undertaking an environmental authorisation in the form of a Basic Assessment (BA) process in order to obtain a waste license for the proposed project in accordance with the National Environmental Management Act (No. 107 of 1998), as amended (NEMA) and the National Environmental Management: Waste Act (No. 59 of 2008) (NEM:WA). Due to the fact that the project will handle hazardous waste, the Department of Environmental Affairs (DEA) will be responsible for granting the waste license.

This quote is currently be amended to include decommissioning as a listed activity under the NEMA EIA Regulations 2010 for various decommissioning activities. These include the decommissioning of "*existing facilities or infrastructure, for ... activities where the land on which it is located is contaminated ... [or] storage, or storage and handling of dangerous goods or more than 80 cubic metres*".

Other key legal decisions were:

- The existence of the dams pre-dated the Environment Conservation Act ("ECA"). The tar dams fell within the exclusion of matters regarded as waste for purposes of the ECA and consequently no section 20 permit was required when the ECA commenced. Despite various changes in legislation governing mining activities, the exclusion continued to apply until 1 July 2009 when section 20 of the ECA was repealed and the Waste Act came into force.
- The dams are not registered under the National Water Act and are also not licensed under that Act. However, disposing of waste in a manner which may detrimentally impact on a water resource is the continuation of an existing lawful use for which no water use licence is required.
- Further investigation of the quality of the groundwater and the removal of the source of the pollution and the remediation of the area in which it is stored would fall within the ambit of "reasonable measures" as contemplated in NEMA. A similar duty exists under the NWA. Since the external legal opinion was prepared, the groundwater has been investigated and ambient air quality studies have been conducted. A toxicologist is to be appointed. This again, would represent compliance with the duty of care.

6. WAY FORWARD

The following actions will be implemented:

Immediate – 31 Dec 2011:

- Continue with removal of tar from dams (due end of Dec 2011)
- Continue with emission monitoring (monthly)
- Continue with water monitoring (monthly)
- Amend WSP quote and initiate order to apply for authorization (October)
- Obtain quotations for toxicologist and initiate order (October)
- Once authorization obtained, Initiate decommissioning and rehabilitation (November-December)
- Upgrade ground water monitoring e.g. boreholes, based on outcome of Basic Assessment (November-December)

2012 and beyond:

- Continue with monitoring programme (until closure)

Annexure A:

Enviroserve Report (2003)

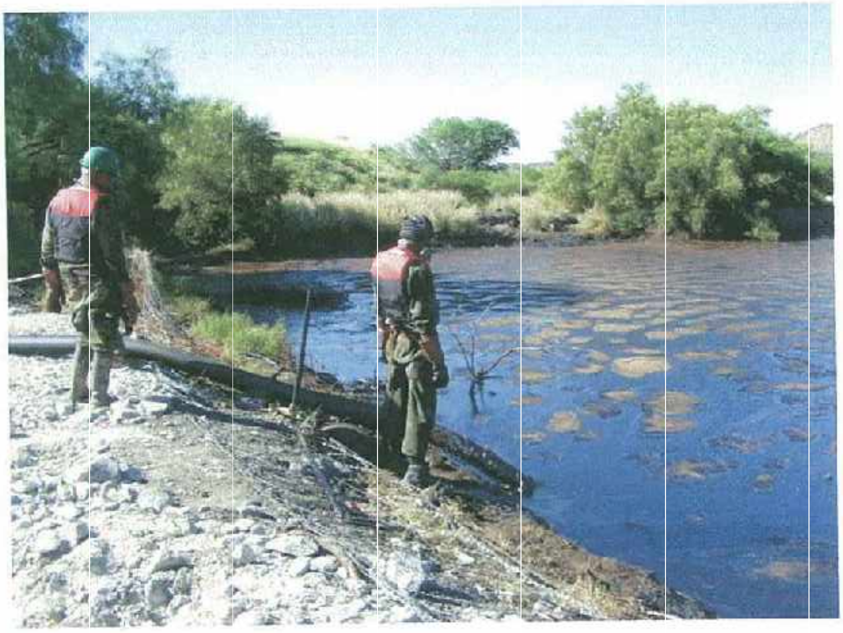
ENVIROSERV

WASTE MANAGEMENT

Please catalogue & file. Thanks

By hand to A. Britz

REMOVAL AND DISPOSAL OF TAR / BITUMEN DAM



ANGLO PLATINUM

INDEX:

SECTION 1 - REPORT

ENVIROSERV
WASTE MANAGEMENT

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Website: www.enviroserv.co.za,
e-mail: info.ho@enviroserv.co.za

RUSTENBURG PLATINUM MINES LTD
ANGLO PLATINUM
Rustenburg Section
PO Box 8208
RUSTENBURG
0300

07 November 2003

Attention: Mr. Andre Britz

Dear Sir,

RE: REMOVAL AND DISPOSAL OF TAR / BITUMEN DAM

Enviroserv's divisions Waste-Tech and Process Management were involved in the removal and disposal of the Tar / Bitumen dam near Temso.

Scope of Work:

- Removal and disposal of the contents in the dam near Temso in the best practicable and environmentally responsible manner;
- Excavation of the undercut to remove all residues and potential contamination.

Information used as the basis:

- The contents are a tar / bitumen mix.
- The dams have not been in use for more than 60 years.
- The size per dam is 40 x 40 meters.
- **Depth is unknown. The assumption is that the depth is 1m.**
- The tar content is estimated at 1500 tons.
- The undercut is estimated at 280 tons.
- The viscosity of the contents of the dam surveyed is such that it can be pumped.

Initial investigative work:

Samples were taken from the surface of the dam as well as during the excavation trial (below surface) and analysed for: (Please refer to Appendix A for results)

- Organic content
- Inorganic / metal content
- Calorific value
- Insolubles
- Ash content
- Viscosity at various temperatures
- Chlorides
- Sulphur
- Moisture content

From the analysis it was clear that no heavy metals leached above their acceptable risk limit, although both Ammonia-N and cyanide leached above their acceptable risk limit. Cyanide is classified as extreme hazard specie, and therefore the contents of the dam will be classified as extreme hazard waste. Also, a number of phenols leached out above their acceptable risk limit. One of which is a class B carcinogen namely cresol.

According to the Minimum Requirements from DWAF, the waste had to be disposed of at an H:H site, such as Holfontein. The waste could not be delisted because of the reasons named above.

Enviroserv's Process Division together with Alpha cement embarked on a program during 2001 to investigate the potential for the development of using waste material as an alternative fuel and resource (AFR). The use of waste material in cement kilns have been practiced for over 20 years in the USA and Europe and more recently, Australia. Internet

Based on the chemical analysis performed and comparing it to the parameters set for suitability of materials as AFR, the contents of the dam was ideally suited as a fuel supplement to cement kilns. The Alpha cement plant in Lichtenburg is capable of accepting the material under certain conditions:

Conditions to be met

- The material must be in a liquid form and pumpable.
- It must be chemically compatible to the processes of the cement manufacturing plant.
- It must not alter the quality of the cement.
- It must not negatively influence the air and environmental emissions.
- It must have a sufficiently high calorific value in order to replace a percentage of coal as a fuel source.

Site establishment:

Waste-Tech operations on Anglo Platinum's Rustenburg site commenced on 11th of March 2003. Airvac (subcontractor to Waste-Tech) crew filled 6 x 10kl tanks per day, which increased later to 8 x 10kl tanks per day. It was found that the temperature played a very important role in the viscosity of the waste product. Also, due to rain, approx. 60kl of water was removed off the site.

Process Management division commenced operations on the 13th of March 2003. The objective was to recover material out of the dam for co-combustion at Alpha's cement kiln in Lichtenburg.

Process description:

The intention was to remove the bitumous material from the dam in which it was stored using *super sucker equipment*. The material from the dam was placed in a $5m^3$ vacuum tank. The vacuum tank was elevated above a heating skip system. The bitumous material was fed into the heating system from the vacuum tank. The heating system comprised of a flu, which was heated using LPG gas, a strainer system and a positive displacement pump which enabled the transfer of filtered material from the heating system to a $30m^3$ heated storage tank. Once the storage tank had been filled (11 April 2003), the material was transferred to a bitumen tanker and transported to Alpha in Lichtenburg. The material was transferred from the tanker into another heated storage vessel at Lichtenburg. An attempt was made to co-combust the material through cement kiln.

In the meantime, Waste-Tech was still removing and disposing of the waste at Holfontein landfill site. (Please refer to Appendix B for a list of all the manifests generated together with the tonnages removed to Holfontein & Rosslyn)

All the pumpable material was removed, and then a grader was used to mix the undercut with the semi-solid tar / bitumen left in the dam. This was then loaded into tippers and transported to Holfontein.

Results:

- The transfer system from the dam to the heating system was inefficient. Considerable delays were experienced connecting as well as filling the vacuum tank with the super sucker.
- The heating system was completely inefficient as it could not produce the volume required (30 tons per day) – only 25 tons of material was produced over a period of 1 month.
- The filtration system was inadequate resulting in a delay in the production rate.
- The transfer system at Alpha was initially inadequate for the type of material;
- The system was upgraded, but still could not handle the transfer of the material for the reason that the transfer lines should have been heat-traced.

- It was decided to remove the bitumen tanker from Alpha on the 23rd of July 2003 and the material was disposed of at EnviroServ's Holfontein landfill site.

Disposal of the contaminated soil undercut:

Samples were taken from the undercut and sent for analysis to test for inorganic and organic species. The analysis showed that the material from under the dam still contained significant amounts of phenols and possibly cyanide, although no ammonia was found. Also, it was found that the undercut leached some heavy metals, in particular Manganese at a concentration above its acceptable risk limit. The waste had to be treated with 10kg Ferrous Sulphate per ton prior to ash blending two parts by mass of ash. Only small volumes of waste could go to Rosslyn. (Refer to Appendix B; volumes marked in pink were disposed at Rosslyn)
(Please refer to Appendix C for results of analysis)

Conclusion:

- Originally, when the proposal was done, a total tonnage of 1780 was estimated, but the contamination was deeper than what we anticipated, and the total tonnage ended up at 3702.72
- The system at Alpha has since been upgraded and similar material to that generated at Anglo, has of recent been successfully co-combusted at Alpha's facility;
- A new design based on the test information obtained from the initial dam has been completed and we are confident that we would be able to process most of the material (except the undercut material) from the remaining dams within a period of 2 months. Ideally this could be performed during the early part of 2004;
- Lab test work on dissolving the material in various solvents has been performed with no positive results

Intellectual Property:

The technology and know-how developed by EnviroServ and which is disclosed in this report is of a unique nature and the intellectual property rights of such technology and the proprietorship thereof, vests in EnviroServ.

Anglo Platinum undertakes that it will not during the course of its association with EnviroServ, disclose the technology, concept and know how which forms the subject matter of this proposal, or any part thereof, to any third party for any reason or purpose whatsoever without the written consent of EnviroServ.

Yours sincerely,
FOR ENVIROSERV WASTE MANAGEMENT (PTY) LTD.

Arenstein

LIZE ARENSTEIN
WASTE CONSULTANT

CONFIDENTIALITY

1. Proprietary and/or confidential information may be disclosed by one party to the other or exchanged between the parties orally, visually or through the transfer of documents, diagrams or computer storage media. Proprietary and/or confidential information includes, but is not limited to performance, sales, planning, financial, contractual and technical data.

2. The receiving party shall hold such information in confidence and shall use such information only for the purposes of this agreement or for agreements concluded between them, and shall not disclose such information to any third party without prior written approval by the other party.

3. This agreement may not be assigned or otherwise transferred by either party in whole or in part without the express prior written consent of the other party.

4. This agreement contains all agreements, representations and understandings of the parties hereto and supersedes and replaces any and all previous understandings, commitments or agreements, oral or written, related to the exchange of confidential and/or proprietary information, data and ideas for the opportunities as set forth herein.

A.J. BRITZ

Print Name

CHIEF ENG OFF.

Signature and Designation

Witness 1

Witness 2

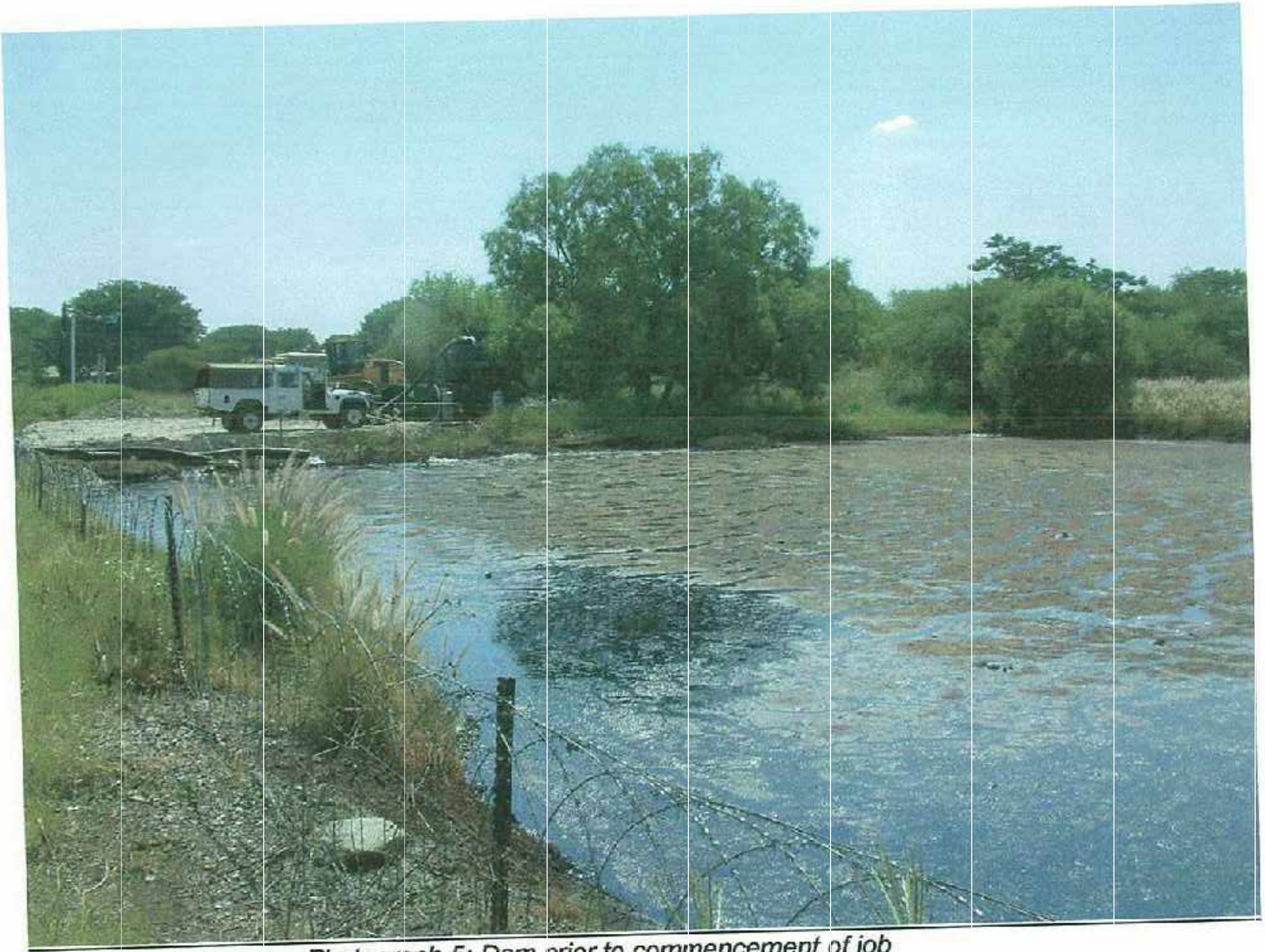
PHOTO RECORD

Photographs 1 – 4: Excavator is used to sample the consistency of the tar dams

Photograph 2

Photograph 3

Photograph 4: Test sample is loaded into skip container



Photograph 5: Dam prior to commencement of job

Photograph 6: Super sucking of pumpable waste

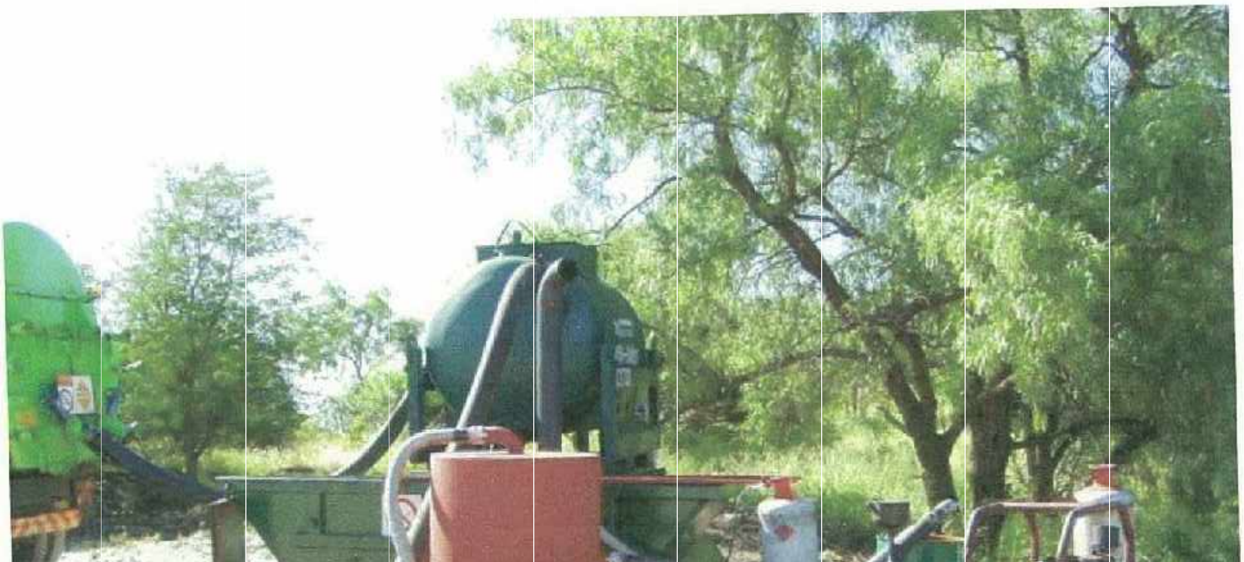
Photograph 7: Pumpable material transferred to 10kl tanks

Photograph 8: Loaded 10kl tank lifted onto RoRo truck

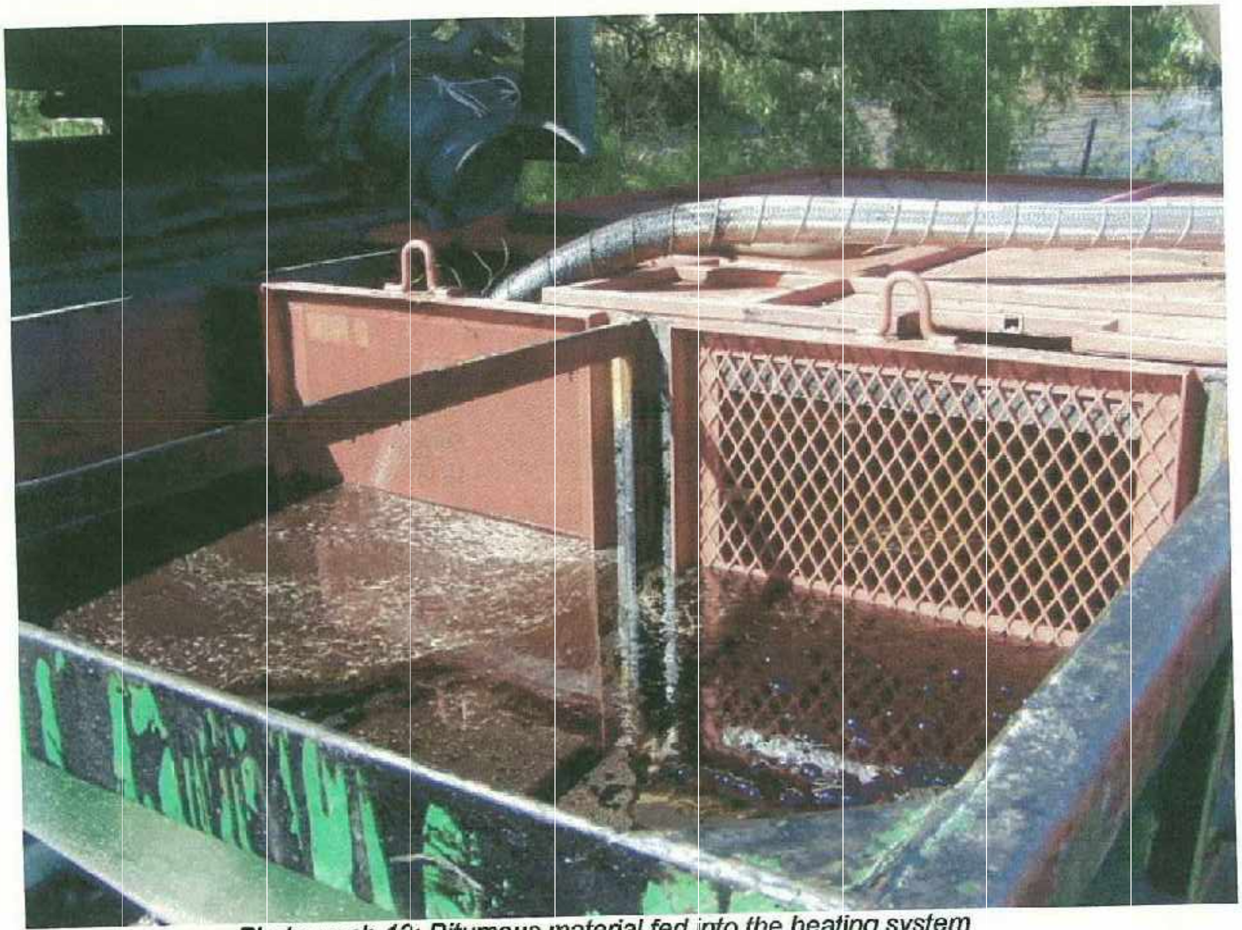
Photograph 9: Triple combination truck ready to transport waste to Holfontein Landfill site

Photograph 10: Disposal at Holfontein Landfill site

Photograph 11: Process Management's plant



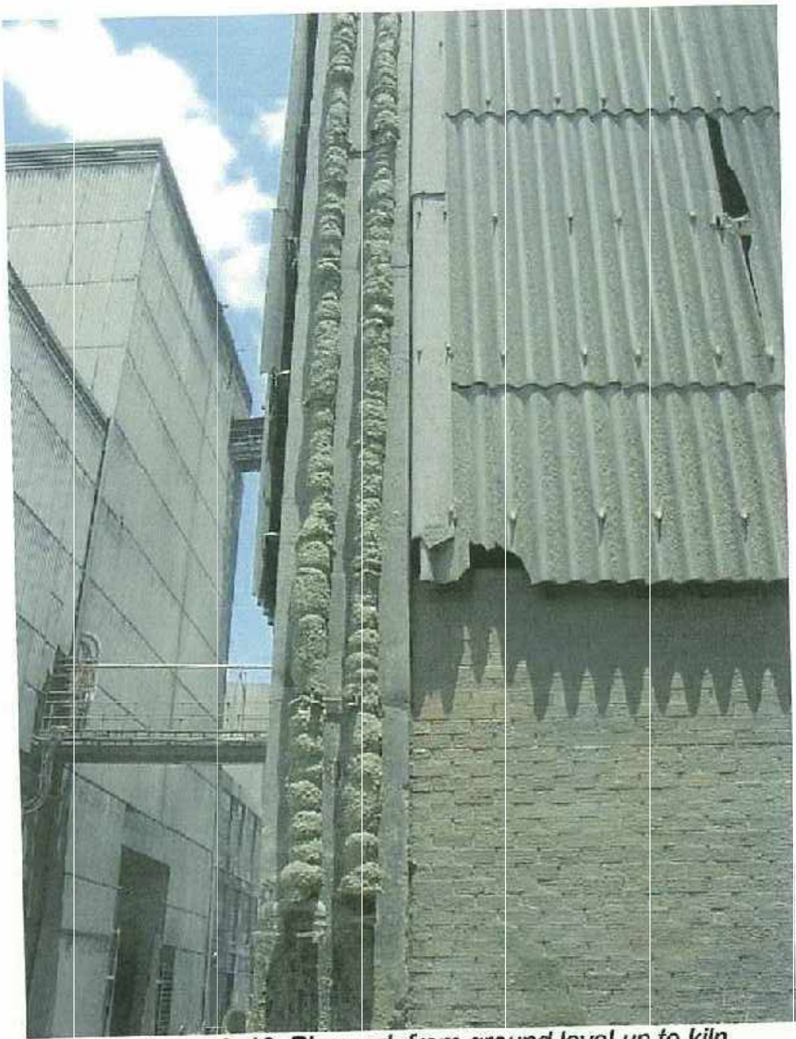
Photograph 12: Super sucker filling $5m^3$ vacuum tank



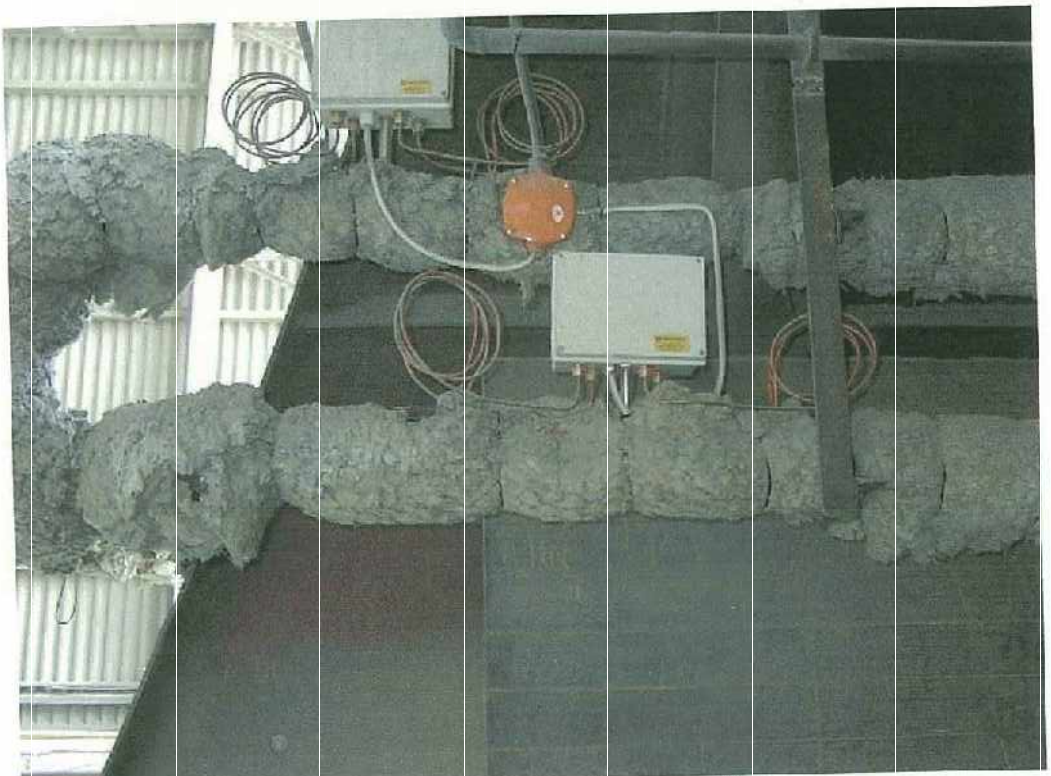
Photograph 13: Bitumous material fed into the heating system

Photograph 14: Scaffolding erected for safety purposes

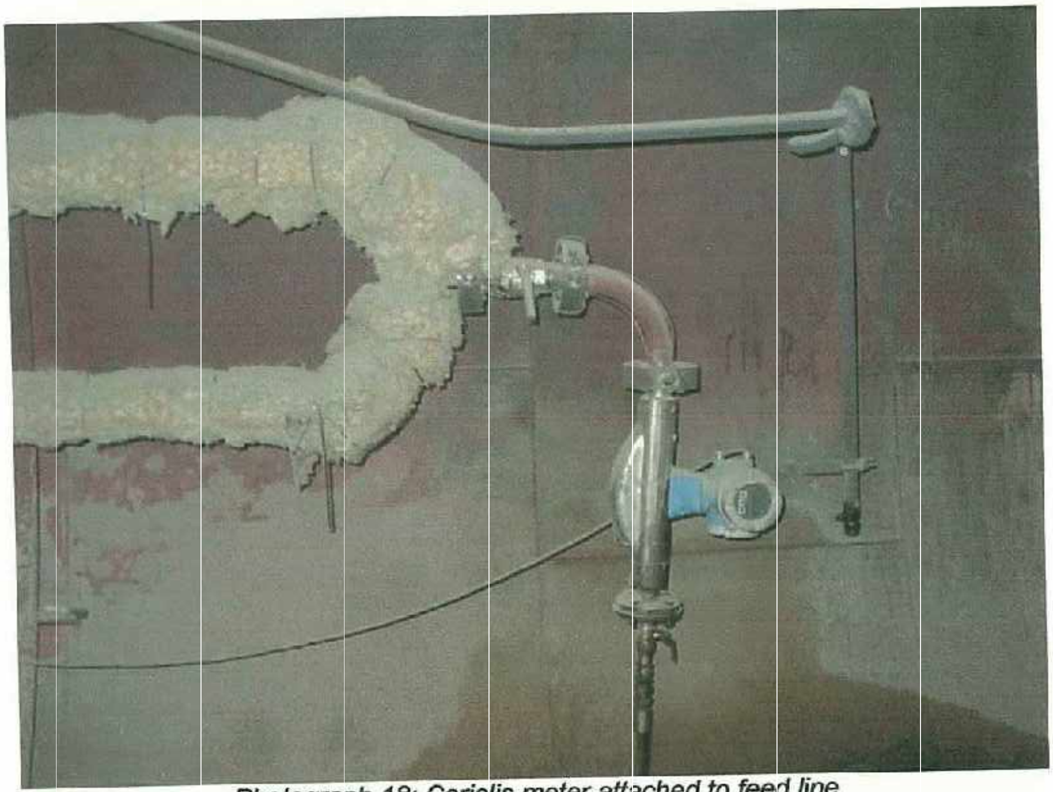
Photograph 15: Filtered material transferred to $30m^3$ heated storage tank



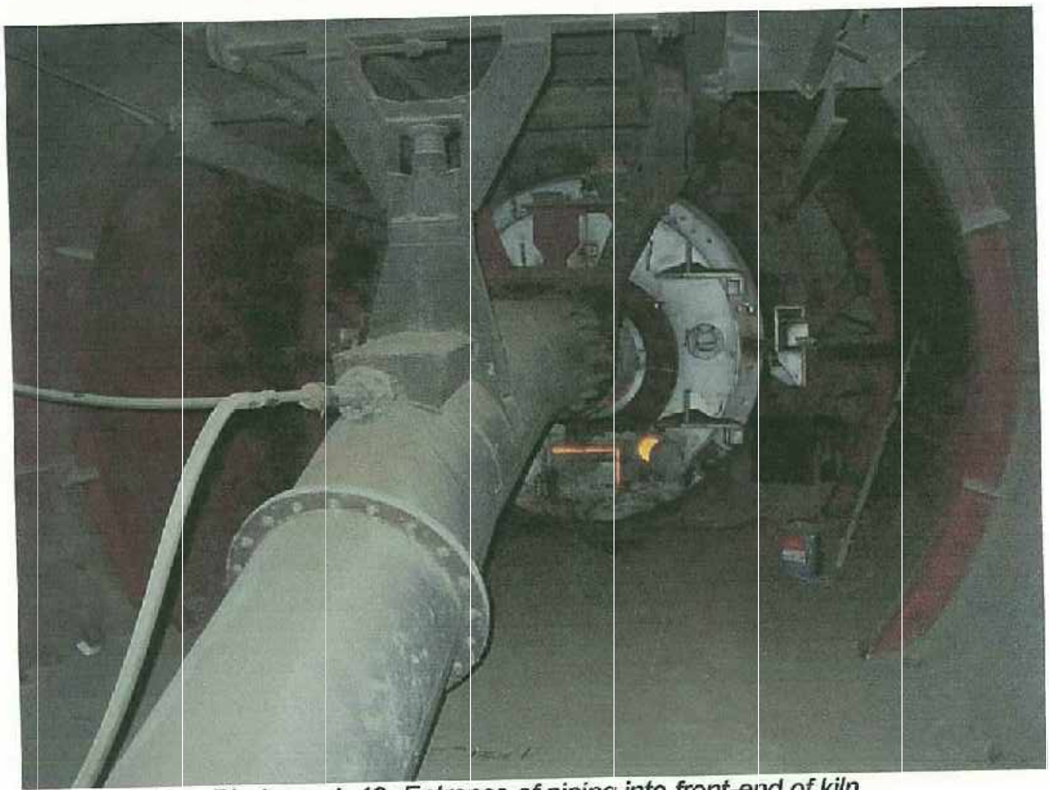
Photograph 16: Pipework from ground level up to kiln



Photograph 17: Heat tracing connections



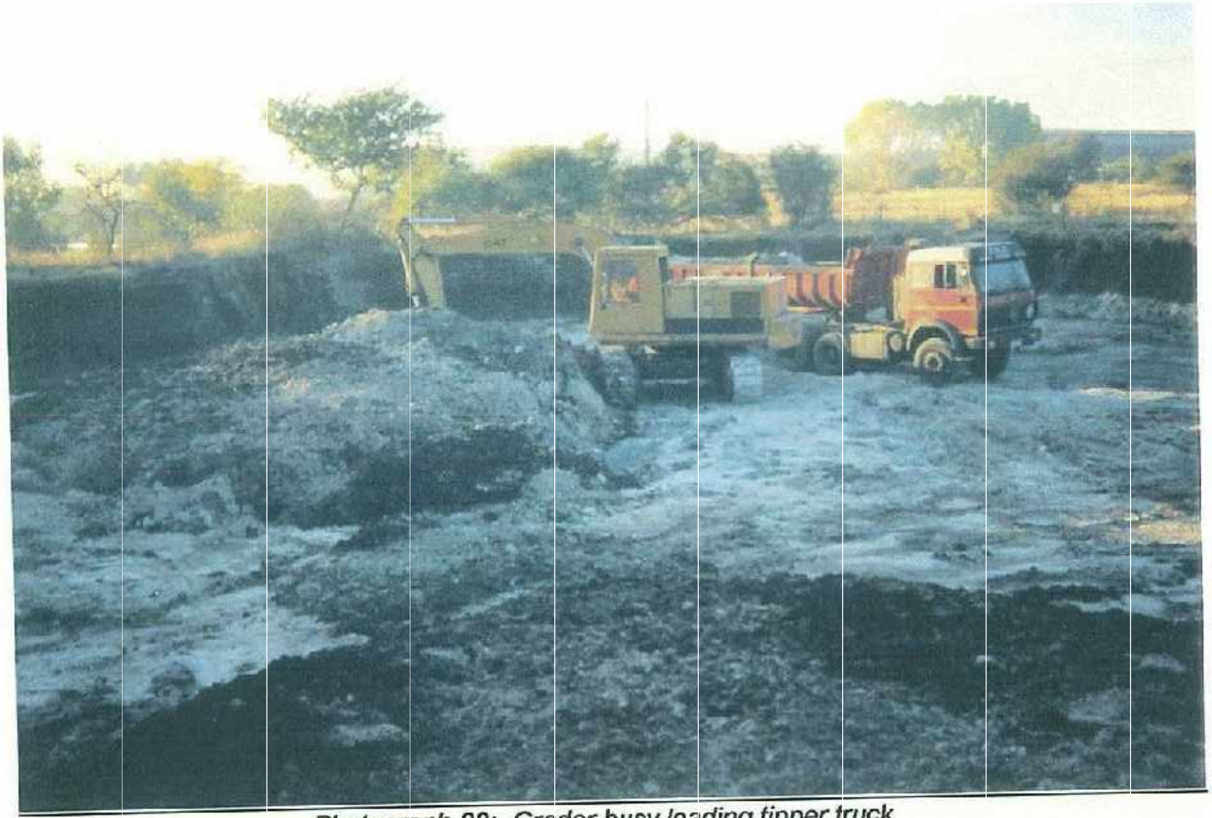
Photograph 18: Coriolis meter attached to feed line



Photograph 19: Entrance of piping into front-end of kiln

Photograph 20: All pumpable waste have been removed

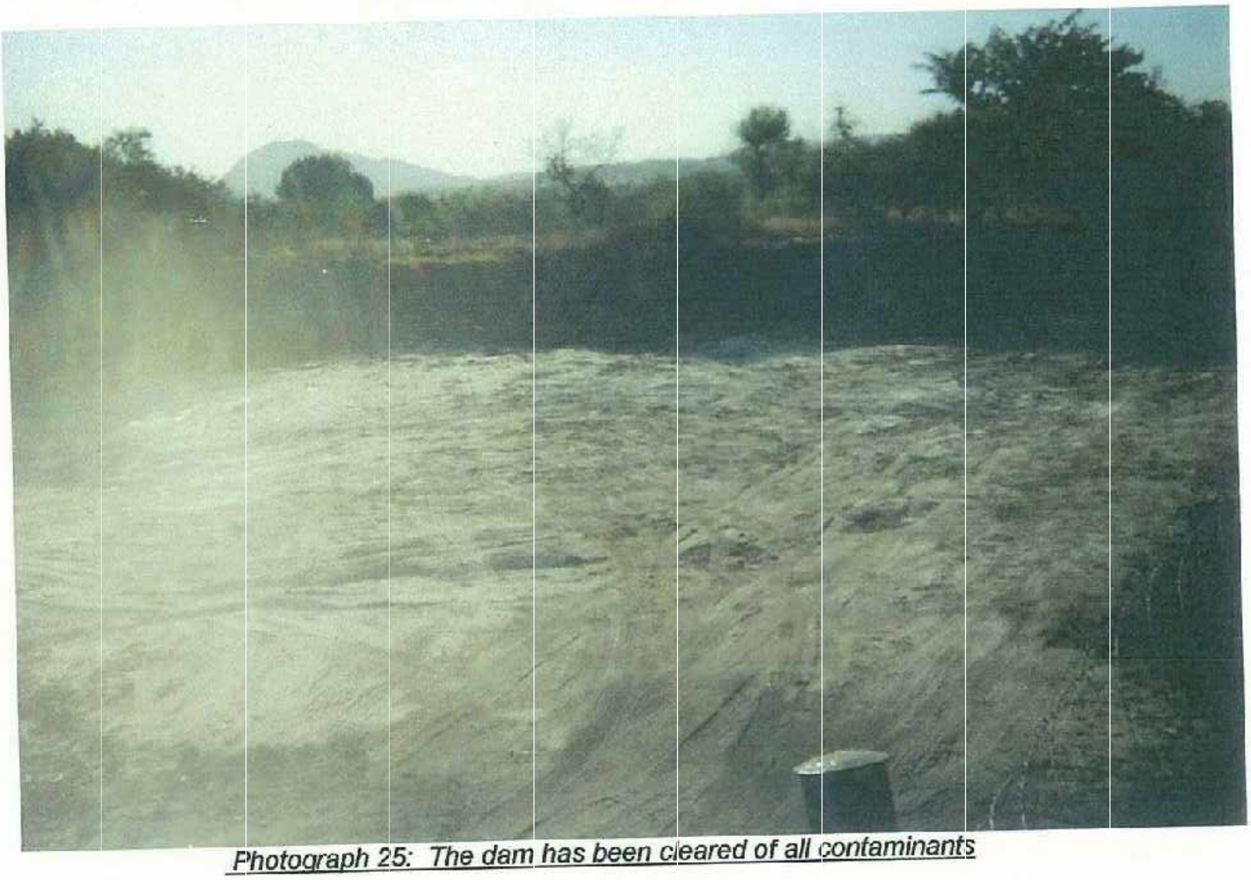
Photograph 21: Grader busy mixing undercut with semi-solid waste



Photograph 22: Grader busy loading tipper truck

Photograph 23: More undercut and semi-solid waste to be mixed

Photograph 24: The end is in sight



Photograph 25: The dam has been cleared of all contaminants

Photograph 26: Undercut disposed at Rosslyn

SECTION 2 – APPENDIX A

Environmental & Chemical Consultants			
Waste Classification No.	**425**	**Date:**	**25 July 2002**
Waste Generator	**Anglo Platinum, Rustenburg**		
Waste Origin/Type	**Pitch Waste**		

Introduction:
Anglo Platinum has four historical tar or pitch dams at their Rustenburg site that require removal: the average size of the dams is 2000 m^3.

Waste Analysis:
SGS Laboratory Services leached a sample of the waste using the TCLP and analysed the leach solution for 33 elements. The sample was screened in the Enviroserv Laboratory and the waste was found to have an average density of 1.01 g/cm^3 and to contain both cyanide and phenols. The elements of concern, i.e. those above their detection limit, are given in table 1 together with their hazard rating and acceptable risk limits. The TCLP solution was forwarded to CSIR Bio/Chemtek for organic analysis and these results are presented in table 2.

Table 1: Elements of concern leached using the TCLP, mg/l

Element	Tar Waste, mg/l	HG	ARL, ppm	Comments
Ammonia-N	138	4	10.9	As ammonium
Ca	3.72	NT		
Cyanide	5.0	1	0.0053	Average 5 samples
Fe	0.06	3	9.0	
K	1.38	4	43.5	
Mn	0.03	2	0.30	
P	1.70	4	10	
S	51.7	NT		As sulphate
Zn	0.11	2	0.70	
pH final	4.95			

Table 2: Organic compounds in the TCLP leachate

Compound	TCLP, mg/l	HG	ARL, ppm	Comments
Phenol	0.69	3	2.3	
Cresols	6.85	2	0.4	B carcinogens
2,6-Dimethylphenol	0.69	3	2.7	
2,4-Dimethylphenol	3.89	3	1.66	
3,5-Dimethylphenol	2.82	3	1.4	
3,4-Dimethylphenol	0.73	3	1.4	
2,4,5-Trimethylphenol	0.78	3	-	Moderate hazard?
Ethylmethylphenols	4.00	3	1.04	
5-Indanol	0.72	-	-	LD50=3250 mg/kg
1,4-Dimethyl-2-(1-methylethyl) phenol	0.84	2	-	High to low toxicity
2-Naphthenol	0.76	2	0.346	

Results:
The results show that:

1. The waste leaches no heavy metals at concentrations above their acceptable risk limit. However, it leaches both ammonia-N and cyanide at concentrations above their acceptable risk limits and since cyanide is classified an extreme hazard species, the pitch classifies as an extreme hazard waste. According to the Minimum Requirements, the waste must be disposed to an HH site.

2. Note that the pH of the final TCLP solution is only 4.95, which means that the waste has a limited alkalinity and yet is doesn't leach heavy metals.
3. The waste leaches a number of phenols some of which are above their acceptable risk limits. Note that the cresols, which are class B carcinogens, are present. Presumably the tar/pitch also contain PAHs and other non-leachable organic compounds.
4. Because of the high concentration of cyanide, only small amounts of the waste can theoretically be disposed to landfill, i.e. to an HH landfill the load or dose calculates out to only 1.61 tons per hectare per month. The amount of waste available is 8080 tons: treatment is therefore required prior to landfilling.

Treatment and Disposal Options

Recycling/Recovery
Often tar and pitch wastes can be blended with waste oils and other waste petroleum products to give a second grade fuel oil. However, this is not acceptable, because of the presence of cyanide and, therefore, the risks posed to users.

Incineration:
Controlled incineration is the preferred treatment option because of the presence of cyanide.

Landfilling:
Pre-treatment is required prior to disposal to landfill. Treatment of cyanide with sodium hypochlorite is, normally, the preferred method but the presence of phenols would result in the formation of a number of chlorophenols, which are classified as extreme or high hazard substances. Treatment with ferrous sulphate to form the ferrocyanide anion followed by ash blending, i.e. one part ash to one part waste is recommended.

a) Holfontein:
After treatment the waste can be co-disposed to Holfontein.
b) GLB^+ Landfill:
Because of the presence of cyanide it is highly unlikely that the waste would delist for disposal to a GLB^+ landfill even after treatment.

D A Baldwin, Ph.D., Pr.Sci.Nat, MIWM, MSACI

SECTION 3 – APPENDIX B

MANIFEST	VOLUME	UofM
0000218578	19.40	TONS
0000218579	12.35	TONS
0000218580	14.45	TONS
0000218914	7.30	TONS
0000218919	20.90	TONS
0000218922	23.75	TONS
0000218927	23.20	TONS
0000218984	21.05	TONS
0000228266	13.90	TONS
0000228273	15.60	TONS
0000228276	18.40	TONS
0000228281	4.00	TONS
0000228284	15.55	TONS
0000228297	12.05	TONS
0000228344	21.40	TONS
0000228350	11.50	TONS
0000228365	14.45	TONS
0000228371	18.00	TONS

MANIFEST	VOLUME	UofM
0000228374	21.35	TONS
0000228375	13.25	TONS
0000228377	17.05	TONS
0000228380	16.20	TONS
0000230593	16.20	TONS
0000230597	13.35	TONS
0000230598	13.75	TONS
0000230600	14.15	TONS
0000231015	8.10	TONS
0000231721	14.35	TONS
0000231723	17.15	TONS
0000231727	19.50	TONS
0000232690	8.15	TONS
0000245310	21.05	TONS
0000245312	21.88	TONS
0000245314	24.60	TONS
0000245316	22.45	TONS
0000245320	20.15	TONS

MANIFEST	VOLUME	UofM
0000245323	21.45	TONS
0000245325	20.50	TONS
0000245327	19.80	TONS
0000245328	19.55	TONS
0000245333	20.55	TONS
0000245371	19.05	TONS
0000245980	26.30	TONS
0000245982	22.40	TONS
0000245983	22.45	TONS
0000245986	19.50	TONS
0000245988	25.25	TONS
0000245990	19.60	TONS
0000245991	18.75	TONS
0000245992	21.34	TONS
0000245994	17.65	TONS
0000245995	23.95	TONS
0000245996	22.18	TONS
0000245999	19.92	TONS

MANIFEST	VOLUME	UofM	MANIFEST	VOLUME	UofM	MANIFEST	VOLUME	UofM
0000246000	22.48	TONS	0000246036	20.70	TONS	0000248328	22.68	TONS
0000246001	21.75	TONS	0000246039	20.60	TONS	0000248330	23.86	TONS
0000246003	22.24	TONS	0000246040	22.40	TONS	0000248332	22.08	TONS
0000246004	20.50	TONS	0000246068	23.85	TONS	0000248334	22.54	TONS
0000246005	21.52	TONS	0000246070	28.40	TONS	0000248339	21.32	TONS
0000246007	23.54	TONS	0000246071	25.65	TONS	0000248343	22.80	TONS
0000246009	20.42	TONS	0000246072	22.90	TONS	0000248349	23.78	TONS
0000246012	10.90	TONS	0000246073	22.40	TONS	0000248351	21.58	TONS
0000246015	24.16	TONS	0000248303	22.62	TONS	0000248352	19.84	TONS
0000246016	21.65	TONS	0000248306	21.72	TONS	0000248353	22.78	TONS
0000246018	22.34	TONS	0000248309	22.86	TONS	0000248354	23.90	TONS
0000246019	21.80	TONS	0000248310	22.52	TONS	0000249111	21.74	TONS
0000246020	25.54	TONS	0000248312	21.24	TONS	0000249112	22.22	TONS
0000246029	20.40	TONS	0000248313	22.94	TONS	0000249114	24.32	TONS
0000246030	18.15	TONS	0000248315	23.15	TONS	0000249115	23.70	TONS
0000246031	20.05	TONS	0000248318	22.32	TONS	0000249118	24.24	TONS
0000246033	20.50	TONS	0000248319	23.78	TONS	0000249120	23.06	TONS
0000246034	20.40	TONS	0000248323	23.72	TONS	0000249121	22.44	TONS

MANIFEST	VOLUME	UofM	MANIFEST	VOLUME	UofM	MANIFEST	VOLUME	UofM
0000249122	22.62	TONS	C000216945	18.40	TONS	C000218883	20.40	TONS
0000249126	22.94	TONS	C000218557	16.45	TONS	C000218888	20.90	TONS
0000249130	24.12	TONS	C000218560	22.00	TONS	C000218895	21.35	TONS
0000249133	22.98	TONS	C000218562	20.30	TONS	C000218898	20.00	TONS
0000249134	23.90	TONS	C000218563	19.75	TONS	C000218903	18.80	TONS
0000249135	23.16	TONS	C000218564	22.70	TONS	C000218930	20.70	TONS
0000249139	22.78	TONS	C000218565	20.20	TONS	C000220120	19.80	TONS
0000249141	22.38	TONS	C000218566	17.65	TONS	C000220124	19.55	TONS
0000249142	22.86	TONS	C000218568	15.25	TONS	C000220132	19.35	TONS
0000249144	19.50	TONS	C000218569	22.20	TONS	C000220137	21.70	TONS
0000249145	21.32	TONS	C000218570	24.85	TONS	C000235899	17.15	TONS
C000216928	6.80	TONS	C000218571	22.80	TONS	C000235906	21.70	TONS
C000216929	18.60	TONS	C000218572	23.25	TONS	C000235912	17.65	TONS
C000216930	25.25	TONS	C000218573	18.85	TONS	C000235915	15.30	TONS
C000216931	23.10	TONS	C000218574	20.75	TONS	C000235918	21.95	TONS
C000216932	22.55	TONS	C000218575	19.40	TONS	C000235920	19.25	TONS
C000216933	18.85	TONS	C000218576	24.05	TONS	C000235921	22.15	TONS
C000216942	20.30	TONS	C000218577	25.70	TONS	C000235922	16.05	TONS

MANIFEST	VOLUME	UofM
C000235924	19.00	TONS
C000235925	18.45	TONS
C000235926	13.40	TONS
C000235928	15.75	TONS
C000244064	19.95	TONS
C000244068	20.15	TONS
C000244075	19.95	TONS
C000244079	21.45	TONS
C000244082	23.60	TONS
C000244087	23.60	TONS
C000244094	20.00	TONS
C000244098	19.95	TONS
C000244100	20.30	TONS
C000244105	19.95	TONS
C000244115	22.45	TONS
C000244123	21.30	TONS
C000244133	20.70	TONS
C000244139	22.80	TONS

MANIFEST	VOLUME	UofM
R000244091	22.15	TONS
R000244107	23.00	TONS
0000230604	11.40	TONS

Rosslyn
Holfontein

TOTAL: **3,702.72**

SECTION 4 – APPENDIX C

Environmental & Chemical Consultants			
Waste Classification No.	**456**	**Date:**	**29 April 2003**
Waste Generator	**Anglo Platinum**		
Waste Origin/Type	**Undercut of Tar/Pitch Dam**		

Introduction:
Approximately 280 tons of a contaminated material from under a tar/pitch dam requires disposal.

Waste Analysis:
Rietfontein Laboratory subjected a sample of the waste to a TCLP and the leach solution was analysed by Lakefield Research for 30 inorganic species by ICP and screened for organic compounds using GC-MS by Inspectorate M & L. The elements of concern, i.e. those above their detection limit, obtained using the TCLP, are given in table 1, together with their acceptable risk limits and hazard ratings. Comparison is made with the results obtained previously on the actual tar in the dam: see waste classification 425.

Table 1: Leachable Elements of Concern in the TCLP solution of the waste, mg/l

Element	Undercut Waste	Tar Waste WC 425	HG	ARL, ppm	Comments
Ammonia-N	neg	138	4	10.9	As ammonium
B	0.67	<0.08	4	10	
Ba	0.66	0.10	3	7.8	
Ca	865	3.72	NT		
Cyanide	<10mg/l	5.0	1	0.0053	
Fe	<0.02	0.06	3	9.0	
K	2.4	1.38	4	43.5	
Mn	4.0	0.03	2	0.30	
P	<0.53	1.70	4	10	
S	12	51.7	NT		As sulphate
Si	13	0.71	NT		
Sr	0.82	<0.04	NT	180	
Zn	<0.17	0.11	2	0.70	
Zr	0.14	<0.08	3	2	
pH waste	6.85				
pH final		4.95			

The tar analysed in waste classification 425 showed significant levels of phenols, which included cresols and dialkyl-substituted phenols, although according to the results from M & L no phenols were observed. However, the Rietfontein laboratory tests indicated levels of phenols equivalent to 2.42 mg/l in a 10% water leach: this level is too high to be inaccurate, as the laboratory has confirmed the accuracy of their method by testing standard phenol solutions.

Results:
The results indicate that:
1. Like the tar waste, the contaminated material from under the dam contains significant amounts of phenols and possibly cyanide, although no ammonia was evident. The presence of cyanide classifies this material as an extreme hazard, HG 1, waste and, therefore it must be disposed to an HH landfill.
2. The undercut waste leaches some heavy metals, in particular Mn, at a concentration well above its acceptable risk limit. This is to be expected, as the material will contain soil, aggregate and other inorganic materials.

Treatment and Disposal Options

The possible presence of cyanide suggests that the waste should be treated with hypochlorite. However, addition of hypochlorite would chlorinate the phenols giving rise to the more hazardous chlorinated phenols, so treatment with 10kg of ferrous sulphate per ton is recommended prior to ash blending two parts by mass of ash at the Holfontein HH facility. The presence of cyanide means that very little of the waste, i.e. only 0.08 tons per hectare per month, can be disposed to a GB^+ Landfill, such as Rosslyn or Rietfontein.

D A Baldwin, Ph.D., Pr.Sci.Nat, MIWM, MSACI

SECTION 5 – PERMIT FOR PROCESS AT ALPHA

DEPARTMENT
OF AGRICULTURE
CONSERVATION
AND ENVIRONMENT
NORTH WEST PROVINCE

OFFICE OF THE
DEPUTY DIRECTOR GENERAL
Agricentre, Dr. James Moroka Drive, Mmabatho, 2735
Private Bag X2039, Mmabatho, 2735
Tel: +27 (18) 389 5111
Fax: +27 (18) 392 1732

My Ref: Alpha Pty (Ltd) / SP 22
Tel No: 083-6727971
Enquiries: Witold Bryszewski

Mr Karl Meissner-Roloff
Managing Director
Alpha Pty (Ltd)
PO Box 6367
1715 WELTEVREDENPARK

Attn: Johan Schoonraad

19 April 2003

Dear Sir,

THE CEMENT PROCESS - SCHEDULED PROCESS 22
Situation - Farm 57 IP, District Lichtenburg, North West Province
Title Deed no.: /-/

Act: **Atmospheric Pollution Prevention Act 45 of 1965**
Reg. in terms of the Act, Certificate No.: **NWPG/DAC&E/ALPHA/SP22/10Oct2002**

Re.: Trial burns - Anglo Platinum tars

In terms of Section 11 (2) (c) of the Act and subject to the requirements of p. 3 of the Certificate, the authorisation is granted herewith to operate this process for the purpose of trial burn.

Application:

E-mails from Dr Johan Schoonraad of 8th and 15th April 2003 - copies attached hereto

Material processed: Anglo Platinum tars

Specification: As per application

NORTH WEST
PROVINCE

Maximum processing rate :	the lesser of: 15t/day or 5% of the total fuel by mass.
Maximum total mass to be processed:	1500t
Validity of the authorisation:	from 22nd April 2003 - 31st August 2003

The necessary tests following Air Pollution Compliance Assessment guidelines will be performed and report submitted by:

30th September 2003

Yours faithfully

CHIEF AIR POLLUTION CONTROL OFFICER

Annexure B:

Enviroserve Quotation
(Not Applicable to the Environmental Authorisation Process)

Annexure C:

Baseline Ambient Air Quality Assessment (6 Sep 2011) – Anglo Platinum Limited: Tar Dam site

Margot Saner & Associates

a Department of Labour Approved Inspection Authority (Cert no. C I036 OH)

CONFIDENTIAL REPORT

PROJECT NUMBER	**:**	MS&A 02626
COMPANY	**:**	Enviroserv Waste Management (Pty) Ltd Inland Commercial
ATTENTION	**:**	**Mr W. Minnie**
DATE	**:**	6 September 2011
SUBJECT	**:**	Baseline Ambient Air Quality Assessment – Anglo Platinum Limited: Tar Dam site
COMPILED BY	**:**	A S G Dickson

STATEMENT

This survey was conducted on behalf of Margot Saner & Associates (MS&A) (Pty) Ltd.

Although every endeavour has been made to ensure the correctness and accuracy of the results and recommendations in this survey, neither MS&A nor its officials will be responsible in any way for any incorrectness or inaccuracy of results or the interpretation thereof.

This report, if published or reproduced by the client, must be in full, unless prior approval for the publication or reproduction in the abridged form is granted by Margot Saner & Associates (Pty) Ltd.

SIGNED: .... DATE: ....2011-09-12........
A S G Dickson
(Registered OH - SAIOH)

SIGNED: .... DATE: ..... 2011-09-12..........
M D V Saner
(Managing Director)

DEPARTMENT
OF LABOUR

Certificate

This is to certify that

MARGOT SANER AND ASSOCIATES (PTY) LTD
has been approved as an

APPROVED INSPECTION AUTHORITY

in terms of the Occupational Health
and Safety Act, 1993,
for the monitoring of

Physical Stress Factors and Chemical Stress Factors
(including Lead and Asbestos)

1995-08-29

DATE

CI 036 OH

CERTIFICATE NUMBER

CHIEF INSPECTOR

DOCUMENT CONTROL SHEET

DOCUMENT: **Margot Saner & Associates Project No 02626: Enviroserv Inland Commercial – Baseline Ambient Air Quality Assessment: Anglo Platinum Limited Tar Dams site**

REVISION	PREPARED BY	REVIEWED BY	APPROVED BY
0	ASG Dickson (Reg OH-SAIOH)	MDV Saner (Reg OH-SAIOH)	MDV Saner (Managing Director)
SIGNED			
DATE	2011-09-12	2011-09-12	2011-09-12

REVISION	PREPARED BY	REVIEWED BY	APPROVED BY

GLOSSARY OF TERMS

*** AQA**	=	Air Quality Act (Act 39 of 2004)
*** BTEX**	=	Benzene, Toluene, Ethylbenzene, Xylene
*** CSIR**	=	Council for Scientific and Industrial Research
*** EC**	=	Exposure (Environmental) Concentration
*** HI**	=	Hazard Index
*** HQ**	=	Hazard Quotient
*** IUR**	=	Inhalation Unit Risk
*** PM10**	=	Particulate Matter with aerodynamic diameter of 10μ or less
*** SABS**	=	South African Bureau of Standards
*** TSP**	=	Total Suspended Particulates
*** UK-EAL**	=	United Kingdom Environmental Assessment Level
*** URF**	=	Unit Risk Factor
*** US EPA**	=	United States Environmental Protection Agency
*** VOC**	=	Volatile Organic Compound
*** WHO**	=	World Health Organisation

CONTENTS

1. PURPOSE

At the request of Enviroserv Inland Commercial, a baseline ambient air quality assessment was performed at a tar dam site on the Anglo American Platinum Limited premises near Rustenburg. The purpose of this baseline air sampling was to:

- quantitatively measure existing (current) ambient concentrations of selected contaminants on this site – i.e. prior to removal of the tar dam contents by Enviroserv
- compare the results to relevant local and international ambient air quality standards
- comment on the community health risks associated with exposure to current ambient contaminant concentrations

2. PREMISES

The survey was conducted on the site of 2 x tar dams located on Anglo Platinum Limited property near Kroondal outside Rustenburg in the North West Province. The tar dams are located at: S25 41.903 E27 21.365. The baseline ambient air sampling was performed on 3 August 2011.

Figure 1: Map showing locality the site

3. INTRODUCTION

Figure 2: Satellite image of the site

Enviroserv Inland Commercial operations has been contracted to remove the contents of 2 x tar dams located on Anglo Platinum property. The tar dams are located ~60 metres due East of the Anglo Plat Medical Centre.

Bulk sample analysis of the tar dam contents has indicated that the tar material contains a mixture of the following (priority) hazardous compounds:

- phenols: 700 parts per million (ppm)
- ammonia: 500 parts per million (ppm)
- cyanide: 200 parts per million (ppm)

Enviroserv and Anglo Platinum Mines expressed some concerns about the potential for both worker exposure and external receptor (hospital patients) exposure to airborne concentrations of these contaminant compounds during excavation and removal of the tar dam contents.

The health effects associated with excessive exposure to the priority contaminants are detailed overleaf.

3. INTRODUCTION...continued

<u>Health effects associated with exposure to Phenol</u>:
Exposure to excessive airborne concentrations of phenols may cause several health effects in humans, including impairment of the central nervous system impairment, liver and kidney damage. Acute, local effects may include irritation of the eyes, skin and mucous membranes. <u>Phenol has a relatively low volatility however and does not therefore pose a serious inhalation hazard within the occupational setting</u>. Skin exposure is regarded as the primary route of entry into the body and should be actively prevented as far as possible. Chronic exposure to excessive concentrations of phenol (inhalation and/or dermal routes) may be characterized by systemic disorders such as digestive disturbances, nervous system effects, and possible skin discoloration and eruptions.

<u>Health effects associated with exposure to Ammonia</u>:
Exposure to excessive airborne concentrations of ammonia typically causes eye, nose and throat irritation. Corneal burns and lung oedema may result following very excessive exposure. Chest pain and pneumonitis may also be experienced.

<u>Health effects associated with exposure to Cyanide</u>:
Cyanide is a powerful chemical asphyxiant compound. Acute exposure to elevated airborne concentrations of cyanide is unlikely within occupational settings nut may cause severe symptoms including weakness, headaches, confusion, fatigue, anxiety and nausea. Respiratory failure may occur following very excessive exposures. Chronic exposure to cyanide may cause similar symptoms to those listed above as well as skin itchiness, dermatitis and possible thyroid damage.

In order to assess the existing (current) ambient air quality at the tar dam site (specifically ambient concentrations of the identified priority contaminant compounds), MS&A was instructed to conduct an appropriate baseline ambient air quality assessment. In addition, MS&A decided that it would be prudent to also assess baseline ambient concentrations of the following compounds (potential contaminants within the tar dams):

- <u>Polycyclic aromatic hydrocarbons</u> (PAHs)
- <u>Volatile Organic Compounds</u> (VOC)

The outcome of the baseline Ambient Air Quality Assessment is detailed in the ensuing report.

4. STATUTORY REQUIREMENTS

The National Environmental Management **Air Quality Act** (Act 39 of 2004) was promulgated on the 25 February 2005. This Act repealed the previous Atmospheric Pollution Prevention Act (Act 45 of 1965). Ambient air quality standards for selected priority pollutants were promulgated in terms of the AQA in Government Gazette No 32816 dated 24 December 2009.

It should be noted that there are currently no South African ambient air quality standards for any of the priority contaminants likely to emitted from the tar dams – i.e. phenol, ammonia and cyanide.

The sole South African ambient air quality standard of relevance to this investigation is:
- **Benzene** = 10µg/m^3 (Annual)

South Africa's air quality guidelines are however set for review and, pending this revision, reference is made to international 'best practice' standards.

For the purposes of this baseline ambient air study, reference was made to the relevant ambient standards listed in the Integrated Pollution Prevention and Control (IPPC) – Best Available Techniques publication - United Kingdom Environment Agency (UK-EA). ***These referenced ambient air quality guideline values are termed Environmental Assessment Levels (EALs) and indicate safe daily exposure levels for the majority of the population, including the very young, the elderly and susceptible individuals throughout an individuals' lifetime.***

The following Environmental Assessment Levels (EALs) were referenced:

Table 1

Compound	UK-EAL* Short Term (µg/m^3)	UK-EAL* Long Term (µg/m^3)
Phenol	3900	200
Cresol	6600	220
Ammonia	2500	180
Cyanides	1500	50
PAH (benzo-a-pyrene)	-	0.00025
Toluene	8000	1910
Ethylbenzene	55200	4410
Xylenes (all isomers)	66200	4410
Trimethylbenzenes	37500	1250

4. STATUTORY REQUIREMENTS...continued

Ambient air quality guidelines and environmental benchmarks like the UK Environmental Assessment Levels (EALs) are estimates of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), non-cancer effects. The benchmarks are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic) and should not be used as predictors of harmful (adverse) health effects.

5. INSTRUMENTATION

Phenol, Ammonia, VOC sampling:
Rupprect & Patashnick Co., Inc. - Radiello Model 3310 Passive Sampling System:

- RAD130: Volatile Organic Compounds
- RAD147: Phenol
- RAD168: Ammonia

The Radiello monitors/samplers are passive air sampling devices designed to measure average airborne ambient concentrations of contaminants present within an environment. The contaminants enter the monitors/samplers by passive diffusion through a diffusive body (at a known diffusion rate) and are adsorbed onto a media. Samples were analysed by Chemtech Laboratory Services in Monument Park, Pretoria in accordance with Radiello methodologies.

The Radiello system is included in the ISO 16200-2: Standard for the sampling and analysis of volatile organics, and has been used extensively as part of the European Commissions MACBETH (Monitoring of Airborne Concentrations of Benzene in European Towns and Homes) programme.

Cyanide sampling:

- Gilian sampling pumps
- Gilian Gilibrator
- SKC 3 piece filter cassettes
- MCE membranes

PAH sampling:

- Gilian sampling pumps
- Gilian Gilibrator
- PTFE membranes
- SKC 3 piece filter cassettes
- XAD-2 sorbent tubes
- SKC sorbent tube holders

6. METHODOLOGIES

Phenol, Ammonia, VOC sampling: Radiello methodologies

Cyanide sampling: OSHA method ID120

PAH sampling: NIOSH method 5515

In order to quantitatively measure the baseline ambient concentrations of the airborne contaminants at the tar dam site, the following sampling locations were selected (refer Figure 3 below):

- Location 1 (Anglo Plats Medical Centre Eastern Fenceline)
- Location 2 (Northern dam wall – upwind location)
- Location 3 (Southern dam wall – downwind location)

Figure 3: Locations of sampling stations

Sampling was initiated at 08:00 on 3 August 2011 and terminated at 16:00 on 3 August 2011 – i.e. 8 hour sampling period.

Following termination of the sampling period, the samples were removed, capped/sealed, labelled and placed into a cooled transport container. The samples were delivered to Chemtech Laboratory Services in Monument Park, Pretoria for analysis in accordance with the approved methodologies.

7. RESULTS

Table 2: Ambient concentrations of priority contaminants – refer Annexure 1 for photographs of sampling locations

Sample location	Location 1 Medical centre fenceline	Location 2 Northern dam wall (upwind)	Location 3 Southern dam wall (downwind)	**SA-AQA***	**UK-EAL***
Date	2011/08/03	2011/08/03	2011/08/03		
Units	ug/m^3	ug/m^3	ug/m^3	ug/m^3	ug/m^3
Sample No	**AP-01**	**AP-04**	**AP-07**		
Benzene	BDL	BDL	BDL	10	5
Toluene	BDL	BDL	BDL	-	1910 (8000)
Ethylbenzene	BDL	BDL	BDL	-	4410 (55200)
Xylenes	BDL	BDL	BDL	-	4410 (66200)
Trimethylbenzenes	BDL	BDL	BDL	-	1250 (37500)
Sample No	**AP-02**	**AP-05**	**AP-08**		
Phenol	5.6	5.8	9.03	-	200 (3900)
Sample No	**AP-03**	**AP-06**	**AP-09**		
Ammonia	16.3	16.3	19.21	-	180 (2500)
Sample No	**-**	**AP-13**	**AP-12**		
Cyanide		BDL	BDL	-	50 (1500)
Sample No	**-**	**-**	**AP-10/11**		
PAH			BDL	-	0.00025

* SA-AQA: South African Air Quality Act Ambient Air Quality Standard – Annual Average (24 Hour Average)
* UK-EAL: United Kingdom Environmental Assessment Level – Long Term Annual Average (24 Hour Average)
* BDL = Below Detection Limits of the analytical method – refer Evaluation of Results

7. RESULTS...continued

Meteorological conditions:

2011-08-03 @ 13:00:

Air temperature = 20.6^{0}C
RH = 17%
Average windspeed = 1.4 – 2.1m/s
Prevailing wind direction = NNW

Detection Limits of analytical methodologies:

Benzene:	0.21µg/m^3
Toluene:	0.29µg/m^3
Ethylbenzene:	0.25µg/m^3
Xylene:	0.24µg/m^3
TMBs:	0.64 – 0.72µg/m^3
Cyanide:	0.01µg/m^3
PAHs:	0.17µg/m^3

8. EVALUATION OF RESULTS

8.1 Location 1: Anglo Plat Medical Centre – Eastern fenceline

Volatile Organic Compounds:

Ambient concentrations of Benzene, Toluene, Ethylbenzene, Xylene and Trimethylbenzenes were all below the detection limits of the analytical method and therefore *well below the relevant South African Ambient Air Quality Standard (Benzene) and/or the equivalent UK Environmental Assessment Levels (UK EALs*).

Phenol:

The sample yielded a trace result for phenol – i.e. *far below the relevant ambient reference standard (UK Environmental Assessment Level).*

Ammonia:

The sample yielded a trace result for ammonia – i.e. *far below the relevant ambient reference standard (UK Environmental Assessment Level).*

Cyanide:

The ambient concentration of cyanide was below the detection limit of the analytical methodology and therefore *far below the ambient reference standard (UK Environmental Assessment Level).*

PAHs:

Ambient concentrations of PAHs were below the detection limits of the analytical methodology and therefore *far below the ambient reference standard (UK Environmental Assessment Level).*

In summary, the ambient concentrations of all priority contaminant compounds at Location 1 were far below the relevant ambient air quality reference standards during the baseline survey period. Inhalation exposure to the measured ambient concentrations of these contaminants (whether acute or chronic) is therefore very unlikely to cause any adverse health effects – even in particularly sensitive individuals (hospital patients).

8. EVALUATION OF RESULTS...continued

8.2 Location 2: Northern dam wall (upwind location)

Volatile Organic Compounds:
Ambient concentrations of Benzene, Toluene, Ethylbenzene, Xylene and Trimethylbenzenes were all below the detection limits of the analytical method and therefore *well below the relevant South African Ambient Air Quality Standard (Benzene) and/or the equivalent UK Environmental Assessment Levels (UK EALs*).

Phenol:
The sample yielded a trace result for phenol – i.e. *far below the relevant ambient reference standard (UK Environmental Assessment Level).*

Ammonia:
The sample yielded a trace result for ammonia – i.e. *far below the relevant ambient reference standard (UK Environmental Assessment Level).*

Cyanide:
The ambient concentration of cyanide was below the detection limit of the analytical methodology and therefore *far below the ambient reference standard (UK Environmental Assessment Level).*

PAHs:
Ambient concentrations of PAHs were below the detection limits of the analytical methodology and therefore *far below the ambient reference standard (UK Environmental Assessment Level).*

In summary, the ambient concentrations of all priority contaminant compounds at Location 2 were far below the relevant ambient air quality reference standards during the baseline survey period. Inhalation exposure to the measured ambient concentrations of these contaminants (whether acute or chronic) is therefore very unlikely to cause any adverse health effects – even in particularly sensitive individuals (hospital patients).

8. EVALUATION OF RESULTS...continued

8.3 Location 3: Southern dam wall (downwind location)

Volatile Organic Compounds:

Ambient concentrations of Benzene, Toluene, Ethylbenzene, Xylene and Trimethylbenzenes were all below the detection limits of the analytical method and therefore *well below the relevant South African Ambient Air Quality Standard (Benzene) and/or the equivalent UK Environmental Assessment Levels (UK EALs*).

Phenol:

The sample yielded a trace result for phenol – i.e. *far below the relevant ambient reference standard (UK Environmental Assessment Level). The result was noted to be marginally higher than that recorded at Location 2 (upwind location) – i.e. suggesting that there was some site contribution to ambient phenol concentrations by emissions from the tar dam.*

Ammonia:

The sample yielded a trace result for ammonia – i.e. *far below the relevant ambient reference standard (UK Environmental Assessment Level). The result was noted to be marginally higher than that recorded at Location 2 (upwind location) – i.e. suggesting that there was some site contribution to ambient ammonia concentrations by emissions from the tar dam.*

Cyanide:

The ambient concentration of cyanide was below the detection limit of the analytical methodology and therefore *far below the ambient reference standard (UK Environmental Assessment Level).*

PAHs:

Ambient concentrations of PAHs were below the detection limits of the analytical methodology and therefore *far below the ambient reference standard (UK Environmental Assessment Level).*

In summary, the ambient concentrations of all priority contaminant compounds at Location 3 were marginally higher than those recorded at the upwind location but remained far below the relevant ambient air quality reference standards during the baseline survey period. Inhalation exposure to the measured ambient concentrations of these contaminants (whether acute or chronic) is therefore very unlikely to cause any adverse health effects – even in particularly sensitive individuals (hospital patients).

9. CONCLUSION / EXECUTIVE SUMMARY

The results obtained during this Baseline ambient air quality assessment conducted at the tar dam site adjacent to the Anglo Plats Medical Centre revealed that ambient concentrations of Benzene, Toluene, Ethylbenzene, Xylene, Trimethylbenzenes, Phenol, Ammonia, Cyanide and PAHs at all three of the sampling locations were well below the relevant South African Ambient Air Quality Standard (Benzene) and/or the equivalent UK Environmental Assessment Levels (UK EALs).

Ambient concentrations of Phenol and Ammonia downwind of the tar dams were marginally higher than those recorded at the upwind sampling location, suggesting that tar dam emissions contributed (marginally) to ambient concentrations of these contaminants.

Based on the results of this baseline study, the health risks associated with acute and/or chronic inhalation exposure to the measured ambient contaminant concentrations at the tar dam site, are minimal.

10. REFERENCES

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10.10 Travis C.C., Richter S.A., Crouch E.A., Wilson D.E. and Klema A.D. (1987). Cancer Risk Management, Environmental Science and Technology, 21, 415.

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Annexure 1: Photographs of Ambient Air Sampling Locations

Photo No 1: Location 1 (Anglo Plat Medical Centre Eastern fenceline)

Photo No 2: Location 2 (Northern dam wall)

Photo No 3: Location 3 (Southern dam wall)

Annexure 2: :Laboratory results

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LABORATORY SERVICES

TEST REPORT

DATE OF REPORT	:	25 August 2011
REFERENCE NO	:	CLS112055
CLIENT REFERENCE NO	:	Anglo-Plat Baseline August 2011
CLIENT ORDER NO	:	Anglo-Plat Baseline August 2011
CONTACT PERSON	:	Eugene Cowley
CLIENT	:	Margot Saner & Associates (Pty) Ltd
CLIENT ADDRESS	:	P O Box 287
		ALLENS NEK
		1737
CLIENT CONTACT PERSON	:	Andrew Dickson
CLIENT TELEPHONE NO	:	(011) 475 3161
CLIENT FAX NO	:	(011) 475 1110
CLIENT e-MAIL ADDRESS	:	andrewd@msa-sa.com
ANALYSIS REQUIRED	:	Analysis for Volatile Organic Compounds.
	:	Analysis for Phenol.
	:	Analysis for Ammonia.
	:	Analysis for Poly Aromatic Hydrocarbons.
	:	Analysis for Cyanide.
METHOD USED	:	Radiello Methods.\
	:	NIOSH 5515.
	:	NIOSH 7904.

Chemtech Laboratory Services (Pty) Ltd. Reg. No: (1998/37710/23). V.A.T. No: 4730185131. Directors: Mr. E Cowley, Mrs. A Cowley
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TEST RESULTS :

Table 1 – Analysis for Volatile Organic Compounds.

TEST ITEM DESCRIPTION	*TEST ITEM CONDITION*	*DATE RECEIVED*	*DATE OF ANALYSIS*
Radiello Passive Monitors	***Sealed in glass tubes. Received cold.***	***04/08/2011***	***18/08/2011***

The following compounds were specifically tested for:

Pentane	*3-Methylhexane*	*n-Butyl acetate*
Ethanol	*Benzene*	*Ethyl benzene*
Acetone	*Isooctane*	*Xylene*
2-Methylpentane	*n-Heptane*	*2-Butoxyethanol*
3-Methylpentane	*Trichloroethylene*	*Cyclohexanone*
n-Hexane	*Methylmethacrylate*	*Isopropyl benzene*
Methyl Ethyl Ketone	*Propyl acetate*	*Propyl benzene*
Ethyl acetate	*Methyl Isobutyl Ketone*	*1,2,3-Trimethylbenzene*
2-Methylhexane	*Toluene*	*1,2,4-Trimethylbenzene*
Cyclohexane	*Perchloroethylene*	*1,3,5-Trimethylbenzene*

RESULTS: ($\mu g/m^3$)

Volatile Organic compounds could not be detected on samples AP-01, AP-04 and AP-07.

Detection Limits: (μg)

Compound	*Detection Limit*	*Compound*	*Detection Limit*
Pentane	*0.45*	*Methylmethacrylate*	*0.29*
Ethanol	*1.12*	*Propyl acetate*	*0.55*
Acetone	*1.02*	*Methyl Isobutyl Ketone*	*0.89*
2-Methylpentane	*0.53*	*Toluene*	*0.29*
3-Methylpentane	*0.74*	*Perchloroethylene*	*1.16*
n-Hexane	*0.43*	*n-Butyl acetate*	*0.59*
Methyl Ethyl Ketone	*1.89*	*Ethyl benzene*	*0.25*
Ethyl acetate	*1.59*	*Xylene*	*0.24*
2-Methylhexane	*0.35*	*2-Butoxyethanol*	*0.59*
Cyclohexane	*0.33*	*Cyclohexanone*	*0.95*
3-Methylhexane	*0.35*	*Isopropyl benzene*	*0.65*
Benzene	*0.21*	*Propyl benzene*	*0.55*
Isooctane	*0.35*	*1,2,3-Trimethylbenzene*	*0.64*
n-Heptane	*0.44*	*1,2,4-Trimethylbenzene*	*0.68*
Trichloroethylene	*1.21*	*1,3,5-Trimethylbenzene*	*0.72*

Specific Test Conditions	***Samples stored at < 5^0C prior to analysis.*** ***Environmental temperature during analysis: 22.8 ^0C.*** ***Results confirmed using Gas Chromatography/Mass Spectrometry.***
Deviations	***None.***

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Table 2 – Analysis for Phenol.

TEST ITEM DESCRIPTION	TEST ITEM CONDITION	DATE RECEIVED	DATE OF ANALYSIS
Radiello Passive Monitors	Sealed in glass tubes. Received cold.	04/08/2011	18/08/2011

RESULTS: ($\mu g/m^3$)

Sample	Phenol
AP-02	5.60
AP-05	5.80
AP-08	9.03

Specific Test Conditions	Samples stored at < 5^0C prior to analysis. Environmental temperature during analysis: 22.8 ^0C. Analysis performed using Thermal Desorption Gas Chromatography/Mass Spectrometry.
Deviations	None.

Table 3 – Analysis for Ammonia.

TEST ITEM DESCRIPTION	TEST ITEM CONDITION	DATE RECEIVED	DATE OF ANALYSIS
Radiello Passive Monitors	Sealed in glass tubes. Received cold.	04/08/2011	22/08/2011

RESULTS: ($\mu g/m^3$)

Sample	Ammonia
AP-03	16.30
AP-06	16.30
AP-09	19.21

Specific Test Conditions	Samples stored at < 5^0C prior to analysis. Environmental temperature during analysis: 22.8 ^0C.
Deviations	None.

Table 4– Analysis for Poly Aromatic Hydrocarbons .

TEST ITEM DESCRIPTION	TEST ITEM CONDITION	DATE RECEIVED	DATE OF ANALYSIS
Filter & XAD-2 Tube	Filter sealed a cassette. Tube sealed with end caps. Received cold	4/08/2011	8/08/2011

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The following compounds were specifically tested for:

Naphthalene	Fluoranthene	Benzo[k]Fluoranthene
Acenaphthylene	Pyrene	Benzo[a]Pyrene
Acenaphthene	Benz[a]Anthracene	Dibenz[a,h]Anthracene
Fluorene	Chrysene	Benzo[g,h,i]Perylene
Phenanthrene	Benzo[e]Pyrene	Indeno[1,2,3-c,d]Pyrene
Anthracene	Benzo[b]Fluoranthene	

RESULTS: (µg)

Poly Aromatic Hydrocarbons could not be detected in samples AP-10 and AP-11.

Detection Limits.

Compound	LOD (µg)	Compound	LOD (µg)
Naphthalene	0.04	Chrysene	0.10
Acenaphthylene	0.04	Benzo[e]Pyrene	0.08
Acenaphthene	0.07	Benzo[b]Fluoranthene	0.08
Fluorene	0.05	Benzo[k]Fluoranthene	0.31
Phenanthrene	0.05	Benzo[a]Pyrene	0.17
Anthracene	0.05	Dibenz[a,h]Anthracene	0.17
Fluoranthene	0.06	Benzo[g,h,i]Perylene	0.17
Pyrene	0.07	Indeno[1,2,3-c,d]Pyrene	0.17
Benz[a]Anthracene	0.12		

Specific Test Conditions	*Samples stored at < 5⁰C prior to analysis.* *Environmental temperature during analysis: 23.2 ⁰C.* *Analysis performed by Gas Chromatography/Mass Spectrometry.*

Table 5 – Analysis for Cyanide.

TEST ITEM DESCRIPTION	TEST ITEM CONDITION	DATE RECEIVED	DATE OF ANALYSIS
Filters	**Sealed in cassettes. Received cold**	**4/08/2011**	**18/08/2011**

RESULTS: (µg)

Sample	Cyanide
AP-12	< 0.01
AP-13	< 0.01

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Specific Test Conditions	*Samples stored at < 5°C prior to analysis.* *Environmental temperature during analysis: 22.8 °C.*
Deviations	*None.*

WORK APPROVED BY:

Adri Cowley — *25/08/2011* ***Date***

(Laboratory Manager)

(Technical Signatory)

This report relates to the specific sample(s) tested as identified herein, it does not imply Chemtech Laboratory Services approval of the quality and/or performance of the item(s) in question and the test results do not apply to any similar item that has not been tested.

This report may only be reproduced in full, with the written approval of Chemtech Laboratory Services.

The acceptance of an item for test and the issue of a test report are subject to Chemtech Laboratory Services condition of test. This document is available on request.

Chemtech Laboratory Services does not accept responsibility for errors that might have arisen during sampling and transport of samples by external parties.

Results express in ppm, ppb, mg/m³ or µg/m³ were calculated using data supplied by the client.

* *This test method is not included in the Scope of Accreditation for Chemtech Laboratory Services.*

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Annexure D:

Follow-up Air Sampling Survey – Anglo Platinum Limited: Tar Dam site (7 Sep 2011) – Anglo Platinum Limited: Tar Dam site

Margot Saner & Associates

a Department of Labour Approved Inspection Authority (Cert no. C I036 OH)

CONFIDENTIAL REPORT

PROJECT NUMBER	:	MS&A 02627
COMPANY	:	Enviroserv Waste Management (Pty) Ltd Inland Commercial
ATTENTION	:	**Mr W. Minnie**
DATE	:	7 September 2011
SUBJECT	:	Follow-up Air Sampling Survey – Anglo Platinum Limited: Tar Dam site
COMPILED BY	:	A S G Dickson

STATEMENT

This survey was conducted on behalf of Margot Saner & Associates (MS&A) (Pty) Ltd.

Although every endeavour has been made to ensure the correctness and accuracy of the results and recommendations in this survey, neither MS&A nor its officials will be responsible in any way for any incorrectness or inaccuracy of results or the interpretation thereof.

This report, if published or reproduced by the client, must be in full, unless prior approval for the publication or reproduction in the abridged form is granted by Margot Saner & Associates (Pty) Ltd.

SIGNED: .... DATE: ....2011-09-12........
A S G Dickson
(Registered OH - SAIOH)

SIGNED: .... DATE: ..... 2011-09-12..........
M D V Saner
(Managing Director)

DEPARTMENT
OF LABOUR

Certificate

This is to certify that

MARGOT SANER AND ASSOCIATES (PTY) LTD
has been approved as an

APPROVED INSPECTION AUTHORITY

in terms of the Occupational Health
and Safety Act, 1993,
for the monitoring of

Physical Stress Factors and Chemical Stress Factors
(including Lead and Asbestos)

1995-08-29
DATE

CI 036 OH
CERTIFICATE NUMBER

CHIEF INSPECTOR

DOCUMENT CONTROL SHEET

DOCUMENT: **Margot Saner & Associates Project No 02627: Enviroserv Waste Management Inland Commercial – Follow-up Air Sampling Survey: Anglo Platinum Limited Tar Dams site**

REVISION	PREPARED BY	REVIEWED BY	APPROVED BY
0	ASG Dickson (Reg OH-SAIOH)	MDV Saner (Reg OH-SAIOH)	MDV Saner (Managing Director)
SIGNED			
DATE	2011-09-12	2011-09-12	2011-09-12

REVISION	PREPARED BY	REVIEWED BY	APPROVED BY

GLOSSARY OF TERMS

*** AQA**	=	Air Quality Act (Act 39 of 2004)
*** BTEX**	=	Benzene, Toluene, Ethylbenzene, Xylene
*** CSIR**	=	Council for Scientific and Industrial Research
*** EC**	=	Exposure (Environmental) Concentration
*** HI**	=	Hazard Index
*** HQ**	=	Hazard Quotient
*** IUR**	=	Inhalation Unit Risk
*** PM10**	=	Particulate Matter with aerodynamic diameter of 10µ or less
*** SABS**	=	South African Bureau of Standards
*** TSP**	=	Total Suspended Particulates
*** UK-EAL**	=	United Kingdom Environmental Assessment Level
*** URF**	=	Unit Risk Factor
*** US EPA**	=	United States Environmental Protection Agency
*** VOC**	=	Volatile Organic Compound
*** WHO**	=	World Health Organisation

CONTENTS

1. PURPOSE

At the request of Enviroserv Inland Commercial, Margot Saner & Associates (MS&A) conducted a follow-up air sampling survey at the tar dam site on the Anglo American Platinum Limited premises near Kroondal, Rustenburg. The purpose of this follow-up air sampling was to:

- quantitatively measure ambient concentrations of selected contaminants on this site during active removal of the tar dam contents by Enviroserv
- quantitatively measure (Enviroserv) worker exposure to airborne concentrations of selected contaminants during the tar dam operations
- compare the results to relevant local and international ambient/occupational standards
- comment on the health risks (community and worker) associated with exposure to the measured contaminant concentrations

2. PREMISES

The follow-up survey was again conducted on the site of 2 x tar dams located on Anglo Platinum Limited property near Kroondal outside Rustenburg in the North West Province. The tar dams are located at: S25 41.903 E27 21.365. The worker sampling was performed on 10 August 2011 whilst the ambient air sampling was initiated on 10 August and terminated on 17 August 2011.

Figure 1: Map showing locality the site

3. INTRODUCTION

Figure 2: Satellite image of the site

Enviroserv Inland Commercial operations has been contracted to remove the contents of 2 x tar dams located on Anglo Platinum property. The tar dams are located ~60 metres due East of the Anglo Plat Medical Centre.

Bulk sample analysis of the tar dam contents indicated that the tar material contains a mixture of several hazardous compounds including phenols (700 ppm), ammonia: 500 (ppm) and cyanide (200 ppm).

Enviroserv and Anglo Platinum Mines expressed some concerns about the potential for both worker exposure and external receptor (hospital patients) exposure to airborne concentrations of these contaminant compounds during excavation and removal of the tar dam contents. Following completion of the baseline ambient air sampling survey (MS&A Project No 02626) it was evident that airborne *phenols, cresols and ammonia* compounds were likely to present the highest potential health risk to both workers and surrounding off-site receptors during tar dam removal activities.

Tar removal activities were initiated on 8 August using a ‘Super-sucker’ vacuum pump system to vacuum the dam contents into waiting RoRo tanks. These ‘Super-sucker’ activities were underway during the course of the follow-up air sampling period (worker and ambient sampling).

3. INTRODUCTION...continued

The health effects associated with excessive exposure to the priority contaminants are detailed below:

Health effects associated with exposure to Phenol/Cresol:
Exposure to excessive airborne concentrations of phenols and cresols may cause several health effects in humans, including impairment of the central nervous system impairment, liver and kidney damage. Acute, local effects may include irritation of the eyes, skin and mucous membranes. Phenol has a relatively low volatility however and does not therefore pose a serious inhalation hazard within the occupational setting. *Skin exposure is regarded as the primary route of entry into the body and should be actively prevented as far as possible. Chronic exposure to excessive concentrations of phenol/cresol (inhalation and/or dermal routes) may be characterized by systemic disorders such as digestive disturbances, nervous system effects, and possible skin discoloration and eruptions.*

Health effects associated with exposure to Ammonia:
Exposure to excessive airborne concentrations of ammonia typically causes eye, nose and throat irritation. Corneal burns and lung oedema may result following very excessive exposure. Chest pain and pneumonitis may also be experienced.

The outcomes of the follow-up air sampling survey are detailed in the ensuing report.

4. STATUTORY REQUIREMENTS

Ambient air sampling

The National Environmental Management **Air Quality Act** (Act 39 of 2004) was promulgated on the 25 February 2005. Ambient air quality standards for selected priority pollutants were promulgated in terms of the AQA in Government Gazette No 32816 dated 24 December 2009.

It should be noted that there are currently no South African ambient air quality standards for any of the priority contaminants likely to emitted from the tar dams – i.e. phenol, cresol, and ammonia.

The sole South African ambient air quality standard of relevance to this investigation is:

- **Benzene** = 10µg/m^3 (Annual)

South Africa's air quality guidelines are however set for review and, pending this revision, reference is made to international 'best practice' standards.

For the purposes of the ambient study, reference was made to the relevant ambient air quality standards listed in the Integrated Pollution Prevention and Control (IPPC) – Best Available Techniques publication - United Kingdom Environment Agency (UK-EA). ***These referenced ambient air quality guideline values are termed Environmental Assessment Levels (EALs) and indicate safe daily exposure levels for the majority of the population, including the very young, the elderly and susceptible individuals throughout an individuals' lifetime.***

The following Environmental Assessment Levels (EALs) were referenced:

Table 1

Compound	UK-EAL* Short Term (µg/m^3)	UK-EAL* Long Term (µg/m^3)
Phenol	3900	200
Cresol	6600	220
Ammonia	2500	180
Toluene	8000	1910
Ethylbenzene	55200	4410
Xylenes (all isomers)	66200	4410
Trimethylbenzenes	37500	1250

4. STATUTORY REQUIREMENTS...continued

Ambient air quality guidelines and environmental benchmarks like the UK Environmental Assessment Levels (EALs) are estimates of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), non-cancer effects. The benchmarks are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic) and should not be used as predictors of harmful (adverse) health effects.

Worker exposure sampling

Environmental Regulation No. 5 of the Occupational Health and Safety Act No. 85 of 1993, states, inter alia, that an employer must ensure that the air breathed by employees does not endanger their safety and, that prescribed *Exposure Limits* for airborne substances therein are not exceeded. The **Occupational Exposure Limits (OELs)** for Hazardous Chemical Substances are tabled in the **Regulations for Hazardous Chemical Substances**.

Of particular relevance to this investigation are the following OELs:

HCS	OEL (mg/m^3)	CL or RL	Skin	BEI
Benzene	16	CL	No	Yes
Toluene	188	RL	Yes	Yes
Xylene	435	RL	Yes	Yes
Ethylbenzene	435	RL	No	Yes
Trimethylbenzene (all isomers)	123	RL	No	No
Phenol	19	RL	Yes	No
Cresol	22	RL	Yes	No
Ammonia	17	RL	No	No

Where:

TWA OEL-RL = The Time Weighted Average Occupational Exposure Limit – Recommended Limit: defined as the concentration of an airborne substance, averaged over a reference period, at which, according to current knowledge, there is no evidence that it is likely to be injurious to employees if they are exposed by inhalation, day after day, to that concentration.

TWA OEL-CL = The Time Weighted Average Occupational Exposure Limit – Control Limit: defined as the maximum concentration of an airborne substance, averaged over a reference period, to which an employee may be exposed by inhalation under any circumstances.

4. STATUTORY REQUIREMENTS…continued

Skin = HCS readily penetrates intact skin and enters the body via this route

BEI = Biological Exposure Index – as listed under Table 3 of the Regulations for Hazardous Chemical Substances. BEIs are reference values intended as guidelines for the evaluation of potential hazards. BEIs represent the level of an HCS or metabolite most likely to be observed in a specimen collected from a healthy worker who has been exposed to an HCS to the same extent as the worker with inhalation exposure to the TWA OEL.

Regulation 5(4) of the Regulations for Hazardous Chemical Substances states inter alia that: If an assessment of a workplace indicates that any employee may be exposed, the employer shall ensure that monitoring is carried out in accordance with the provisions of regulations 6 and 7. Regulation 6 requires, inter alia, that such monitoring of employee exposure be conducted by an approved inspection authority **- Regulation 6(c)**.

5. INSTRUMENTATION

Phenol, Cresol, Ammonia, VOC sampling:
Rupprect & Patashnick Co., Inc. - Radiello Model 3310 Passive Sampling System:

- RAD130: Volatile Organic Compounds
- RAD147: Phenol / Cresol
- RAD168: Ammonia

The Radiello monitors/samplers are passive air sampling devices designed to measure average airborne ambient concentrations of contaminants present within an environment. The contaminants enter the monitors/samplers by passive diffusion through a diffusive body (at a known diffusion rate) and are adsorbed onto a media. Samples were analysed by Chemtech Laboratory Services in Monument Park, Pretoria in accordance with Radiello methodologies.

The Radiello system is included in the ISO 16200-2: Standard for the sampling and analysis of volatile organics, and has been used extensively as part of the European Commissions MACBETH (Monitoring of Airborne Concentrations of Benzene in European Towns and Homes) programme.

6. METHODOLOGIES

Phenol, Cresol, Ammonia, VOC sampling: Radiello methodologies

Ambient sampling:

In order to quantitatively measure the ambient concentrations of the priority airborne contaminants at the tar dam site, the following sampling locations were selected (refer Figure 3 below):

- Location 1 (Anglo Plats Medical Centre Eastern Fenceline)
- Location 2 (Southern dam wall – downwind location)

Figure 3: Sampling locations (ambient + worker)

Ambient air sampling was initiated at 09:00 on 10 August 2011 and terminated at 09:00 on 17 August 2011 – i.e. 7 day sampling period.

Following termination of the sampling period, the samples were removed, capped/sealed, labelled and placed into a cooled transport container. The samples were delivered to Chemtech Laboratory Services in Monument Park, Pretoria for analysis in accordance with the approved methodologies.

6. METHODOLOGIES…continued

Worker exposure sampling:
The following workers were selected to partake in the study:

- **S. Mohale: Technical assistant**
- **B. Manyike: Technical assistant**

Both of these workers were issued with and required to wear Radiello passive samplers for the duration of the survey period. The samplers were located so as to obtain personal breathing zone samples – i.e. affixed to the collars of the workers.

Sampling periods were as long as practicably possible in order to ensure sufficient representivity of worker exposure.

Following completion of the survey period, the samplers were removed and sealed before being forwarded to the analytical laboratory (Chemtech Laboratory Services) for analysis according to the prescribed methodologies.

7. RESULTS

7.1 Ambient air sampling

Table 2: Ambient concentrations of priority contaminants – refer Annexure 1 for photographs of sampling locations

Sample location	Location 1 Medical centre fenceline	Location 2 Southern dam wall (downwind)	**SA-AQA***	**UK-EAL***
Date	2011/08/10-17	2011/08/10-17		
Units	ug/m^3	ug/m^3	ug/m^3	ug/m^3
Sample No	**NJ163**	**NJ166**		
Benzene	1.95	1.97	10	5
Toluene	2.12	2.13	-	1910 (8000)
Ethylbenzene	BDL	BDL	-	4410 (55200)
Xylenes	BDL	BDL	-	4410 (66200)
Trimethylbenzenes	9.32	8.3	-	1250 (37500)
Sample No	**NJ164**	**NJ167**		
Phenol	9.63	10.82	-	200 (3900)
Cresol	0.86	2.75		220 (6600)
Sample No	**NJ165**	**NJ168**		
Ammonia	12.18	10.45	-	180 (2500)

* SA-AQA: South African Air Quality Act Ambient Air Quality Standard – Annual Average (24 Hour Average)
* UK-EAL: United Kingdom Environmental Assessment Level – Long Term Annual Average (24 Hour Average)
* BDL = Below Detection Limits of the analytical method – refer Evaluation of Results

7. RESULTS...continued

Meteorological conditions:

2011-08-10 @ 10:00:

Air temperature = 18^0C
RH = 15%
Average windspeed = 1.8m/s
Prevailing wind direction = NE

2011-08-17 @ 10:00:

Air temperature = 17^0C
RH = 19%
Average windspeed = 1.1m/s
Prevailing wind direction = NE

Detection Limits of analytical methodologies:

Benzene:	0.21μg/m^3
Toluene:	0.29μg/m^3
Ethylbenzene:	0.25μg/m^3
Xylene:	0.24μg/m^3
TMBs:	0.64 – 0.72μg/m^3

7. RESULTS

7.2 Worker exposure sampling

NOTE: The tabled results are **8 hour time weighted averages (TWA)** calculated in accordance with the procedure specified under Annexure 2 of the Regulations for HCS.

*** S. Mohale: Technical assistant (Sampling period: 08:35 – 15:05 = 390 minutes)**

Sample No	Contaminant	Results mg/m^3	OEL mg/m^3
NJ157	Benzene	BDL	16
	Toluene	BDL	188
	Ethylbenzene	BDL	535
	Xylene	BDL	535
	Trimethylbenzenes	BDL	123
NJ158	Phenol	0.023	19
NJ158	Cresol	0.016	22
NJ162	Ammonia	0.024	17

* BDL = Below Detection Limits of the analytical method – refer Evaluation of Results

*** B. Manyike: Technical assistant (Sampling period: 08:35 – 15:05 = 390 minutes)**

Sample No	Contaminant	Results mg/m^3	OEL mg/m^3
NJ160	Benzene	BDL	16
	Toluene	BDL	188
	Ethylbenzene	BDL	535
	Xylene	BDL	535
	Trimethylbenzenes	BDL	123
NJ161	Phenol	0.061	19
NJ161	Cresol	0.077	22
NJ159	Ammonia	0.033	17

* BDL = Below Detection Limits of the analytical method – refer Evaluation of Results

8. EVALUATION OF RESULTS

8.1 Ambient air sampling

Location 1: Anglo Plat Medical Centre – Eastern fenceline

Volatile Organic Compounds (Sample No NJ163):
The sample yielded trace results for Benzene, Toluene and Trimethylbenzenes – i.e. *far below the relevant South African Ambient Air Quality Standard (Benzene) and/or the equivalent UK Environmental Assessment Levels (UK EALs*).

Ambient concentrations of Ethylbenzene and Xylene were below the detection limits of the analytical method and therefore *well below the relevant UK Environmental Assessment Levels (UK EALs*).

Phenols and Cresols (Sample No NJ164):
The sample yielded trace results for phenol and cresol – i.e. *far below the relevant ambient reference standards (UK Environmental Assessment Level).*

Ammonia (Sample No NJ165):
The sample yielded a result for ammonia *far below the relevant ambient reference standard (UK Environmental Assessment Level).*

In summary: the ambient concentrations of priority contaminant compounds at Location 1 were far below the relevant ambient air quality reference standards during the baseline survey period. Inhalation exposure to the measured ambient concentrations of these contaminants (whether acute or chronic) is therefore very unlikely to cause any adverse health effects – even in particularly sensitive individuals (hospital patients).

8. EVALUATION OF RESULTS

8.1 Ambient air sampling...continued

Location 2: Southern dam wall (downwind location)

Volatile Organic Compounds (Sample No NJ166):
The sample yielded trace results for Benzene, Toluene and Trimethylbenzenes – i.e. *far below the relevant South African Ambient Air Quality Standard (Benzene) and/or the equivalent UK Environmental Assessment Levels (UK EALs*).

Ambient concentrations of Ethylbenzene and Xylene were below the detection limits of the analytical method and therefore *well below the relevant UK Environmental Assessment Levels (UK EALs*).

Phenols and Cresols (Sample No 167):
The sample yielded trace results for phenol and cresol – i.e. *far below the relevant ambient reference standards (UK Environmental Assessment Level).*

Ammonia (Sample No 168):
The sample yielded a result for ammonia *far below the relevant ambient reference standard (UK Environmental Assessment Level).*

In summary: the ambient concentrations of priority contaminant compounds at Location 2 were far below the relevant ambient air quality reference standards during the baseline survey period. Inhalation exposure to the measured ambient concentrations of these contaminants (whether acute or chronic) is therefore very unlikely to cause any adverse health effects – even in particularly sensitive individuals (hospital patients).

8. EVALUATION OF RESULTS...continued

8.2 Worker exposure sampling

S. Mohale: Technical assistant:

Volatile Organic Compounds (Sample No NJ157):

Results yielded for Benzene, Toluene, Ethylbenzene, Toluene and Trimethylbenzenes were below the detection limits of the analytical method and therefore *far below the relevant Occupational Exposure Limits (OELs).*

Phenols and Cresols (Sample No NJ158):

The sample yielded trace results for phenol and cresol – i.e. *far below the relevant Occupational Exposure Limits (OELs).*

Ammonia (Sample No 162):

The sample yielded a trace result for ammonia – i.e. *far below the relevant Occupational Exposure Limit (OEL).*

B. Manyike: Technical assistant:

Volatile Organic Compounds (Sample No NJ160):

Results yielded for Benzene, Toluene, Ethylbenzene, Toluene and Trimethylbenzenes were below the detection limits of the analytical method and therefore *far below the relevant Occupational Exposure Limits (OELs).*

Phenols and Cresols (Sample No NJ161):

The sample yielded trace results for phenol and cresol – i.e. *far below the relevant Occupational Exposure Limits (OELs).*

Ammonia (Sample No NJ159):

The sample yielded a trace result for ammonia – i.e. *far below the relevant Occupational Exposure Limit (OEL).*

In summary: neither of the workers were exposed to significant airborne concentrations of priority contaminants during the survey period – i.e. all results were far below the relevant Occupational Exposure Limits. Inhalation exposure to the measured concentrations of these contaminants (whether acute or chronic) will not cause any adverse health effects in workers. Current issue Personal Protective Equipment (PPE) is deemed capable of ensuring adequate protection against all likely exposures to priority contaminants via all viable routes of exposure (inhalation, dermal ocular).

9. CONCLUSION / EXECUTIVE SUMMARY

The outcome of the follow-up air sampling surveys conducted at the tar dam site adjacent to the Anglo Plats Medical Centre, revealed the following:

- Ambient concentrations of Benzene, Toluene, Ethylbenzene, Xylene, Trimethylbenzenes, Phenol, Cresol and Ammonia at both of the sampling locations were well below the relevant South African Ambient Air Quality Standard (Benzene) and/or the equivalent UK Environmental Assessment Levels (UK EALs).

- Worker exposure to airborne concentrations of Benzene, Toluene, Ethylbenzene, Xylene, Trimethylbenzenes, Phenol, Cresol and Ammonia was minimal during the survey period – i.e. all results were well below the relevant Occupational Exposure Limits (OELs).

Based on these results it is evident that:

- The health risks associated with acute and/or chronic inhalation exposure to the measured ambient contaminant concentrations at the tar dam site remain minimal.

- The health risks associated with worker inhalation exposure to priority contaminant concentrations at the tar dam site were low.

10. RECOMMENDATIONS

Based on the results obtained during both the baseline air sampling survey (MS&A Project No 02626) and this follow-up study, the following recommendations are made:

- Additional follow-up air sampling (ambient and worker) must be conducted during full-scale excavation of the tar dams using excavator equipment (set to replace the 'Super-sucker'). This will allow for informed comment on the risks of worker / off-site receptor exposure to priority airborne contaminants under *worst-case conditions*. *(Note: this additional sampling was conducted on 30 August 2011 and results are awaited).*

- Pending completion of this additional air sampling it is recommended that all workers required to engage in any activities within the demarcated operational area, continue to be issued with the following Personal Protective Equipment (PPE):
  - Cotton overalls
  - Safety boots / Rubber gum boots
  - Tyvek oversuits
  - Safety goggles
  - Rubber gloves (elbow length)
  - Type ABEK1 half mask respirators

- Use of the above PPE must be enforced, with special priority being given to ensuring that workers make diligent use of hand protection (gloves) so as to prevent direct skin contact with the tar mixture as far as practicably possible. Despite the low risk of exposure to excessive airborne concentrations of contaminant compounds, use of respiratory protective equipment (RPE) by workers should be encouraged when engaged within the demarcated operational area and enforced whenever workers are actively engaged in actual tar removal activities. Additional comment in this regard will follow once the recommended follow-up air sampling has been completed and the results are available for interpretation.

- Workers must be fully informed about the health risks associated with exposure to the tar dam contents as well as the likely routes of exposure – particularly direct skin/eye contact.

- All workers must remain subject to appropriate medical surveillance protocols. The structure and frequency of these protocols should be at the discretion of the company Occupational Medical Practitioner (OMP). Both this report and MS&A Project No 02626 must be made available to the OMP.

11. REFERENCES

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11.5 Radiello brochure. Fondazione Salvatore Maugeri – IRCCS. 2003. Padova, Italy

11.6 Air Quality Guidelines for Europe. World Health Organisation Regional Publications, European Series No91. www.euro.who.int/air/Activities/20020620_1

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11.8 IRIS (1998). US-EPA's Integrated Risk Information Data Base, available from www.epa.gov/iris (last updated 20 February 1998).

11.9 Junker A. and Schwela D. (1998). Air Quality Guidelines and Standards Based on Risk Considerations, Paper 17D-1, Papers of the 11th World Clean Air and Environment Congress, 13-18 September 1998, Durban, South Africa.

11.10 Travis C.C., Richter S.A., Crouch E.A., Wilson D.E. and Klema A.D. (1987). Cancer Risk Management, Environmental Science and Technology, 21, 415.

11.11 WHO (2000). Guidelines for Air Quality, World Health Organisation, Geneva.

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Annexure 1: Photographs of Ambient Air Sampling Locations

Photo No 1: Location 1 (Anglo Plat Medical Centre Eastern fenceline)

Photo No 2: Location 2 (Southern dam wall)

Photo No 3: Super sucker operations

Annexure 2: Laboratory results

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TEST REPORT

DATE OF REPORT	:	*1 September 2011*
REFERENCE NO	:	*CLS112206*
CLIENT REFERENCE NO	:	*Anglo-Plat Follow-up August 2011*
CLIENT ORDER NO	:	*Anglo-Plat Follow-up August 2011*
CONTACT PERSON	:	*Eugene Cowley*
CLIENT	:	*Margot Saner & Associates (Pty) Ltd*
CLIENT ADDRESS	:	*P O Box 287*
		ALLENS NEK
		1737
CLIENT CONTACT PERSON	:	*Andrew Dickson*
CLIENT TELEPHONE NO	:	*(011) 475 3161*
CLIENT FAX NO	:	*(011) 475 1110*
CLIENT e-MAIL ADDRESS	:	*andrewd@msa-sa.com*
ANALYSIS REQUIRED	:	*Analysis for Volatile Organic Compounds.*
	:	*Analysis for Phenol.*
	:	*Analysis for Ammonia.*
METHOD USED	:	*Radiello Methods.*

Chemtech Laboratory Services (Pty) Ltd. ***Reg. No:*** (1998/37710/23), ***V.A.T. No:*** 4730185131. **Directors:** Mr. E Cowley, Mrs. A Cowley
Physical: 732 Makou Street, Monument Park, Pretoria. ***Postal:*** P.O. Box 25825, Monument Park, 0105
Telephone/Facsimile: +27(0) 12 347 4979, ***E-Mail:*** info@chemtechlab.co.za, ***Web:*** www.chemtechlab.co.za

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TEST RESULTS :

Table 1 – Analysis for Volatile Organic Compounds.

TEST ITEM DESCRIPTION	TEST ITEM CONDITION	DATE RECEIVED	DATE OF ANALYSIS
Radiello Passive Monitors	**Sealed in glass tubes. Received cold.**	**17/08/2011**	**22/08/2011**

The following compounds were specifically tested for:

Pentane	3-Methylhexane	n-Butyl acetate
Ethanol	Benzene	Ethyl benzene
Acetone	Isooctane	Xylene
2-Methylpentane	n-Heptane	2-Butoxyethanol
3-Methylpentane	Trichloroethylene	Cyclohexanone
n-Hexane	Methylmethacrylate	Isopropyl benzene
Methyl Ethyl Ketone	Propyl acetate	Propyl benzene
Ethyl acetate	Methyl Isobutyl Ketone	1,2,3-Trimethylbenzene
2-Methylhexane	Toluene	1,2,4-Trimethylbenzene
Cyclohexane	Perchloroethylene	1,3,5-Trimethylbenzene

RESULTS: (µg/m³)

Compound	NJ163	NJ166
Isohexane	4.17	3.28
Benzene	1.95	1.97
Toluene	2.12	2.13
Perchloroethylene	< 1.68	12.29
1,2,4-Trimethylbenzene	9.32	8.30

Detection Limits: (µg)

Compound	Detection Limit	Compound	Detection Limit
Pentane	0.45	Methylmethacrylate	0.29
Ethanol	1.12	Propyl acetate	0.55
Acetone	1.02	Methyl Isobutyl Ketone	0.89
2-Methylpentane	0.53	Toluene	0.29
3-Methylpentane	0.74	Perchloroethylene	1.16
n-Hexane	0.43	n-Butyl acetate	0.59
Methyl Ethyl Ketone	1.89	Ethyl benzene	0.25
Ethyl acetate	1.59	Xylene	0.24
2-Methylhexane	0.35	2-Butoxyethanol	0.59
Cyclohexane	0.33	Cyclohexanone	0.95
3-Methylhexane	0.35	Isopropyl benzene	0.65
Benzene	0.21	Propyl benzene	0.55
Isooctane	0.35	1,2,3-Trimethylbenzene	0.64
n-Heptane	0.44	1,2,4-Trimethylbenzene	0.68
Trichloroethylene	1.21	1,3,5-Trimethylbenzene	0.72

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Specific Test Conditions	*Samples stored at < 5^{0}C prior to analysis.* *Environmental temperature during analysis: 22.8 ^{0}C.* *Results confirmed using Gas Chromatography/Mass Spectrometry.*
Deviations	*None.*

Table 2 – Analysis for Phenol.

TEST ITEM DESCRIPTION	TEST ITEM CONDITION	DATE RECEIVED	DATE OF ANALYSIS
Radiello Passive Monitors	*Sealed in glass tubes. Received cold.*	*04/08/2011*	*18/08/2011*

RESULTS: (µg/m^3)

Sample	Phenol	Cresol
NJ164	9.63	0.86
NJ167	10.82	2.75

Specific Test Conditions	*Samples stored at < 5^{0}C prior to analysis.* *Environmental temperature during analysis: 22.8 ^{0}C.* *Analysis performed using Thermal Desorption Gas Chromatography/Mass Spectrometry.*
Deviations	*None.*

Table 3 – Analysis for Ammonia.

TEST ITEM DESCRIPTION	TEST ITEM CONDITION	DATE RECEIVED	DATE OF ANALYSIS
Radiello Passive Monitors	*Sealed in glass tubes. Received cold.*	*11/08/2011*	*19/08/2011*

RESULTS: (µg/m^3)

Sample	Ammonia
NJ 165	12.18
NJ 168	10.45

Specific Test Conditions	*Samples stored at < 5^{0}C prior to analysis.* *Environmental temperature during analysis: 22.8 ^{0}C.*
Deviations	*None.*

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WORK APPROVED BY: *Adri Cowley* *1/09/2011*

(Laboratory Manager) ***Date***

(Technical Signatory)

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Chemtech Laboratory Services does not accept responsibility for errors that might have arisen during sampling and transport of samples by external parties.

Results express in ppm, ppb, mg/m^3 or $\mu g/m^3$ were calculated using data supplied by the client.

* *This test method is not included in the Scope of Accreditation for Chemtech Laboratory Services.*

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TEST REPORT

DATE OF REPORT	:	*1 September 2011*
REFERENCE NO	:	*CLS112154*
CLIENT REFERENCE NO	:	*Anglo-Plat WS August 2011*
CLIENT ORDER NO	:	*Anglo-Plat WS August 2011*
CONTACT PERSON	:	*Eugene Cowley*
CLIENT	:	*Margot Saner & Associates (Pty) Ltd*
CLIENT ADDRESS	:	*P O Box 287*
		ALLENS NEK
		1737
CLIENT CONTACT PERSON	:	*Andrew Dickson*
CLIENT TELEPHONE NO	:	*(011) 475 3161*
CLIENT FAX NO	:	*(011) 475 1110*
CLIENT e-MAIL ADDRESS	:	*andrewd@msa-sa.com*
ANALYSIS REQUIRED	:	*Analysis for Volatile Organic Compounds.*
	:	*Analysis for Phenol.*
	:	*Analysis for Ammonia.*
METHOD USED	:	*Radiello Methods.*

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TEST RESULTS :

Table 1 – Analysis for Volatile Organic Compounds.

TEST ITEM DESCRIPTION	TEST ITEM CONDITION	DATE RECEIVED	DATE OF ANALYSIS
Radiello Passive Monitors	**Sealed in glass tubes. Received cold.**	**04/08/2011**	**18/08/2011**

The following compounds were specifically tested for:

Pentane	3-Methylhexane	n-Butyl acetate
Ethanol	Benzene	Ethyl benzene
Acetone	Isooctane	Xylene
2-Methylpentane	n-Heptane	2-Butoxyethanol
3-Methylpentane	Trichloroethylene	Cyclohexanone
n-Hexane	Methylmethacrylate	Isopropyl benzene
Methyl Ethyl Ketone	Propyl acetate	Propyl benzene
Ethyl acetate	Methyl Isobutyl Ketone	1,2,3-Trimethylbenzene
2-Methylhexane	Toluene	1,2,4-Trimethylbenzene
Cyclohexane	Perchloroethylene	1,3,5-Trimethylbenzene

RESULTS: (µg/m³)

Volatile Organic compounds could not be detected on samples NJ157 and NJ161.

Detection Limits: (µg)

Compound	Detection Limit	Compound	Detection Limit
Pentane	0.45	Methylmethacrylate	0.29
Ethanol	1.12	Propyl acetate	0.55
Acetone	1.02	Methyl Isobutyl Ketone	0.89
2-Methylpentane	0.53	Toluene	0.29
3-Methylpentane	0.74	Perchloroethylene	1.16
n-Hexane	0.43	n-Butyl acetate	0.59
Methyl Ethyl Ketone	1.89	Ethyl benzene	0.25
Ethyl acetate	1.59	Xylene	0.24
2-Methylhexane	0.35	2-Butoxyethanol	0.59
Cyclohexane	0.33	Cyclohexanone	0.95
3-Methylhexane	0.35	Isopropyl benzene	0.65
Benzene	0.21	Propyl benzene	0.55
Isooctane	0.35	1,2,3-Trimethylbenzene	0.64
n-Heptane	0.44	1,2,4-Trimethylbenzene	0.68
Trichloroethylene	1.21	1,3,5-Trimethylbenzene	0.72

Specific Test Conditions	***Samples stored at < 5°C prior to analysis.*** ***Environmental temperature during analysis: 22.8 °C.*** ***Results confirmed using Gas Chromatography/Mass Spectrometry.***
Deviations	*None.*

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Table 2 – Analysis for Phenol.

TEST ITEM DESCRIPTION	TEST ITEM CONDITION	DATE RECEIVED	DATE OF ANALYSIS
Radiello Passive Monitors	Sealed in glass tubes. Received cold.	04/08/2011	18/08/2011

RESULTS: (µg/m^3)

Sample	Phenol	Cresol
NJ158	22.89	15.49
NJ161	60.55	77.39

Specific Test Conditions	Samples stored at < 5°C prior to analysis. Environmental temperature during analysis: 22.8 °C. Analysis performed using Thermal Desorption Gas Chromatography/Mass Spectrometry.
Deviations	None.

Table 3 – Analysis for Ammonia.

TEST ITEM DESCRIPTION	TEST ITEM CONDITION	DATE RECEIVED	DATE OF ANALYSIS
Radiello Passive Monitors	Sealed in glass tubes. Received cold.	11/08/2011	19/08/2011

RESULTS: (µg/m^3)

Sample	Ammonia
NJ 159	32.69
NJ 162	24.36

Specific Test Conditions	Samples stored at < 5°C prior to analysis. Environmental temperature during analysis: 22.8 °C.
Deviations	None.

WORK APPROVED BY:

Adri Cowley
(Laboratory Manager)
(Technical Signatory)

1/09/2011
Date

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Chemtech Laboratory Services does not accept responsibility for errors that might have arisen during sampling and transport of samples by external parties.

Results express in ppm, ppb, mg/m^3 or $\mu g/m^3$ were calculated using data supplied by the client.

* *This test method is not included in the Scope of Accreditation for Chemtech Laboratory Services.*

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Annexure E:

The Status of Soil, Surface Water and Groundwater at the Tar Dam (August 2011)

ENVIRONMENTAL SPECIALISTS

RUSTENBURG PLATINUM MINES
RUSTENBURG SECTION

The Status of Soil, Surface Water and Groundwater at the Tar Dam

August 2011

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RPM-RS

The Status of Soil, Surface and Groundwater at the Klipfontein Tar Dam

August 2011

Report Number: RPM/Tar Dam1/2011/OFS

This report should be cited as:

Clean Stream Scientific Services,

The Status of Soil, Surface Water and
Groundwater at the Klipfontein Tar Dam

August 2011

RUSTENBURG PLATINUM MINES: RUSTENBURG SECTION

The Status of Soil, Surface Water and Groundwater at the Klipfontein Tar Dam

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

RUSTENBURG PLATINUM MINES: RUSTENBURG SECTION

The Status of Soil, Surface Water and Groundwater at the Klipfontein Tar Dam

August 2011

1. INTRODUCTION AND SCOPE OF WORKS

Rustenburg Platinum Mines Rustenburg Section (RPM-RS) contracted Clean Stream Scientific Services to assess the potential impact of the Klipfontein Tar Dam on adjacent surface water, groundwater and the soil regimes. The Klipfontein tar dam comprises of two compartments, a dormant dam that contains the tar and a dam rehabilitated in 2002 by removing the tar to a hazardous waste management facility.

This assessment was conducted by evaluating and comparing the organic and inorganic constituents of ground- and surface-water situated up- and down-stream relative to the Klipfontein Tar Dam (Figure 1-1). The water samples assessed were:

1. N12a – groundwater upstream of the tar dam
2. NB12 – groundwater downstream of the tar dam
3. K110 – surface water upstream of the Klipfontein complex
4. K058 – surface water downstream of the Klipfontein complex
5. K083 – effluent from TEMSO/engineering workshop upstream from the tar dam (included as possible pollution source to downstream receiving environment)
6. Tar Dam Water – the liquid fraction on the dormant tar dam was also sampled and labeled as the Tar Dam Water

Two soil samples, one adjacent to the existing tar dam (soil-1) and one from the rehabilitated tar dam (soil-2), were also sent for Terratest analysis to identify potential pollutants/tracers originating from the tar dam and to assess the efficiency of rehabilitation on the rehabilitated tar dam to assess whether any organic remnants still remain.

The surface water and groundwater localities included in this investigation forms part of the routine inorganic water quality monitoring programme for RPM-RS and trends of specific parameters for the localities will be compared with trends of localities in the survey area to define the significance of any deteriorating trends.

Note that the tar dam and soil analyses do not form part of the routine monitoring programme and the pollution assessment will therefore only include one dataset for each of the above-mentioned.

The assessment of the status of the soil, surface water and groundwater quality entailed the following:

- Total oil and grease analysis (only water samples);
- TerrAttesT® (Refer to Section 3);
- Cyanide (only water samples); and
- Trend analyses of the general salinity and selected inorganic parameters (only water samples) and comparison with regional quality of the lease area.

The TerrAttesT® is an organic and inorganic analysis package developed by Eurofins Analytico, Holland, offering the most advanced analytical techniques for quantitative measurements of more than 200 compounds in soil and water. TerrAttesT® analysis is very competitive compared with more traditional laboratory survey methods. Because of the wide scope of analysis included in the package, costs are significantly reduced compared to local laboratories offering the same analyses. In addition, because the technology is so refined, sample sizes can be significantly reduced compared to status quo, reducing costs and enabling efficient transport, for example: 120 ml instead of 450 ml for soil samples, and 130 ml instead of 2000 ml for groundwater samples. TerrAttesT® complies with many official laws and regulations; all relevant compounds mentioned in the common used European laws dealing with soil survey work. Note that the TerrAttesT® analytical reports only report on identified parameters exceeding the various detection limits. Parameters included in this test with respective detection limits can be viewed in Appendix A.

2. LIMITATIONS OF STUDY

It should be noted that this assessment was based on grab samples for organic and specific inorganic (cyanide) analysis and as a result no trend analyses for these parameters will therefore be used as assessment tool in this study.

In addition, detailed risk and pollution assessments of which include depth of (mostly soil) and extent of pollution are outside the scope of this investigation.

This assessment recommends that specialist soil and hydrogeological investigations follow this pollution status report to evaluate the risks pertaining to it.

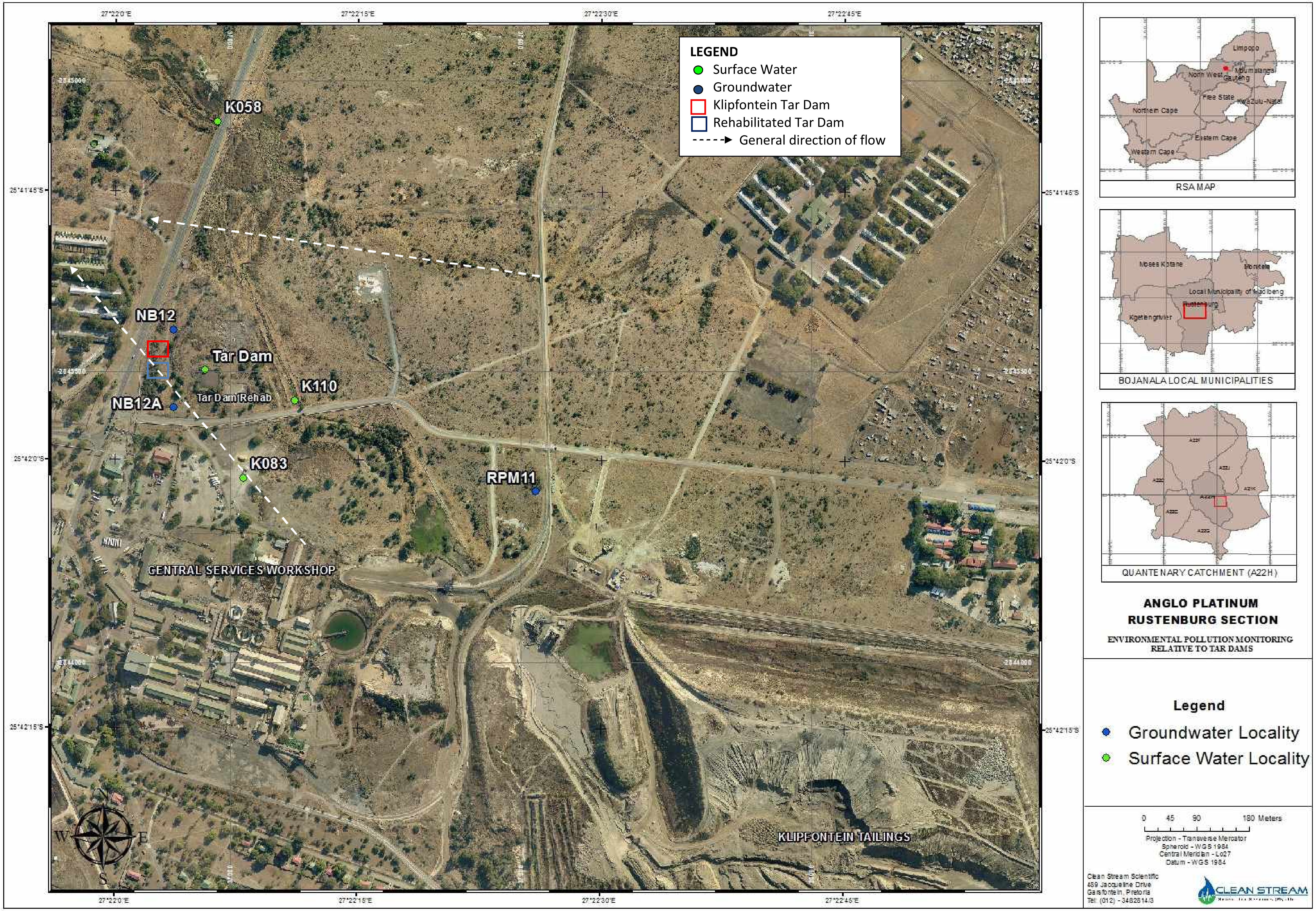

Figure 1-1: Surface and groundwater localities relative to the Klipfontein Tar Dam.

3. METHODOLOGY

3.1 Groundwater and surface water sampling approach

All fieldwork was conducted based on the protocols and specifications, and code of practice contained in the SABS International Organization for Standardization (ISO) 5667:1-15. These international standards address all aspects from the program design, sampling methods as well as sample preservation and many other aspects. Applicable standards include:

- ISO 5667-1: 2006 Part 1: Guidance on the design of sampling programs and sampling techniques;
- ISO 5667-3: 2003 Part 3: Guidance on preservation and handling of samples;
- ISO 5667-6: 2005 Part 6: Guidance on sampling of rivers and streams;
- ISO 5667-11: 1993 Part 11: Guidance on sampling of groundwater; and
- Department of Water Affairs (DWA) Best Practice Guidelines Series G3: General Guidelines for Water Monitoring Systems.

Ground- and surface water were sampled by Clean Stream Scientific Services on the 8th of August 2011.

To minimize cross contamination, groundwater abstracted from boreholes were not purged. Because of the adsorption of organic (and inorganic) particles onto the pump tubing cross contamination was likely to occur. Groundwater was sampled by lowering a Teflon bailer into a borehole (5 m below water table) and allowing the container to fill with water (according to ISO SABS 5667-11 guideline). Organic results reported on in this document therefore include dissolved fractions and not free product. New bailers were used for each borehole. This method was used for groundwater samples scheduled for both organic and inorganic analyses.

Surface and groundwater samples were immediately cooled following sampling.

3.2 Soil sampling approach

The status of two soil samples was also assessed:
1. Soil sample 1: sampled at 5 m away from the existing dormant tar dam on the north facing dam wall, and sampled at a depth of 20 cm;
2. Soil sample 2: sampled from the rehabilitated tar dam taken at the center of the dam at a depth of 20 cm.

Soil was sampled by Clean Stream Scientific Services on the 8th of August 2011.

Soil was sampled in amber glass containers at a depth of 20 cm using a stainless steel soil auger. Samples were immediately cooled following sampling.

3.3 Laboratory analyses

3.3.1 TerrAttesT®

The determinations in TerrAttesT® are all ISO/IEC 17025 accredited by the Dutch Accreditation Council (RvA) and ISO 9001:2000 certified by Lloyds RQA.
Analytes included in the TerrAttesT® include:

- Metals
- Aromatic compounds
  - Mono Aromatic Hydrocarbons
  - Phenols
  - Polycyclic Aromatic Hydrocarbons (PAH)
- Halogenated Hydrocarbons
  - Volatile Halogenated Hydrocarbons
  - Chlorinated Benzenes
  - Chlorinated Phenols
  - Polychlorinated Biphenyls
  - Chloronitrobenzenes
- Pesticides, herbicides and fungacides
  - Chlorine pesticides
  - Phosphor pesticides
  - Nitrogen pesticides
- Phthalates
- Total Petroleum Hydrocarbons (TPH)
  - C10 – C40 ranges

3.3.2 Cyanide and Total Oil and Grease

A waste classification study by SGS Laboratory in July 2002, using the toxicity characteristic leaching procedure (TCLP), indicated the presence of cyanide in the tar waste. Therefore cyanide analysis was included in the present investigation to identify whether cyanide remnants still remain or have since degraded. Cyanide was analysed by the Midvaal Laboratory in Pretoria.

Total oil and grease, analysed for by the UIS Laboratory include for fats, oils and greases soluble in hexane.

3.3.3 Inorganic analysis

Clean Stream Scientific Services analysed inorganic parameters. Clean Stream Scientific Services is a SANAS (South African Nation Accreditation System) Accredited Testing Laboratory, No. T0374. Inorganic parameters include:

- pH, Total alkalinity, EC, TDS
- Mg, Na, K, Ca, Cl, F, SO_4, NO_3-N, NH_4-N, PO_4-P
- Al, Cd, Cr, Cu, Fe, Mn, Ni, Pb, Zn

4. RESULTS SUMMARY

4.1 Tar Dam Water

Both organic and inorganic elements of concern recorded for the tar dam as recorded by various laboratories are shown in Tables 4.1-1 and 4.1-2. For the purpose of this report an element or organic constituent of concern include those that were recorded above allowable drinking water standards for the protection of human health. Note that where no guideline are available for establishing health based criteria (mostly organic compounds) but the compound recorded above detection limits and is regarded as toxic or a risk to human health or is significant in the environment, it is also regarded as a concern. Compounds that are considered as carcinogens (benzene & ethylbenzene) but which recorded within acceptable drinking water standards are also regarded as concerns.

The tables include short summaries on respective significance in the environment, potential health risks, maximum risk levels (MRL) towards human health, impacts on downstream water resources, most probable source of the contamination including a health hazard rating.

For the purpose of this report a tracer is defined as an element or compound occurring in the tar dam, soil and / or the receiving environment but is absent in the background or upstream localities.

Table 4.1-1: Inorganic elements of concern in the tar dam.

Results	Significance in environment	Potential health risk	Maximum Risk Level (water)	Impact & Possible source	Health Hazard Rating
Element: Aluminium Concentration: 4.4 mg/l Laboratory: CSSS	Aluminium solubility is strongly pH dependent and at neutral pH values it is partially soluble and most biologically unavailable.	The most sensitive target of aluminum toxicity is the nervous system.	0.15 mg/l	None	Medium
Element: Arsenic Concentration:0.063 mg/l TERRA	Transport and partitioning of arsenic in water depends upon the chemical form. Soluble forms move with the water and may be carried long distances. Arsenic may be adsorbed from water onto sediments or soils.	Carcinogenic	0.001 mg/l	Not quantified	Medium
Element: Chloride Concentration: 1490.4 mg/l Laboratory: CSSS	Chloride is a conservative ion which does not take part in soil attenuation or biological processes (mostly) and behaves as a tracer.	Chloride in water supplies is objectionable because it imparts undesirable tastes to water and beverages prepared from water.	100 mg/l	Impact on downstream groundwater regime Tar dam as potential source	Medium
Element: Cyanide Concentration: 2.24 mg/l Laboratory: Midvaal	Most cyanide in surface water will form hydrogen cyanide and evaporate.	Cyanides are fairly mobile in soil and could seep into groundwater. Impact on human health?	0.2 mg/l	No cyanide recorded above detection limits in water resources.	High
Element: Fluoride Concentration: 45.22 mg/l Laboratory: CSSS	Fluoride is released to the air from fluoride-containing substances, including coal, minerals, and clays. Fluoride is a conservative ion.	Skeletal fluorosis can be caused by eating, drinking, or breathing very large amounts of fluorides.	1.0 mg/l	Impact on downstream groundwater regime Tar dam as potential source	High
Element: Iron Concentration: 10.89 mg/l Laboratory: CSSS	Two common states of iron in the environment are the reduced ferrous (Fe2+) and the oxidized ferric (Fe2+) forms.	No significant health hazards exist only aesthetic risks.	1.0 mg/l	No significant impact	Medium
Element: Lead	The fate of lead in soil is affected by the adsorption at mineral	Lead is a cumulative general poison, with fetuses, infants, young children	0.001 mg/l	None	High

Concentration: 0.27 mg/l Laboratory: CSSS	interfaces, which are dependent upon physical and chemical characteristics of the soil (e.g., pH, soil type, particle size, organic matter content).	and pregnant women being most susceptible to adverse health effects. Lead can severely affect the central nervous system.			
Element: Manganese Concentration: 5.07 mg/l Laboratory: CSSS	Behaves similarly than iron in the environment. Soluble manganese (Mn^{2+}) occurs at low redox potentials and low pH	Similar effects compared to iron	0.40 mg/l	Slight increase in downstream groundwater Tar dam/reducing conditions as potential sources	Medium
Element: Mercury Concentration: 0.21 mg/l Laboratory: Analytico	Mercury can enter and accumulate in the food chain as methylmercury (organic form).	Methylmercury causes permanent brain and kidney damage	0.001 mg/l	Possible tracer identified in downstream groundwater. Very low levels of mercury detected in downstream groundwater at 0.000092 mg/l Mercury also detected for upstream K083 (0.00043 mg/l) Tar dam & K083 as potential sources	High
Nickel CSSS – 1.07 mg/l Analytico – 0.91 mg/l	Nickel strongly attached to soil where it readily accumulates in plants	The most common harmful health effect of nickel in humans is an allergic reaction.	0.15 mg/l	Slight Impact on downstream Klipfontein Spruit	Low
Element: Phosphorous Concentration: 38.5 mg P/l Laboratory: CSSS	Extremely reactive under oxidizing conditions forming precipitates of many elements. Inorganic phosphorous limiting factor in stimulation of aquatic plants	No health risks	No data	Significant impact on downstream groundwater regime Tar dam & K083 as potential sources	Medium

Parameter: Sulphate Concentration: 3970 mg/l Laboratory: CSSS	Sulphate are discharged into the aquatic environment in wastes from industries that use sulphates and sulphuric acid	Sulphate is one of the least toxic anions. Sulphate can cause diarrhea especially in conjunction with magnesium.	400 mg/l	None	Medium

Table 4.1-2: Organic compounds of concern in the tar dam.

Contaminant Concentration & Laboratory	Significance in environment	Potential health risk	Maximum Risk Level (water)	Impact & Possible source	Hazard Rating
Compound: Benzene Concentration: 0.051 mg/l Laboratory: Analytico	Benzene is a natural part of crude oil, gasoline, and cigarette smoke. Benzene is slightly soluble in water and can pass through the soil into underground water.	Carcinogenic	0.01 mg/l	Tracer identified in downstream groundwater regime at 0.0004 mg/l Tar dam & K083 as potential sources	High
Compound: Ethylbenzene Concentration: 0.0048 mg/l Laboratory: Analytico	Ethylbenzene is found naturally in oil. Ethylbenzene may get into the soil by gasoline or other fuel spills and poor disposal of industrial and household wastes. Ethylbenzene is partially soluble in water and can contaminate groundwater.	Carcinogenic	0.30 mg/l	Tracer identified in downstream groundwater regime at 0.001 mg/l Tar dam & K083 as potential sources	Medium
Compound: Toluene Concentration: 0.057 mg/l Laboratory: Analytico	Toluene occurs naturally in crude oil. Does not bio-accumulate to high levels in animals because it is broken down and excreted.	Toluene can cause headaches and sleepiness, and can impair your ability to think clearly.	0.70 mg/l	None	Low
Compound: Xylenes Concentration: 0.038 mg/l Laboratory: Analytico	Xylene occurs naturally in petroleum and coal tar. When released to soil or surface water, xylene volatilizes into the atmosphere, where it is quickly degraded. Xylene may also leach into groundwater; microbial degradation primary removal	The primary effects of xylene exposure involve the nervous system by all routes of exposure	0.50 mg/l	None	Low

Compound: Phenol Concentration: 500 mg/l Laboratory: Analytico	Natural constituent of coal tar. High mobility in soil and groundwater. Phenols do not accumulate in fish, other animals, or in plants.	Ingestion of high concentrations of phenol can produce internal burns.	No data	Tracer identified in downstream groundwater regime at 1.8 mg/l Tar dam as most probable source although phenols also recorded for K083 (0.015 mg/l)	High
Compound: Cresol (sum) Concentration: 370 mg/l Laboratory: Analytico	Natural constituent of coal tar. Cresols do not attach strongly to soil and may move to groundwater.	Possible carcinogen	No data	Tracer identified in downstream groundwater regime at 4.1 mg/l Tar dam as most probable source	High
Compound: 2, 4 Dimethylphenol Concentration: 13 mg/l Laboratory: Analytico	Natural constituent of coal tar. May adsorb moderately to sediment and will be readily biodegradable. Exposure to sunlight causes degradation.	Clinical course was similar to that observed in other phenolic poisonings with active bowel sounds, nausea, and vomiting.	No data	No impact on water resources	Low-medium
Compound: 2, 5 Dimethylphenol Concentration: 4.3 mg/l Laboratory: Analytico	Natural constituent of coal tar. May adsorb moderately to sediment and is readily biodegradable. Exposure to sunlight causes degradation.	Clinical course was similar to that observed in other phenolic poisonings with active bowel sounds, nausea, and vomiting.	No data	No impact on water resources	Low-medium
Compound: o-Ethylphenol Concentration; 2.3 mg/l Laboratory: Analytico	Highly soluble in water. m-ethylphenol is moderately soluble in water	Low human health hazard	No data	No impact on water resources	Low-medium
Compound: m-Ethylphenol Concentration: 13 mg/l Laboratory: Analytico	Moderately soluble in water. m-ethylphenol is moderately soluble in water.	Low human health hazard	No data	No impact on water resources	Low-medium
Compound: Total Petroleum Hydrocarbons (sum)	TPH is a term used to describe a broad family of several hundred	Depends on fractions and specific constituents	Guidelines relate to specific constituents	Significant impact on downstream	High

Concentration: 65 mg/l Laboratory: Analytico	chemical compounds that originally come from crude oil.			groundwater regime	
Compound: Total fats, oils and greases Concentration; 91.8 mg/l Laboratory: UIS	Non-specific gravimetric technique that includes for all organic material soluble in hexane.	Depends on fractions and specific constituents	Guidelines relate to specific constituents		-

4.2 Central Services Workshop Effluent (K083)

Both organic and inorganic elements of concern recorded for the effluent from the Central Services Workshop (K083) as recorded by various laboratories are shown in Tables 4.2-1 and 4.2-2. The tables also include short summaries potential health risks, maximum risk levels (MRL) towards human health including a health hazard rating.

For the purpose of this report an element or organic constituent of concern include those that were recorded above allowable drinking water standards for the protection of human health. Note that where no guideline are available for establishing health based criteria (mostly organic compounds) but the compound recorded above detection limits and is regarded as toxic or a risk to human health or is significant in the environment, it is also regarded as a concern. Compounds that are considered as carcinogens (benzene & ethylbenzene) but recorded within acceptable drinking water standards are also regarded as concerns.

4.3 Possible Tracers

For the purpose of this report, a tracer is defined as a substance recorded in significant quantities (above detection limits) in the tar dam or Central Services effluent (K083), the soil environment and / or in the downstream surface and / or groundwater receiving environments. Table 4.3-1 tabulates the possible inorganic and organic tracers identified which include:

- Mercury (Hg);
- Benzene;
- Ehtylbenzene;
- Phenol;
- O-Cresol; and
- Total petroleum hydrocarbons (TPH).

Table 4.2-1: Inorganic elements of concern in K083.

Contaminant Concentration & Laboratory	Significance in environment	Potential health risk	Maximum Risk Level (water)	Health Hazard Rating
Element: Mercury Concentration: 0.00043 mg/l Laboratory: Analytico	Mercury can enter and accumulate in the food chain as methylmercury (organic form	Methylmercury causes permanent brain and kidney damage	0.001 mg/l	Low
Element: Phosphorous Concentration: 1.90 mg P/l Laboratory: CSSS	Extremely reactive under oxidizing conditions forming precipitates of many elements. Inorganic phosphorous limiting factor in stimulation of aquatic plants	No health risks	No data	Low

Table 4.2-2: Organic compounds of concern in K083.

Contaminant Concentration & Laboratory	Significance in environment	Potential health risk	Maximum Risk Level (water)	Hazard Rating
Compound: Benzene Concentration: 0.0055 mg/l Laboratory: Analytico	Benzene is a natural part of crude oil, gasoline, and cigarette smoke. Benzene is slightly soluble in water and can pass through the soil into underground water.	Carcinogenic	0.01 mg/l	Low
Compound: Ethylbenzene Concentration: 0.0019 mg/l Laboratory: Analytico	Ethylbenzene is found naturally in oil. Ethylbenzene may get into the soil by gasoline or other fuel spills and poor disposal of industrial and household wastes. Ethylbenzene is partially soluble in water and can contaminate groundwater.	Carcinogenic	0.30 mg/l	Low
Compound: Toluene Concentration: 0.013 mg/l Laboratory: Analytico	Toluene occurs naturally in crude oil. Does not bio-accumulate to high levels in animals because it is broken down and excreted.	Toluene can cause headaches and sleepiness, and can impair your ability to think clearly.	0.70 mg/l	Low

Compound: Xylenes Concentration: 0.011 mg/l Laboratory: Analytico	Xylene occurs naturally in petroleum and coal tar. When released to soil or surface water, xylene volatilizes into the atmosphere, where it is quickly degraded. Xylene may also leach into groundwater; microbial degradation primary removal	The primary effects of xylene exposure involve the nervous system by all routes of exposure	0.50 mg/l	Low
Compound: Phenol Concentration: 0.015 mg/l Laboratory: Analytico	Natural constituent of coal tar. High mobility in soil and groundwater. Phenols does not accumulate in fish, other animals, or in plants.	Ingestion of high concentrations of phenol can produce internal burns.	No data	-
Compound: Chrysene Concentration: 0.00026 mg/l Laboratory: Analytico	Chrysene is a polycyclic aromatic hydrocarbon (PAH) and a natural component of coal tar	As with other PAHs, chrysene is suspected to be a human carcinogen.	No data	
Compound: Trichloromethane (chloroform) Concentration: 0.0013 mg/l Laboratory: Analytico	Trichloromethane is one of the trihalomethanes which is formed following chlorination of organic substances. It is considered harmful	Chronic chloroform exposure can damage the liver and to the kidneys, and some people develop sores when the skin is immersed in chloroform. Birth defects and miscarriages have been reported in animal studies.	0.3 mg/l	Low
Compound: Total Petroleum Hydrocarbons Concentration (sum) – 19 mg/l Laboratory: Analytico	TPH is a term used to describe a broad family of several hundred chemical compounds that originally come from crude oil.	Depends on fractions and specific constituents	Guidelines relate to specific constituents	

Table 4.3-1: Possible organic and inorganic tracers identified in the tar dams, soil and downstream receiving environment.

Salinity and metals	Guidelines	Tar Dam (SW)	K083 (SW)	K110 (SW)	K058 (SW)	NB12 (GW)	NB12A (GW)
Hg (mg/l)	0.006 (3)	***0.021***	***0.00043***			***0.000092***	
Volatile organic hydrocarbons							
Benzene (mg/l)	0.010 (2)	***0.051***	***0.0055***			***0.0004***	
Ethylbenzene (mg/l)	0.30 (3)	***0.048***	***0.0019***			***0.001***	
Phenols							
Phenol (mg/l)	4 (2)	***500 (1)***	***0.015***			***1.8***	
p-Cresol (mg/l)	no data	***13***				***4.1***	
Cresols (sum) (4) (mg/l)	no data	***370***				***4.1***	
Total Petroleum Hydrocarbons (5)							
TPH C10-C12 (mg/l)	no data	***23***	***0.26***			***0.028***	
TPH C12-C16 (mg/l)	no data	***20***	***10***			***0.14***	
TPH C16-C21 (mg/l)	no data	***13***	***3.6***			***0.021***	
TPH C21-C30 (mg/l)	no data	***7.5***	***2.5***			***0.019***	
TPH (sum C10-C40) (mg/l)	no data	***65***	***19***			***0.22***	

Matrices - Surface (SW) Groundwater (GW)

Analysis: Terratest (Analytico, Holland)

Remark (1) - Upper limit of detection

Remark (2) - EPA (2007) drinking water guideline

Remark (3) - WHO (2006) drinking water guideline

Remark (4) - The parameter is composed of several compounds for which individual guidelines may be required

Remark (5) - Petroleum products are complex mixtures of many individual hydrocarbons is a complicating factor in determining the potential risks to consumers.

4.4 Physical and Chemical Impacts on Downstream Environment

Table 4.4-1 shows water quality data for the tar dam including surface and groundwater quality situated upstream and downstream relative to the tar dam.

Table 4.4-1: Physical, chemical and total oil and grease results for the Klipfontein Tar Dam and surface and groundwater situated upstream and downstream relative thereof.

Variable	Tar Dam	Groundwater		Klipfontein Spruit		Impact	
		NB12A (u/s)	NB12 (d/s)	K110 (u/s)	K058 (d/s)	Ground	Surface
pH	7.23	7.60	7.90	8.66	8.23	0.30	-0.43
EC (mS/m)	1852.00	63.20	158.80	501.00	373.00	95.60	-128.00
TDS (mg/l)	8422.00	324.00	750.00	2938.00	2447.00	426.00	-491.00
T alk (mg/l)	3482.70	198.30	742.70	17.50	96.30	544.40	78.80
Cl (mg/l)	1490.40	16.00	46.60	760.90	589.50	30.60	-171.40
SO_4 (mg/l)	3970.12	84.90	12.48	1129.05	1017.71	-72.42	-111.34
NO_3 (mg N/l)	2.62	0.17	0.16	6.25	7.15	-0.01	0.90
NH_4 (mg N/l)	1.12	5.44	44.22	1.26	0.02	38.78	-1.25
PO_4 (mg P/l)	38.51	0.98	3.90	-0.03	-0.03	2.92	0.00
F (mg/l)	45.22	0.21	0.40	-0.18	-0.18	0.19	0.00
Ca (mg/l)	209.07	27.30	93.02	534.51	349.62	65.72	-184.90
Mg (mg/l)	263.55	47.15	59.72	54.04	186.16	12.57	132.12
Na (mg/l)	341.07	28.70	81.43	411.07	226.49	52.73	-184.58
K (mg/l)	55.52	1.01	11.08	31.64	13.02	10.07	-18.62
Al (mg/l)	4.40	-0.01	-0.01	-0.01	-0.01	0.00	0.0
Fe (mg/l)	10.89	-0.01	0.07	-0.01	-0.01	0.08	0.0
Mn (mg/l)	5.07	0.11	0.28	0.12	0.05	0.16	-0.07
Cr (mg/l)	-0.002	-0.002	-0.002	-0.002	-0.002	0.0	0.0
Cu (mg/l)	0.610	0.010	0.005	0.011	0.032	-0.005	0.021
Ni (mg/l)	1.066	-0.003	-0.003	0.031	0.250	0.0	0.219
Zn (mg/l)	0.334	0.008	-0.004	0.030	0.069	-0.012	0.039
Co (mg/l)	-0.002	-0.002	-0.002	0.005	0.003	0.0	-0.002
Cd (mg/l)	-0.001	-0.001	-0.001	-0.001	-0.001	0.0	0.0
Pb (mg/l)	0.270	-0.010	-0.010	-0.010	-0.010	0.0	0.0
CN (mg/l)	2.24	-0.005	-0.005	-0.005	-0.005	0.0	0.0
Oil/grease	91.8	-0.1	-0.1	-0.1	-0.1	0.0	0.0
T hardness (mg/l)	1607.000	262.000	478.000	1557.000	1640.000	216.000	83.000

Shaded values indicate negative impact on downgradient receiving environment (Derived by subtracting the upstream value from the downstream). A negative value implies and improvement in concentration of that contaminant for the given value. The shaded value denotes an increase in the contaminant by the given value in the downstream sample.

4.5 Soil Samples

Two soil samples were included in the scope of works for analysis which included soil from the wall of the existing tar dam (soil-1) and another soil sample taken from the center of the rehabilitated tar dam to assess whether any remnants remain following rehabilitation. Table 4.5-1 shows the results recorded together with soil quality guidelines for the protection of human health. Due to the lack of South African soil quality guidelines, the Dutch soil quality guidelines were consulted.

Table 4.5-1: Terratest results for soil samples.

Element/Compound	Soil quality guidelines	Soil-1	Soil-2
Metals			
Ba	500	150	88
Cr	64	500	86
Co	50	30	5.6
Cu	63	39	19
Pb	140	9.1	
Ni	50	160	47
V	130	25	6.3
Zn	200	29	11
Volatile organic hydrocarbons			
Benzene	0.0095		1
Phenols			
Phenol	0.33	3.4	
o-Cresol	no data	7.3	
m-Cresol	no data	7.8	
p-Cresol	no data	6.4	
Cresols (sum)	0.4	22	
2,4-Dimethylphenol	no data	19	
2,5-Dimethylphenol	no data	7.1	
2,6-Dimethylphenol	no data	1.8	
3,4-Dimethylphenol	no data	9.1	
o-Ethylphenol	no data	3.1	
m-Ethylphenol	no data	13	
2,3/3,5-Dimethylphenol + 4-Ethylphenol	no data	36	
Polycyclic Aromatic Hydrocarbons (PAHs)			
Naphtalene	no data	61	0.01
Acenaphtylene	no data	4.6	
Acenaphtene	no data	22	0.02
Fluorene	no data	92	0.08
Phenanthrene	no data	120	0.17
Anthracene	no data	70	0.09
Fluoranthene	no data	45	0.3
Pyrene	no data	49	0.54
Benzo(a)fluoranthene	no data	35	0.34

Chrysene	no data	27	0.46
Benzo(b)fluoranthene	no data	9.9	0.39
Benzo(k)fluoranthene	no data	9.9	0.39
Benzo(a)pyrene	no data	30	0.55
Dibenzo(ah)anthracene	no data	5.7	0.18
Benzo(ghi)perylene	no data	34	1.3
Ideno(123cd)pyrene	no data	17	0.81
PAH 10 VROM (sum)	9	450	4.5
PAH 16 EPA (sum)	no data	690	7.2
Volatile Chlorinated Hydrocarbons			
o-Chlorophenol		1.1	
Monochlorophenols	0.06	1.1	
Organic Chlorinated compounds			
a-Chlordan	no data		0.003
Chlordans (sum)	no data	0.0004	0.003
Miscellaneious Organic compounds			
Biphenyl	no data	15	0.009
Dibenzofurane	no data	59	0.05
Total Petroleum Hydrocarbons			
TPH C10-C12	no data	730	5.3
TPH C12-C16	no data	6600	16
TPH C16-C21	no data	11000	82
TPH C21-C30	no data	16000	370
TPH C30-C35	no data	51000	170
TPH C35-C40	no data	2200	74
TPH (sum C10-C40)	250	42000	720

Shaded values exceed Dutch soil quality guidelines for the protection of human health

5. DISCUSSION

5.1 Tar Dam Water

The results summary in Table 4.1-1 indicates that in terms of inorganic constituents the parameters that exceed acceptable drinking water quality guidelines in the tar dam water are shown in Table 5.1-1. The maximum risk level (MLR) is based on the maximum allowable limit for acceptable drinking water standards and the hazard rating on potential health risks following exposure to humans at the concentration observed.

Table 5.1-1: Inorganic parameters of concern in the tar dam water exceeding permissible drinking water standards.

Parameter	Concentration (mg/l)	MRL (mg/l)	Health Hazard rating
Al	4.4	0.15	Medium
As	0.063	0.001	Medium
Cl	1490	100	High
CN	2.24	0.2	High
F	45.22	1.0	High
Pb	0.27	0.001	High
Mn	5.07	0.40	Medium
Hg	0.21	0.001	High
Ni	1.07	0.15	Medium
SO_4	3970	400	High

MLR: Maximum risk level for human consumption

Cyanide is a major concern in the tar dam. The recorded concentration of 2.24 mg/l total cyanide is significantly greater compared to the health based guideline of 0.2 mg/l. Cyanides are a family of compounds containing the highly reactive cyanide anion. The cyanide compounds most commonly found in the environment include hydrogen cyanide and two cyanide salts -- sodium cyanide and potassium cyanide. Cyanides are fairly mobile in soil. At soil surfaces, cyanide compounds will form hydrogen sulfide and evaporate but since cyanide is fairly mobile in soil it may contaminate groundwater. However, low concentrations may biodegrade in the subsurface. High inhalation, oral or dermal exposure levels may result in convulsions, unconsciousness and death. Other health effects may include upper respiratory irritation and dyspnea. Alterations in male reproductive tissue were found in animals orally exposed to cyanide. It is not known if children are more susceptible to cyanide poisoning than adults (ATSDR, 2006).

The results summary in Table 4.1-2 indicate that in terms of organic constituents, the tar dam water is mostly composed of Volatile Organic Hydrocarbons, including the benzene, ethylbenzene, toluene and xylene (BTEX) compounds, phenols and petroleum components in the C10 to C40 ranges. The greatest concentrations were recorded for the C10 – C21 ranges which mostly include the lighter aromatic organic phases such as the BTEX compounds and phenols. The following organic components (Table 5.1-2) exceed allowable concentrations for potable usage and / or are classified as carcinogens. Where no water quality guideline exists for a specific constituent, no health hazard rating is given.

Table 5.1-2: Organic parameters of concern in the tar dam water exceeding permissible drinking water standards.

Parameter	Concentration (mg/l)	MRL (mg/l)	Health Hazard rating
Benzene*	0.051	0.01	High
Ethylbenzene*	0.0048	0.30	Medium
Phenol	500	4	High
Cresol*	370	-	-

MLR: Maximum risk level for human consumption
*Carcinogen/possible carcinogen

The following organic constituents recorded above detection limits in the **tar dam water** which could pose potential toxicity but for which no guideline is currently available.

Table 5.1-3: Organic parameters of concern in the tar dam for which no guidelines are available but may pose to be toxic to humans.

Parameter	Concentration (mg/l)	MRL (mg/l)	Health Hazard rating
Cresols[1]	370	-	-
2,4-dimethylphenol	13	-	-
2,5-dimethylphenol	45.3	-	-
TPH[1]	65	-	-
Total oils and greases[1]	91.8	-	-

[1]Made up of different constituents some of which are toxic

5.2 Central Surfaces Workshop Effluent

The results summary (Refer to Section 4, Table 4.1-3) indicates that in terms of inorganic constituents no parameters exceed acceptable drinking water quality guidelines at K083.

The results summary in Table 4.1-4 indicate that in terms of organic constituents, K083 water contains above detection limits of Volatile Organic Hydrocarbons, including the benzene, ethylbenzene, toluene and xylene (BTEX) compounds, phenols, chrysene (PAH), trichloromethane (a trihalomethane) and petroleum components in the C10 to C40 ranges. The greatest concentrations were recorded for the C10 – C21 ranges which mostly include the lighter aromatic organic phases such as the BTEX compounds and phenols. No organic component exceeded permissible domestic use guidelines but the following organic components recorded in K083 are classified as carcinogens and / or poisons and should be cause for concern.

Table 5.2-1: Poisons and carcinogens recorded in K083.

Parameter	Concentration (mg/l)	MRL (mg/l)	Health hazard	Health Hazard rating
Benzene	0.0051	0.01	Carcinogen	Low-Medium
Ethylbenzene	0.0048	0.30	Carcinogen	Low-Medium
Mercury	0.000043	0.001	Poison	Low-Medium

The following organic constituents recorded above detection limits in **K083** which could pose potential toxicity but for which no guideline is currently available.

Table 5.2-2: Possible toxic constituents recorded in K083.

Parameter	Concentration (mg/l)	MRL (mg/l)	Health Hazard rating
Chrysene	0.00026	-	-
TPH[1]	19	-	-

[1]Made up of different constituents some of which are toxic

5.3 Surface Water

Table 4.3-1 shows possible tracers identified in the downstream receiving environment.

The Klipfontein Spruit (**K058**) is ***unaffected by the tar dam with no tracers*** identified in this section of the Klipfontein Spruit. It is however interesting to note that the upstream Klipfontein Spruit locality, **K110**, did record very low concentrations of the TerrAttesT® constituents including phenols, PAHs, nitrogen based pesticides and Volatile Chlorinated Hydrocarbons. Specific constituents of the above mentioned groups and concentrations include (drinking water quality guidelines in brackets): i) *2,4-Dimethylphenol at 0.11 µg/l (no guideline)*; *o-Ethylphenol at 0.04 µg/l (no guideline)*; *Thymol at 0.02 µg/l (no guideline)*; fluorene at 0.02 *µg/l (no guideline); phenanthrene at 0.08 µg/l (no guideline); chlorophenols at 0.021 µg/l (500 µg/l); 2,3,4,6/2,3,5,6-Tetrachlorophenol at 0.21 µg/l (100 µg/l); and Terbuthylazine at 0.15 µg/l (7.0 µg/l)*. The compliance towards these guidelines given in brackets above or lack thereof ***indicate no immediate risk or concern*** in terms of these constituents.

The Klipfontein Spruit at **K110** receives waste water from General Services Workshop as sampled at **K083** which drains from the south-west towards the Klipfontein Spruit. Another stream drains from the south-east, most probably from the Klipfontein re-mining activities, combining with K083 at the Klipfontein Spruit locality at K110. It is significant that the above-mentioned constituents recorded below detection limits at K083 which ***may indicate contamination from another source***. Since the waste stream draining from the south-east was not included in the scope of works or in the routine water quality monitoring programme for RPM-RS, the source of the above mentioned phenols at K110 is therefore unknown. A ***possible scenario could be that hydraulic oil or fuel from the re-mining activities*** could contribute but this should be verified.

Table 4.4-1 show impacts (in brackets) calculated on the Klipfontein Spruit between K110 and K058. Impacts were quantified for nitrate (0.90 mg N/l), magnesium (132 mg/l), copper

(0.021 mg/l), nickel (0.22 mg/l) and zinc (0.039 mg/l). Acceptable drinking water guidelines for these parameters are 10 mg/l, 100 mg/l, 1.0 mg/l, 0.15 mg/l and 20 mg/l, respectively. The magnesium and nickel increases are significant with both parameters increasing from within their respective acceptable standards at the upstream locality, K110 (54.04 mg Mg/l & 0.031 mg Ni/l), ***to exceedance of acceptable drinking water standards*** at the downstream locality, K058 (186.16 mg Mg/l & 0.25 mg Ni/l). It is ***unlikely that these impacts are tar dam related with most probable sources being sewage*** from Siyavuya informal settlement and / or discharge from Siphumelele 3 Mine.

5.4 Groundwater

In terms of groundwater, the TerrAttesT® results indicate ***tracers for both inorganic and organic constituents*** in the downstream groundwater regime as recorded at **NB12**. Mercury (Hg) was recorded for the tar dam at a concentration of 0.210 mg/l which, although significantly reduced was also recorded for the downstream groundwater at NB12 at 0.000092 mg/l. However, the ***Hg concentration recorded for NB12 is well within the guideline for acceptable domestic*** use of <0.006 mg/l. It is significant that the effluent form the Central Services Workshop at K083 did also record Hg above detection limits at 0.00043 mg/l. Therefore, although the ***health risks in terms of Hg at NB12 remain low the detection of Hg at both sources could be indicative of leachate from the tar dam and / or seepage from K083*** into the downstream groundwater regime.

In terms of organic parameters, the less dense ***benzene and ethylbenzene, and equally dense phenols and cresols*** (compared to water) were identified as tracers in both the tar dam, K083 and downstream groundwater as recorded at borehole NB12 with possible sources being the tar dam or K083. ***All of these compounds except for the cresols were recorded above detection limits in the tar dam and K083*** (Cresols recorded below detection limits at K083). The total petroleum hydrocarbons (TPH) in borehole NB12 also recorded mostly in the lighter C10-C31 ranges. These compounds, generally known as light-non-aqueous-phase-liquids (LNAPLs), will generally spread across the surface of the water table and form a layer on top of the water table. Soluble components will follow the direction of groundwater movement creating a typical pollution plume.

A potable water quality guideline for phenol is set at 4.0 mg/l with the concentration in NB12 recording significantly less at 1.8 mg/l. No drinking water quality guidelines exist for cresols or total TPH compounds but are regarded as toxic. Therefore, although the ***health risks at NB12 in terms of the organic tracers and available guidelines remain low, this could be indicative of leachate from the tar dam and or seepage*** from K083 migrating into downgradient groundwater.

A ***significant impact on the downgradient groundwater regime was calculated in terms of salinity***, mostly contributed by chloride, bicarbonate, calcium, magnesium, sodium, potassium and saline ammonia (NH_4^+). Other parameters increasing significantly from NB12A (upstream) towards NB12 (downstream) include phosphate (PO_4-P), iron and manganese. Of significance is the increase in salinity, alkalinity, NH_4^+ and PO_4-P in NB12 (downstream) relative to NB12A (upstream). EC increased more than double to values exceeding acceptable drinking water standards as proposed by the DWA (DWAF, 1998). An EC increase from 63.2 mS/m to 158.8 mS/m was recorded with the acceptable maximum ranges set at 70 mS/m exceeded at NB12. An alkalinity increase of 544.4 mg/l was recorded at NB12 relative to NB12A with concentrations of 742.7 mg/l and 198.3 mg/l recorded respectively. Phosphate increased from 0.98 mg P/l at NB12A to 3.90 mg P/l with a calculated impact of 2.92 mg/l. Although no drinking water guidelines exist for alkalinity or phosphate, the resource quality objectives (RQO) for alkalinity (50 mg/l) and phosphate (0.1 mg P/l) are significantly exceeded; these impacts should therefore be seen as significant.

A saline ammonia increase of 38.78 mg N/l was recorded at NB12 relative to NB12A with respective concentrations of 44.22 mg N/l and 5.44 mg N/l. ***No health based guideline exists for saline ammonia but the RQO, set at 1.0 mg N/l, is significantly exceeded at both locations. It is significant to note that the tar dam did not record high inorganic nitrogen (N) with NH_4^+ recording a concentration of 1.12 mg N/l and NO_3 2.62 mg N/l which may indicate contamination from other sources***. Other sources may include historic sewage pollution and / or organic matter degradation (borehole is uncapped and could result as a trap for small mammals and reptiles). Frequent theft of borehole caps is a concern at RPM-RS. Current measures of securing the caps are by Allen keys but new more effective measures should be reviewed.

5.5 Soil Samples

Two soil samples, namely soil-1 and soil-2 were sampled in vicinity of the existing tar dam and the rehabilitated tar dam at Klipfontein, respectively and subjected to TerrAttesT® analysis. Results (refer to Table 4.5-1) indicate heavy metals, benezene (volatile organic hydrocarbon) phenols, polycyclic aromatic hydrocarbons, volatile chlorinated hydrocarbons, organic chlorinated compounds, miscellaneous organic compounds and total petroleum hydrocarbons (TPH). Due to the lack of applicable South African soil guidelines for the protection of human health, the Dutch soil quality guidelines were consulted.

Metals recorded for the existing tar dam (soil-1) which exceed soil quality guidelines for the protection of human health, are Cr (500 mg/kg) and Ni (160 mg/kg). Guidelines set for Cr and Ni are 64 mg/kg and 50 mg/kg, respectively.

A wide range of phenolic compounds were recorded above detection limits in **soil-1** but only phenol and cresols (sum) have established health based guidelines of 0.33 mg/kg and 0.40 mg/kg, respectively. ***Phenol recorded a concentration of 3.44 mg/kg and the sum of cresols 22.0 mg/kg both of which significantly exceed the health based guidelines***.

The health based guideline for the sum of PAH of 9.0 mg/kg is significantly exceeded in soil-1 with a concentration of 450 mg/kg. Similarly, the health based guideline for the sum of TPH, 250 mg/kg are more than 165 times greater in soil-1 with a concentration of 42 000 mg/kg.

Other constituents which ***exceed soil quality health based guidelines in soil-1 are the volatile chlorinated hydrocarbon, monochlorophenol*****,** which at 1.1 mg/kg, exceed the guideline set at 0.06 mg/kg.

Chromium (Cr) and benzene recorded concentrations of 86 mg/kg and 1.0 mg/kg in the rehabilitated tar dam (soil-2) which are significantly greater compared to their particular guidelines of 64 mg/kg and 0.0095 mg/kg, respectively. A wide range of PAH and TPH constituents were recorded for soil-2 but with guidelines only available for the sum of total constituents recorded. The sum of PAH calculated for soil-1 are 4.5 mg/kg which is well within the health based guideline of 9.0 mg/kg. However, the sum of TPH constituents calculated to 720 mg/kg which is significantly greater than the health based guideline of 250 mg/kg. The organic chlorinated compound a-chlordan recorded a concentration of 0.003 mg/kg which is significantly greater than the health based guideline of 0.0004 mg/kg for the sum of chlordans. Chlordan was mostly used as a pesticide in the United States but due to the human and environmental concerns it was banned by the Environmental Protection Agency (EPA) in 1988.

5.6 Inorganic Trend Analyses

The RPM-RS database for inorganic surface and groundwater quality as managed by Clean Stream Scientific Services was sourced for trend analyses.

Parameters included for trend analyses:

- Total dissolved solids (TDS);
- Nitrate (NO_3-N);
- Ammonium (NH_4-N); and
- Phosphate (PO_4-P)

5.6.1 Surface water trends

Decreasing (improving) trends are noted for both up- and downstream Klipfontein Spruit localities (Figure 5.6.1-1), but mean TDS for downstream locality at **K058** are 10% greater compared to the upstream locality at **K110**. Average TDS for the database period at K110 are 3361 mg/l and for K058 3463 mg/l. ***TDS in this section of the Klipfontein Spruit is a concern with the Resource Quality Objective (RQO) as per the Draft Water Use Licence (162/7/A220/C5) of 2007, set at 515 mg/l.*** Similarly, average NO_3 for the upstream locality K110 is 4% greater than for the downstream locality at K058. Average NO_3 for K110 is 56.3 mg N/l while for K058 it was calculated at 53.9 mg N/l. ***NO_3 also remains a concern with the bulk of the NO_3 is most probably introduced from the Klipfontein re-mining activities***.

A Stiff diagram is a graphical representation of chemical analyses. It is widely used by hydrogeologists and geochemists to display the major ion composition of a water sample. A polygonal shape is created from four parallel horizontal axes extending on either side of a vertical zero axis. Cations are plotted in milliequivalents per liter (meq/l) on the left side of the zero axis, one to each horizontal axis, and anions are plotted on the right side. Stiff patterns are useful in making a rapid visual comparison between water from different sources.

Stiff diagrams for the Klipfontein Spruit localities indicate domination by the Cl and SO_4 anions and Na and Ca and / or Mg cations (Figure 5.6.1-2). The tar dam profile indicates domination by the bicarbonate (HCO-) and SO_4 anions and the Mg and Na cations. The different shapes between the Klipfontein Spruit localities and the tar dam indicate water from different sources. ***The Klipfontein Spruit is therefore not impacted by the tar dam in terms of salinity.***

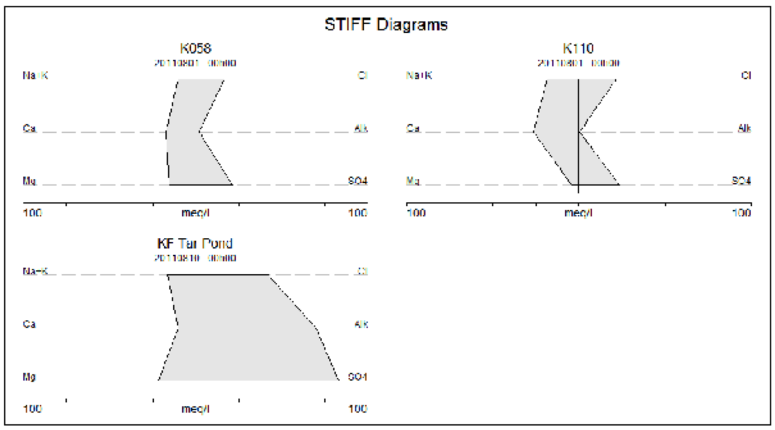

Figure 5.6.1-2: Stiff diagrams indicating meq/l for the Klipfontein Spruit localities and the tar dam.

5.6.2 Groundwater trends

Salinity, NH_4 (as N) and PO_4 (as P) was raised as potential concerns in groundwater situated downstream from the tar dam and trend analyses are compared with other borehole qualities in the vicinity.

Table 5.6.2-1 illustrates the surface and groundwater localities included in this document for trend analyses located up- and downstream from the Klipfontein tar dam.

Table 5.6.2-1: Localities included for the linear trend analyses.

Locality ID	Description
NB12A	**Borehole upstream from the tar dam situated 80 m south-west**
NB12	**Borehole downstream from the tar dam situated 200 m north-west**
RPM11	**Borehole upstream from the tar dam situated 600 m south-east**
EM54	**Borehole upstream from the tar dam situated**

	250 m south –east on the north-western perimeter of Klipfontein Tailings
NB14	**Borehole upstream from the tar dam situated 400 m south-east**

Increasing trends are noted for downstream groundwater (NB12) relative to the tar dam indicating an impact. ***Increasing (deterioration) trends in terms of TDS, PO_4-P and NH_4-N are noted for NB12 with quality deteriorating from beginning of 2010 onwards (Figure 5.6.2-1)***. Of significance is that ***no similar distributions exist for the upstream tar dam borehole NB12A or additional upstream boreholes in the vicinity (Figure 5.6.2-2).*** It is uncertain whether any RPM-RS related activities coincide with the timeframe but a possible scenario could be that due to the slow movement of groundwater, soluble contaminants emanating from the tar dam moving with groundwater have reached the downstream NB12 only at this time. However, this is dependent on aquifer hydraulic characteristics such as groundwater velocity and hydraulic conductivity and should be verified by a specialist geohydrologist.

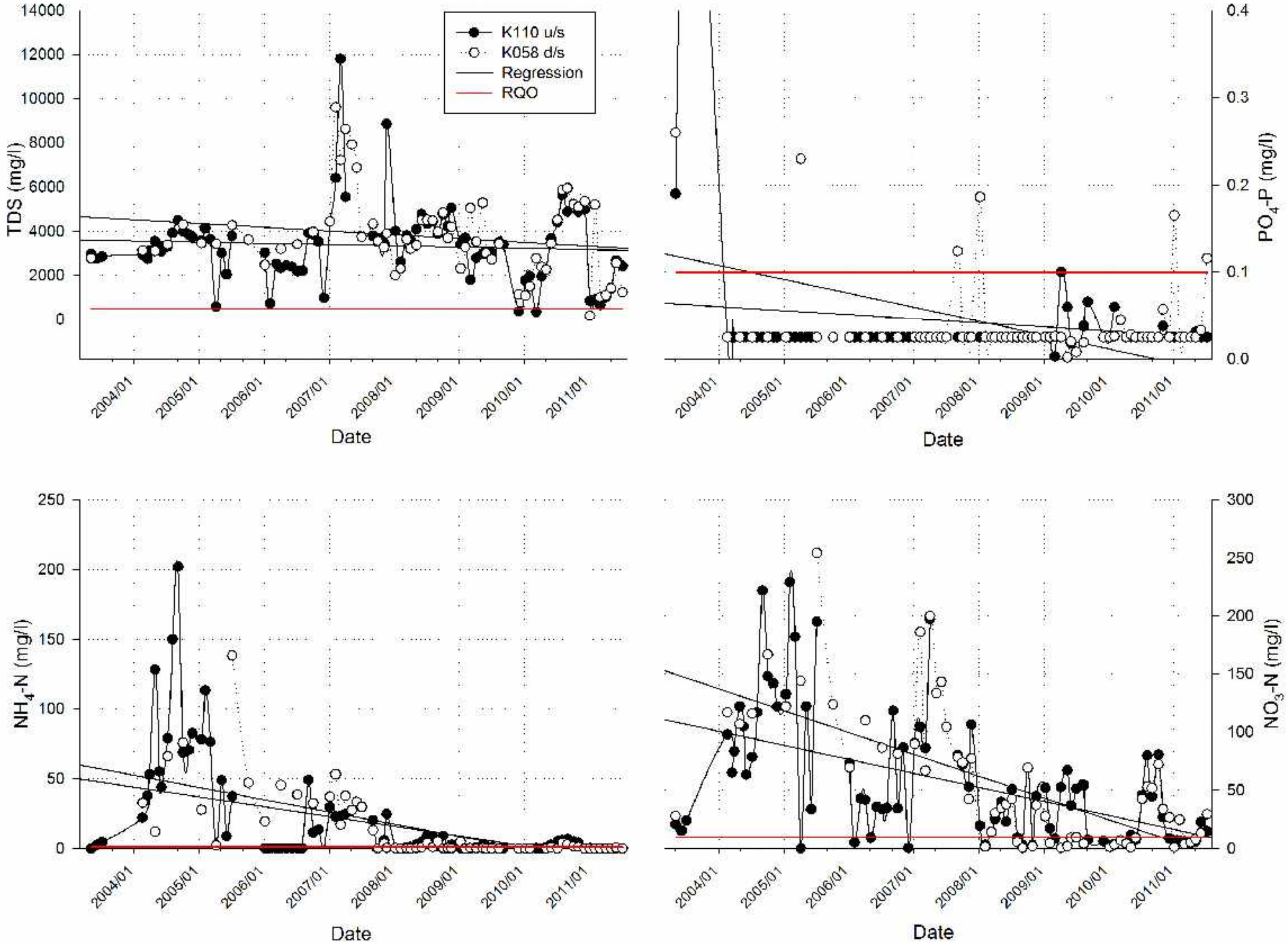

Figure 5.6.1-1: Trend analyses for the Klipfontein Spruit localities situated upstream and downstream relative to the tar dam.

Although the RQO for TDS is significantly exceeded at the additional upstream boreholes, trend analyses indicate improving conditions. All these additional localities remain well within RQO in terms PO_4-P and NO_3-N. Only NB14 show historic high NH_4-N but trend analysis indicate improving conditions.

Uncommon peaks are noted for NB12A (NH_4-N) and RPM11 (PO_4-P & NH_4-N) recorded during July 2011 and March 2011, respectively. On-going monitoring is necessary to verify whether these trends persist.

Stiff diagrams in Figure 5.6.2-3 indicate similar profiles for the boreholes EM54, NB14 and RPM11 and NB12 and NB12A, with the tar dam showing a distinctly different profile. ***From these diagrams it seems that the tar dam does not impact on the downstream groundwater regime but because of the significant difference in salinity between the tar dam and the downstream NB12, and other unknowns such as groundwater velocity and volumes concerned including other possible influences, the use of Stiff diagrams in this regard is not conclusive.***

When the stiff diagrams for NB12 and NB12A are compared with the Central Services Workshop effluent (K083) fairly similar profiles are seen on the anion side of the Stiff diagrams (Figure 5.6.2-4). ***It should however be noted that is difficult to directly compare surface water and groundwater for source identification due to the slow movement of groundwater.*** For instance, depending on hydrogeological characteristics such as hydraulic conductivity and the absence or presence of fractures and bedding planes, water seepage of surface water into the subsurface and rate of flow may take a very long time.

A Schoeller plot (Figure 5.6.2-5) between these localities does compare somewhat, specifically the anions which may indicate water from similar sources but with some mixing in-between. The Durov diagram in Figure 5.6.2-7 indicates that NB12, NB12A and K083 plot predominantly in fields 2 and 3 but NB12 and K083 have plotted occasionally in field 5 which indicates mixing with SO_4 rich water.

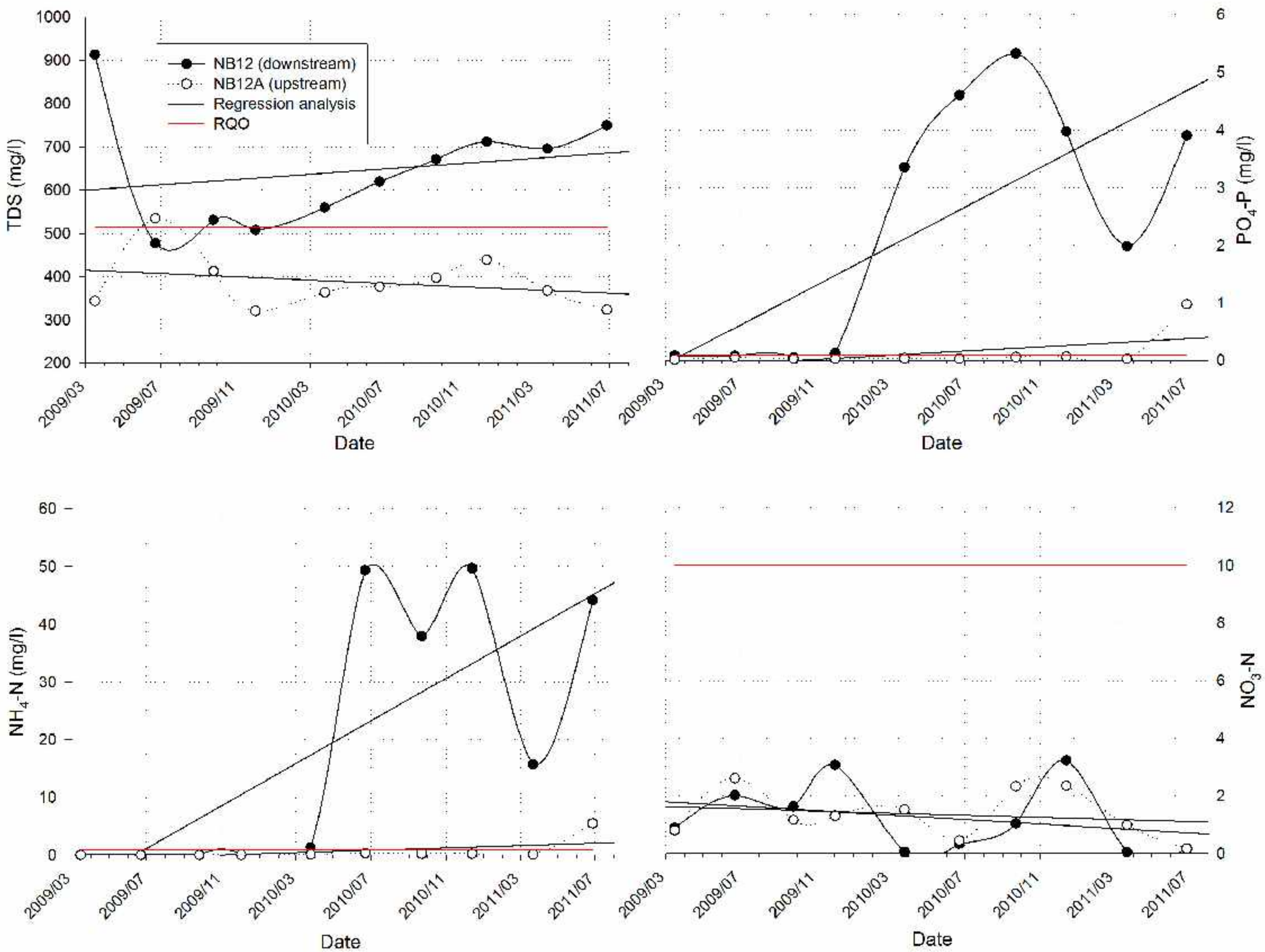

Figure 5.6.2-1: Trend analyses for borehole NB12A and NB12 situated upstream and downstream relative to the tar dam.

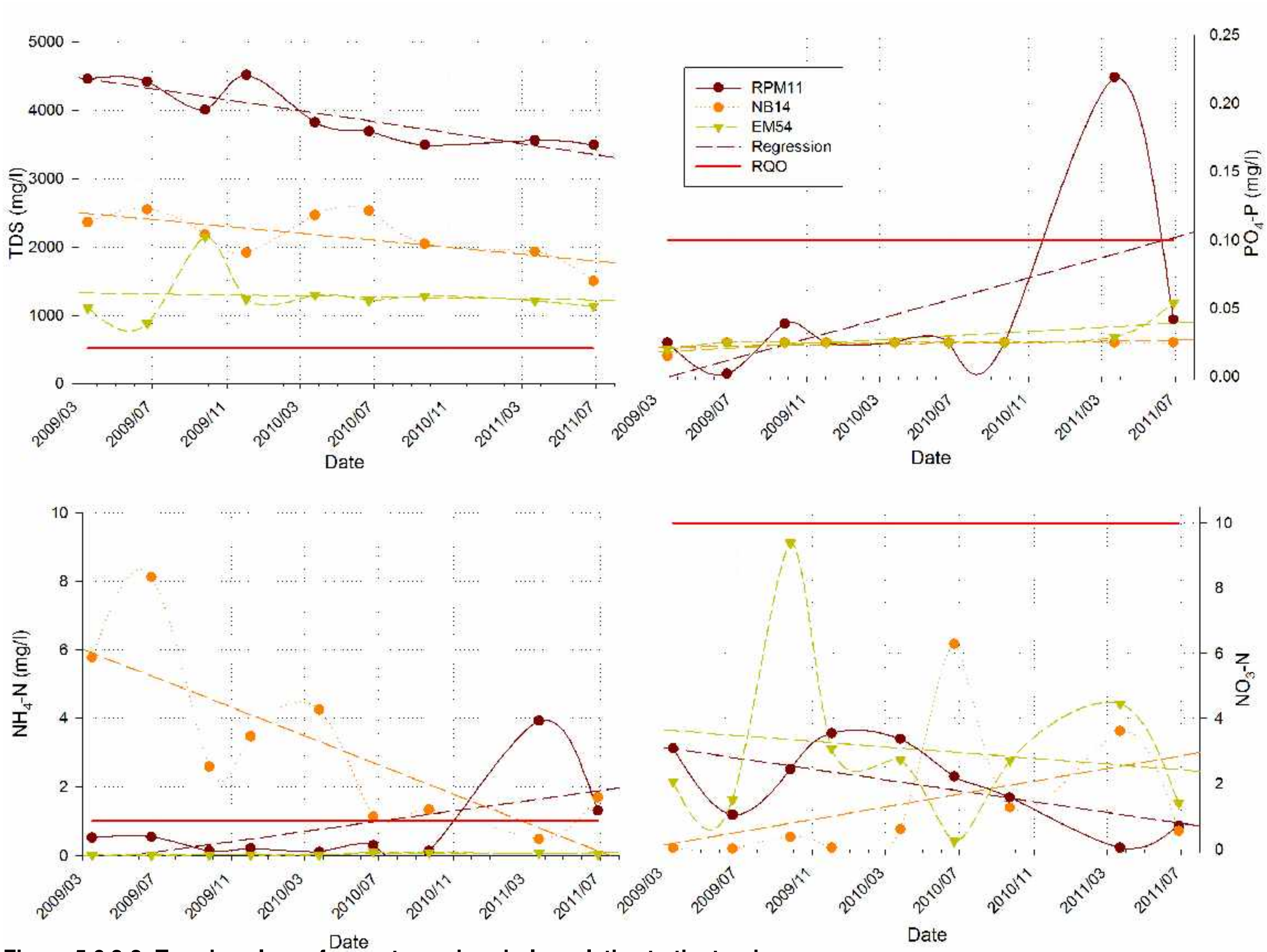

Figure 5.6.2-2: Trend analyses for upstream boreholes relative to the tar dam.

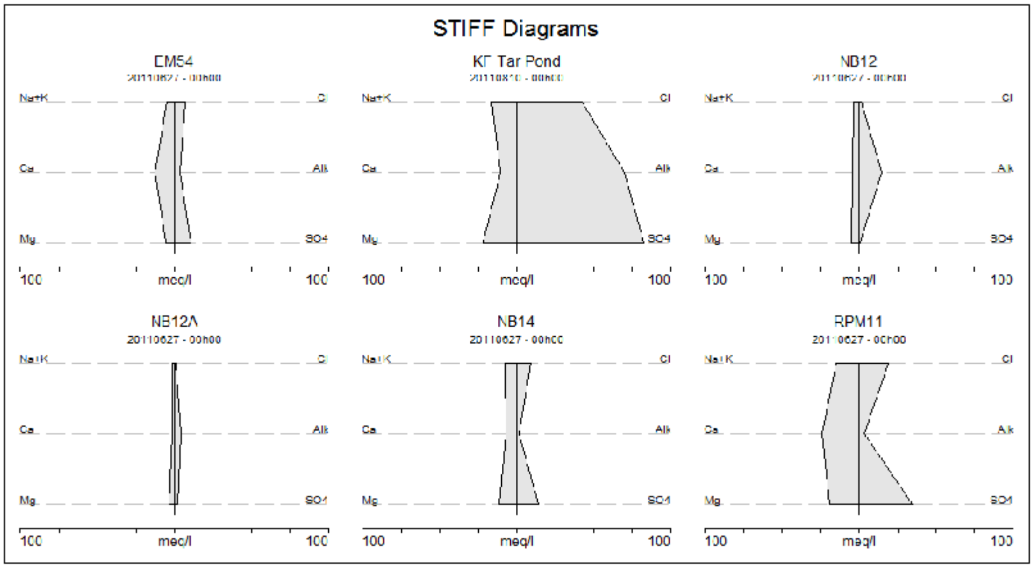

Figure 5.6.2-3: Stiff diagrams showing meq/l for the tar dam and boreholes situated upstream (NB12A, NB14, EM54, RPM11) and downstream (NB12) relative to the tar dam.

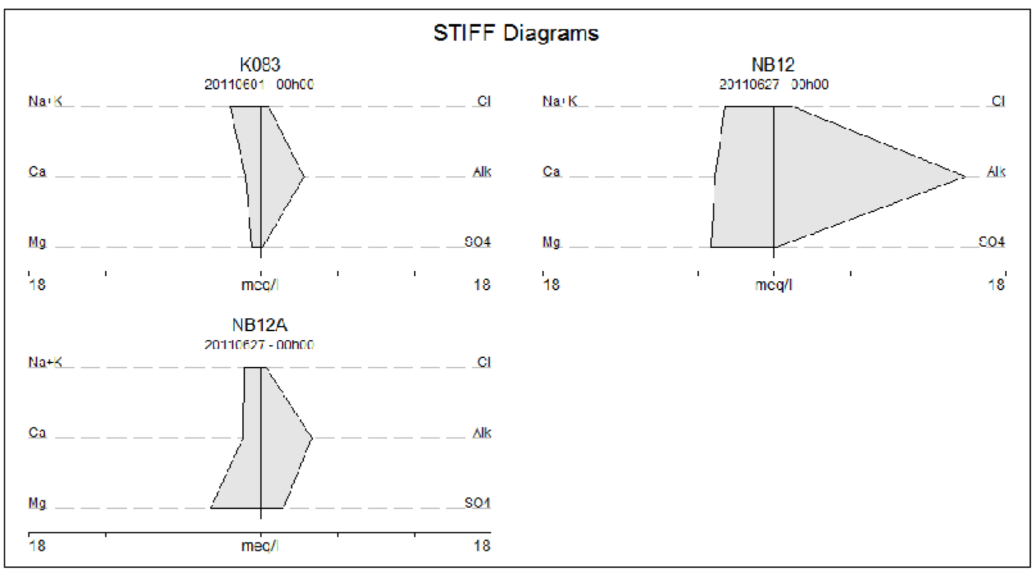

Figure 5.6.2-4: Stiff diagrams showing meq/l for K083 and boreholes situated upstream (NB12A) and downstream (NB12) relative to K083.

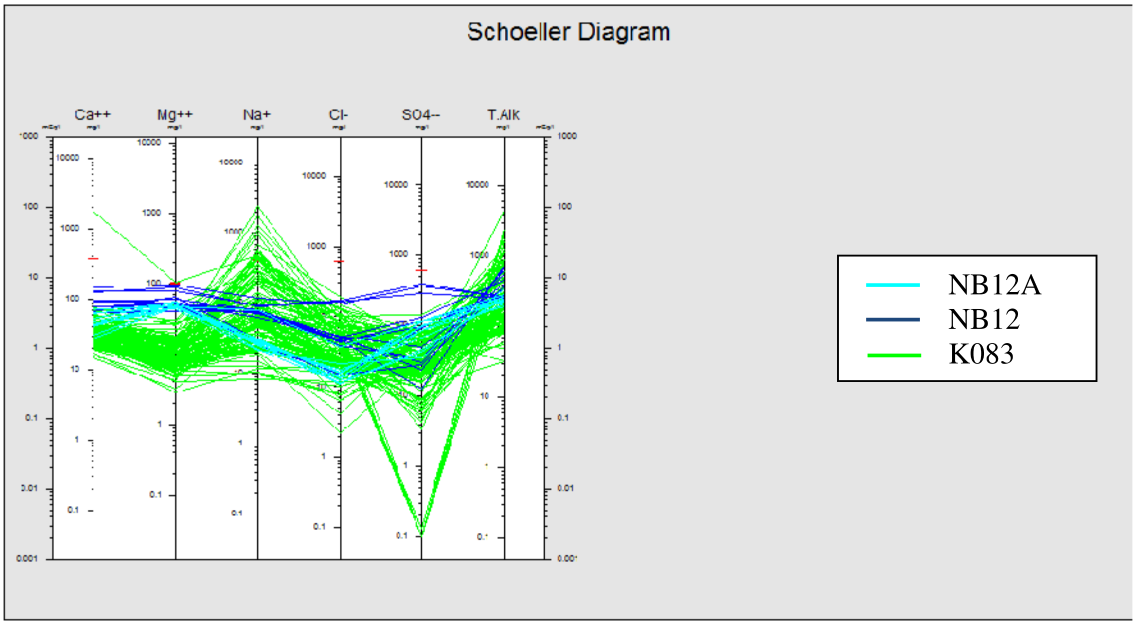

Figure 5.6.2-5: Schoeller diagram showing concentrations in mg/l and ionic compositions in meq/l for K083, NB12 and NB12A.

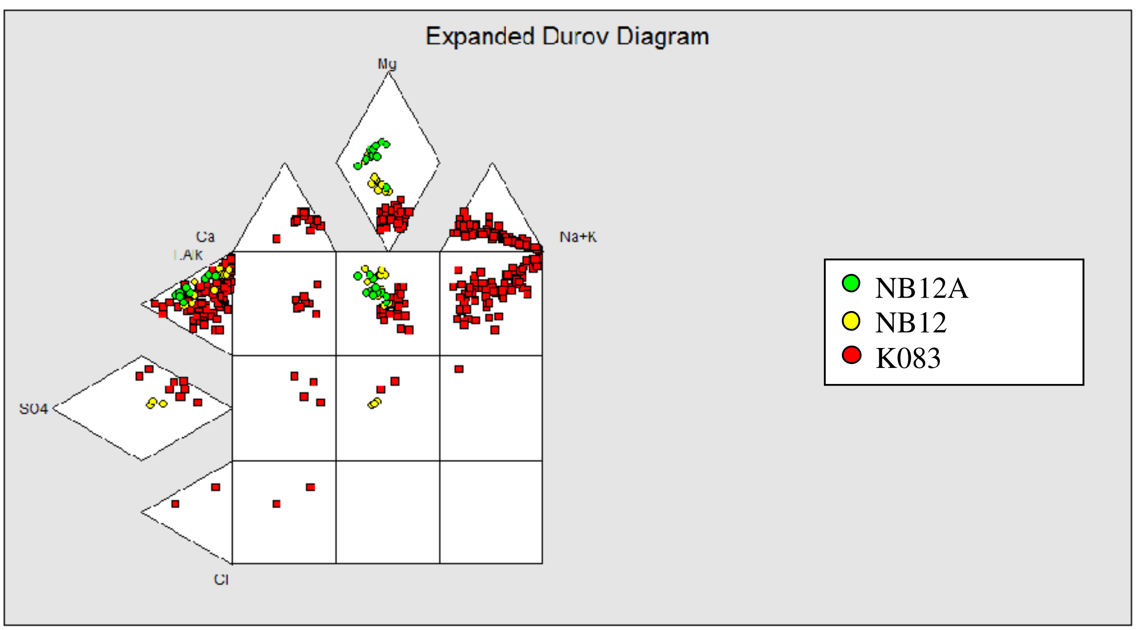

Figure 5.6.2-6: Expanded Durov Diagram showing concentrations in mg/l and ionic compositions in meq/l for K083, NB12 and NB12A.

6. SUMMARY AND CONCLUSIONS

6.1 Surface water

<u>Water in the tar dam</u>

The organic and inorganic results from this study clearly indicate that the water in the **Klipfontein Tar Dam** is polluted. Pollutants identified in the water of the tar dam which exceeds guidelines for the protection of human health, and which could pose possible contamination of receiving ground and surface water environment include (drinking water guidelines shown in brackets):

• Aluminium	4.4 mg/l	(0.15 mg/l)
• Arsenic	0.063 mg/l	(0.010 mg/l)
• Chloride	1490 mg/l	(100 mg/l)
• Cyanide	2.24 mg/l	(0.20 mg/l)
• Fluoride	45.22 mg/l	(1.0 mg/l)
• Lead	0.021 mg/l	(0.020 mg/l)
• Manganese	5.07 mg/l	(0.40 mg/l)
• Mercury	0.21 mg/l	(0.006 mg/l)
• Nickel	0.91 mg/l	(0.15 mg/l)
• Selenium	0.031 mg/l	(0.010 mg/l)
• Sulphate	3790 mg/l	(400 mg/l)
• Benzene	0.051 mg/l	(0.010 mg/l)
• Phenol	500 mg/l	(4.0 mg/l)

Other constituents, that recorded above detection limits, but are within health based guidelines, or for which no health based guideline are available include (where available drinking water guidelines are shown in brackets):

• Ethylbenzne	0.0048 mg/l	(0.30 mg/l)
• Toluene	0.057 mg/l	(0.70 mg/l)
• o-xylene	0.013 mg/l	
• m,p, xylene	0.026 mg/l	
• Trimethylbenzene	0.016 mg/l	
• n-Butylbenzene	0.0048 mg/l	
• Cresols	370 mg/l	
• 2,4-Dimethylphenol	13.0 mg/l	
• 2,5-Dimethylphenol	4.3 mg/l	
• o-Ethylphenol	2.3 mg/l	
• m-Ethylphenol	13.0 mg/l	
• TPH (C10 – C40)	65.0 mg/l	

Significant impacts are related to (risks to human health at the concentration recorded are shown in brackets):

• Chloride	(Medium)
• Sulphate	(Medium)
• Cyanide	(High)
• Mercury	(High)
• Fluoride	(High)
• Phenol	(High)
• Cresols	(High)
• Total petroleum hydrocarbons	(High)

Surface water in adjacent streams

The Central Services Workshop effluent (**K083**) located upstream from the tar dam including NB12 and NB12A was included in this pollution assessment. Although K083 did not record any organic or inorganic constituents above health based guidelines, it did contain volatile oragnic hydrocarbons, mercury, chrysene, trichloromethane, phenol and TPH above detection limits (some of which no health based guidelines are available). Parameters and concentrations include (where available guidelines are shown in brackets):

• Mercury	0.00043 mg/l	(0.001 mg/l)
• Benzene	0.0055 mg/l	(0.010 mg/l)
• Ethylbenzene	0.0019 mg/l	(0.30 mg/l)
• Toluene	0.013 mg/l	(700 mg/l)
• o-xylene	0.0057 mg/l	
• m,p, xylene	0.0054 mg/l	
• Xylenes (sum)	0.011 mg/l	(0.50 mg/l)
• Trimethylbenzene	0.0037 mg/l	
• p-Isopropyltoluene	0.0008 mg/l	
• Phenol	0.015 mg/l	
• Chrysene	0.00026 mg/l	
• Trichloromethane	0.0013 mg/l	(0.30 mg/l)
• TPH (C10-C40)	19.0 mg/l	

Significant impacts are related to risks to human health at the concentration recorded are shown in brackets):

- Total Petroleum Hydrocarbons

The organic and inorganic results for the Klipfontein Spruit, K110 and K058, situated downstream from K083 and upstream and downstream from the tar dam respectively, do not show any indication of impact from the the tar dam or the effluent from Central Services Workshop (K083).

Average TDS for the database period, as managed by Clean Stream Scientific Services relating to the routine RPM-RS monthly surface water monitoring programme, at K110 are 3361 mg/l and for K058 3463 mg/l. TDS in this section of the Klipfontein Spruit is a concern with the Resource Quality Objective (RQO) as per the Draft Water Use Licence (162/7/A220/C5) of 2007, set at 515 mg/l. Similarly, average NO_3 for the upstream locality K110 is 4% greater than for the downstream locality at K058. Average NO_3 for K110 is 56.3 mg N/l while for K058 it was calculated at 53.9 mg N/l. NO_3 also remain a concern with the bulk of the NO_3 is most probably introduced from the Klipfontein re-mining activities. The additional contributions at the downstream locality, K058, is most probably from other upstream sources, such as from Siphumelele 3 Mine or could be sewage related (Siyavuya informal settlement) as high *E.coli* is typically recorded for K058.

Significant impacts (non-tar dam related) are related to risks to human health at the concentration recorded are shown in brackets)::

• Salinity	(medium)
• Nitrate	(high)
• *E.coli*	(high)

6.2 Groundwater

In terms of groundwater the Terratest results indicate tracers for both inorganic and organic constituents in the downstream groundwater regime as recorded at **NB12**.

Mercury (Hg) was recorded for NB12 downstream from the tar dam and K083 at a concentration of 0.000092 mg/l. Mercury (Hg) was also recorded for the tar dam and **K083** with concentrations of 0.210 mg/l and 0.00043 mg/l. Although the Hg concentration is well within the health based guideline of 0.006 mg/l, it is nevertheless significant, because no Hg has been recorded above detection limits for the other surface or groundwater localities. This could be indicative of leachate from the tar dam or seepage from K083 into the downstream groundwater regime.

No cyanide was recorded in any of the groundwater localities sampled.

Organic constituents recorded for NB12 above detection limits include (where available human health guidelines are shown in brackets):

• Benzene	0.0004 mg/l	(0.010 mg/l)
• Ethylbenzene	0.01 mg/l	(0.30 mg/l)
• Phenol	1.8 mg/l	(4.0 mg/l)

- Cresols 4.1 mg/l
- TPH (C10 – C40) 0.20 mg/l

In terms of organic parameters, the less dense benzene and ethylbenzene, and equally dense phenols and cresols were identified as tracers in both the tar dam and downstream groundwater as recorded at borehole NB12. The total petroleum hydrocarbons (TPH) in borehole NB12 also recorded mostly in the lighter C10-C31 ranges. All of the above constituents, except for the cresols were also recorded for the Central Services Workshop (K083). These compounds, generally known as light-non-aqueous-phase-liquids (LNAPLs), will generally spread across the surface of the water table and form a layer on top of the water table. Soluble components will follow the direction of groundwater movement creating a typical pollution plume.

The potable water quality guideline for phenol is set at 4.0 mg/l with the concentration in NB12 recording significantly less at 1.8 mg/l. No drinking water quality guidelines exist for cresols or total TPH compounds but are regarded as toxic. Therefore, although the health risks at NB12 in terms of the organic tracers and available guidelines remain low, leachate from the tar dam and / or seepage from K083 are the most probable sources for the organic constituents.

The phenol concentration for NB12, recorded at 1.8 mg/l, is significantly greater than the concentration at K083 – 0.015 mg/l. Because a pollution plume decreases in concentration away from the source, K083 may contribute to the pollution but cannot be solely responsible. Furthermore, it is significant that cresols of 4.1 mg/l and 370 mg/l were recorded for NB12 and the tar dam, respectively, but was not detected for K083. *However, some phenols may be formed as a result of natural processes like the formation of phenol and p-cresol during decomposition of organic matter (Swarts et. al., 1998). Decomposed organic matter was noted to be present at NB12 during time of sampling as a result of the borehole being uncapped.*

A significant impact on the downgradient groundwater regime relative to the tar dam was calculated in terms of salinity, mostly contributed by chloride, bicarbonate, calcium, magnesium, sodium, potassium and saline ammonia (NH_4^+). Other parameters increasing significantly from NB12A (upstream) towards NB12 (downstream) include phosphate, iron and manganese.

Of significance is the increase in salinity, alkalinity and saline ammonia in NB12 (downstream) relative to NB12A (upstream). EC increased more than double to values exceeding acceptable drinking water standards as proposed by the DWA (DWAF, 1998). An EC increase from 63.2 mS/m to 158.8 mS/m was recorded with acceptable maximum ranges set at 70 mS/m. An alkalinity increase of 544.4 mg/l was recorded at NB12 relative to NB12A with concentrations of 742.7 mg/l and 198.3 mg/l recorded respectively. Although no drinking water guideline exist for alkalinity, this should nevertheless be seen as significant since a very high alkalinity concentration of 3483 mg/l was recorded for the tar dam.

A saline ammonia increase of 38.78 mg N/l was recorded at NB12 relative to NB12A with respective concentrations of 44.22 mg N/l and 5.44 mg N/l. No health based guideline exists for saline ammonia. It is significant to note that the tar dam did not record high saline ammonia or nitrate (both as N) which may indicate contamination from other sources. Other sources may include historic sewage pollution and organic matter degradation (borehole is uncapped and could result as a trap for small mammals and reptiles). Frequent theft of borehole caps is a concern at RPM-RS. Current measures of securing the caps are by Allen keys but new more effective measures should be revised.

The significant PO_4-P concentration at NB12 relative to NB12A are cause for concern. An increase of 2.92 mg P/l was recorded downstream from NB12A (0.98 mg P/l) towards NB12 (3.90 mg P/l). High PO_4 of 38.5 mg P/l was recorded for the tar dam with K083 averaging at 8.1 mg P/l for the database period. Leachate from the tar and / or seepage from K083 could be responsible for the increase in PO_4 concentrations although P from organic matter degradation is also highly probable. In addition, seepage from water at K083 into the subsurface may follow a preferential pathway to NB12 which may be why a similar distribution is not noted for NB12A. However, a specialist geohydrological investigation should confirm this.

Significant impacts are related to:

- Phenols (Low)
- Cresols (Low)
- Mercury (Low)

6.3 Soil

Metals recorded for soil-1 which exceeds soil quality guidelines for the protection of human health are Cr (500 mg/kg) and Ni (160 mg/kg). Guidelines set for Cr and Ni are 64 mg/kg and 50 mg/kg, respectively.

A wide range of phenolic compounds were recorded above detection limits in **soil-1** but only phenol and cresols (sum) have established health based guidelines of 0.33 mg/kg and 0.40 mg/kg, respectively. Phenol recorded a concentration of 3.44 mg/kg and the sum of cresols 22.0 mg/kg both of which significantly exceed the health based guidelines.

The health based guideline for the sum of PAH of 9.0 mg/kg is significantly exceeded in **soil-1** with a concentration of 450 mg/kg. Similarly, the health based guideline for the sum of TPH, 250 mg/kg are more than 165 times greater in soil-1 with a concentration of 42 000 mg/kg.

Other constituents which exceed soil quality health based guidelines in **soil-1** are the volatile chlorinated hydrocarbon monochlorophenol which at 1.1 mg/kg exceed the guideline set at 0.06 mg/kg.

Chromium (Cr) and benzene recorded concentrations of 86 mg/kg and 1.0 mg/kg in **soil-2** which are significantly greater compared to their respective guidelines of 64 mg/kg and 0.0095 mg/kg, respectively. A wide range of PAH and TPH constituents were recorded for soil-2 but with only guidelines available for the sum of total constituents recorded. The sum of PAH calculated for soil-1 are 4.5 mg/kg which is well within the health based guideline of 9.0 mg/kg. However, the sum of TPH constituents calculated to 720 mg/kg which is significantly greater than the health based guideline of 250 mg/kg. The organic chlorinated compound a-chlordan recorded a concentration of 0.003 mg/kg which is significantly greater than the health based guideline of 0.0004 mg/kg for the sum of chlordans. Chlordan was mostly used as a pesticide in the United States but due to the human and environmental concerns it was banned by the Environmental Protection Agency (EPA) in 1988.

Significant impacts are related to:

- Chromium
- Nickel
- Phenols
- Cresols
- Polycyclic aromatic hydrocarbons
- Total Petroleum Hydrocarbons

7. RECOMMENDATIONS

Based only on the results presented in this study it is clear that the Klipfontein Tar Dam are impacting on the downstream groundwater regime in terms of salinity and organic compounds. However other contributing sources, specifically related to nutrient enrichment, such as the effluent from the Central Services Workshop (K083) and / or organic matter decomposition, should not be excluded. Since the tracers identified in NB12 are below available drinking water standards for the protection of human health, no immediate risk remain towards the receiving surface or groundwater environment in terms of human health. However for many of the constituents which recorded above detection limits, no health based guidelines are available and it is therefore difficult to assign a human health risk towards it. The concentrations recorded at the possible sources (Klipfontein Tar Dam and effluent from General Services Workshop – K083) remain medium to high with some variables exceeding human health guidelines. ***It is therefore recommended that these probable sources of contamination, the tar dam and K083, be removed and that specialist soil and hydrogeological investigations follow this pollution status report to evaluate the radius and / or depth of influence of contamination***.

Groundwater pump-and-treat systems are probably the most common remediation option for addressing contaminated aquifers. This technology pumps groundwater out of contaminated zones to remove dissolved contaminants and, if present, to slowly dissolve any trapped NAPLs. The pumped water is then treated on the surface to remove or destroy the dissolved contaminants. However, the first option in remediation should always be source removal if possible (EPA, 1990). The residual NAPL that remains trapped in the soil matrix acts as a continuing source of dissolved contaminants to ground water, and effectively prevents the restoration of NAPL-affected aquifers for many years. The soil in this instance should therefore also be seen as a source and if possible, all polluted fractions should be removed by excavation.

Ongoing monitoring of the groundwater and soil, preferably stratified sampling in the case of soil, should be performed to assess the extent of and / or depth of pollution which should be extended until after source removal.

It is recommended that the borehole at NB12 be purged to remove all stagnant water and be re-tested for nutrients which could have been contaminated by organic matter. This will define the source of the high nutrients (N, P) recorded for NB12 more clearly, whether it be from organic matter degradation or indeed contamination by upstream sources.

8. REFERENCES

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APPENDIX A

Constituents included in the TerrAttesT® analysis and limits of detection

Analytico, Holland

TERRATTEST® INTEGRAL SOILANALYSIS

TERRATTEST SPECTRUM SHEET 5.22

ACC. S	ACC. W		TERRATTEST 5.22 REPORTING LIMIT soil mg/kg d.w.	ground water µg/l
		Characteristics		
Q		Dry weight (% m/m)	1	-
Q		Clay content (% m/m)	1	-
Q		Organic matter	0,5	-
	Q	pH	-	2-12
	Q	Conductivity (mS/m)	-	10
		Metals		
Q	Q	Arsenic	3	4
Q	Q	Antimony	3	5
Q	Q	Barium	5	1
Q	Q	Beryllium	1	1
Q	Q	Cadmium	0,3	0,4
Q	Q	Chromium	3	2
Q	Q	Cobalt	2	1
Q	Q	Copper	3	3
Q	Q	Mercury	0,05	0,04
Q	Q	Lead	3	3
Q	Q	Molybdenum	1	2
Q	Q	Nickel	2	2
Q	Q	Selenium	5	5
Q	Q	Tin	5	5
Q	Q	Vanadium	2	2
Q	Q	Zinc	10	5
		Aromatic compounds		
		Mono Aromatic Hydrocarbons		
Q	Q	Benzene	0,1	0,1
Q	Q	Ethylbenzene	0,2	0,1
Q	Q	Toluene	0,2	0,1
Q	Q	o-Xylene	0,2	0,1
Q	Q	m/p-Xylene	0,1	0,1
Q	Q	Xylenes (sum)	Σ	Σ
Q	Q	Styrene	0,2	0,1
Q	Q	1,2,4-Trimethylbenzene	0,05	0,1
Q	Q	1,3,5-Trimethylbenzene	0,05	0,1
Q	Q	n-Propylbenzene	0,05	0,1
Q	Q	Isopropylbenzene	0,05	0,1
Q	Q	n-Butylbenzene	0,05	0,1
Q	Q	sec-Butylbenzene	0,05	0,1
Q	Q	tert-Butylbenzene	0,05	0,1
Q	Q	p-Isopropyltoluene	0,05	0,1
		Phenols		
Q	Q	Phenol	0,01	0,5
Q	Q	o-Cresol	0,01	0,3
Q	Q	m-Cresol	0,01	0,3
Q	Q	p-Cresol	0,01	0,2
Q	Q	Cresoles (sum)	Σ	Σ
Q	Q	2,4-Dimethylphenol	0,01	0,02
Q	Q	2,5-Dimethylphenol	0,01	0,02
Q	Q	2,6-Dimethylphenol	0,01	0,03
Q	Q	3,4-Dimethylphenol	0,01	0,02
Q	Q	o-Ethylphenol	0,02	0,03
Q	Q	m-Ethylphenol	0,01	0,02
Q	Q	Thymol	0,01	0,01
Q	Q	4-Ethyl/2,3 ; 3,5 Dimethylphenol	0,01	0,02
		PAHs		
Q	Q	Naphthalene	0,01	0,4
Q	Q	Acenaphthylene	0,01	0,04
Q	Q	Acenaphthene	0,01	0,1
Q	Q	Fluorene	0,01	0,003
Q	Q	Phenanthrene	0,01	0,02
Q	Q	Anthracene	0,01	0,01
Q	Q	Fluoranthene	0,01	0,02
Q	Q	Pyrene	0,01	0,06
Q	Q	Benzo(a)anthracene	0,01	0,04
Q	Q	Chrysene	0,01	0,02
	Q	Benzo(b/k)fluoranthene	-	0,06
Q		Benzo(b)fluoranthene	0,01	-
Q		Benzo(k)fluoranthene	0,01	-
Q	Q	Benzo(a)pyrene	0,01	0,1
Q	Q	Benzo(ghi)perylene	0,01	0,1
Q	Q	Dibenzo(ah)anthracene	0,01	0,08
Q	Q	Indeno(123cd)pyrene	0,01	0,06
Q	Q	PAHs (sum 10 Dutch VROM)	Σ	Σ
Q	Q	PAHs (sum 16 US EPA)	Σ	Σ
		Halogenated hydrocarbons		
		Volatile halogenated HC's		
	Q	Chloromethane	-	0,2
	Q	Dichloromethane	-	0,2
	Q	Vinylchlorine	-	0,2
	Q	1,1 Dichloroethene	-	0,1
	Q	tr-1,2 Dichloroethene	-	0,05
	Q	cis -1,2 Dichloroethene	-	0,05
	Q	Chloroethane	-	0,1
	Q	Trichlorofluoromethane	-	0,1
	Q	Trichloromethane (chloroform)	-	0,2
Q	Q	Tetrachloromethane (tetra)	0,05	0,1
	Q	1,1 Dichloroethane	-	0,1
Q	Q	1,2 Dichloroethane	0,1	0,1
Q	Q	1,1,1-Trichloroethane	0,05	0,1

ACC. S	ACC. W		TERRATTEST 5.22 REPORTING LIMIT soil mg/kg d.w.	ground water µg/l
Q	Q	1,1,2-Trichloroethane	0,05	0,1
Q	Q	Trichloroethanes (sum)	Σ	Σ
Q	Q	1,1,1,2-Tetrachloroethane	0,05	0,1
Q	Q	1,1,2,2-Tetrachloroethane	0,05	0,1
Q	Q	Tetrachloroethanes (sum)	Σ	Σ
Q	Q	Trichloroethene	0,2	0,1
Q	Q	Tetrachloroethene	0,2	0,1
	Q	2,2-Dichloropropane	-	0,1
Q	Q	1,2-Dichloropropane	0,05	0,1
Q	Q	1,3-Dichloropropane	0,05	0,1
Q	Q	1,2,3-Trichloropropane	0,05	0,1
Q	Q	1,1-Dichloropropylene	0,1	0,1
Q	Q	cis 1,3-Dichloropropylene	0,05	0,1
Q	Q	trans 1,3-Dichloropropylene	0,05	0,1
Q	Q	1,3-Dichloropropylenes (sum)	Σ	Σ
	Q	Bromomethane	-	0,1
	Q	Bromochloromethane	-	0,1
Q	Q	Dibromomethane	0,05	0,1
Q	Q	1,2-Dibromoethane	0,05	0,1
Q	Q	Tribromomethane (Bromoform)	0,05	0,1
Q	Q	Bromodichloromethane	0,1	0,1
Q	Q	Dibromochloromethane	0,05	0,1
Q	Q	1,2-Dibromo-3-chloropropane	0,05	0,1
Q	Q	Bromobenzene	0,05	0,1
		Chlorinated Benzenes		
Q	Q	Monochlorbenzene	0,01	0,05
Q	Q	1,2-Dichlorobenzene	0,01	0,1
Q	Q	1,3-Dichlorobenzene	0,01	0,1
Q	Q	1,4-Dichlorobenzene	0,01	0,1
Q	Q	Dichlorobenzenes (sum)	Σ	Σ
Q	Q	1,2,3-Trichlorobenzene	0,01	0,1
Q	Q	1,2,4-Trichlorobenzene	0,01	0,1
Q	Q	1,3,5-Trichlorobenzene	0,003	0,01
Q	Q	Trichloorbenzene (sum)	Σ	Σ
Q	Q	1,2,3,4-Tetrachlorobenzene	0,003	0,02
Q	Q	1,2,3,5/1,2,4,5-Tetrachlorobenzene	0,002	0,01
Q	Q	Tetrachlorobenzenes (sum)	Σ	Σ
Q	Q	Pentachlorobenzene	0,002	0,005
Q	Q	Hexachlorobenzene	0,002	0,03
		Chlorinated Phenols		
Q	Q	o-Chlorophenol	0,01	0,1
Q	Q	m-Chlorophenol	0,01	0,02
Q	Q	p-Chlorophenol	0,01	0,02
Q	Q	Monochlorophenols (sum)	Σ	Σ
Q	Q	2,3-Dichlorophenol	0,002	0,02
Q	Q	2,4/2,5-Dichlorophenol	0,001	0,005
Q	Q	2,6-Dichlorophenol	0,001	0,03
Q	Q	3,4-Dichlorophenol	0,002	0,02
Q	Q	3,5-Dichlorophenol	0,001	0,03
Q	Q	Dichlorophenols (sum)	Σ	Σ
Q	Q	2,3,4-Trichlorophenol	0,01	0,02
	Q	2,3,5 / 2,4,5-Trichlorophenol	-	0,02
Q		2,3,5-Trichlorophenol	0,001	-
Q	Q	2,3,6-Trichlorophenol	0,001	0,01
Q		2,4,5-Trichlorophenol	0,001	-
Q	Q	2,4,6-Trichlorophenol	0,001	0,05
Q	Q	3,4,5-Trichlorophenol	0,002	0,01
Q	Q	Trichlorophenols (sum)	Σ	Σ
Q	Q	2,3,4,5-Tetrachlorophenol	0,002	0,01
Q	Q	2,3,4,6/2,3,5,6-Tetrachlorophenol	0,01	0,02
Q	Q	Tetrachlorophenols (sum)	Σ	Σ
Q	Q	Pentachlorophenol	0,001	0,01
Q	Q	4-Chloro-3-methylphenol	0,001	0,02
		PCB		
Q	Q	PCB 28	0,002	0,01
Q	Q	PCB 52	0,002	0,01
Q	Q	PCB 101	0,002	0,01
Q	Q	PCB 118	0,002	0,01
Q	Q	PCB 138	0,005	0,01
Q	Q	PCB 153	0,005	0,01
Q	Q	PCB 180	0,002	0,01
Q	Q	PCB (sum 6)	Σ	Σ
Q	Q	PCB (sum 7)	Σ	Σ
		Chloronitrobenzenes		
Q	Q	o/p-Chloronitrobenzene	0,01	0,2
Q	Q	m-Chloronitrobenzene	0,01	0,2
Q	Q	Monochloronitrobenzenes (sum)	Σ	Σ
Q	Q	2,3 / 3,4-Dichloronitrobenzene	0,01	0,1
	Q	2,3-Dichloronitrobenzene	-	0,1
Q	Q	2,4-Dichloronitrobenzene	0,02	0,1
Q	Q	2,5-Dichloronitrobenzene	0,01	0,1
	Q	3,4-Dichloronitrobenzene	-	0,1
Q	Q	3,5-Dichloronitrobenzene	0,02	0,06
Q	Q	Dichloronitrobenzenes (sum)	Σ	Σ
		Miscellaneous Chlor. HCs		
Q	Q	2-Chlorotoluene	0,01	0,1
Q	Q	4-Chlorotoluene	0,01	0,1
Q	Q	Chlorotoluenes (sum)	Σ	Σ
Q	Q	1-Chloronaphthalene	0,005	0,02

ACC. S	ACC. W		TERRATTEST 5.22 REPORTING LIMIT soil mg/kg d.w.	ground water µg/l
		Pesticides		
		Chlorine pesticides		
Q	Q	4,4-DDE	0,001	0,01
Q	Q	2,4-DDE	0,001	0,01
Q	Q	4,4-DDT	0,002	0,2
Q	Q	4,4-DDD/2,4-DDT	0,001	0,02
Q	Q	2,4-DDD	0,001	0,01
Q	Q	DDT/DDE/DDD (sum)	Σ	Σ
Q	Q	Aldrin	0,002	0,02
Q	Q	Dieldrin	0,002	0,02
Q	Q	Endrin	0,005	0,02
Q	Q	Drins (sum)	Σ	Σ
Q	Q	alfa-HCH	0,05	0,08
Q	Q	beta-HCH	0,005	0,07
Q	Q	gamma-HCH	0,005	0,1
Q	Q	delta-HCH	0,02	0,04
Q	Q	HCH (sum)	Σ	Σ
Q	Q	Alfa-endosulfan	0,01	0,05
Q	Q	Alfa-endosulfansulphate	0,02	0,03
Q	Q	Alfa-chlordane	0,002	0,01
Q	Q	Gamma-chlordane	0,002	0,01
Q	Q	Chlordanes (sum)	Σ	Σ
Q	Q	Heptachlor	0,002	0,01
Q	Q	Heptachloroepoxide	0,005	0,03
Q	Q	Isodrin	0,002	0,1
Q	Q	Hexachlorobutadiene	0,005	0,03
Q	Q	Telodrin	0,005	0,07
Q	Q	Tedion	0,005	0,07
		Phosphor pesticides		
Q	Q	Azinphos-ethyl	0,005	0,1
Q	Q	Azinphos-methyl	0,005	0,07
Q	Q	Bromophos-ethyl	0,02	0,07
Q	Q	Bromophos-methyl	0,02	0,06
Q	Q	Chloropyrophos-ethyl	0,01	0,06
Q	Q	Chloropyrophos-methyl	0,01	0,1
Q	Q	Cumaphos	0,005	0,02
Q	Q	Demeton-S /Demeton-O (ethyl)	0,02	0,1
Q	Q	Diazinon	0,005	0,04
	Q	Dichlorovos	-	0,1
Q	Q	Disulfoton	0,02	0,04
Q	Q	Fenitrothion	0,005	0,1
Q	Q	Fenthion	0,002	0,1
Q	Q	Malathion	0,005	0,1
Q	Q	Parathion-ethyl	0,005	0,2
Q	Q	Parathion-methyl	0,01	0,2
Q	Q	Pyrazophos	0,005	0,2
Q	Q	Triazophos	0,02	0,2
		Nitrogen pesticides		
Q	Q	Ametryne	0,01	0,1
Q	Q	Atrazine	0,02	0,08
Q	Q	Cyanazine	0,02	0,1
Q	Q	Desmetryne	0,005	0,1
Q	Q	Prometryne	0,02	0,1
Q	Q	Propazine	0,02	0,08
Q	Q	Simazine	0,02	0,2
Q	Q	Terbuthylazine	0,02	0,06
Q	Q	Terbutryne	0,05	0,1
		Miscellaneous pesticides		
Q	Q	Bifenthrin	0,005	0,08
	Q	Carbaryl	-	0,1
Q	Q	Cypermethrin (A,B,C,D)	0,01	0,2
Q	Q	Deltamethrin	0,01	0,2
	Q	Linuron	-	0,1
Q		Permethrin	0,01	-
Q	Q	Permethrin A	0,01	0,06
	Q	Permethrin B	-	0,06
	Q	Permethrin (sum)	-	Σ
Q	Q	Propachloor	0,02	0,02
Q	Q	Trifluralin	0,005	0,02
		Miscellaneous HCs		
Q	Q	Biphenyl	0,005	0,01
Q	Q	Nitrobenzene	0,1	0,3
Q	Q	Dibenzofurane	0,01	0,1
		Phthalates		
Q		Dimethylphthalate	0,2	-
Q		Diethylphthalate	0,2	-
Q		Di-isobutylphthalate	0,5	-
Q		Dibutylphthalate	0,5	-
Q		Butylbenzylphthalate	0,2	-
Q		Bis(ethylhexyl)phthalate	5	-
Q		Di-n-octylphthalate	0,2	-
Q		Phthalates (sum)	Σ	-
		Total Petroleum Hydrocarbons		
Q	Q	C10-C16	10	25
Q	Q	C16-C22	10	25
Q	Q	C22-C30	10	25
Q	Q	C30-C40	10	25
Q	Q	TPH (sum C10-C40)	Σ	Σ

APPENDIX B

TerrAttesT® Surface and Groundwater Results

Client	Rustenburg Platinum Mines Rustenburg Section	Sampled date 04/08/2011	
Project	RPM-RS Tar Dam Pollution Monitoring	**Units: EC**	**mS/m**
Matrix	Surface (SW) & Groundwater (GW)	**Units: SW & GW**	**µg/l**
Analysis Package and Laboratroy	Terratest (Analytico, Holland)	**Units: Guidelines**	**µg/l**
Sampled by	Clean Stream Scientific Services		

Salinity and metals	**Guideline (potable water quality)**	**Tar Dam (SW)**	**K083 (SW)**	**K110 (SW)**	**K058 (SW)**	**RPM11 GW)**	**NB12 (GW)**	**NB12A (GW)**
EC	150 $_{(2)}$	1300	69	510	370	510	230	70
As	10 $_{(2)}$	63						
Ba	1000 $_{(3)}$	190	280	56	46	37	360	22
Cr	50 $_{(3)}$	23		3.8				
Co	5000 $_{(2)}$	44	1.96		1.4			
Cu	1300 $_{(2)}$	150	3.8	3.4	3.2			
Hg $_{(7)}$	6 $_{(3)}$	210	0.43				0.092	
Pb	20 $_{(2)}$	21						
Mo	70 $_{(3)}$		8.7	56	19	8.3		
Ni	150 $_{(2)}$	907.84	77.12	153.84	346.44	19.77	11.19	2.76
Se	10 $_{(3)}$	31		7.3	5.4			
V	100 $_{(2)}$	35	3.8	4.4	4.1	4.2	3.3	3.5
Zn	20 000 $_{(2)}$	200	18				5.8	
Volatile organic hydrocarbons								
Benzene	10 $_{(4)}$	51	5.5				0.4	
Ethylbenzene	300 $_{(3)}$	4.8	1.9				10	
Toluene	700 $_{(3)}$	57	13					
o-xylene	no data	13	5.7					
m,p-xylene	no data	26	5.4					
Xylenes (sum)	500 $_{(3)}$	38	11					
1,2,3-Trimethylbenzene	no data	12	2					
1,3,5-Trimethylbenzene	no data	4.4	1.7					
n-Butylbenzene	no data	4.8						
p-Isopropyltoluene	no data		0.8					
Phenols								
Phenol	4000 $_{(4)}$	500000 $_{(1)}$	15				1800	
o-Cresol	no data	56000						
m-Cresol	no data	18000 $_{(1)}$						
p-Cresol	no data	13000					4100	
Cresols (sum)	no data	370000					4100	
2,4-Dimethylphenol	no data	13000		0.11				

2,5-Dimethylphenol	no data	4300				
o-Ethylphenol	no data	2300		0.04		
m-Ethylphenol	no data	13000				
Thymol	no data			0.02		
2,3/3,5-Dimethylphenol + 4-Ethylphenol	no data	31000		0.68		
Polycyclic Aromatic Hydrocarbons (PAHs)						
Fluorene	no data			0.02		
Phenanthrene	no data			0.08	0.05	
Chrysene	no data		0.26			
Volatile Chlorinated Hydrocarbons						
Trichloromethane	300 (3)		1.3			
Chlorophenols	500 (5)			0.021		
2,3,4,6/2,3,5,6-Tetrachlorophenol	100 (6)			0.21		
Nitrogen pesticides						
Terbuthylazine	7 (3)			0.15		
Total Petroleum Hydrocarbons (8)						
TPH C10-C12	no data	23000	260			28
TPH C12-C16	no data	20000	10000			140
TPH C16-C21	no data	13000	3600			21
TPH C21-C30	no data	7500	2500			19
TPH C30-C35	no data	1200	1600			
TPH C35-C40	no data	480	960			
TPH (sum C10-C40)	no data	65000	19000			220

Remark (1) - Upper limit of detection

Remark (2) - DWA class 01 potable quality

Remark (3) - WHO guidelines for drinking water quality

Remark (4) - EPA guidelines for drinking water quality

Remark (5) - Australian guidelines for drinking water quality

Remark (6) - Canadian guidelines for drinking water quality

Remark (7) - Analytical laboratory = MIDVAAL

Remark (8) - Petroleum products are complex mixtures of many individual hydrocarbons is a complicating factor in determining the potential risks to consumers.

APPENDIX C

TerrAttesT® Soil Results

Evaluated according to Dutch soil guidelines for the protection of human health (Wonen)

Verification: Soil Quality land

Project number	RPM/RS
Project name	RPM/RS
Order number	RPM/RS Tar Dam
Date sampling	
Sampler	
Certificate number	2011132179
Start date	08-08-2011
Report date	18-08-2011

Analysis	Unit	Soil-1		AW	AW x 2	Wonen	> AW+W	indust.
Bodemtype correctie								
Organic matter		13.3						
Fraction < 2 µm (Clay)		50.8						
TerrAttesT								
Version number		7.22						
Characteristics								
Dry matter	% (w/w)	75.4						
Organic matter	% (w/w) dm	13.3						
Fraction < 2 µm (Clay)	% (w/w) dm	50.8						
Characteristics								
Fraction < 2 µm (Clay)	% (w/w) dm	50.8						
Metals								
Barium (Ba)	mg/kg dm	150						
Chromium (Cr)	mg/kg dm	500	*****	83	94	94	180	270
Cobalt (Co)	mg/kg dm	30	*	27	54	63	90	340
Copper (Cu)	mg/kg dm	39	-	59	80	80	140	280
Lead (Pb)	mg/kg dm	9.1	-	67	130	280	350	710
Nickel (Ni)	mg/kg dm	160	****	61	68	68	130	170
Vanadium (V)	mg/kg dm	25	-	140	170	170	310	430
Zinc (Zn)	mg/kg dm	29	-	220	320	320	540	1100
Phenols								
Phenol	mg/kg dm	3.4	*****	0.33	0.33	0.33	0.67	1.7
o-Cresol	mg/kg dm	7.3						
m-Cresol	mg/kg dm	7.8						
p-Cresol	mg/kg dm	6.4						
Cresols (sum)	mg/kg dm	22	*****	0.4	0.4	0.4	0.8	6.7
2,4-Dimethylphenol	mg/kg dm	19						
2,5-Dimethylphenol	mg/kg dm	7.1						
2,6-Dimethylphenol	mg/kg dm	1.8						

3,4-Dimethylphenol	mg/kg dm	9.1						
o-Ethylphenol	mg/kg dm	3.1						
m-Ethylphenol	mg/kg dm	13						
2,3/3,5-Dimethylphenol + 4-Ethylphenol	mg/kg dm	36						
Polycyclic Aromatic Hydrocarbons								
Naphtalene	mg/kg dm	61						
Acenaphtylene	mg/kg dm	4.6						
Acenaphtene	mg/kg dm	22						
Fluorene	mg/kg dm	92						
Phenanthrene	mg/kg dm	120						
Anthracene	mg/kg dm	70						
Fluoranthene	mg/kg dm	45						
Pyrene	mg/kg dm	49						
Benzo(a)anthracene	mg/kg dm	35						
Chrysene	mg/kg dm	27						
Benzo(b)fluoranthene	mg/kg dm	61						
Benzo(k)fluoranthene	mg/kg dm	9.9						
Benzo(a)pyrene	mg/kg dm	30						
Dibenzo(ah)anthracene	mg/kg dm	5.7						
Benzo(ghi)perylene	mg/kg dm	34						
Indeno(123cd)pyrene	mg/kg dm	17						
PAH 10 VROM (sum)	mg/kg dm	450	*****	2	4	9	11	53
PAH 16 EPA (sum)	mg/kg dm	690						
Chlorophenols								
o-Chlorophenol	mg/kg dm	1.1						
Monochlorophenols (sum)	mg/kg dm	1.1	****	0.06	0.06	0.06	0.12	7.2
Miscellaneous Organic compounds								
Biphenyl	mg/kg dm	15						
Dibenzofurane	mg/kg dm	59						
Total Petroleum Hydrocarbons								
TPH (C10-C12)	mg/kg dm	730						
TPH (C12-C16)	mg/kg dm	6600						
TPH (C16-C21)	mg/kg dm	11000						
TPH (C21-C30)	mg/kg dm	16000						
TPH (C30-C35)	mg/kg dm	5100						
TPH (C35-C40)	mg/kg dm	2200						
TPH (sum C10-C40)	mg/kg dm	42000	*****	250	250	250	510	670
Metals								
Barium (Ba)	mg/kg dm	150						
Chromium (Cr)	mg/kg dm	500	*****	83	94	94	180	270
Cobalt (Co)	mg/kg dm	30	*	27	54	63	90	340
Copper (Cu)	mg/kg dm	39	-	59	80	80	140	280

Nickel (Ni)	mg/kg dm	160	****	61	68	68	130	170
Vanadium (V)	mg/kg dm	25	-	140	170	170	310	430
Zinc (Zn)	mg/kg dm	29	-	220	320	320	540	1100

Legend

Nr.	Sample descrip	Analytico number
1	Soil-1	6292753

> Background value	*	1
> 2xAW max W	**	0
> Norm value living	***	0
> background+living area value	****	2
> Norm value industry	*****	5
Number of verified components		12
Number exceedings allowed	2	
Indicative result ontvangende bodem	Nooit toepasbaar	
Indicative result toe te passen bodem	NIET toepasbaar	

This limit check has been created with the greatest attention,
however, Eurofins Analytico B.V. is not responsible for the outcome of this Limit Check.
If you might find a problem in this Limit Check, we kindly ask you
to send this information to pais.helpdesk@analytico.com

Verification: Soil Quality land

Project number	RPM/RS
Project name	RPM/RS
Order number	RPM/RS Tar Dam
Date sampling	
Sampler	
Certificate number	2011132179
Start date	08-08-2011
Report date	18-08-2011

Analysis	Unit	Soil-2		AW	AW x 2	Wonen	> AW+W	indust.
Bodemtype correctie								
Organic matter		2						
Fraction < 2 µm (Clay)		7.3						
TerrAttesT								
Version number		7.22						
Characteristics								
Dry matter	% (w/w)	95.1						
Organic matter	% (w/w) dm	2						
Fraction < 2 µm (Clay)	% (w/w) dm	7.3						
Characteristics								
Fraction < 2 µm (Clay)	% (w/w) dm	7.3						
Metals								
Barium (Ba)	mg/kg dm	88						
Chromium (Cr)	mg/kg dm	86	****	36	40	40	76	120
Cobalt (Co)	mg/kg dm	5.6	-	6.7	13	16	22	85
Copper (Cu)	mg/kg dm	19	-	23	31	31	54	110
Nickel (Ni)	mg/kg dm	47	****	17	19	19	37	49
Vanadium (V)	mg/kg dm	6.3	-	40	48	48	87	120
Zinc (Zn)	mg/kg dm	11	-	75	110	110	180	390
Polycyclic Aromatic Hydrocarbons								
Naphtalene	mg/kg dm	0.01						
Acenaphtene	mg/kg dm	0.02						
Fluorene	mg/kg dm	0.08						
Phenanthrene	mg/kg dm	0.17						
Anthracene	mg/kg dm	0.09						
Fluoranthene	mg/kg dm	0.3						
Pyrene	mg/kg dm	0.54						
Benzo(a)anthracene	mg/kg dm	0.34						
Chrysene	mg/kg dm	0.46						
Benzo(b)fluoranthene	mg/kg dm	2						

Benzo(k)fluoranthene	mg/kg dm	0.39						
Benzo(a)pyrene	mg/kg dm	0.55						
Dibenzo(ah)anthracene	mg/kg dm	0.18						
Benzo(ghi)perylene	mg/kg dm	1.3						
Indeno(123cd)pyrene	mg/kg dm	0.81						
PAH 10 VROM (sum)	mg/kg dm	4.5	**	1.5	3	6.8	8.3	40
PAH 16 EPA (sum)	mg/kg dm	7.2						
Miscellaneous Organic compounds								
Biphenyl	mg/kg dm	0.009						
Dibenzofurane	mg/kg dm	0.05						
Total Petroleum Hydrocarbons								
TPH (C10-C12)	mg/kg dm	5.3						
TPH (C12-C16)	mg/kg dm	16						
TPH (C16-C21)	mg/kg dm	82						
TPH (C21-C30)	mg/kg dm	370						
TPH (C30-C35)	mg/kg dm	170						
TPH (C35-C40)	mg/kg dm	74						
TPH (sum C10-C40)	mg/kg dm	720	*****	38	38	38	76	100
Metals								
Barium (Ba)	mg/kg dm	88						
Chromium (Cr)	mg/kg dm	86	****	36	40	40	76	120
Cobalt (Co)	mg/kg dm	5.6	-	6.7	13	16	22	85
Copper (Cu)	mg/kg dm	19	-	23	31	31	54	110
Nickel (Ni)	mg/kg dm	47	****	17	19	19	37	49
Vanadium (V)	mg/kg dm	6.3	-	40	48	48	87	120
Zinc (Zn)	mg/kg dm	11	-	75	110	110	180	390
Volatile Organic Hydrocarbons								
Benzene	mg/kg dm	1	*****	0.04	0.04	0.04	0.08	0.2
Organic Chlorinated Pesticides								
a-Chlordan	mg/kg dm	0.003						
Chlordans (sum)	mg/kg dm	0.003	****	0.0004	0.0004	0.0004	0.0008	0.02

Legend

Nr.	Sample descrip	Analytico number
2	Soil-2	6292754

> Background value	*	0
> 2xAW max W	**	1
> Norm value living	***	0
> background+living area value	****	3
> Norm value industry	*****	2

Number of verified components	10
Number exceedings allowed	2
Indicative result ontvangende bodem	Nooit toepasbaar
Indicative result toe te passen bodem	NIET toepasbaar

APPENDIX D

Clean Stream Scientific Services Laboratory Certificate for the Tar Dam

CLEAN STREAM Scientific Services (Pty.) Ltd.
489 Jacqueline Drive, Garsfontein, Pretoria, 0042
P.O. Box 905008, Garsfontein, 0042
Tel (012) 348 2813/4, Fax 012 348 8575

Specialists in environmental monitoring

Test Report

Client: **Anglo Platinum - Rustenburg Platinum Mines**
Address: Environmental Department, Marikana Road, Klipfontein Complex, Rustenburg, 0300
Report No: 6103 **Project:** RBMR -Ad hoc

Date of certificate: 23 Aug 2011
Date accepted: 22 Aug 2011
Date completed: 23 Aug 2011

Lab no:			65773
Date sampled:			10 Aug 2011
Sample type:			Water
Locality description			Tar Dam
Analyses:		**Method**	
A	pH	CSM 20	7.23
A	Electrical conductivity (EC) mS/m	CSM 20	1852.00
A	Total dissolved solids (TDS) mg/l	CSM 06	8422
A	Total alkalinity mg/l	CSM 01	3482.7
A	Chloride (Cl) mg/l	CSM 02	1490.4
A	Sulphate (SO4) mg/l	CSM 03	3970.12
A	Nitrate (NO3) mg/l as N	CSM 06	2.620
A	Ammonium(NH4) mg/l as N	CSM 05	1.120
A	Orthophosphate (PO4) mg/l as P	CSM 04	38.510
A	Fluoride (F) mg/l	CSM 11	45.220
A	Calcium (Ca) mg/l	CSM 30	209.068
A	Magnesium (Mg) mg/l	CSM 30	263.547
A	Sodium (Na) mg/l	CSM 30	341.07
A	Potassium (K) mg/l	CSM 30	55.518
A	Aluminium (Al) mg/l	CSM 31	4.400
A	Iron (Fe) mg/l	CSM 31	10.892
A	Manganese (Mn) mg/l	CSM 31	5.072
A	Total chromium (Cr) mg/l	CSM 31	<0.002
A	Copper (Cu) mg/l	CSM 31	0.610
A	Nickel (Ni) mg/l	CSM 31	1.066
A	Zinc (Zn) mg/l	CSM 31	0.334
A	Cobalt (Co) mg/l	CSM 31	<0.002
A	Cadmium (Cd) mg/l	CSM 31	<0.001
A	Lead (Pb) mg/l	CSM 31	0.27
A	Total hardness mg/l	CSM 26	1607

A = Accredited (Included in the SANAS Schedule of Accreditation); N = Not accredited (Excluded from the SANAS Schedule of Accreditation)
OSD = Outsourced; S = Sub-contracted; NR = Not requested; RTF = Results to follow; TNTC = To numerous to count; ND = Not detected
NATD = Not able to determine

Clean Stream Scientific Services does not accept responsibility for any matters arising from the further use of these results. This certificate shall not be reproduced without written approval by the Managing Director. Measurement of uncertainty available on request for all methods included in the SANAS Schedule of Accreditation. This report only relates to the above samples and variables analysed.

sanas Testing Laboratory
T0374

Report checked by: H. Holtzhausen (Laboratory Manager) HHausen

Directors: Ryno Erdmann (Managing), Fritz Bekker, Jaco de Klerk. Company registration number: 2006/028605/07. Vat no: 4360195723

Annexure F:

Tar dam rehabilitation status report (September 2011)
(Not Applicable to the Environmental Authorisation)

Appendix D - Annexure F: Tar dam rehabilitation status report (September 2011)

Not applicable: The status report contains information pertaining to costs associated with the removal and disposal of the tar residue and contaminated undercut. This report can be made available upon request.

Appendix D - Annexure G: WSP Geo-environmental Assessment Report

TAR DAMS PHASE II CONTAMINATED LAND ASSESSMENT

Rustenburg Platinum Mines Limited

2012/05/29

Quality Management

Issue/revision	Issue 1	Revision 1	Revision 2	Revision 3
Remarks	Final			
Date	29th May 2012			
Prepared by	Adam Smith			
Signature				
Checked by	Philip Hughes			
Signature				
Authorised by	Greg Matthews			
Signature				
Project number	28470			
Report number	R01			
File reference	28470_RPM_TarPit_ContLandAss_Final_20120531.docx			

TAR DAMS PHASE II CONTAMINATED LAND ASSESSMENT

Rustenburg Platinum Mines Limited

2012/05/29

Client

Rustenburg Platinum Mines Ltd
PO Box 8208
Rustenburg
0300

Consultant

WSP Environment and Energy
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Bryanston
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Table of Contents

Appendices

Executive Summary

Sites	Bleskop Tar Dams and TESMO Tar Dams
Current Site Use	Abandoned Tar Dams
Appointment	WSP Environment & Energy (WSP) was appointed by Rustenburg Platinum Mine Limited (RPM) to undertake a Phase II contaminated land assessment of four former tar dams located with the Rustenburg Platinum Mine lease area outside Rustenburg, North West Province. In support of the contamination assessment, an appointment detailed within Purchase Order 5502572055 was issued to WSP.
Site Investigation Summary	The sites represented clay lined pits that were previously used for the temporary storage of processed tar. An intrusive investigation has identified sites that are underlain by clay resting upon Norite. It appears that the tar dams were formed by excavating into the underlying clay to create pits with the remnant clay material forming the sides of the dams. The upper side material was exposed and subject to the weathering which allowed for small cracks to form which subsequently allowed for some shallow penetration of waste tar into the nearby soils. However, the extent of this penetration is extremely limited and it is considered that the clay has been extremely effective in maintaining the waste material in place. The investigation focused upon identifying the possible extent of hydrocarbon contamination in the areas surrounding the former tar dams and assessing whether such contamination could be remediated through the use of bio-remediation. The investigation identified that any spread of hydrocarbon contamination outside of the footprint of the former tar dams is extremely limited and that the sidewalls and base of the tar dams were effective in limiting the potential loss of hydrocarbons into the surrounding soils. In this regard only two hot spots with elevated levels of total oil and grease were identified. The investigation confirmed that hydrocarbons are present in the soil in the most part as a heavy tar fraction but also that elevated levels of hydrocarbons in the C6 to C35 range are also present. With regards to the latter the samples obtained did not exhibit concentrations above industrial acceptable standards but were useful in determining the probable distribution of hydrocarbon chains within any more concentrated soils that are stockpiled on site. It is considered that the investigation area is impacted but does not present an immediate risk as most of the source material has been removed. However, measures are required to fully define and address the management of the remaining soils.
Recommendations	This investigation has confirmed that hydrocarbons are present in some locations immediately adjacent to the tar pits and that the soils that are present are within a range where bioremediation is considered possible. In order to finalise a remediation and rehabilitation strategy it is necessary that additional testing be undertaken to determine the full range and type of hydrocarbon products that may be present in the site soils and excavated soils.
This sheet is intended as a summary only of the assessment of the tar dam site in relation to current ground conditions.	

1 Introduction

1.1 Terms of Reference

WSP Environment & Energy (WSP) was appointed by Rustenburg Platinum Mine Limited (RPM) to undertake a Phase II contaminated land assessment of four former tar dams located with the Rustenburg Platinum Mine lease area outside Rustenburg, North West Province. In support of the contamination assessment, an appointment detailed within Purchase Order 5502572055 was issued to WSP.

1.2 Aims and Objectives

The purpose of the assessment was to determine the possible extent of contaminated land arising from impacts associated with the materials contained within the former tar dams and assessing whether such contamination could be remediated through the use of bio-remediation. The following elements have been included in the assessment:

- Desktop Study;
  - Site Environmental Setting
  - Conceptual Site Model
- Limited-intrusive ground investigation;
- Chemical laboratory testing
  - Analytical Scheduling
  - Soil Screening;
- Geo-Environmental Assessment; and
- Recommendation.

1.3 Background

The tar dam pits contain legacy residues that were generated from the gas fired smelter at Klipfontein, which existed more than 60 years ago. The tar residue from the smelter was stored in four separate clay-lined, soil compartments.

In 2003, a decision was taken to recover the material from Tar Dam D closest to the road to TEMSO. The excavated tar was to be used in the Alpha Cement Plant kiln in Litchtenburg as an Alternative Fuel and Resource (AFR). However, as the melted tar was fed into the furnace, it solidified due to a failure to heat the transfer line and, as a result, the project was stopped. A decision was subsequently made in March 2003 to move the rest of the content of the same tar dam to Holfontein H:H Hazardous Waste Landfill Site. The transfer of tar started immediately after the Alpha Cement Plant project was terminated.

In July 2011, Rustenburg Platinum Mines contracted EnviroServ Waste Management to remove and dispose of tar in the three remaining dams. The tar was to be removed to its H:H Holfontein Landfill Facility in Springs.

In August 2011, Clean Stream Scientific Services Pty Ltd was appointed by Rustenburg Platinum Mines Rustenburg Section (RPM-RS) to assess the potential impact of the Klipfontein Tar Dams on adjacent surface water, groundwater and the soil regimes. Detailed risk and pollution assessments including identification of the depth and extent of pollution fell outside of the scope of this investigation. The assessment recommended that probable sources of contamination (including the tar dams) be removed and that specialist soils and hydrogeological investigations be undertaken to evaluate the radius and/or depth of influence of contamination.

WSP was originally appointed in December 2011 to assist RPM in obtaining an Environmental Authorisation for remediation and decommissioning of the facility. WSP is in the process of undertaking a Basic Assessment and compiling an Environmental Management Programme for the decommissioning and remediation of contaminated land associated with the tar dams. This investigative report provides information that will aid in the compilation of the EMP.

1.4 Limitations

This report is based on and limited to an assessment of all the resulting information. WSP are not responsible for ground conditions not revealed by this investigation. The information contained within this report has been prepared for RPM and their agents only and is not to be relied upon by any third parties.

2 Desktop Study

Information from personnel interviews and desktop reviews was used to develop an understanding of the environmental setting. This information included maps, site plans, incident reports and verbal communication.

2.1 Legal Review

The following legal provisions are relevant to the decommissioning works of the tar dams at RPM and were reviewed in order to ensure that the management of potentially contaminated land is performed within lawful and acceptable industry expectations:

- Ch*apter 7 Section 28 of the National Environmental Management Act* (No 107 of 1998) (NEMA); imposes the duty of care principle on any person who causes pollution and requires measures to investigate, assess and evaluate any impacts on the environment to be undertaken.
- *EIA Regulations GNR544* (Activity No. 27); as amended and in reference to Chapter 5 of the National Environmental Management Act (No 107 of 1998) (NEMA) requires a Basic Assessment for the decommissioning of existing facilities or infrastructure, for (iv) activities where the facility or the land on which it is located is contaminated.
- *Site Assessments and Reports Regulations* GN234; referenced in Chapter 4, Part 8 of the National Environmental Management Act: Waste Act (No 58 of 2008); regulates the contents of site assessment reports in respect of contaminated land.
- *National Norms and Standards for the Remediation of Contaminated Land and Soil Quality* Regulations GN233 in reference to Chapter 4, Part 8 of the National Environmental Management Act: Waste Act (No 58 of 2008); provides minimum standards relating to the remediation of contaminated land in South Africa.

2.2 Site Environmental Setting

2.2.1 Site Details

The tar dam assessment consists of two dual tar dam sites located approximately 10 km to the west of Rustenburg in the North West Province. Details for each site are provided in **Table 1** and a site locality plan is provided as **Figure 1**.

Table 1: Summary of site details

Site Name	**Bleskop Tar Dams (Tar Dams A & B)**	**TEMSO Tar Dams (Tar Dams C & D)**
Site Details	2 x 1,600m^2 tar dams with an estimated capacity of 3,200m^3 (each dam is approximately 2m in depth).	2 x 1,600m^2 tar dams with an estimated capacity of 3,200m^3 (each dam is approximately 2m in depth).
Land Owner	Anglo American Platinum Limited	Royal Bafokeng Nation (Makhatle Tribe)
Address	Portion 170 of the farm Kroondal 304 JQ	Portion 2 (Remaining Extent) of the farm Klipfontein 300 JQ
erf Number	T0JQ00000000030400170	T0JQ00000000030000002
Coordinates	-25.697569°, 27.358690°	-25.698734°, 27.368113°
Plan	A site location plan is presented in **Figure 1** and **Figure 2**	A site location plan is presented in **Figure 1** and **Figure 3**

Tar Dams A and B (referred to as the Bleskop Tar Dams) are located between the Bleskop Stadium and the Rustenburg Platinum Mines Hospital, while Tar Dams C and D (referred to as the TEMSO Tar Dams) are located north of the Klipfontein Concentrator, adjacent to the road to TEMSO. The two pairs of tar dams are separated from each other by a distance of approximately 900m.

Temporary service roads have been constructed around the Bleskop Tar Dams and Tar Dam D built for the removal of tar in July 2011. The remainder of the area immediately surrounding the TEMSO Tar Dams has remained untouched and covered in vegetation.

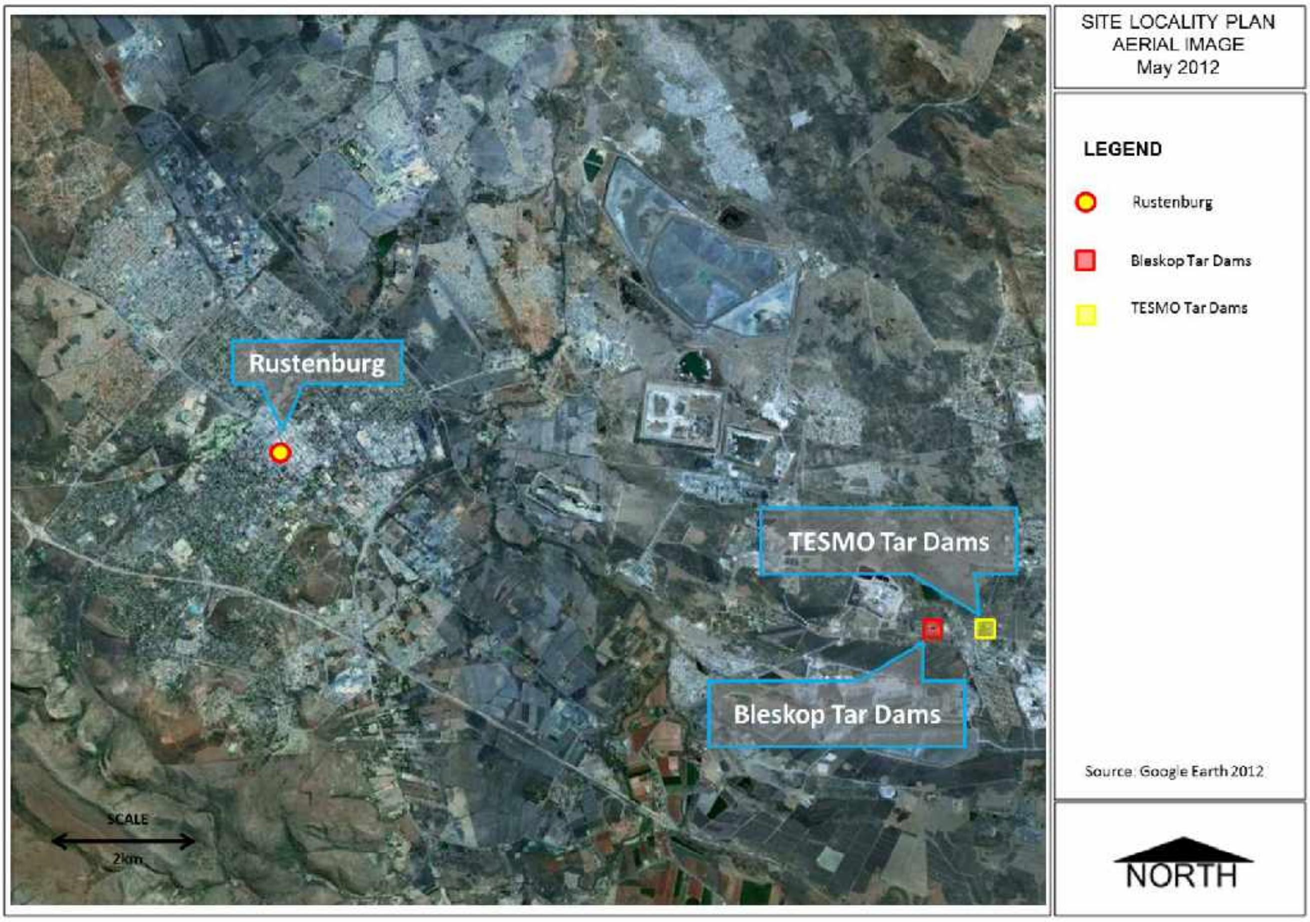


Figure 1: Site Locality Plan

2.2.2 Surrounding Land Use

A desktop assessment of the surrounding land use was undertaken to identify potential receptors within the vicinity of the tar dams, whether that be human receptors orf ecological receptors. The surrounding land uses for both Bleskop and TESMO tar dams are summarised in **Table 3** and **Table 4** and displayed in **Figure 2** and **Figure 3**.

2.2.2.1 Bleskop Tar Dams

Table 2: Bleskop Tar Dams Surrounding Land Uses

Direction	Identified Land Uses within <500m	Ground Truth Comment	Potential Receptors
North	Mining lease land	An informal graveyard with numerous marked and unmarked grave sites	Human Recreational
East	Sports and recreation facilities	Bleskop Stadium, cricket oval and football field	Human Recreational
South	Mining lease land	Residential staff housing largely surrounded by unused land.	Human Residential
West	Hospital	Rustenburg Platinum Mines Hospital	Human Residential

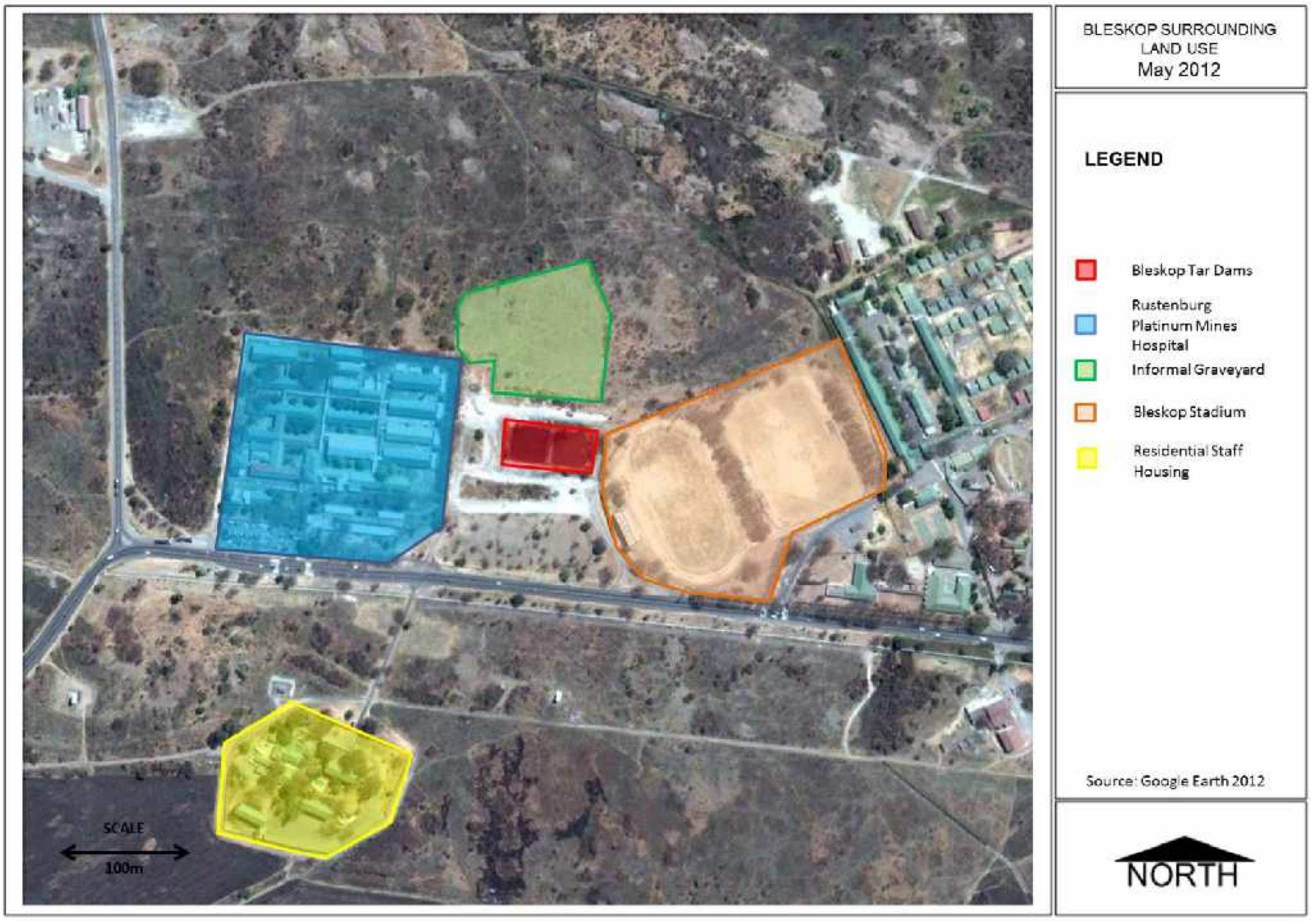


Figure 2: Surrounding Land Use Bleskop

2.2.2.2 TESMO Tar Dams

Table 3: TESMO Tar Dams Surrounding Land Uses

Direction	Identified Land Uses within <500m	Ground Truth Comment	Potential Receptors
North	Mining lease land	Vacant lease land	Ecological
East	Mining lease land	Vacant lease land	Ecological
South	Mining	Klipfontein Concentrator	Human Industrial
West	Residential	Bleskop Mine Residence	Human Residential

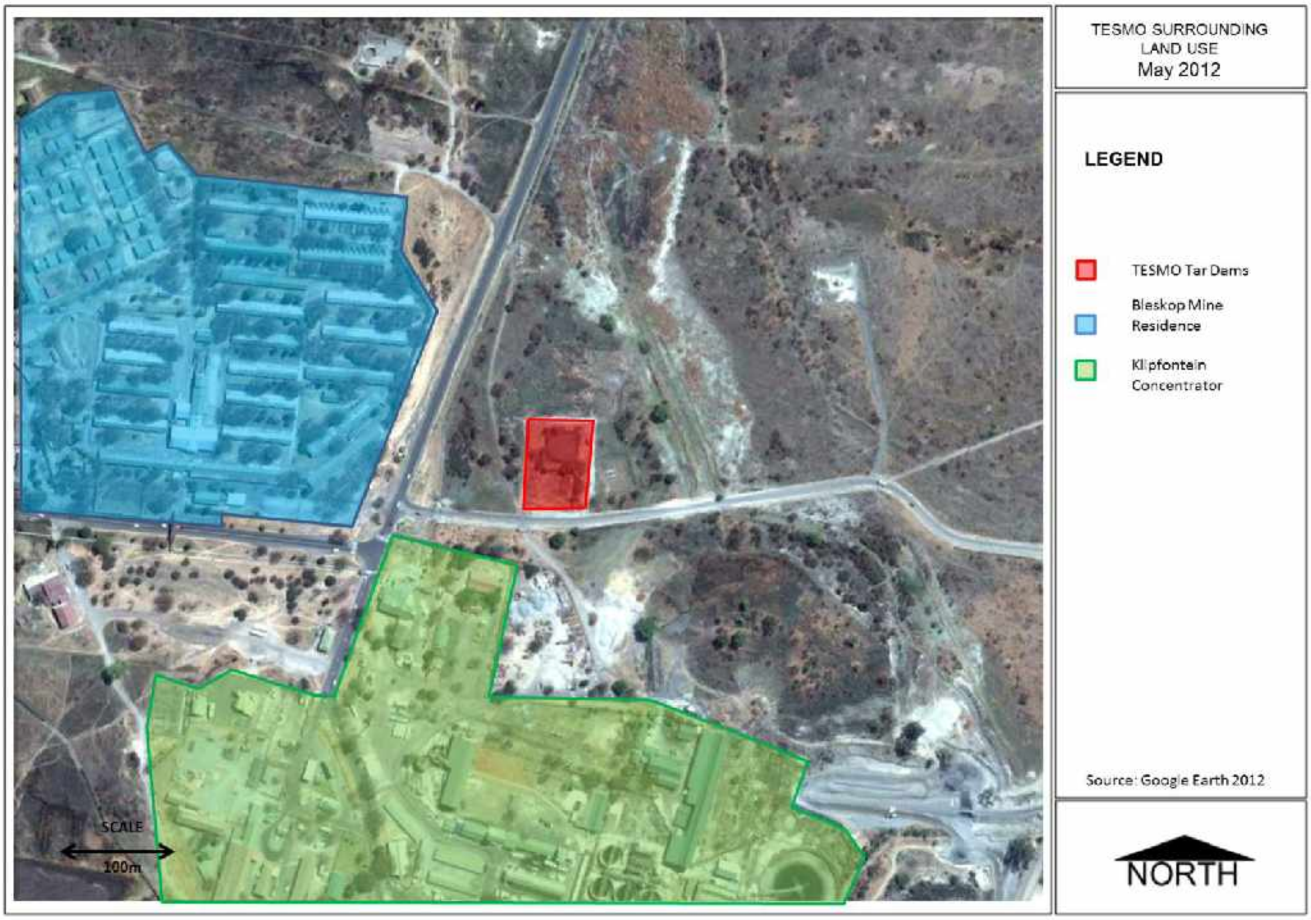


Figure 3: Surrounding Land Use TESMO

2.2.3 Surface Water Features

The tar dams are located within Quarternary catchment A22H of catchment A22. **Table 4** identifies water features within the potential influence of the Tar Dams. The relative locations of which are shown in **Figure 4**.

Table 4: Summary of Surface Water Features

Identified surface water feature	Approximate distance	Direction
Perennial stream and dam	500 metres	North of Bleskop Tar Dams
Perennial stream	100 metres	East of TESMO Tar Dams
Water Purification works	400 metres	North of TESMO Tar Dams

All three identified surface water features are connected with the perennial stream flowing from the south to north past the TESMO Tar Dams. The stream changes direction to the east past the water purification works and discharges into the dam to the north of the Bleskop Tar Dams. Surface water eventually drains into the Hex River approximately 8km to the north west.

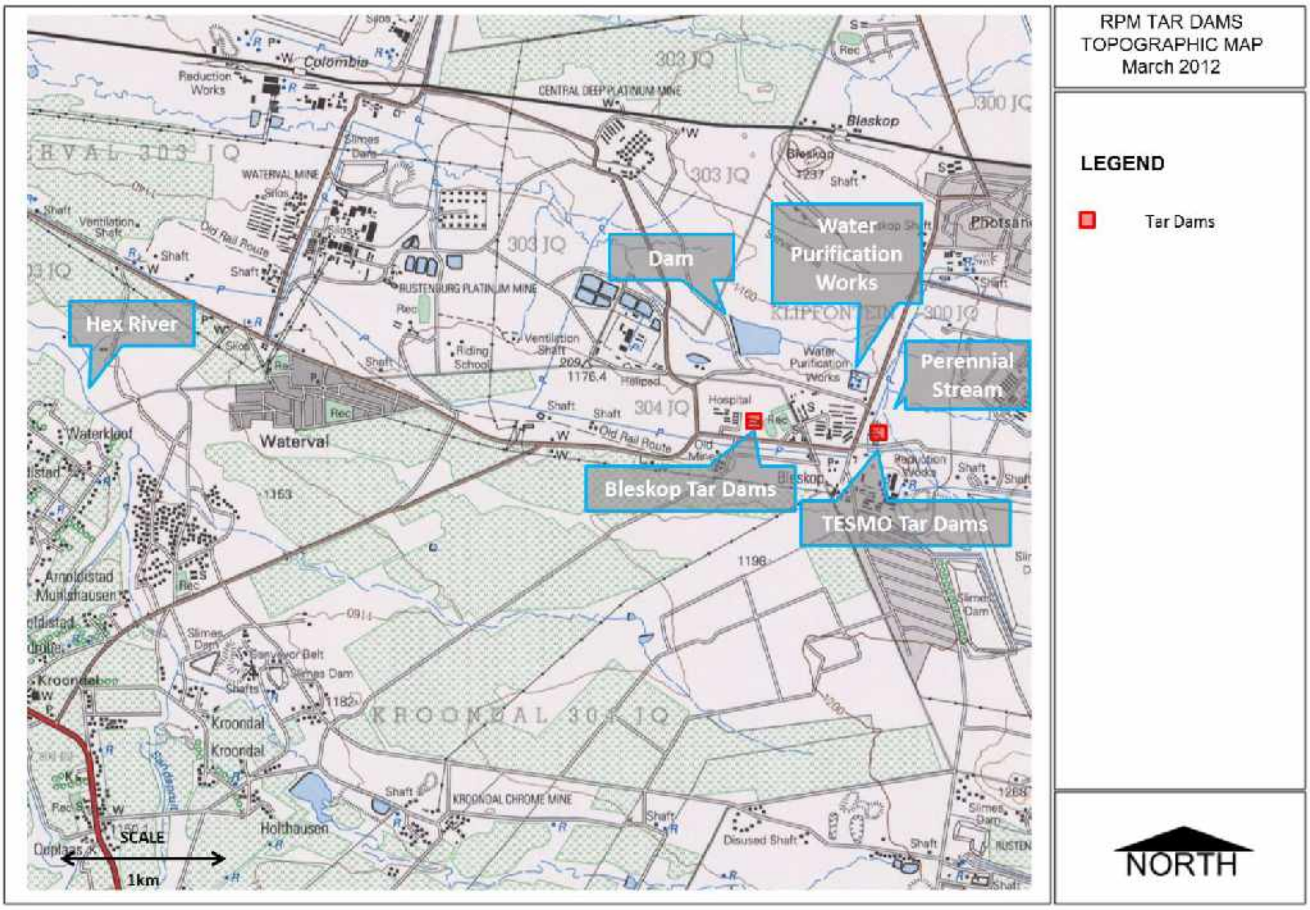


Figure 4: Topographical Map (1: 50 000 topographic series – 2527CB Rustenburg (EAST))

2.2.4 Topography, Geology and Geohydrology

Both tar dam sites are covered by soft-standing soil. Temporary roads have been constructed around the sites using dump rock to provide access to the tar removal works. The immediate slope appears to be low in a northerly direction from the Bleskop Tar Dams and low becoming moderate in an easterly and north easterly direction from the TESMO Tar Dams.

Based on published geological maps, the site is underlain by the Rustenburg Layered Suite of the Bushveld Complex, which consists of a layered sequence of mafic rocks. The soils are mostly deep, black clay (montmorillonite) of the Arcadian form, characteristically developed as a residual soil over gabbro-norite rocks, under partly waterlogged conditions. Arcadia soils are characterised by base saturation and a high cation exchange and high shrink and swell capacity.

Given the published geology, the rock formation underlying the site is considered to represent a minor aquifer. The mean annual recharge is reported to occur between 25mm – 37mm. The regional hydrochemical water quality is described as Type A, with dominant cations consisting of calcium and/or magnesium, and anions consisting of chloride and sulphate. The total amount of dissolved solids is less than 300mg/l, which is indicative of fair quality of groundwater.

Groundwater beneath the tar dams is likely to flow towards the north, although this may be influenced by undetermined ground conditions. Based on published information, the underlying aquifer is expected to occur between 20m – 30m and considered least vulnerable and low susceptibility to anthropogenic contamination.

2.2.5 Regional Hydrocensus

According to the Department of Water Affairs (DWA) National Groundwater Archive, accessed on 16th May 2012, no boreholes have been registered within a 2km radius of the site.

2.3 Conceptual Site Model

2.3.1 Preliminary Conceptual Risk Model

A Preliminary Conceptual Risk Model was developed to define the potential source, receptor and pathway relationship which may be applicable to the site under specific land use assumptions and which, based on identification of significant source-pathway-receptor linkages, could give rise to potential human health and/or environmental risk as a result of contaminant releases in that area.

The model has defined those risks as showing plausible linkages between these three aspects, however in the event that no significant linkages exist; then no significant risk is considered to exist. These aspects are described in **Table 5**.

Table 5: Summery of Preliminary Conceptual Risk Model

Model Factors	Details
Source	Residual contamination associated with the decommissioned of the tar dams
Pathway/s	Contamination pathways associated with the tar dams include, but are not limited to, ingestion of soil/groundwater, inhalation of vapours and dermal contact with or absorption of contaminated media by human receptors, as well as contamination of groundwater by vertical migration under gravity or dissolution. The lateral migration of impacted groundwater may also represent a plausible pathway
Receptor/s	Potential receptors may include humans accessing the site and surrounding area (on and off-site workers) and sensitive aquatic systems (i.e. nearby non-perennial streams and canals and/or the underlying major aquifer)

3 Intrusive Site Investigation

3.1 Soil Sampling

Soils sampling was undertaken using a tractor loaded backhoe (TLB) on the 27th March 2012. Trial pits were excavated at various points adjacent to and inside the tar dams. The Bleskop trial pit locations are indicated in **Figure 5** and TESMO trial pit locations in **Figure 6**.

Figure 5: Bleskop Trial Pit Locations

Seven trial pits were excavated around the Bleskop Tar Dams. Two trial pits to the north and south; one to the west and one each within Tar Dam A and Tar Dam B. A trial pit could not be located to the east of the tar dams due to the proximity of the Bleskop Stadium and storm water service line located on the eastern boundary of the site.

Figure 6: TESMO Trial Pit Locations

Five trial pits were excavated around the TESMO Tar Dams. Two trial pits to the east and west; with one to the north. A trial pit could not be located to the south due to the proximity of the road and underground services running parallel with the road; nor could trial pits be located within Tar Dam C and Tar Dam D due to the steep sides of the excavated tar pits and as no access ramp was present.

Trial pits were excavated to between 2m and 3m below ground level, or at refusal of TLB. Samples were collected from various depths within the excavation with at least two samples collected from each trial pit. The two samples consisted of one each of the two soil types identified during the investigation. **Table 6** shows a summary of the samples retrieved and the adopted analytical analysis.

Table 6: Summary of Soil Samples and Analytical Method

Target Area	Sample Soil Location/Type	No. of Samples	Laboratory Analysis
Bleskop Tar Dams	TOP	4	Total Oil & Grease TPH(GRO range) Speciated PHENOLS Total Organohalogens TPH DRO aliphatics Heavy Metals
Bleskop Tar Dams	BOTTOM	4	
TESMO Tar Dam	TOP	4	
TESMO Tar Dam	BOTTOM	4	

3.2 Groundwater Sampling

No groundwater seepage was encountered during the investigation and as such no groundwater samples were recovered from the trial holes.

3.3 Ground Conditions

3.3.1 Bleskop Tar Dams

Both Tar Dams A and B have been emptied to a depth of roughly 2m below ground level. The remaining soil on the floor and side walls of the tar pits consists of very stiff dark brown to black clay. The underlying floors of the tar pits are free of tar residue, however tar residue is observed to be “leaking” from the side walls back into the tar pits. Site photographs are provided in **Appendix A**.

To the east of the tar dams between Tar Dam B and Bleskop Stadium is an area approximately $10m^2$ of damp saturated top soil. The source of the water is unknown but could be the result of a slow leak from a storm water pipe running past the eastern edge of the tar dam. The water appears to be contained within the upper clay soils as there was no indication of the water draining through the soil into the excavated tar pit.

The seven trial pits excavated at the Bleskop Tar Dams sites contained similar soil profiles indicating consisted soil types across the entire site. The soil profile is described in general in **Table 7**. Trial pit logs are provided in **Appendix B.**

Table 7: General Ground Conditions at Bleskop Tar Dams

From (m bgl)	To (m bgl)	Designation	Field Description
0.0	0.2	MADE GROUND	Light grey brown, stiff, sand and gravel – Dump rock for temporary road
0.2	0.3	Topsoil	Brown to dark brown, soft to stiff, clay – Natural topsoil level
0.3	1.5	Clay	Dark brown, stiff, clay – Residual clay soil
1.5	> 2.0	NORITE	White, dense, coarse sand and gravel – Weathered Norite into fresh rock

bgl – below ground level

It is noted that there is some minor variation with regards to thickness and composition of the upper Made Ground fill material. Such is considered to be representative of the variable nature of Made Ground.

The clay soils at the base of the tar pits are thin, typically 0.15m in thickness. Trial pit investigations within the pit indicated clear white weathered norite and fresh norite bedrock directly beneath the clay soils.

With the exception of the tar residue in the side walls there was no visual of olfactory evidence of tar contamination within the trial pits.

3.3.2 TESMO Tar Dams

Tar Dam C and Tar Dam D were empty at the time of the investigation. Tar Dam C had been emptied at the same time as the Bleskop Tar Dams while Tar Dam D had been emptied in 2003 and is currently covered by vegetation. Entry could not be gained into either of the tar dams; however observations from outside the dams indicated similar ground conditions to those at the Bleskop Tar Dams (i.e tar pit floors appear to be free of tar residue).

Temporary road construction is in place to the east of the tar dams for the removal of the tar from Tar Dam C. The remaining surrounds are largely untouched and well vegetated.

The five trial pits excavated at the TESMO Tar Dams sites contained similar soil profiles indicating consisted soil types across the entire site. The soil profile is summarized in general in **Table 8**.

Table 8: General Ground Conditions at Bleskop Tar Dams

From (m bgl)	To (m bgl)	Designation	Field Description
0.0	0.6	MADE GROUND	Light grey brown, stiff, sand and gravel – Dump rock for temporary road
0.6	1.6	Clay	Dark brown, stiff, clay – Residual clay soil
1.6	> 2.3	NORITE	White, dense, coarse sand and gravel – Weathered Norite into fresh rock

Bgl – below ground level

As was noted at Bleskop there is some minor variation with regards to thickness and composition of the upper Made Ground fill material. Such is considered to be representative of the variable nature of Made Ground.

No visual of olfactory evidence of tar contamination was evident within the trial pits during the site investigation.

3.3.3 Soils of Interest

Two soil horizons were identified during the investigation that are considered likely to be impacted on during the life cycle of the tar dams. The residual clay horizon was target for possible lateral migration of contaminants and has been designated TOP horizon in soil sampling nomenclature. The weathered Norite horizon was target as a possible preferential pathway for mobile contaminants and has been designated BOTTOM horizon in the soils sampling nomenclature.

The BOTTOM soil horizon is found to be conformably overlain by the TOP soil horizon, which aids in identifying whether contaminants have migrated through the soil profile from one soil horizon to the other.

3.4 Access Limitations

- Intrusive investigation was limited to the outside of the TEMSO Tar Dam. No ramp into the tar dam pit had been constructed as was the case for the Bleskop Tar Dams. As a result soil samples could only be taken of the soils immediately adjacent to the tar dam pits.
- Excavation within the Bleskop Tar Dam pits encountered shallow bedrock immediately below the base of the tar dams allowing only for the collection a single sample from Tar Dam B.

4 Laboratory Testing

4.1 Analytical Scheduling

Soil samples collected from both tar dam sites were analysed for organics species and inorganic species. Samples were submitted to a SANAS accredited laboratory to undertake the following suite of analyses:

- Organics
  - Total Oil and Grease (PLE Extraction) and Gravimetric;
  - Phenols;
  - Extractable Petroleum Hydrocarbons (EPH);
  - Total Petroleum Hydrocarbons (TPH) - Gasoline Range Organics (GRO);
  - Volatile Organic Compounds (VOC's); and
  - Semi-Volatile Organic Compounds (SVOC's).
- Inorganics
  - Soils - Heavy Metals – ICP-MS Scan; and
  - Water Leach – Heavy Metals – ICP-MS Scan.

Full laboratory certificates of analysis are provided in **Appendix C**.

4.2 Soil Screening Methodology

South Africa has recently developed soil screening values in line with the National Environmental Management Act: Waste Act (NEM:WA) (59 of 2008) in order to provide 'norms and standards' for enabling the identification and registration of contaminated sites, to provide a risk-based decision support protocol for assessing sites, and to offer a set of guidelines for the submission of site assessment reports.

The Framework for the Management of Contaminated Land includes a tiered system of Soil Screening Values for priority soil contaminants in order to facilitate the sensitivity of the relevant receptor which may be subject to exposure. These are defined as follows:

- Soil Screening Value (SSV) 1 represents the lowest value calculated for each parameter from both the Human Health and Water Resource Protection pathways. SSV1 values are not land-use specific; and
- Soil Screening Value (SSV) 2 represents the land-use specific soil value and are appropriate for screening level site assessment in cases where protection of water resource is not an applicable pathway for consid-eration.

In this regard, the chemical analytical results were compared to SSV-2 Commercial/Industrial in order to assess exposure thresholds applicable to the tar remaining in the soil.

4.3 Tabulated Laboratory Results

4.3.1 Organics

The vast majority of organic species were recorded below laboratory detection limits. Those determinants that were recorded above laboratory detection limits are recorded in **Table 9** and **Table 10** and are compare to the adopted SSV. Where concentrations are above laboratory detection limits values are bolded and where exceedences are above the lowest prescribed SSV, these are highlighted in red.

Table 9: Summary of Bleskop Tar Dams Organic Results

Contaminants	Screening Values (mg/kg)	Sample Results (mg/kg)					
	SSV-2 Industrial	TP1 TOP	TP3 TOP	TP4 TOP	TP4 BOTTOM	TP5 BOTTOM	TP6 BOTTOM
Total Oil and Grease (PLE Extraction) and Gravimetric							
Total Oil and Grease (mg/kg)	-	**200**	<100	<100	<100	<100	**680**
Extractable Petroleum Hydrocarbons (EPH)							
TPH (C_{10}-C_{12})	4,400	<0.04	<0.04	<0.04	<0.04	<0.04	
TPH (C_{12}-C_{16})	4,400	<0.04	<0.04	<0.04	<0.04	<0.04	**3.2**
TPH (C_{16}-C_{21})	70,000	<0.04	<0.04	<0.04	<0.04	<0.04	**7.9**
TPH (C_{21}-C_{30})	70,000	<0.04	<0.04	<0.04	<0.04	<0.04	**4.64**
TPH (C_{30}-C_{35})	70,000	<0.04	<0.04	<0.04	<0.04	<0.04	
TPH (C_{35}-C_{40})	70,000	<0.04	<0.04	<0.04	<0.04	<0.04	
TPH sum (C_{10}-C_{40})	70,000	<0.2	<0.2	<0.2	<0.2	<0.2	**15.7**

Note 1. TOP = Clay, Note 2. BOTTOM = Weather Norite

Table 10: Summary of TESMO Tar Dams Organic Results

Contaminants	Screening Values (mg/kg)	Sample Results (mg/kg)					
	SSV-2 Industrial	TP9 TOP	TP10 TOP	TP12 TOP	TP8 BOTTOM	TP9 BOTTOM	TP10 BOTTOM
Total Oil and Grease (PLE Extraction) and Gravimetric							
Total Oil and Grease (mg/kg)	-	**200**	**1,600**	--	<100	<100	--
Extractable Petroleum Hydrocarbons (EPH)							
TPH (C_{10}-C_{12})	4,400	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
TPH (C_{12}-C_{16})	4,400	<0.04	**8.22**	<0.04	<0.04	<0.04	<0.04
TPH (C_{16}-C_{21})	70,000	<0.04	**12.1**	<0.04	<0.04	<0.04	<0.04
TPH (C_{21}-C_{30})	70,000	<0.04	**12.2**	<0.04	<0.04	<0.04	<0.04
TPH (C_{30}-C_{35})	70,000	<0.04	**2.64**	<0.04	<0.04	<0.04	<0.04
TPH (C_{35}-C_{40})	70,000	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
TPH sum (C_{10}-C_{40})	70,000	<0.2	**35.1**	<0.2	<0.2	<0.2	<0.2

Note 1. TOP = Clay, Note 2. BOTTOM = Weather Norite

4.3.2 Heavy Metals

Two types of heavy metal analysis were performed on selected soil samples. A full analysis conducted on original samples received by the laboratory as well as water leach analysis on selected samples. **Table 11** and **Table 12** compare those metal contaminants of concern listed within the Framework for the Management of Contaminated Land with the SSV2 guideline values.

Table 11: Selected Potential Heavy Metals of Concern Bleskop Tar Dams

Contaminants	Screening Values (mg/kg)	Sample Results (mg/kg)						
	SSV-2 Industrial	TP1 TOP	TP2 TOP	TP3 TOP	TP4 TOP	TP4 BOTTOM	TP5 BOTTOM	TP6 BOTTOM
Arsenic	150	**1.15**	**1.58**	**3.67**	**3.88**	**1.95**	**1.83**	**1.24**
Cadmium	260	**0.013**	**0.012**	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	790,000	**582**	**897**	**1,056**	**1,187**	**711**	**259**	**523**
Cobalt	5,000	**29.1**	**36.1**	**51.9**	**49.9**	**59.8**	**41.1**	**48.5**
Copper	19,000	**47.5**	**33.4**	**34.6**	**40.7**	**47.3**	**35.7**	**7.98**
Lead	1,900	**9.84**	**9.50**	**6.98**	**6.18**	**4.54**	**4.95**	**8.58**
Manganese	12,000	**1,145**	**1,272**	**1,449**	**1,589**	**423**	**546**	**390**
Mercury	6.7	**0.813**	**1.27**	**2.16**	**2.91**	**14.9**	**13.3**	**17.0**
Nickel	10,000	**220**	**176**	**188**	**237**	**167**	**151**	**46.0**
Vanadium	2,600	**35.8**	**40.9**	**54.1**	**60.7**	**38.4**	**42.3**	**35.2**
Zinc	150,000	**35.4**	**41.7**	**40.9**	**41.8**	**30.0**	**56.9**	**31.8**

Note 1. TOP = Clay, Note 2. BOTTOM = Weather Norite

Table 12: Selected Potential Heavy Metals of Concern TESMO Tar Dams

Contaminants	Screening Values (mg/kg)	Sample Results (mg/kg)							
	SSV-2 Industrial	TP9 TOP	TP10 TOP	TP12 TOP	TP8 BOTTOM	TP9 BOTTOM	TP10 BOTTOM	TP12 BOTTOM	TP11 BOTTOM
Arsenic	150	**3.58**	**3.49**	**2.67**	**1.27**	**1.41**	**1.74**	**2.66**	**1.89**
Cadmium	260	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0.011**	<0.01
Chromium	790,000	**2,394**	**766**	**1,356**	**1,243**	**305**	**347**	**693**	**586**
Cobalt	5,000	**47.8**	**47.3**	**55.1**	**43.8**	**42.2**	**30.8**	**67.2**	**54.1**
Copper	19,000	**43.5**	**27.0**	**38.6**	**14.6**	**17.3**	**16.1**	**132**	**57.7**
Lead	1,900	**8.73**	**7.52**	**5.11**	**2.48**	**3.72**	**3.57**	**30.0**	**11.5**
Manganese	12,000	**1,253**	**860**	**795**	**575**	**1,190**	**932**	**522**	**1,054**
Mercury	6.7	**3.63**	**5.13**	**5.97**	**13.3**	**5.97**	**3.42**	**12.8**	**5.80**
Nickel	10,000	**224**	**141**	**188**	**78.0**	**153**	**109**	**429**	**259**
Vanadium	2,600	**61.7**	**42.7**	**50.3**	**20.8**	**34.6**	**25.7**	**36.9**	**37.6**
Zinc	150,000	**47.6**	**32.9**	**32.9**	**26.7**	**24.4**	**22.6**	**57.4**	**38.1**

Note 1. TOP = Clay, Note 2. BOTTOM = Weather Norite

As a ratio the majority of metals recorded in the soils samples consisted of the following five elements; Silicon (42-58%); Aluminium (21-29%); Calcium (6-24%); Iron (2-8%) and Magnesium (2-5%). The recorded concentrations of the five elements are presented in **Table 13** and **Table 14**.

Table 13: Five Major Elements by concentration Bleskop Tar Dams

Element	Sample Results (mg/kg)						
	TP1 TOP	TP2 TOP	TP3 TOP	TP4 TOP	TP4 BOTTOM	TP5 BOTTOM	TP6 BOTTOM
Aluminium	**100,700**	**111,000**	**92,220**	**111,900**	**135,800**	**123,200**	**139,900**
Calcium	**47,180**	**29,200**	**41,900**	**35,580**	**85,350**	**75,220**	**93,800**
Iron	**30,240**	**30,200**	**30,580**	**33,810**	**20,690**	**24,250**	**13,390**
Magnesium	**15,930**	**12,840**	**11,770**	**18,040**	**17,030**	**16,980**	**10,140**
Silicon	**226,400**	**256,600**	**217,800**	**281,900**	**227,600**	**218,800**	**219,700**

Note 1. TOP = Clay, Note 2. BOTTOM = Weather Norite

Table 14: Five Major Elements by concentration TESMO Tar Dams

Element	Sample Results (mg/kg)							
	TP9 TOP	TP10 TOP	TP12 TOP	TP8 BOTTOM	TP9 BOTTOM	TP10 BOTTOM	TP12 BOTTOM	TP11 BOTTOM
Aluminium	**106,500**	**95,130**	**91,410**	**138,800**	**130,900**	**132,700**	**114,200**	**110,200**
Calcium	**35,940**	**74,690**	**100,100**	**98,980**	**85,110**	**71,760**	**81,390**	**97,410**
Iron	**33,030**	**24,400**	**25,570**	**13,350**	**19,590**	**18,560**	**22,960**	**21,340**
Magnesium	**18,800**	**13,610**	**11,700**	**12,320**	**15,440**	**18,080**	**20,910**	**19,440**
Silicon	**249,600**	**185,700**	**192,700**	**213,700**	**218,900**	**227,200**	**204,900**	**194,425**

Note 1. TOP = Clay, Note 2. BOTTOM = Weather Norite

Leachate Analysis

Table 15: Selected Potential Leachate Contaminants of Concern.

Contaminants	Water Guidelines (mg/l)		Sample Results (mg/l)							
	Drinking	Aquatic	TP1 TOP	TP2 TOP	TP3 TOP	TP4 TOP	TP4 BOTTOM	TP5 BOTTOM	TP6 BOTTOM	TP8 BOTTOM
Arsenic	0.01	0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Cadmium	0.005	0.00025	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Chromium	0.05	0.012	**0.010**	**0.008**	**0.002**	**0.006**	**0.004**	**0.004**	**0.002**	**0.007**
Cobalt	N/A	0.11	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Copper	1	0.0008	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Lead	0.01	0.0005	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Manganese	5	0.18	**0.012**	**0.002**	**0.002**	**0.010**	**0.006**	**0.006**	**0.005**	**0.014**
Mercury	0.001	0.00004	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	**0.0001**	< 0.0001	**0.0001**
Nickel	0.07	0.011	**0.003**	**0.002**	**0.001**	**0.002**	**0.005**	**0.003**	< 0.001	**0.002**
Vanadium	0.1	0.019	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Zinc	3	0.002	**0.003**	< 0.001	< 0.001	**0.008**	**0.001**	**0.005**	< 0.001	**0.001**

Note 1. TOP = Clay, Note 2. BOTTOM = Weather Norite

The water leach analysis results were obtained by performing water leach testing on 100g of sample, which was leached for 18 hours in 2000ml of water at a pH of 7. Thereafter the solution was filtered and analysed. This was done to provide an indication of those metals most likely to leach out of the remaining tar pit soils.

The water leach solution results were compared with South African Water Quality Guidelines, Vol. 1 (1996) to provide an indication of potential leachate quality. It should be recognised that the drinking water guidelines are very conservative for this assessment as there is no indication of groundwater use in the vicinity of the tar dams.

5 Geo-Environmental Assessment

5.1 Validity of Conceptual Site Model

The site visit largely confirmed the validity of the preliminary conceptual site model given that field observations showed evidence of tar residue to be contained within the excavated side walls and the in-situ material in the excavation.

This site model has considered the excavated fill material as well as in-situ material to evaluate various probabilities associated with the residual contamination.

The likely pathways associated with the tank excavation include ingestion of soil through vertical and lateral migration given the permeable soils in the excavation. The inhalation of vapours and dermal contact with or absorption of contaminated media by human receptors constitutes further plausible pathways given the lack of access control to the site.

Receptors are likely limited to those accessing the site, although neighbouring facilities and surface water features also represent plausible receptors to any significant residual contamination arising from the tar pits.

5.2 Hydrocarbon Contamination

The majority of hydrocarbons of concern were recorded below detection limits within the soils samples of both tar dam sites. The assessment did identify two potential ‘hot spot’ locations, one at each of the Bleskop and TESMO Tar Dams sites.

5.2.1 Bleskop “Hot Spot”

At the Bleskop Tar Dams soils recovered from beneath the central section of Tar Dam B (TP6 BOTTOM) recorded Total Oil and Grease as well as EPH concentrations above laboratory detection limits. Whilst the hydrocarbon concentrations is considered a result of the impacts associated with the tar dam, the concentrations are marginal and fall below SSV for industrial sites and therefore are considered unlikely to impact on human health and the environment.

5.2.2 TESMO “Hot Spot”

The ‘hot spot’ at the TESMO Tar Dams was recorded in the sample recovered from the top clay soil horizon to the north of Tar Dam C (TP10 TOP). EPH concentrations are similar to those recorded at the Bleskop Tar Dam (TP6 BOTTOM) and as such, whilst indicative of impacts from the tar dams, the contaminant concentrations fall below SSV guidelines and are considered to be of limited concern.

The Total Oil and Grease concentration of 1,600 mg/kg recorded in the sample collected from the top clay horizon is significant. In this regard a typical target “clean up” value for remediation may range between 50 mg/kg and 1,000 mg/kg depending upon the hydrocarbon range present and the requirements of the local authorities. This would suggest further excavation works should be undertaken in the vicinity of TP10 to the north of Tar Dam C to remove the potentially contaminated soils.

5.2.3 Interior of Tar Pits

Visual inspection of the excavated tar dam pits identified a number of locations within the sidewalls of the pits where tar residue can be seen seeping out of the walls of the pits. The seepage of tar residue back into the excavated tar dams is a result of the reduction of pressure of the tar material on the tar dam walls. Whilst the tar dams were full the fluid pressure forced the tar into fractures and micro-fractures within the dam walls. Once the pressure was removed the tar residue could flow out of the fractures back into the tar pit, thus giving the impression of tar “leaking” into the pit.

This residual tar residue seeping back into the excavated tar pits is of concern and will require further excavation into the tar dam walls to remove the contaminated soil.

5.3 Heavy Metal Concentration

A number of potentially hazardous heavy metals were recorded in the soils sampled in the vicinity of the tar dams. Mercury is the only metal that was recorded at concentrations marginally above SSV. The remaining metals within the soils were recorded as trace elements within the soil with the exception of the major rock forming metals; aluminium, silicon, calcium, iron and magnesium.

Elevated mercury concentrations were recorded in the BOTTOM weathered soil horizon across both the Bleskop and TESMO Tar Dam sites. No elevated mercury was identified in the clay soil horizons and it is therefore considered that the elevated levels of mercury may reflect natural geological background levels rather than contamination.

6 Conclusions and Recommendations

6.1 Conclusions

6.1.1 Summary

The sites represented clay lined pits that were previously used for the temporary storage of processed tar.

An intrusive investigation has identified sites that are underlain by clay resting upon Norite. It appears that the tar dams were formed by excavating into the underlying clay to create pits with the remnant clay material forming the sides of the dams. The upper side material was exposed and subject to the weathering which allowed for small cracks to form which subsequently allowed for some shallow penetration of waste tar into the nearby soils. However, the extent of this penetration is extremely limited and it is considered that the clay has been extremely effective in maintaining the waste material in place.

The investigation focused upon identifying the possible extent of hydrocarbon contamination in the areas surrounding the former tar dams and assessing whether such contamination could be remediated through the use of bio-remediation.

The investigation identified that any spread of hydrocarbon contamination outside of the footprint of the former tar dams is extremely limited and that the sidewalls and base of the tar dams were effective in limiting the potential loss of hydrocarbons into the surrounding soils. In this regard only two hot spots with elevated levels of total oil and grease were identified. The investigation confirmed that hydrocarbons are present in the soil in the most part as a heavy tar fraction but also that elevated levels of hydrocarbons in the C6 to C35 range are also present. With regards to the latter the samples obtained did not exhibit concentrations above industrial acceptable standards but were useful in determining the probable distribution of hydrocarbon chains within any more concentrated soils that are stockpiled on site.

It is considered that the investigation area is impacted but does not present an immediate risk as most of the source material has been removed. However, measures are required to fully define and address the management of the remaining soils.

6.1.2 Contamination Assessment

6.1.2.1 Extent of Contamination

Chemical analysis does not indicate that there is extensive hydrocarbon contamination outside of the immediate area of the former tar dams. Rather only localised hotspots have been identified in two locations. Where contamination was identified it was in the form of elevated Total Oil and Grease.

During the intrusive investigation visual evidence of heavy tar hydrocarbon contamination in some of the former embankments surrounding the pits was noted; however the extent of this contamination is not considered to be extensive and is assumed at this point that any penetration of the tar based hydrocarbons is limited to a nominal 0.5m to 1m. To the north of Tar Dam C contamination was noted extending 3m beyond the edge of the tar dam however this is not considered to be "penetration" but rather a result of overspill during discharge of oil to the site.

6.1.2.2 Future Excavation

It is recommended that where obvious signs of contamination are present that the soils that formed the sidewalls around the pits should be locally excavated out and chased back to a distance where no obvious hydrocarbon contamination is evident.

Significant volumes of soil have already been removed from site and based upon worst case scenario where all the clay material around the tar dams has obvious signs of contamination it is currently estimated that 780m^3 of soil may be affected by hydrocarbon contamination (**Table 16**).

Table 16: Breakdown of Potential Areas for Excavation

Target Area	Soils requiring further works	Volume
Bleskop Tar Dams	Entire Central Divide Between Tar Dams A and B (40m x1m x 1.5m)	60m^3
	Outer perimeter of Tar Dams A and B (240m x 1m x 1.5m)	360m^3
TESMO Tar Dam	Northern extension and perimeter of Tar Dam C (40m x 3m x1.5m and 120m x 1m x1.5m)	360m^3
	Tar Dam D no further excavation anticipated at this time	-
	Total Volume of Soil	**780m^3**

6.1.2.3 Groundwater

There is no evidence of groundwater flow resulting in movement of hydrocarbons. Basic quantitative risk assessments have indicated that there are no significant impacts to groundwater or surface waters.

6.1.3 Working Remediation and Rehabilitation Solution

Consideration should be given to the following working remediation and rehabilitation solution:

1. Separation of the heavy tar fractions by screening and sieving.
2. Removal from site as hazardous waste of the separated heavy tar fraction.
3. Undertake extended chemical analysis on separated soils to determine range of hydrocarbons remaining present.
4. Should subsequent chemical testing of the separated soils confirm that elevated TPH is present in the C6 to C35 fraction and that such levels are above acceptable limits then consideration could be given to offsite removal or ex-situ bioremediation by Composting (soil banking) or Engineered Biopiling. Both bioremediation options would involve excavation of the contaminated soil and placement of long windrows. The options differ in that Engineered Biopiling aims to optimise the biodegradation process in part by the installation of linked pipes that allow for controlled air movement through the windrows to ensure complete aeration. However, bioremediation in this instance may prove to be difficult and time consuming as the contamination is present within clay soils which can limit the diffusion of oxygen and water and prevent even aeration and uniform nutrient distribution.
5. Engineer remediated soils into place and rehabilitate the site (subject to environmental approval).

6.1.4 Bench Testing

In order to determine if bioremediation is effective and in order to facilitate production of a remediation and rehabilitation strategy document it is recommended that monies previously allowed for possible drilling to assess groundwater contamination be used instead to undertake additional testing for possible contaminants and limited bench testing that includes for an assessment of potential for germination. Bench testing would involve obtaining additional samples of excavated and stockpiled material and subjecting the soils to a range of land capability scenarios (i.e. nutrient and fertigations potentials) under varying environmental conditions.

Upon completion of the bench testing it should be possible to produce a single document that includes engineering recommendations for remediation and rehabilitation.

6.1.5 Offsite Waste Disposal

It should be noted that any material removed from site is likely to be classed as waste and subject to appropriate levels of disposal costs. Prior to disposal the landfill operator will require test certificates to identify the type of waste and confirm that it is permitted to accept the waste. The waste would be classified as inert, hazardous or non-hazardous. Careful monitoring of the soils during excavation may allow for the separation of contaminated soils and inert material with the potential for a reduction in actual disposal costs.

6.1.6 Recommendations

This investigation has confirmed that hydrocarbons are present in some locations immediately adjacent to the tar pits and that the soils that are present are within a range where bioremediation is considered possible.

In order to finalise a remediation and rehabilitation strategy it is necessary that additional testing be undertaken to determine the full range and type of hydrocarbon products that may be present in the site soils and excavated soils.

Therefore, we recommend the following:

- Using available monies to undertake additional sampling, chemical analysis and bench testing of excavated and stockpiled material to confirm best possible remediation solution.
  - Include analysis for a more extensive range of possible hydrocarbon based contaminants.
  - This will fully characterise the site with respect to possible contamination.
- Finalise initial working Remediation and Rehabilitation Strategy Document.
  - Solution to be based upon bench testing and site trials.
  - Report to consider opportunities for retaining soil materials on site.
  - Such is expected to be represent a finalisation and improvement upon the current Working Remediation and Rehabilitation Solution (Section 6.1.3)

Appendices

Appendix A – Site Photographs

Appendix B – Trial Pit Logs

Appendix C – Laboratory Test Results

Appendix A – Site Photographs

Bleskop Tar Dams

Plate 1. View of decommissioning works (South East)

Plate 2. View of decommissioning works and excavated material (South)

Plate 3. View of decommissioning works (South West)

Plate 4. View of decommissioning works (West South West)

Plate 5. View of decommissioning works on Tar Dam A (South)

Plate 6. View of decommissioning works on Tar Dam B (south East)

Plate 7. View of tar residue seeping out of pit wall on Tar Dam B (East)

Plate 8. View of tar residue seeping out of pit wall on Tar Dam B (East)

Plate 9. View of tar residue seeping out of pit wall on Tar Dam B (South)

Plate 10. View of tar residue seeping out of pit wall on Tar Dam A (South)

Plate 11. View of tar residue seeping out of pit wall on Tar Dam A (West)

TESMO Tar Dams

Plate 12. View of Tar Dam C (South West)

Plate 12. View of Tar Dam C (North West)

Plate 12. View of Tar Dam C Floor (West)

Appendix B – Trial Pit Logs

SOIL PROFILE

PROJECT: RBMR Tar Pit Assessment

PROJECT NO: 28470

LOGGED BY: Adam Smith

METHOD OF INVESTIGATION: Trial hole

DATE: 27 March 2012

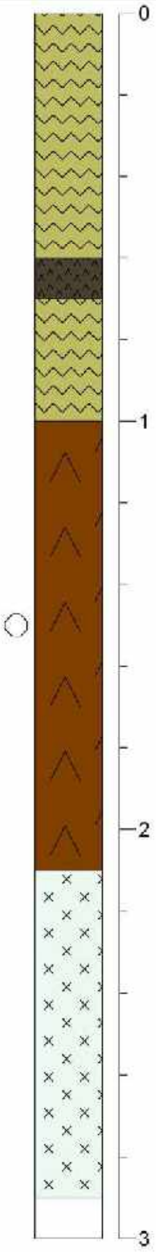
HOLE NO:TP1

HOLE COORDINATES (Lat , Long):(-25.697175°, 27.358499°)

Coordinates based on visual positioning only

WSP ENVIRONMENTAL

DEPTH (m)	DESCRIPTIONS



Dry, light grey/brown, stiff, made ground

Dry, brown, loose, Fine Sand and organic matter

Dry, brown, loose, gravel and pebbles, made ground

Slightly moist to dry, dark brown, soft to stiff, Clay

Slightly moist, white to off white, weathered Norite

NOTE: -

○ DISTURBED SAMPLE ☐ UNDISTURBED SAMPLE ▼ WATER TABLE ▽ PERCHED WATER TABLE

SOIL PROFILE

PROJECT: RBMR Tar Pit Assessment
PROJECT NO: 28470
LOGGED BY: Adam Smith
METHOD OF INVESTIGATION: Trial hole

DATE: 27 March 2012
HOLE NO: TP2
HOLE COORDINATES (Lat , Long): (-25.697200°, 27.358945°)
Coordinates based on visual positioning only

DEPTH (m)	DESCRIPTIONS
0	Dry, light grey/brown, stiff, made ground
	Dry, brown, loose, Fine Sand and organic matter
	Slightly moist to dry, dark brown, soft to stiff, Clay
1	
	Slightly moist, white to off white, weathered Norite
2	
3	

NOTE: -

○ DISTURBED SAMPLE ☐ UNDISTURBED SAMPLE ▼ WATER TABLE ▽ PERCHED WATER TABLE

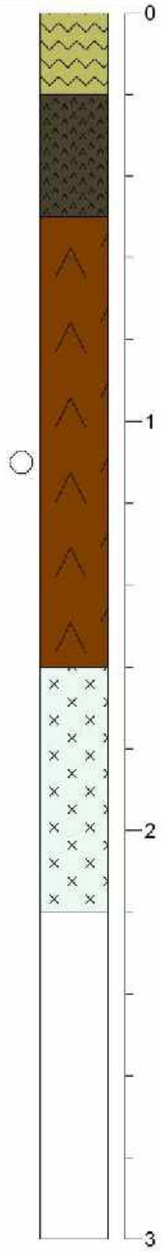
SOIL PROFILE

PROJECT: RBMR Tar Pit Assessment
PROJECT NO: 28470
LOGGED BY: Adam Smith
METHOD OF INVESTIGATION: Trial hole

DATE: 27 March 2012
HOLE NO: TP3
HOLE COORDINATES (Lat, Long): (-25.697420°, 27.358200°)
Coordinates based on visual positioning only

WSP ENVIRONMENTAL

DEPTH (m)	DESCRIPTIONS



Dry, light grey/brown, stiff, made ground

Dry, brown, loose, Fine Sand and organic matter

Slightly moist to dry, dark brown, soft to stiff, Clay

Slightly moist, white to off white, weathered Norite

NOTE: -

○ DISTURBED SAMPLE   □ UNDISTURBED SAMPLE   ▼ WATER TABLE   ▽ PERCHED WATER TABLE

SOIL PROFILE

PROJECT: RBMR Tar Pit Assessment

PROJECT NO: 28470

LOGGED BY: Adam Smith

METHOD OF INVESTIGATION: Trial hole

DATE: 27 March 2012

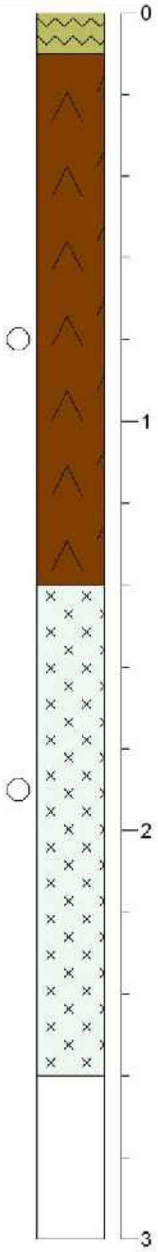
HOLE NO:TP4

HOLE COORDINATES (Lat , Long):(-25.697742°, 27.358389°)

Coordinates based on visual positioning only

ENVIRONMENTAL

DEPTH (m)	DESCRIPTIONS



Dry, light grey/brown, stiff, made ground

Slightly moist to dry, dark brown, soft to stiff, Clay

Slightly moist, white to off white, weathered Norite

NOTE: -

○ DISTURBED SAMPLE ☐ UNDISTURBED SAMPLE ▼ WATER TABLE ▽ PERCHED WATER TABLE

SOIL PROFILE

PROJECT: RBMR Tar Pit Assessment

PROJECT NO: 28470

LOGGED BY: Adam Smith

METHOD OF INVESTIGATION: Trial hole

DATE: 27 March 2012

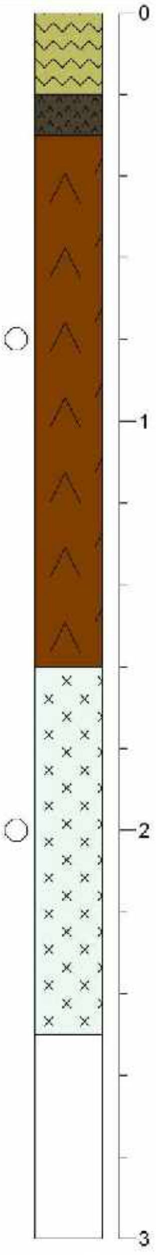
HOLE NO:TP5

HOLE COORDINATES (Lat , Long):(-25.697793°, 27.358818°)

Coordinates based on visual positioning only

WSP ENVIRONMENTAL

DEPTH (m)	DESCRIPTIONS
0	Dry, light grey/brown, stiff, made ground
	Dry, brown, loose, Fine Sand and organic matter
	Slightly moist to dry, dark brown, soft to stiff, Clay
	Slightly moist, white to off white, weathered Norite



NOTE: -

◯ DISTURBED SAMPLE ☐ UNDISTURBED SAMPLE ▼ WATER TABLE ▽ PERCHED WATER TABLE

SOIL PROFILE

PROJECT: RBMR Tar Pit Assessment

PROJECT NO: 28470

LOGGED BY: Adam Smith

METHOD OF INVESTIGATION: Trial hole

DATE: 27 March 2012

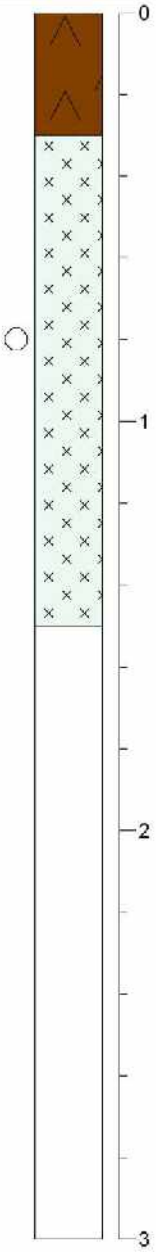
HOLE NO:TP6

HOLE COORDINATES (Lat , Long):(-25.697500°, 27.358928°)

Coordinates based on visual positioning only

WSP ENVIRONMENTAL

DEPTH (m)	DESCRIPTIONS



Slightly moist to dry, dark brown, soft to stiff, Clay

Slightly moist, white to off white, weathered Norite

NOTE: -

◯ DISTURBED SAMPLE ☐ UNDISTURBED SAMPLE ▼ WATER TABLE ▽ PERCHED WATER TABLE

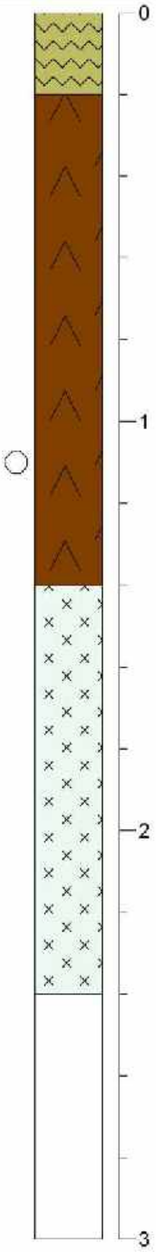
SOIL PROFILE

PROJECT: RBMR Tar Pit Assessment
PROJECT NO: 28470
LOGGED BY: Adam Smith
METHOD OF INVESTIGATION: Trial hole

DATE: 27 March 2012
HOLE NO:TP8
HOLE COORDINATES (Lat , Long):(-25.699030°, 27.368410°)
Coordinates based on visual positioning only

WSP ENVIRONMENTAL

DEPTH (m)	DESCRIPTIONS
0	Dry, grey brown, loose, gravel and pebbles, made ground
	Slightly moist to dry, dark brown, soft to stiff, Clay
	Slightly moist, white to off white, weathered Norite



NOTE: -

○ DISTURBED SAMPLE ☐ UNDISTURBED SAMPLE ▼ WATER TABLE ▽ PERCHED WATER TABLE

SOIL PROFILE

PROJECT: RBMR Tar Pit Assessment

PROJECT NO: 28470

LOGGED BY: Adam Smith

METHOD OF INVESTIGATION: Trial hole

DATE: 27 March 2012

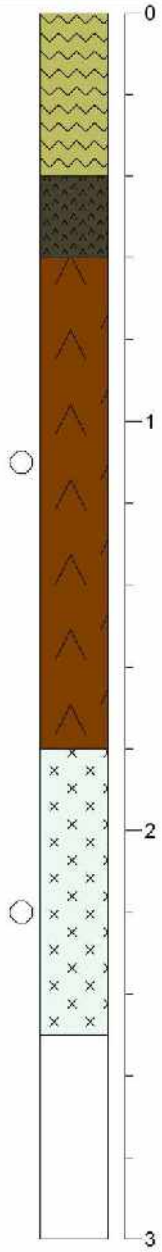
HOLE NO:TP9

HOLE COORDINATES (Lat , Long):(-25.698647°, 27.368443°)

Coordinates based on visual positioning only

WSP ENVIRONMENTAL

DEPTH (m)	DESCRIPTIONS



Dry, grey brown, loose, gravel and pebbles, made ground

Dry, brown, loose, Fine Sand and organic matter

Slightly moist to dry, dark brown, soft to stiff, Clay

Slightly moist, white to off white, weathered Norite

NOTE: -

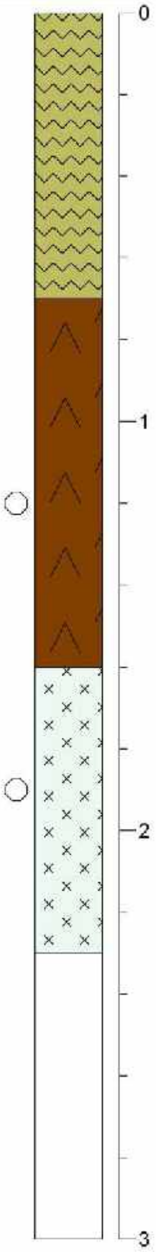
○ DISTURBED SAMPLE ☐ UNDISTURBED SAMPLE ▼ WATER TABLE ▽ PERCHED WATER TABLE

SOIL PROFILE

PROJECT: RBMR Tar Pit Assessment
PROJECT NO: 28470
LOGGED BY: Adam Smith
METHOD OF INVESTIGATION: Trial hole

DATE: 27 March 2012
HOLE NO:TP10
HOLE COORDINATES (Lat , Long):(-25.698389°, 27.368269°)
Coordinates based on visual positioning only

DEPTH (m)	DESCRIPTIONS



Dry, grey brown, loose, gravel and pebbles, made ground

Slightly moist to dry, dark brown, soft to stiff, Clay

Slightly moist, white to off white, weathered Norite

NOTE: -

○ DISTURBED SAMPLE ☐ UNDISTURBED SAMPLE ▼ WATER TABLE ▽ PERCHED WATER TABLE

SOIL PROFILE

PROJECT: RBMR Tar Pit Assessment

PROJECT NO: 28470

LOGGED BY: Adam Smith

METHOD OF INVESTIGATION: Trial hole

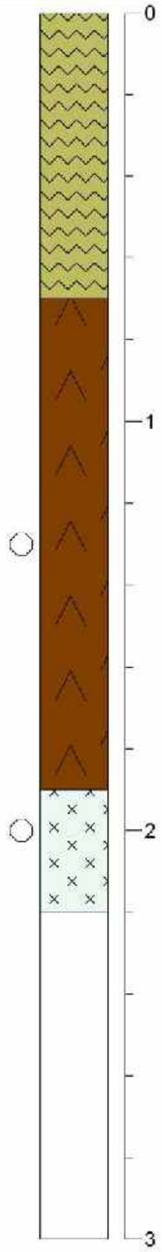
DATE: 27 March 2012

HOLE NO:TP12

HOLE COORDINATES (Lat , Long):(-25.699070°, 27.367622°)

Coordinates based on visual positioning only

DEPTH (m)	DESCRIPTIONS



Dry, grey brown, loose, gravel and pebbles, made ground

Slightly moist to dry, dark brown, soft to stiff, Clay

Slightly moist, white to off white, weathered Norite

NOTE: -

○ DISTURBED SAMPLE ☐ UNDISTURBED SAMPLE ▼ WATER TABLE ▽ PERCHED WATER TABLE

SOIL PROFILE

PROJECT: RBMR Tar Pit Assessment

PROJECT NO: 28470

LOGGED BY: Adam Smith

METHOD OF INVESTIGATION: Trial hole

DATE: 27 March 2012

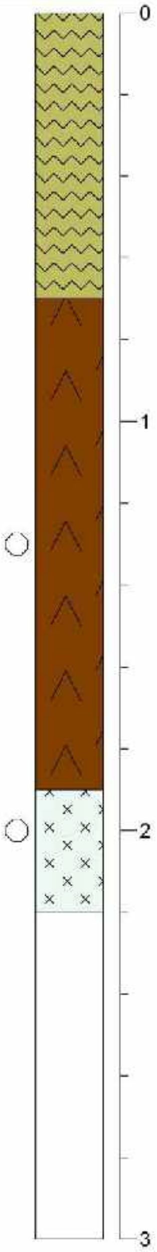
HOLE NO: TP12

HOLE COORDINATES (Lat , Long):(-25.699070°, 27.367622°)

Coordinates based on visual positioning only

WSP ENVIRONMENTAL

DEPTH (m)	DESCRIPTIONS
0	Dry, grey brown, loose, gravel and pebbles, made ground
	Slightly moist to dry, dark brown, soft to stiff, Clay
	Slightly moist, white to off white, weathered Norite



NOTE: -

○ DISTURBED SAMPLE ☐ UNDISTURBED SAMPLE ▼ WATER TABLE ▽ PERCHED WATER TABLE

Appendix C – Certificate of Analytical Results

UIS ORGANIC LABORATORY

UIS Organic Laboratory (Pty) Ltd ▪ Reg. No. 2007/001896/07
VAT No 4340243221
Unit 3 Carrera House ▪ 17 Sovereign St ▪
Route 21 Office Park ▪ Irene ▪ 0062
Tel. +27 83 3098373
willieh@uisol.co.za ▪ http://www.uisol.co.za

CLIENT INFORMATION

WSP Environmental (Pty) Ltd
Attention: Adam Smith
PO Box 5384, Attention Accounts
Rivonia

Analysis Report

Lab No : 5212 B

TEST INFORMATION DETERMINATION OF TOX in VOCs and SVOCs USING SPME GC-MS

ANALYTICAL METHOD: SPME Extraction and GC-MS   METHOD Number: UISOL-T-012
DATE RECEIVED 4/4/2012   DATE COMPLETED 4/12/2012   DATE ISSUED 4/18/2012

SAMPLE INFORMATION   Matrix: **Soil**
SAMPLE No **TP1 Top**   Project number 28470
CONTAINER TYPE Glass   Sample dilution Factor 20

VOLATILE ORGANOHALOGENS (VOCs)

Bromoform	<100 ug/kg
Chloroform	<100 ug/kg
Carbon tetrachloride	<100 ug/kg
Trichloroethene (TCE)	<40 ug/kg
Dibromomethane	<200 ug/kg
Dichloromethane	<200 ug/kg
Bromochloromethane	<200 ug/kg
Bromodichloromethane	<200 ug/kg
Dibromochloromethane	<40 ug/kg
1,2 Dibromoethane	<40 ug/kg
Tetrachloroethene	<40 ug/kg
1,1,1 Trichloroethane	<100 ug/kg
1,2,3 Trichloropropane	<200 ug/kg
1,1,2,2 Tetrachloroethane	<200 ug/kg
2 Chlorotoluene	<40 ug/kg
4 Chlorotoluene	<40 ug/kg
Hexachlorobutadiene	<40 ug/kg
1,3 Dibromo-3-chloropropane	<40 ug/kg

PHENOLIC HALOGENS

2-Chlorophenol	<1 ug/kg
2,4-Dichlorophenol	<1 ug/kg
Pentachlorophenol	<1 ug/kg
4-Chloro-3-methylphenol	<1 ug/kg

SEMI-VOLATILE ORGANOHALOGENS (SVOCs

2-Chloronaphthalene	<20 ug/kg
Hexachlorobenzene	<20 ug/kg
Hexachloroethane	<20 ug/kg
1,2,4 Trichlorobenzene	<20 ug/kg
4-Chlorophenylphenyl ether	<20 ug/kg
4-Bromophenylphenyl ether	<20 ug/kg

CHLOROBENZENES

Bromobenzene	<40 ug/kg
Monochlorobenzene	<40 ug/kg
1,2 Dichlorobenzene	<40 ug/kg
1,3 Dichlorobenzene	<40 ug/kg
1,4 Dichlorobenzene	<40 ug/kg
1,2,4 Trichlorobenzene	<40 ug/kg
1,2,3 Trichlorobenzene	<40 ug/kg

TOTAL ORGANOHALOGENS (PHENOLS, VOCs SVOCs) <1000 ug/kg

Authorised Signatory :
WJ Havenga
Laboratory Manager

4/18/2012

UIS ORGANIC LABORATORY
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Route 21 Office Park • Irene • 0062
Tel. +27 83 3098373
willieh@uisol.co.za • http://www.uisol.co.za

CLIENT INFORMATION

WSP Environmental (Pty) Ltd
Attention: Adam Smith
PO Box 5384, Attention Accounts
Rivonia

Analysis Report

Lab No : 5212 B

TEST INFORMATION **DETERMINATION OF TOX in VOCs and SVOCs USING SPME GC-MS**

ANALYTICAL METHOD: SPME Extraction and GC-MS METHOD Number: UISOL-T-012
DATE RECEIVED 4/4/2012 DATE COMPLETED 4/12/2012 DATE ISSUED 4/18/2012

SAMPLE INFORMATION **Matrix:** **Soil**
SAMPLE No **TP10 Top** **Project number** 28470
CONTAINER TYPE Glass **Sample dilution Factor** 20

VOLATILE ORGANOHALOGENS (VOCs)

Bromoform	<100 ug/kg
Chloroform	<100 ug/kg
Carbon tetrachloride	<100 ug/kg
Trichloroethene (TCE)	<40 ug/kg
Dibromomethane	<200 ug/kg
Dichloromethane	<200 ug/kg
Bromochloromethane	<200 ug/kg
Bromodichloromethane	<200 ug/kg
Dibromochloromethane	<40 ug/kg
1,2 Dibromoethane	<40 ug/kg
Tetrachloroethene	<40 ug/kg
1,1,1 Trichloroethane	<100 ug/kg
1,2,3 Trichloropropane	<200 ug/kg
1,1,2,2 Tetrachloroethane	<200 ug/kg
2 Chlorotoluene	<40 ug/kg
4 Chlorotoluene	<40 ug/kg
Hexachlorobutadiene	<40 ug/kg
1,3 Dibromo-3-chloropropane	<40 ug/kg

PHENOLIC HALOGENS

2-Chlorophenol	<1 ug/kg
2,4-Dichlorophenol	<1 ug/kg
Pentachlorophenol	<1 ug/kg
4-Chloro-3-methylphenol	<1 ug/kg

SEMI-VOLATILE ORGANOHALOGENS (SVOCs

2-Chloronaphthalene	<20 ug/kg
Hexachlorobenzene	<20 ug/kg
Hexachloroethane	<20 ug/kg
1,2,4 Trichlorobenzene	<20 ug/kg
4-Chlorophenylphenyl ether	<20 ug/kg
4-Bromophenylphenyl ether	<20 ug/kg

CHLOROBENZENES

Bromobenzene	<40 ug/kg
Monochlorobenzene	<40 ug/kg
1,2 Dichlorobenzene	<40 ug/kg
1,3 Dichlorobenzene	<40 ug/kg
1,4 Dichlorobenzene	<40 ug/kg
1,2,4 Trichlorobenzene	<40 ug/kg
1,2,3 Trichlorobenzene	<40 ug/kg

TOTAL ORGANOHALOGENS (PHENOLS, VOCs SVOCs) **<1000 ug/kg**

Authorised Signatory :
WJ Havenga
Laboratory Manager

4/18/2012

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CLIENT INFORMATION

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Rivonia

Analysis Report

Lab No : 5212 B

TEST INFORMATION **DETERMINATION OF TOX in VOCs and SVOCs USING SPME GC-MS**

ANALYTICAL METHOD: SPME Extraction and GC-MS   METHOD Number: UISOL-T-012
DATE RECEIVED 4/4/2012   DATE COMPLETED 4/12/2012   DATE ISSUED 4/18/2012

SAMPLE INFORMATION   Matrix: **Soil**
SAMPLE No **TP3 Top**   Project number 28470
CONTAINER TYPE Glass   Sample dilution Factor 20

VOLATILE ORGANOHALOGENS (VOCs)

Bromoform	<100 ug/kg
Chloroform	<100 ug/kg
Carbon tetrachloride	<100 ug/kg
Trichloroethene (TCE)	<40 ug/kg
Dibromomethane	<200 ug/kg
Dichloromethane	<200 ug/kg
Bromochloromethane	<200 ug/kg
Bromodichloromethane	<200 ug/kg
Dibromochloromethane	<40 ug/kg
1,2 Dibromoethane	<40 ug/kg
Tetrachloroethene	<40 ug/kg
1,1,1 Trichloroethane	<100 ug/kg
1,2,3 Trichloropropane	<200 ug/kg
1,1,2,2 Tetrachloroethane	<200 ug/kg
2 Chlorotoluene	<40 ug/kg
4 Chlorotoluene	<40 ug/kg
Hexachlorobutadiene	<40 ug/kg
1,3 Dibromo-3-chloropropane	<40 ug/kg

PHENOLIC HALOGENS

2-Chlorophenol	<1 ug/kg
2,4-Dichlorophenol	<1 ug/kg
Pentachlorophenol	<1 ug/kg
4-Chloro-3-methylphenol	<1 ug/kg

SEMI-VOLATILE ORGANOHALOGENS (SVOCs

2-Chloronaphthalene	<20 ug/kg
Hexachlorobenzene	<20 ug/kg
Hexachloroethane	<20 ug/kg
1,2,4 Trichlorobenzene	<20 ug/kg
4-Chlorophenylphenyl ether	<20 ug/kg
4-Bromophenylphenyl ether	<20 ug/kg

CHLOROBENZENES

Bromobenzene	<40 ug/kg
Monochlorobenzene	<40 ug/kg
1,2 Dichlorobenzene	<40 ug/kg
1,3 Dichlorobenzene	<40 ug/kg
1,4 Dichlorobenzene	<40 ug/kg
1,2,4 Trichlorobenzene	<40 ug/kg
1,2,3 Trichlorobenzene	<40 ug/kg

TOTAL ORGANOHALOGENS (PHENOLS, VOCs SVOCs) **<1000 ug/kg**

Authorised Signatory :
WJ Havenga
Laboratory Manager

4/18/2012

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Rivonia

Analysis Report

Lab No : 5212 B

TEST INFORMATION **DETERMINATION OF TOX in VOCs and SVOCs USING SPME GC-MS**

ANALYTICAL METHOD: SPME Extraction and GC-MS METHOD Number: UISOL-T-012
DATE RECEIVED 4/4/2012 DATE COMPLETED 4/12/2012 DATE ISSUED 4/18/2012

SAMPLE INFORMATION **Matrix:** **Soil**
SAMPLE No **TP4 Bottom** **Project number** 28470
CONTAINER TYPE Glass **Sample dilution Factor** 20

VOLATILE ORGANOHALOGENS (VOCs)

Bromoform	<100 ug/kg
Chloroform	<100 ug/kg
Carbon tetrachloride	<100 ug/kg
Trichloroethene (TCE)	<40 ug/kg
Dibromomethane	<200 ug/kg
Dichloromethane	<200 ug/kg
Bromochloromethane	<200 ug/kg
Bromodichloromethane	<200 ug/kg
Dibromochloromethane	<40 ug/kg
1,2 Dibromoethane	<40 ug/kg
Tetrachloroethene	<40 ug/kg
1,1,1 Trichloroethane	<100 ug/kg
1,2,3 Trichloropropane	<200 ug/kg
1,1,2,2 Tetrachloroethane	<200 ug/kg
2 Chlorotoluene	<40 ug/kg
4 Chlorotoluene	<40 ug/kg
Hexachlorobutadiene	<40 ug/kg
1,3 Dibromo-3-chloropropane	<40 ug/kg

PHENOLIC HALOGENS

2-Chlorophenol	<1 ug/kg
2,4-Dichlorophenol	<1 ug/kg
Pentachlorophenol	<1 ug/kg
4-Chloro-3-methylphenol	<1 ug/kg

SEMI-VOLATILE ORGANOHALOGENS (SVOCs

2-Chloronaphthalene	<20 ug/kg
Hexachlorobenzene	<20 ug/kg
Hexachloroethane	<20 ug/kg
1,2,4 Trichlorobenzene	<20 ug/kg
4-Chlorophenylphenyl ether	<20 ug/kg
4-Bromophenylphenyl ether	<20 ug/kg

CHLOROBENZENES

Bromobenzene	<40 ug/kg
Monochlorobenzene	<40 ug/kg
1,2 Dichlorobenzene	<40 ug/kg
1,3 Dichlorobenzene	<40 ug/kg
1,4 Dichlorobenzene	<40 ug/kg
1,2,4 Trichlorobenzene	<40 ug/kg
1,2,3 Trichlorobenzene	<40 ug/kg

TOTAL ORGANOHALOGENS (PHENOLS, VOCs SVOCs) **<1000 ug/kg**

Authorised Signatory :
WJ Havenga
Laboratory Manager

4/18/2012

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Rivonia

Analysis Report

Lab No : 5212 B

TEST INFORMATION **DETERMINATION OF TOX in VOCs and SVOCs USING SPME GC-MS**

ANALYTICAL METHOD: SPME Extraction and GC-MS   METHOD Number: UISOL-T-012
DATE RECEIVED 4/4/2012   DATE COMPLETED 4/12/2012   DATE ISSUED 4/18/2012

SAMPLE INFORMATION   Matrix: **Soil**
SAMPLE No **TP4 Top**   Project number 28470
CONTAINER TYPE Glass   Sample dilution Factor 20

VOLATILE ORGANOHALOGENS (VOCs)

Bromoform	<100 ug/kg
Chloroform	<100 ug/kg
Carbon tetrachloride	<100 ug/kg
Trichloroethene (TCE)	<40 ug/kg
Dibromomethane	<200 ug/kg
Dichloromethane	<200 ug/kg
Bromochloromethane	<200 ug/kg
Bromodichloromethane	<200 ug/kg
Dibromochloromethane	<40 ug/kg
1,2 Dibromoethane	<40 ug/kg
Tetrachloroethene	<40 ug/kg
1,1,1 Trichloroethane	<100 ug/kg
1,2,3 Trichloropropane	<200 ug/kg
1,1,2,2 Tetrachloroethane	<200 ug/kg
2 Chlorotoluene	<40 ug/kg
4 Chlorotoluene	<40 ug/kg
Hexachlorobutadiene	<40 ug/kg
1,3 Dibromo-3-chloropropane	<40 ug/kg

PHENOLIC HALOGENS

2-Chlorophenol	<1 ug/kg
2,4-Dichlorophenol	<1 ug/kg
Pentachlorophenol	<1 ug/kg
4-Chloro-3-methylphenol	<1 ug/kg

SEMI-VOLATILE ORGANOHALOGENS (SVOCs

2-Chloronaphthalene	<20 ug/kg
Hexachlorobenzene	<20 ug/kg
Hexachloroethane	<20 ug/kg
1,2,4 Trichlorobenzene	<20 ug/kg
4-Chlorophenylphenyl ether	<20 ug/kg
4-Bromophenylphenyl ether	<20 ug/kg

CHLOROBENZENES

Bromobenzene	<40 ug/kg
Monochlorobenzene	<40 ug/kg
1,2 Dichlorobenzene	<40 ug/kg
1,3 Dichlorobenzene	<40 ug/kg
1,4 Dichlorobenzene	<40 ug/kg
1,2,4 Trichlorobenzene	<40 ug/kg
1,2,3 Trichlorobenzene	<40 ug/kg

TOTAL ORGANOHALOGENS (PHENOLS, VOCs SVOCs) <1000 ug/kg

Authorised Signatory :
WJ Havenga
Laboratory Manager

4/18/2012

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Analysis Report

Lab No : 5212 B

TEST INFORMATION **DETERMINATION OF TOX in VOCs and SVOCs USING SPME GC-MS**

ANALYTICAL METHOD: SPME Extraction and GC-MS METHOD Number: UISOL-T-012
DATE RECEIVED 4/4/2012 DATE COMPLETED 4/12/2012 DATE ISSUED 4/18/2012

SAMPLE INFORMATION **Matrix:** **Soil**
SAMPLE No **TP5 Bottom** Project number 28470
CONTAINER TYPE Glass Sample dilution Factor 20

VOLATILE ORGANOHALOGENS (VOCs)

Bromoform	<100 ug/kg
Chloroform	<100 ug/kg
Carbon tetrachloride	<100 ug/kg
Trichloroethene (TCE)	<40 ug/kg
Dibromomethane	<200 ug/kg
Dichloromethane	<200 ug/kg
Bromochloromethane	<200 ug/kg
Bromodichloromethane	<200 ug/kg
Dibromochloromethane	<40 ug/kg
1,2 Dibromoethane	<40 ug/kg
Tetrachloroethene	<40 ug/kg
1,1,1 Trichloroethane	<100 ug/kg
1,2,3 Trichloropropane	<200 ug/kg
1,1,2,2 Tetrachloroethane	<200 ug/kg
2 Chlorotoluene	<40 ug/kg
4 Chlorotoluene	<40 ug/kg
Hexachlorobutadiene	<40 ug/kg
1,3 Dibromo-3-chloropropane	<40 ug/kg

PHENOLIC HALOGENS

2-Chlorophenol	<1 ug/kg
2,4-Dichlorophenol	<1 ug/kg
Pentachlorophenol	<1 ug/kg
4-Chloro-3-methylphenol	<1 ug/kg

SEMI-VOLATILE ORGANOHALOGENS (SVOCs

2-Chloronaphthalene	<20 ug/kg
Hexachlorobenzene	<20 ug/kg
Hexachloroethane	<20 ug/kg
1,2,4 Trichlorobenzene	<20 ug/kg
4-Chlorophenylphenyl ether	<20 ug/kg
4-Bromophenylphenyl ether	<20 ug/kg

CHLOROBENZENES

Bromobenzene	<40 ug/kg
Monochlorobenzene	<40 ug/kg
1,2 Dichlorobenzene	<40 ug/kg
1,3 Dichlorobenzene	<40 ug/kg
1,4 Dichlorobenzene	<40 ug/kg
1,2,4 Trichlorobenzene	<40 ug/kg
1,2,3 Trichlorobenzene	<40 ug/kg

TOTAL ORGANOHALOGENS (PHENOLS, VOCs SVOCs) **<1000 ug/kg**

Authorised Signatory :
WJ Havenga
Laboratory Manager

4/18/2012

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Analysis Report

Lab No : 5212 B

TEST INFORMATION **DETERMINATION OF TOX in VOCs and SVOCs USING SPME GC-MS**

ANALYTICAL METHOD: SPME Extraction and GC-MS METHOD Number: UISOL-T-012
DATE RECEIVED 4/4/2012 DATE COMPLETED 4/12/2012 DATE ISSUED 4/18/2012

SAMPLE INFORMATION Matrix: **Soil**
SAMPLE No **TP6 Bottom** Project number 28470
CONTAINER TYPE Glass Sample dilution Factor 20

VOLATILE ORGANOHALOGENS (VOCs)

Bromoform	<100 ug/kg
Chloroform	<100 ug/kg
Carbon tetrachloride	<100 ug/kg
Trichloroethene (TCE)	<40 ug/kg
Dibromomethane	<200 ug/kg
Dichloromethane	<200 ug/kg
Bromochloromethane	<200 ug/kg
Bromodichloromethane	<200 ug/kg
Dibromochloromethane	<40 ug/kg
1,2 Dibromoethane	<40 ug/kg
Tetrachloroethene	<40 ug/kg
1,1,1 Trichloroethane	<100 ug/kg
1,2,3 Trichloropropane	<200 ug/kg
1,1,2,2 Tetrachloroethane	<200 ug/kg
2 Chlorotoluene	<40 ug/kg
4 Chlorotoluene	<40 ug/kg
Hexachlorobutadiene	<40 ug/kg
1,3 Dibromo-3-chloropropane	<40 ug/kg

PHENOLIC HALOGENS

2-Chlorophenol	<1 ug/kg
2,4-Dichlorophenol	<1 ug/kg
Pentachlorophenol	<1 ug/kg
4-Chloro-3-methylphenol	<1 ug/kg

SEMI-VOLATILE ORGANOHALOGENS (SVOCs

2-Chloronaphthalene	<20 ug/kg
Hexachlorobenzene	<20 ug/kg
Hexachloroethane	<20 ug/kg
1,2,4 Trichlorobenzene	<20 ug/kg
4-Chlorophenylphenyl ether	<20 ug/kg
4-Bromophenylphenyl ether	<20 ug/kg

CHLOROBENZENES

Bromobenzene	<40 ug/kg
Monochlorobenzene	<40 ug/kg
1,2 Dichlorobenzene	<40 ug/kg
1,3 Dichlorobenzene	<40 ug/kg
1,4 Dichlorobenzene	<40 ug/kg
1,2,4 Trichlorobenzene	<40 ug/kg
1,2,3 Trichlorobenzene	<40 ug/kg

TOTAL ORGANOHALOGENS (PHENOLS, VOCs SVOCs) **<1000 ug/kg**

Authorised Signatory :
WJ Havenga
Laboratory Manager

4/18/2012

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Analysis Report

Lab No : 5212 B

TEST INFORMATION **DETERMINATION OF TOX in VOCs and SVOCs USING SPME GC-MS**

ANALYTICAL METHOD: SPME Extraction and GC-MS METHOD Number: UISOL-T-012
DATE RECEIVED 4/4/2012 DATE COMPLETED 4/12/2012 DATE ISSUED 4/18/2012

SAMPLE INFORMATION Matrix: **Soil**
SAMPLE No **TP8 Bottom** Project number 28470
CONTAINER TYPE Glass Sample dilution Factor 20

VOLATILE ORGANOHALOGENS (VOCs)

Bromoform	<100 ug/kg
Chloroform	<100 ug/kg
Carbon tetrachloride	<100 ug/kg
Trichloroethene (TCE)	<40 ug/kg
Dibromomethane	<200 ug/kg
Dichloromethane	<200 ug/kg
Bromochloromethane	<200 ug/kg
Bromodichloromethane	<200 ug/kg
Dibromochloromethane	<40 ug/kg
1,2 Dibromoethane	<40 ug/kg
Tetrachloroethene	<40 ug/kg
1,1,1 Trichloroethane	<100 ug/kg
1,2,3 Trichloropropane	<200 ug/kg
1,1,2,2 Tetrachloroethane	<200 ug/kg
2 Chlorotoluene	<40 ug/kg
4 Chlorotoluene	<40 ug/kg
Hexachlorobutadiene	<40 ug/kg
1,3 Dibromo-3-chloropropane	<40 ug/kg

PHENOLIC HALOGENS

2-Chlorophenol	<1 ug/kg
2,4-Dichlorophenol	<1 ug/kg
Pentachlorophenol	<1 ug/kg
4-Chloro-3-methylphenol	<1 ug/kg

SEMI-VOLATILE ORGANOHALOGENS (SVOCs

2-Chloronaphthalene	<20 ug/kg
Hexachlorobenzene	<20 ug/kg
Hexachloroethane	<20 ug/kg
1,2,4 Trichlorobenzene	<20 ug/kg
4-Chlorophenylphenyl ether	<20 ug/kg
4-Bromophenylphenyl ether	<20 ug/kg

CHLOROBENZENES

Bromobenzene	<40 ug/kg
Monochlorobenzene	<40 ug/kg
1,2 Dichlorobenzene	<40 ug/kg
1,3 Dichlorobenzene	<40 ug/kg
1,4 Dichlorobenzene	<40 ug/kg
1,2,4 Trichlorobenzene	<40 ug/kg
1,2,3 Trichlorobenzene	<40 ug/kg

TOTAL ORGANOHALOGENS (PHENOLS, VOCs SVOCs) **<1000 ug/kg**

Authorised Signatory :
WJ Havenga
Laboratory Manager

4/18/2012

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Rivonia

Analysis Report

Lab No : 5212 B

TEST INFORMATION **DETERMINATION OF TOX in VOCs and SVOCs USING SPME GC-MS**

ANALYTICAL METHOD: SPME Extraction and GC-MS METHOD Number: UISOL-T-012
DATE RECEIVED 4/4/2012 DATE COMPLETED 4/12/2012 DATE ISSUED 4/18/2012

SAMPLE INFORMATION Matrix: **Soil**
SAMPLE No **TP9 Bottom** Project number 28470
CONTAINER TYPE Glass Sample dilution Factor 20

VOLATILE ORGANOHALOGENS (VOCs)

Bromoform	<100 ug/kg
Chloroform	<100 ug/kg
Carbon tetrachloride	<100 ug/kg
Trichloroethene (TCE)	<40 ug/kg
Dibromomethane	<200 ug/kg
Dichloromethane	<200 ug/kg
Bromochloromethane	<200 ug/kg
Bromodichloromethane	<200 ug/kg
Dibromochloromethane	<40 ug/kg
1,2 Dibromoethane	<40 ug/kg
Tetrachloroethene	<40 ug/kg
1,1,1 Trichloroethane	<100 ug/kg
1,2,3 Trichloropropane	<200 ug/kg
1,1,2,2 Tetrachloroethane	<200 ug/kg
2 Chlorotoluene	<40 ug/kg
4 Chlorotoluene	<40 ug/kg
Hexachlorobutadiene	<40 ug/kg
1,3 Dibromo-3-chloropropane	<40 ug/kg

PHENOLIC HALOGENS

2-Chlorophenol	<1 ug/kg
2,4-Dichlorophenol	<1 ug/kg
Pentachlorophenol	<1 ug/kg
4-Chloro-3-methylphenol	<1 ug/kg

SEMI-VOLATILE ORGANOHALOGENS (SVOCs

2-Chloronaphthalene	<20 ug/kg
Hexachlorobenzene	<20 ug/kg
Hexachloroethane	<20 ug/kg
1,2,4 Trichlorobenzene	<20 ug/kg
4-Chlorophenylphenyl ether	<20 ug/kg
4-Bromophenylphenyl ether	<20 ug/kg

CHLOROBENZENES

Bromobenzene	<40 ug/kg
Monochlorobenzene	<40 ug/kg
1,2 Dichlorobenzene	<40 ug/kg
1,3 Dichlorobenzene	<40 ug/kg
1,4 Dichlorobenzene	<40 ug/kg
1,2,4 Trichlorobenzene	<40 ug/kg
1,2,3 Trichlorobenzene	<40 ug/kg

TOTAL ORGANOHALOGENS (PHENOLS, VOCs SVOCs) **<1000 ug/kg**

Authorised Signatory :
WJ Havenga
Laboratory Manager

4/18/2012

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Rivonia

Analysis Report

Lab No : 5212 B

TEST INFORMATION **DETERMINATION OF TOX in VOCs and SVOCs USING SPME GC-MS**

ANALYTICAL METHOD: SPME Extraction and GC-MS METHOD Number: UISOL-T-012
DATE RECEIVED 4/4/2012 DATE COMPLETED 4/12/2012 DATE ISSUED 4/18/2012

SAMPLE INFORMATION Matrix: **Soil**
SAMPLE No **TP9 Top** Project number 28470
CONTAINER TYPE Glass Sample dilution Factor 20

VOLATILE ORGANOHALOGENS (VOCs)

Bromoform	<100 ug/kg
Chloroform	<100 ug/kg
Carbon tetrachloride	<100 ug/kg
Trichloroethene (TCE)	<40 ug/kg
Dibromomethane	<200 ug/kg
Dichloromethane	<200 ug/kg
Bromochloromethane	<200 ug/kg
Bromodichloromethane	<200 ug/kg
Dibromochloromethane	<40 ug/kg
1,2 Dibromoethane	<40 ug/kg
Tetrachloroethene	<40 ug/kg
1,1,1 Trichloroethane	<100 ug/kg
1,2,3 Trichloropropane	<200 ug/kg
1,1,2,2 Tetrachloroethane	<200 ug/kg
2 Chlorotoluene	<40 ug/kg
4 Chlorotoluene	<40 ug/kg
Hexachlorobutadiene	<40 ug/kg
1,3 Dibromo-3-chloropropane	<40 ug/kg

PHENOLIC HALOGENS

2-Chlorophenol	<1 ug/kg
2,4-Dichlorophenol	<1 ug/kg
Pentachlorophenol	<1 ug/kg
4-Chloro-3-methylphenol	<1 ug/kg

SEMI-VOLATILE ORGANOHALOGENS (SVOCs

2-Chloronaphthalene	<20 ug/kg
Hexachlorobenzene	<20 ug/kg
Hexachloroethane	<20 ug/kg
1,2,4 Trichlorobenzene	<20 ug/kg
4-Chlorophenylphenyl ether	<20 ug/kg
4-Bromophenylphenyl ether	<20 ug/kg

CHLOROBENZENES

Bromobenzene	<40 ug/kg
Monochlorobenzene	<40 ug/kg
1,2 Dichlorobenzene	<40 ug/kg
1,3 Dichlorobenzene	<40 ug/kg
1,4 Dichlorobenzene	<40 ug/kg
1,2,4 Trichlorobenzene	<40 ug/kg
1,2,3 Trichlorobenzene	<40 ug/kg

TOTAL ORGANOHALOGENS (PHENOLS, VOCs SVOCs) **<1000 ug/kg**

Authorised Signatory :
WJ Havenga
Laboratory Manager

4/18/2012

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CLIENT INFORMATION

WSP Environmental (Pty) Ltd
Attention: Adam Smith
PO Box 5384, Attention Accounts
Rivonia

Analysis Report

Lab No : 5212 C

TEST INFORMATION **DETERMINATION OF EXTRACTABLE PETROLEUM HYDROCARBONS**

ANALYTICAL METHOD: Solvent Extraction and SPME-GC-M METHOD Number: UISOL-T-012
DATE RECEIVED 4/4/2012 DATE COMPLETED 4/12/2012 DATE ISSUED 4/18/2012

SAMPLE INFORMATION Matrix: **Soil**
SAMPLE No **TP1 Top** Project number 28470

TPH (C10-C12) Aliphatics	**<0.04 mg/kg**
TPH (C12-C16) Aliphatics	**<0.04 mg/kg**
TPH (C16-C21) Aliphatics	**<0.04 mg/kg**
TPH (C21-C30) Aliphatics	**<0.04 mg/kg**
TPH (C30-C35) Aliphatics	**<0.04 mg/kg**
TPH (C35-C40) Aliphatics	**<0.04 mg/kg**
TPH Sum(C10-C40) Aliphatics	**<0.2 mg/kg**

Authorised Signatory : *4/18/2012*
WJ Havenga
Laboratory Manager

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CLIENT INFORMATION
WSP Environmental (Pty) Ltd
Attention: Adam Smith
PO Box 5384, Attention Accounts
Rivonia

Analysis Report

Lab No : 5212 C

TEST INFORMATION **DETERMINATION OF EXTRACTABLE PETROLEUM HYDROCARBONS**

ANALYTICAL METHOD: Solvent Extraction and SPME-GC-M METHOD Number: UISOL-T-012
DATE RECEIVED 4/4/2012 DATE COMPLETED 4/12/2012 DATE ISSUED 4/18/2012

SAMPLE INFORMATION Matrix: **Soil**
SAMPLE No **TP10 Bottom** Project number 28470

TPH (C10-C12) Aliphatics	<0.04 mg/kg
TPH (C12-C16) Aliphatics	<0.04 mg/kg
TPH (C16-C21) Aliphatics	<0.04 mg/kg
TPH (C21-C30) Aliphatics	<0.04 mg/kg
TPH (C30-C35) Aliphatics	<0.04 mg/kg
TPH (C35-C40) Aliphatics	<0.04 mg/kg
TPH Sum(C10-C40) Aliphatics	<0.2 mg/kg

Authorised Signatory : *4/18/2012*
WJ Havenga
Laboratory Manager

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Analysis Report

Lab No : 5212 C

TEST INFORMATION **DETERMINATION OF EXTRACTABLE PETROLEUM HYDROCARBONS**

ANALYTICAL METHOD: Solvent Extraction and SPME-GC-M METHOD Number: UISOL-T-012
DATE RECEIVED 4/4/2012 DATE COMPLETED 4/12/2012 DATE ISSUED 4/18/2012

SAMPLE INFORMATION Matrix: **Soil**
SAMPLE No **TP10 Top** Project number 28470

TPH (C10-C12) Aliphatics	<0.04 mg/kg
TPH (C12-C16) Aliphatics	8.22 mg/kg
TPH (C16-C21) Aliphatics	12.1 mg/kg
TPH (C21-C30) Aliphatics	12.2 mg/kg
TPH (C30-C35) Aliphatics	2.64 mg/kg
TPH (C35-C40) Aliphatics	<0.04 mg/kg
TPH Sum(C10-C40) Aliphatics	35.1 mg/kg

Authorised Signatory : *4/18/2012*
WJ Havenga
Laboratory Manager *Page 3 of 12*

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Analysis Report

Lab No : 5212 C

TEST INFORMATION **DETERMINATION OF EXTRACTABLE PETROLEUM HYDROCARBONS**
ANALYTICAL METHOD: Solvent Extraction and SPME-GC-M METHOD Number: UISOL-T-012
DATE RECEIVED 4/4/2012 DATE COMPLETED 4/12/2012 DATE ISSUED 4/18/2012

SAMPLE INFORMATION Matrix: **Soil**
SAMPLE No **TP12 Top** Project number 28470

TPH (C10-C12) Aliphatics	<0.04 mg/kg
TPH (C12-C16) Aliphatics	<0.04 mg/kg
TPH (C16-C21) Aliphatics	<0.04 mg/kg
TPH (C21-C30) Aliphatics	<0.04 mg/kg
TPH (C30-C35) Aliphatics	<0.04 mg/kg
TPH (C35-C40) Aliphatics	<0.04 mg/kg
TPH Sum(C10-C40) Aliphatics	<0.2 mg/kg

Authorised Signatory : *4/18/2012*
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Lab No : 5212 C

TEST INFORMATION **DETERMINATION OF EXTRACTABLE PETROLEUM HYDROCARBONS**

ANALYTICAL METHOD: Solvent Extraction and SPME-GC-M METHOD Number: UISOL-T-012
DATE RECEIVED 4/4/2012 DATE COMPLETED 4/12/2012 DATE ISSUED 4/18/2012

SAMPLE INFORMATION Matrix: **Soil**
SAMPLE No **TP3 Top** Project number 28470

TPH (C10-C12) Aliphatics	<0.04 mg/kg
TPH (C12-C16) Aliphatics	<0.04 mg/kg
TPH (C16-C21) Aliphatics	<0.04 mg/kg
TPH (C21-C30) Aliphatics	<0.04 mg/kg
TPH (C30-C35) Aliphatics	<0.04 mg/kg
TPH (C35-C40) Aliphatics	<0.04 mg/kg
TPH Sum(C10-C40) Aliphatics	<0.2 mg/kg

Authorised Signatory : *4/18/2012*
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TEST INFORMATION **DETERMINATION OF EXTRACTABLE PETROLEUM HYDROCARBONS**

ANALYTICAL METHOD: Solvent Extraction and SPME-GC-M METHOD Number: UISOL-T-012
DATE RECEIVED 4/4/2012 DATE COMPLETED 4/12/2012 DATE ISSUED 4/18/2012

SAMPLE INFORMATION Matrix: **Soil**
SAMPLE No **TP4 Bottom** Project number 28470

TPH (C10-C12) Aliphatics	<0.04 mg/kg
TPH (C12-C16) Aliphatics	<0.04 mg/kg
TPH (C16-C21) Aliphatics	<0.04 mg/kg
TPH (C21-C30) Aliphatics	<0.04 mg/kg
TPH (C30-C35) Aliphatics	<0.04 mg/kg
TPH (C35-C40) Aliphatics	<0.04 mg/kg
TPH Sum(C10-C40) Aliphatics	<0.2 mg/kg

Authorised Signatory :
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Laboratory Manager

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TEST INFORMATION **DETERMINATION OF EXTRACTABLE PETROLEUM HYDROCARBONS**

ANALYTICAL METHOD: Solvent Extraction and SPME-GC-M METHOD Number: UISOL-T-012
DATE RECEIVED 4/4/2012 DATE COMPLETED 4/12/2012 DATE ISSUED 4/18/2012

SAMPLE INFORMATION Matrix: **Soil**
SAMPLE No **TP4 Top** Project number 28470

TPH (C10-C12) Aliphatics	<0.04 mg/kg
TPH (C12-C16) Aliphatics	<0.04 mg/kg
TPH (C16-C21) Aliphatics	<0.04 mg/kg
TPH (C21-C30) Aliphatics	<0.04 mg/kg
TPH (C30-C35) Aliphatics	<0.04 mg/kg
TPH (C35-C40) Aliphatics	<0.04 mg/kg
TPH Sum(C10-C40) Aliphatics	<0.2 mg/kg

Authorised Signatory :
WJ Havenga
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TEST INFORMATION **DETERMINATION OF EXTRACTABLE PETROLEUM HYDROCARBONS**

ANALYTICAL METHOD: Solvent Extraction and SPME-GC-M METHOD Number: UISOL-T-012
DATE RECEIVED 4/4/2012 DATE COMPLETED 4/12/2012 DATE ISSUED 4/18/2012

SAMPLE INFORMATION Matrix: **Soil**
SAMPLE No **TP5 Bottom** Project number 28470

TPH (C10-C12) Aliphatics	<0.04 mg/kg
TPH (C12-C16) Aliphatics	<0.04 mg/kg
TPH (C16-C21) Aliphatics	<0.04 mg/kg
TPH (C21-C30) Aliphatics	<0.04 mg/kg
TPH (C30-C35) Aliphatics	<0.04 mg/kg
TPH (C35-C40) Aliphatics	<0.04 mg/kg
TPH Sum(C10-C40) Aliphatics	<0.2 mg/kg

Authorised Signatory :
WJ Havenga
Laboratory Manager

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TEST INFORMATION **DETERMINATION OF EXTRACTABLE PETROLEUM HYDROCARBONS**

ANALYTICAL METHOD: Solvent Extraction and SPME-GC-M METHOD Number: UISOL-T-012
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SAMPLE INFORMATION Matrix: **Soil**
SAMPLE No **TP6 Bottom** Project number 28470

TPH (C10-C12) Aliphatics	<0.04 mg/kg
TPH (C12-C16) Aliphatics	3.2 mg/kg
TPH (C16-C21) Aliphatics	7.9 mg/kg
TPH (C21-C30) Aliphatics	4.64 mg/kg
TPH (C30-C35) Aliphatics	<0.04 mg/kg
TPH (C35-C40) Aliphatics	<0.04 mg/kg
TPH Sum(C10-C40) Aliphatics	15.7 mg/kg

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4/18/2012

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TEST INFORMATION **DETERMINATION OF EXTRACTABLE PETROLEUM HYDROCARBONS**

ANALYTICAL METHOD: Solvent Extraction and SPME-GC-M METHOD Number: UISOL-T-012
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SAMPLE INFORMATION Matrix: **Soil**
SAMPLE No **TP8 Bottom** Project number 28470

TPH (C10-C12) Aliphatics	<0.04 mg/kg
TPH (C12-C16) Aliphatics	<0.04 mg/kg
TPH (C16-C21) Aliphatics	<0.04 mg/kg
TPH (C21-C30) Aliphatics	<0.04 mg/kg
TPH (C30-C35) Aliphatics	<0.04 mg/kg
TPH (C35-C40) Aliphatics	<0.04 mg/kg
TPH Sum(C10-C40) Aliphatics	<0.2 mg/kg

Authorised Signatory :
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Laboratory Manager

4/18/2012

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Analysis Report

Lab No : 5212 C

TEST INFORMATION **DETERMINATION OF EXTRACTABLE PETROLEUM HYDROCARBONS**

ANALYTICAL METHOD: Solvent Extraction and SPME-GC-M METHOD Number: UISOL-T-012
DATE RECEIVED 4/4/2012 DATE COMPLETED 4/12/2012 DATE ISSUED 4/18/2012

SAMPLE INFORMATION Matrix: **Soil**
SAMPLE No **TP9 Bottom** Project number 28470

TPH (C10-C12) Aliphatics	<0.04 mg/kg
TPH (C12-C16) Aliphatics	<0.04 mg/kg
TPH (C16-C21) Aliphatics	<0.04 mg/kg
TPH (C21-C30) Aliphatics	<0.04 mg/kg
TPH (C30-C35) Aliphatics	<0.04 mg/kg
TPH (C35-C40) Aliphatics	<0.04 mg/kg
TPH Sum(C10-C40) Aliphatics	<0.2 mg/kg

Authorised Signatory :
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Laboratory Manager

4/18/2012

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Analysis Report

Lab No : 5212 C

TEST INFORMATION **DETERMINATION OF EXTRACTABLE PETROLEUM HYDROCARBONS**

ANALYTICAL METHOD: Solvent Extraction and SPME-GC-M METHOD Number: UISOL-T-012
DATE RECEIVED 4/4/2012 DATE COMPLETED 4/12/2012 DATE ISSUED 4/18/2012

SAMPLE INFORMATION Matrix: **Soil**
SAMPLE No **TP9 Top** Project number 28470

TPH (C10-C12) Aliphatics	<0.04 mg/kg
TPH (C12-C16) Aliphatics	<0.04 mg/kg
TPH (C16-C21) Aliphatics	<0.04 mg/kg
TPH (C21-C30) Aliphatics	<0.04 mg/kg
TPH (C30-C35) Aliphatics	<0.04 mg/kg
TPH (C35-C40) Aliphatics	<0.04 mg/kg
TPH Sum(C10-C40) Aliphatics	<0.2 mg/kg

Authorised Signatory : *4/18/2012*
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Laboratory Manager

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SUPPLEMENT TO TEST REPORT - 5212A

Lab No : 5212A

TEST INFORMATION **TPH Gasoline Range Organics (GRO) - Range C6 - C10**

ANALYTICAL METHOD: SPME Extraction and GC-MS
METHOD Number: UISOL-T-012

DATE RECEIVED 4/4/2012
DATE COMPLETED 4/4/2012
DATE ISSUED 4/18/2012

SAMPLE INFORMATION

Storage conditions in the laboratory is an a Fridge @ < 6 deg C

Matrix: **Soil**

CONTAINER TYPE Glass

Project number 28470

Sample dilution Factor 20

Sample ID	Results
TP1 Top	<0.5 mg/kg
TP10 Bottom	<0.5 mg/kg
TP10 Top	<0.5 mg/kg
TP12 Top	<0.5 mg/kg
TP3 Top	<0.5 mg/kg
TP4 Bottom	<0.5 mg/kg
TP4 Top	<0.5 mg/kg
TP5 Bottom	<0.5 mg/kg
TP6 Bottom	<0.5 mg/kg
TP8 Bottom	<0.5 mg/kg

Authorised Signatory :
WJ Havenga
Laboratory Manager

4/18/2012

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SUPPLEMENT TO TEST REPORT - 5212A

Lab No : 5212A

TEST INFORMATION **TPH Gasoline Range Organics (GRO) - Range C6 - C10**

ANALYTICAL METHOD: SPME Extraction and GC-MS
METHOD Number: UISOL-T-012

DATE RECEIVED 4/4/2012
DATE COMPLETED 4/4/2012
DATE ISSUED 4/18/2012

SAMPLE INFORMATION
Storage conditions in the laboratory is an a Fridge @ < 6 deg C

Matrix: **Soil**

CONTAINER TYPE Glass
Project number 28470
Sample dilution Factor 20

Sample ID	Results
TP9 Bottom	<0.5 mg/kg
TP9 Top	<0.5 mg/kg

Authorised Signatory :
WJ Havenga
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4/18/2012

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Analysis Report

Lab No : 5212 B

TEST INFORMATION **DETERMINATION OF PHENOLS USING SPME GC-MS**
ANALYTICAL METHOD: SPME Extraction and GC-MS-MS METHOD Number: UISOL-T-012
DATE RECEIVED 4/4/2012 DATE COMPLETED 4/12/2012 DATE ISSUED 4/18/2012

SAMPLE INFORMATION Matrix: **Soil**
SAMPLE No **TP1 Top** Project number 28470
CONTAINER TYPE Glass Sample dilution Factor 20

Substance	Results
Phenol	<40 ug/kg
2-Chlorophenol	<20 ug/kg
2-Nitrophenol	<20 ug/kg
2,4-Dichlorophenol	<20 ug/kg
2,6-Dichlorophenol	<20 ug/kg
2-Methylphenol (o-cresol)	<20 ug/kg
3- and 4-Methylphenol (m+p cresol)	<20 ug/kg
2,4 Dimethylphenol	<20 ug/kg
2,4,6 Trichlorophenol	<20 ug/kg
2,4,5 Trichlorophenol	<20 ug/kg
4-Chloro-3-methylphenol	<20 ug/kg
2,3,4,6 Tetrachlorophenol	<20 ug/kg
Pentachlorophenol	<20 ug/kg

Authorised Signatory :
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Lab No : 5212 B

TEST INFORMATION **DETERMINATION OF PHENOLS USING SPME GC-MS**

ANALYTICAL METHOD: SPME Extraction and GC-MS-MS METHOD Number: UISOL-T-012
DATE RECEIVED 4/4/2012 DATE COMPLETED 4/12/2012 DATE ISSUED 4/18/2012

SAMPLE INFORMATION Matrix: **Soil**
SAMPLE No **TP10 Top** Project number 28470
CONTAINER TYPE Glass Sample dilution Factor 20

Substance	Results
Phenol	<40 ug/kg
2-Chlorophenol	<20 ug/kg
2-Nitrophenol	<20 ug/kg
2,4-Dichlorophenol	<20 ug/kg
2,6-Dichlorophenol	<20 ug/kg
2-Methylphenol (o-cresol)	<20 ug/kg
3- and 4-Methylphenol (m+p cresol)	<20 ug/kg
2,4 Dimethylphenol	<20 ug/kg
2,4,6 Trichlorophenol	<20 ug/kg
2,4,5 Trichlorophenol	<20 ug/kg
4-Chloro-3-methylphenol	<20 ug/kg
2,3,4,6 Tetrachlorophenol	<20 ug/kg
Pentachlorophenol	<20 ug/kg

Authorised Signatory :
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TEST INFORMATION **DETERMINATION OF PHENOLS USING SPME GC-MS**

ANALYTICAL METHOD: SPME Extraction and GC-MS-MS METHOD Number: UISOL-T-012
DATE RECEIVED 4/4/2012 DATE COMPLETED 4/12/2012 DATE ISSUED 4/18/2012

SAMPLE INFORMATION Matrix: **Soil**
SAMPLE No **TP3 Top** Project number 28470
CONTAINER TYPE Glass Sample dilution Factor 20

Substance	Results
Phenol	<40 ug/kg
2-Chlorophenol	<20 ug/kg
2-Nitrophenol	<20 ug/kg
2,4-Dichlorophenol	<20 ug/kg
2,6-Dichlorophenol	<20 ug/kg
2-Methylphenol (o-cresol)	<20 ug/kg
3- and 4-Methylphenol (m+p cresol)	<20 ug/kg
2,4 Dimethylphenol	<20 ug/kg
2,4,6 Trichlorophenol	<20 ug/kg
2,4,5 Trichlorophenol	<20 ug/kg
4-Chloro-3-methylphenol	<20 ug/kg
2,3,4,6 Tetrachlorophenol	<20 ug/kg
Pentachlorophenol	<20 ug/kg

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TEST INFORMATION **DETERMINATION OF PHENOLS USING SPME GC-MS**

ANALYTICAL METHOD: SPME Extraction and GC-MS-MS   METHOD Number: UISOL-T-012
DATE RECEIVED 4/4/2012   DATE COMPLETED 4/12/2012   DATE ISSUED 4/18/2012

SAMPLE INFORMATION   Matrix: **Soil**
SAMPLE No **TP4 Bottom**   Project number 28470
CONTAINER TYPE Glass   Sample dilution Factor 20

Substance	Results
Phenol	<40 ug/kg
2-Chlorophenol	<20 ug/kg
2-Nitrophenol	<20 ug/kg
2,4-Dichlorophenol	<20 ug/kg
2,6-Dichlorophenol	<20 ug/kg
2-Methylphenol (o-cresol)	<20 ug/kg
3- and 4-Methylphenol (m+p cresol)	<20 ug/kg
2,4 Dimethylphenol	<20 ug/kg
2,4,6 Trichlorophenol	<20 ug/kg
2,4,5 Trichlorophenol	<20 ug/kg
4-Chloro-3-methylphenol	<20 ug/kg
2,3,4,6 Tetrachlorophenol	<20 ug/kg
Pentachlorophenol	<20 ug/kg

Authorised Signatory :
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ANALYTICAL METHOD: SPME Extraction and GC-MS-MS METHOD Number: UISOL-T-012
DATE RECEIVED 4/4/2012 DATE COMPLETED 4/12/2012 DATE ISSUED 4/18/2012

SAMPLE INFORMATION Matrix: **Soil**
SAMPLE No **TP4 Top** Project number 28470
CONTAINER TYPE Glass Sample dilution Factor 20

Substance	Results
Phenol	<40 ug/kg
2-Chlorophenol	<20 ug/kg
2-Nitrophenol	<20 ug/kg
2,4-Dichlorophenol	<20 ug/kg
2,6-Dichlorophenol	<20 ug/kg
2-Methylphenol (o-cresol)	<20 ug/kg
3- and 4-Methylphenol (m+p cresol)	<20 ug/kg
2,4 Dimethylphenol	<20 ug/kg
2,4,6 Trichlorophenol	<20 ug/kg
2,4,5 Trichlorophenol	<20 ug/kg
4-Chloro-3-methylphenol	<20 ug/kg
2,3,4,6 Tetrachlorophenol	<20 ug/kg
Pentachlorophenol	<20 ug/kg

Authorised Signatory :
WJ Havenga
Laboratory Manager *4/18/2012*

UIS ORGANIC LABORATORY

UIS Organic Laboratory (Pty) Ltd • Reg. No. 2007/001896/07
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CLIENT INFORMATION

WSP Environmental (Pty) Ltd
Attention: Adam Smith
PO Box 5384, Attention Accounts
Rivonia

Analysis Report

Lab No : 5212 B

TEST INFORMATION **DETERMINATION OF PHENOLS USING SPME GC-MS**

ANALYTICAL METHOD: SPME Extraction and GC-MS-MS — METHOD Number: UISOL-T-012
DATE RECEIVED 4/4/2012 — DATE COMPLETED 4/12/2012 — DATE ISSUED 4/18/2012

SAMPLE INFORMATION — Matrix: **Soil**
SAMPLE No **TP5 Bottom** — Project number 28470
CONTAINER TYPE Glass — Sample dilution Factor 20

Substance	Results
Phenol	<40 ug/kg
2-Chlorophenol	<20 ug/kg
2-Nitrophenol	<20 ug/kg
2,4-Dichlorophenol	<20 ug/kg
2,6-Dichlorophenol	<20 ug/kg
2-Methylphenol (o-cresol)	<20 ug/kg
3- and 4-Methylphenol (m+p cresol)	<20 ug/kg
2,4 Dimethylphenol	<20 ug/kg
2,4,6 Trichlorophenol	<20 ug/kg
2,4,5 Trichlorophenol	<20 ug/kg
4-Chloro-3-methylphenol	<20 ug/kg
2,3,4,6 Tetrachlorophenol	<20 ug/kg
Pentachlorophenol	<20 ug/kg

Authorised Signatory :
WJ Havenga
Laboratory Manager
4/18/2012

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CLIENT INFORMATION

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Attention: Adam Smith
PO Box 5384, Attention Accounts
Rivonia

Analysis Report

Lab No : 5212 B

TEST INFORMATION **DETERMINATION OF PHENOLS USING SPME GC-MS**

ANALYTICAL METHOD: SPME Extraction and GC-MS-MS METHOD Number: UISOL-T-012
DATE RECEIVED 4/4/2012 DATE COMPLETED 4/12/2012 DATE ISSUED 4/18/2012

SAMPLE INFORMATION Matrix: **Soil**
SAMPLE No **TP6 Bottom** Project number 28470
CONTAINER TYPE Glass Sample dilution Factor 20

Substance	Results
Phenol	<40 ug/kg
2-Chlorophenol	<20 ug/kg
2-Nitrophenol	<20 ug/kg
2,4-Dichlorophenol	<20 ug/kg
2,6-Dichlorophenol	<20 ug/kg
2-Methylphenol (o-cresol)	<20 ug/kg
3- and 4-Methylphenol (m+p cresol)	<20 ug/kg
2,4 Dimethylphenol	<20 ug/kg
2,4,6 Trichlorophenol	<20 ug/kg
2,4,5 Trichlorophenol	<20 ug/kg
4-Chloro-3-methylphenol	<20 ug/kg
2,3,4,6 Tetrachlorophenol	<20 ug/kg
Pentachlorophenol	<20 ug/kg

Authorised Signatory :
WJ Havenga
Laboratory Manager
4/18/2012

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CLIENT INFORMATION

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Attention: Adam Smith
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Rivonia

Analysis Report

Lab No : 5212 B

TEST INFORMATION **DETERMINATION OF PHENOLS USING SPME GC-MS**

ANALYTICAL METHOD: SPME Extraction and GC-MS-MS METHOD Number: UISOL-T-012
DATE RECEIVED 4/4/2012 DATE COMPLETED 4/12/2012 DATE ISSUED 4/18/2012

SAMPLE INFORMATION Matrix: **Soil**
SAMPLE No **TP8 Bottom** Project number 28470
CONTAINER TYPE Glass Sample dilution Factor 20

Substance	Results
Phenol	<40 ug/kg
2-Chlorophenol	<20 ug/kg
2-Nitrophenol	<20 ug/kg
2,4-Dichlorophenol	<20 ug/kg
2,6-Dichlorophenol	<20 ug/kg
2-Methylphenol (o-cresol)	<20 ug/kg
3- and 4-Methylphenol (m+p cresol)	<20 ug/kg
2,4 Dimethylphenol	<20 ug/kg
2,4,6 Trichlorophenol	<20 ug/kg
2,4,5 Trichlorophenol	<20 ug/kg
4-Chloro-3-methylphenol	<20 ug/kg
2,3,4,6 Tetrachlorophenol	<20 ug/kg
Pentachlorophenol	<20 ug/kg

Authorised Signatory :
WJ Havenga
Laboratory Manager *4/18/2012*

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CLIENT INFORMATION
WSP Environmental (Pty) Ltd
Attention: Adam Smith
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Rivonia

Analysis Report

Lab No : 5212 B

TEST INFORMATION **DETERMINATION OF PHENOLS USING SPME GC-MS**
ANALYTICAL METHOD: SPME Extraction and GC-MS-MS METHOD Number: UISOL-T-012
DATE RECEIVED 4/4/2012 DATE COMPLETED 4/12/2012 DATE ISSUED 4/18/2012

SAMPLE INFORMATION Matrix: **Soil**
SAMPLE No **TP9 Bottom** Project number 28470
CONTAINER TYPE Glass Sample dilution Factor 20

Substance	Results
Phenol	<40 ug/kg
2-Chlorophenol	<20 ug/kg
2-Nitrophenol	<20 ug/kg
2,4-Dichlorophenol	<20 ug/kg
2,6-Dichlorophenol	<20 ug/kg
2-Methylphenol (o-cresol)	<20 ug/kg
3- and 4-Methylphenol (m+p cresol)	<20 ug/kg
2,4 Dimethylphenol	<20 ug/kg
2,4,6 Trichlorophenol	<20 ug/kg
2,4,5 Trichlorophenol	<20 ug/kg
4-Chloro-3-methylphenol	<20 ug/kg
2,3,4,6 Tetrachlorophenol	<20 ug/kg
Pentachlorophenol	<20 ug/kg

Authorised Signatory :
WJ Havenga
Laboratory Manager
4/18/2012

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CLIENT INFORMATION

WSP Environmental (Pty) Ltd
Attention: Adam Smith
PO Box 5384, Attention Accounts
Rivonia

Analysis Report

Lab No : 5212 B

TEST INFORMATION **DETERMINATION OF PHENOLS USING SPME GC-MS**

ANALYTICAL METHOD: SPME Extraction and GC-MS-MS METHOD Number: UISOL-T-012
DATE RECEIVED 4/4/2012 DATE COMPLETED 4/12/2012 DATE ISSUED 4/18/2012

SAMPLE INFORMATION Matrix: **Soil**
SAMPLE No **TP9 Top** Project number 28470
CONTAINER TYPE Glass Sample dilution Factor 20

Substance	Results
Phenol	<40 ug/kg
2-Chlorophenol	<20 ug/kg
2-Nitrophenol	<20 ug/kg
2,4-Dichlorophenol	<20 ug/kg
2,6-Dichlorophenol	<20 ug/kg
2-Methylphenol (o-cresol)	<20 ug/kg
3- and 4-Methylphenol (m+p cresol)	<20 ug/kg
2,4 Dimethylphenol	35 ug/kg
2,4,6 Trichlorophenol	<20 ug/kg
2,4,5 Trichlorophenol	<20 ug/kg
4-Chloro-3-methylphenol	<20 ug/kg
2,3,4,6 Tetrachlorophenol	<20 ug/kg
Pentachlorophenol	<20 ug/kg

Authorised Signatory :
WJ Havenga
Laboratory Manager
4/18/2012

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Analysis Certificate Total Oil and Grease

Lab No : 5212 B

DATE RECEIVED 4/4/2012
DATE COMPLETED 4/12/2012

Project number 28470

Test Method Reference: EPA Method 3545 (PLE Extraction) and Gravimetric

TP1 Top	200	mg/kg (ppm)
TP10 Top	1600	mg/kg (ppm)
TP3 Top	<100	mg/kg (ppm)
TP4 Bottom	<100	mg/kg (ppm)
TP4 Top	<100	mg/kg (ppm)
TP5 Bottom	<100	mg/kg (ppm)
TP6 Bottom	680	mg/kg (ppm)
TP8 Bottom	<100	mg/kg (ppm)
TP9 Bottom	<100	mg/kg (ppm)
TP9 Top	200	mg/kg (ppm)

Authorised Signatory : *4/18/2012*
WJ Havenga
Laboratory Manager *Page 1 of 1*

DISCLAIMER: The results only relate to the test items provided. This report may not be reproduced, except in full, without the prior written approval of the laboratory.

ANALYTICAL REPORT: ICP MS FULL

To:	WSP Environmental (Pty) Ltd	Date of Request:	3/4/2012
Attention	Adam Smith		
Order Number			
Tel:	011 361 1380		
Fax:	011 361 1381		

Note: all results in parts per million (ppm) unless specified otherwise

Sample ID	Lims ID	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs
		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
	Detection Limits	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.01	<0.0001	< 0.001	< 0.001	< 0.001	< 0.001
Water Leach															
TP1/Sample/A	5590 - 292612	< 0.001	0.973	< 0.001	< 0.001	0.002	0.125	< 0.001	< 0.001	16.3	< 0.0001	< 0.001	< 0.001	0.010	< 0.001
TP2/Sample/B	5590 - 292613	< 0.001	0.701	< 0.001	< 0.001	< 0.001	0.063	< 0.001	< 0.001	20.1	< 0.0001	< 0.001	< 0.001	0.008	< 0.001
TP3/Sample/C	5590 - 292614	< 0.001	0.112	< 0.001	< 0.001	< 0.001	0.080	< 0.001	< 0.001	29.3	< 0.0001	< 0.001	< 0.001	0.002	< 0.001
TP4/Sample/E	5590 - 292615	< 0.001	0.987	< 0.001	< 0.001	0.054	0.209	< 0.001	< 0.001	12.1	< 0.0001	< 0.001	< 0.001	0.006	< 0.001
TP4/Sample/D	5590 - 292619	< 0.001	0.962	< 0.001	< 0.001	0.022	0.109	< 0.001	< 0.001	5.71	< 0.0001	< 0.001	< 0.001	0.004	< 0.001
TP5/Sample/F	5590 - 292620	< 0.001	0.875	< 0.001	< 0.001	0.005	0.145	< 0.001	< 0.001	6.26	< 0.0001	< 0.001	< 0.001	0.004	< 0.001
TP6/Sample/H	5590 - 292621	< 0.001	0.859	< 0.001	< 0.001	< 0.001	0.086	< 0.001	< 0.001	5.13	< 0.0001	< 0.001	< 0.001	0.002	< 0.001
TP8/Sample/AA	5590 - 292622	< 0.001	1.16	< 0.001	< 0.001	0.019	0.120	< 0.001	< 0.001	4.32	< 0.0001	< 0.001	< 0.001	0.007	< 0.001

Note: The above results were obtained by perfoming water leach on samples (as received) 100g of sample was leached for 18hrs in 2000ml of water(ph = 7). The solution was filterered after extraction process and the ph was measured before analysis. The results are expressed as milligram of element per 1000ml solution.

Sample ID	Lims ID	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs
		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
	Detection Limits	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.01	<0.1	<0.1	<0.1	<0.1
Full Analysis															
TP1/Sample/A	5590 - 292612	<0.1	100700	1.15	<0.1	3.65	163	0.49	0.154	47180	0.013	49.9	29.1	582	1.06
TP2/Sample/B	5590 - 292613	<0.1	111000	1.58	<0.1	5.26	173	0.58	<0.1	29200	0.012	89.3	36.1	897	2.97
TP3/Sample/C	5590 - 292614	<0.1	92220	3.67	<0.1	9.09	183	0.63	<0.1	41900	<0.01	46.2	51.9	1056	0.339
TP4/Sample/E	5590 - 292615	<0.1	111900	3.88	<0.1	10.1	195	0.72	<0.1	35580	<0.01	37.7	49.9	1187	0.518
TP9/Sample/AC	5590 - 292616	<0.1	106500	3.58	<0.1	12.9	174	0.65	0.118	35940	<0.01	22.6	47.8	2394	0.551
TP10/Sample/AE	5590 - 292617	<0.1	95130	3.49	<0.1	6.90	147	0.45	0.144	74690	<0.01	32.9	47.3	766	0.373
TP12/Sample/AF	5590 - 292618	<0.1	91410	2.67	<0.1	7.92	135	0.49	<0.1	100100	<0.01	30.0	55.1	1356	0.370
TP4/Sample/D	5590 - 292619	<0.1	135800	1.95	<0.1	1.11	101	0.345	<0.1	85350	<0.01	13.1	59.8	711	0.613
TP5/Sample/F	5590 - 292620	<0.1	123200	1.83	<0.1	1.36	110	0.308	<0.1	75220	<0.01	13.5	41.1	259	0.639
TP6/Sample/H	5590 - 292621	<0.1	139900	1.24	<0.1	1.16	90.0	0.314	<0.1	93800	<0.01	5.96	48.5	523	0.297
TP8/Sample/AA	5590 - 292622	<0.1	138800	1.27	<0.1	1.26	93.0	0.338	<0.1	98980	<0.01	11.8	43.8	1243	0.257
TP9/Sample/AB	5590 - 292623	<0.1	130900	1.41	<0.1	0.342	168	0.965	<0.1	85110	<0.01	10.3	42.2	305	0.636
TP10/Sample/AD	5590 - 292624	<0.1	132700	1.74	<0.1	1.01	148	0.230	<0.1	71760	<0.01	12.0	30.8	347	0.312
TP12/Sample/AH	5590 - 292625	<0.1	114200	2.66	<0.1	3.31	161	0.388	0.111	81390	0.011	17.2	67.2	693	<0.1
TP11/Sample/AG	5590 - 292626	<0.1	110200	1.89	<0.1	1.59	191	0.259	<0.1	97410	<0.01	19.4	54.1	586	0.692

Comments / additional information: **Results reported on an air dry basis(as received) in original sample**

Identification of test methods:

Analysed by: W Masoga
Date: 15.05.2012

From : UIS Analytical Services
Analytical Chemistry
Laboratories 4, 6
Tel: (012) 665 4291
Fax: (012) 665 4294

Certificate of analysis: 5590

Cu	Fe	Ga	Ge	Hf	Hg	Ho	Ir	K	La	Li	Mg	Mn	Mo	Na	Nb	Nd	Ni	Pb	Pt
mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
< 0.001	< 0.01	< 0.001	< 0.001	<0.001	<0.0001	< 0.001	< 0.001	< 0.01	< 0.001	< 0.001	< 0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
< 0.001	0.219	< 0.001	< 0.001	< 0.001	< 0.0001	< 0.001	< 0.001	0.230	< 0.001	< 0.001		0.012	< 0.001	3.92	< 0.001	< 0.001	0.003	< 0.001	< 0.001
< 0.001	0.154	< 0.001	< 0.001	< 0.001	< 0.0001	< 0.001	< 0.001	0.139	< 0.001	< 0.001	4.22	0.002	< 0.001	3.12	< 0.001	< 0.001	0.002	< 0.001	< 0.001
< 0.001	0.020	< 0.001	< 0.001	< 0.001	< 0.0001	< 0.001	< 0.001	0.188	< 0.001	< 0.001	9.42	0.002	< 0.001	9.23	< 0.001	< 0.001	0.001	< 0.001	< 0.001
< 0.001	0.128	< 0.001	< 0.001	< 0.001	< 0.0001	< 0.001	< 0.001	0.323	< 0.001	< 0.001	3.68	0.010	< 0.001	6.64	< 0.001	< 0.001	0.002	< 0.001	< 0.001
< 0.001	0.172	< 0.001	< 0.001	< 0.001	< 0.0001	< 0.001	< 0.001	0.203	< 0.001	< 0.001	2.34	0.006	< 0.001	3.18	< 0.001	< 0.001	0.005	< 0.001	< 0.001
< 0.001	0.152	< 0.001	< 0.001	< 0.001	0.0001	< 0.001	< 0.001	0.234	< 0.001	< 0.001	2.56	0.006	< 0.001	4.63	< 0.001	< 0.001	0.003	< 0.001	< 0.001
< 0.001	0.098	< 0.001	< 0.001	< 0.001	< 0.0001	< 0.001	< 0.001	0.104	< 0.001	< 0.001	1.12	0.005	< 0.001	1.42	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
< 0.001	0.142	< 0.001	< 0.001	< 0.001	0.0001	< 0.001	< 0.001	0.291	< 0.001	< 0.001	3.39	0.014	< 0.001	13.3	< 0.001	< 0.001	0.002	< 0.001	< 0.001

Cu	Fe	Ga	Ge	Hf	Hg	Ho	Ir	K	La	Li	Mg	Mn	Mo	Na	Nb	Nd	Ni	Pb	Pt
mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
<0.1	<0.1	<0.1	<0.1	<0.1	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
										3.90									
47.5	30240	13.2	0.395	0.365	0.813	0.415	<0.1	1813	35.5	6.43	15930	1145	<0.1	2370	0.652	22.2	220	9.84	<0.1
33.4	30200	16.5	0.412	0.438	1.27	0.626	<0.1	2231	53.8	7.91	12840	1272	<0.1	2122	0.675	35.8	176	9.50	<0.1
34.6	30580	15.0	0.97	1.52	2.16	0.372	<0.1	1334	18.6	7.05	11770	1449	0.149	3005	5.19	16.1	188	6.98	<0.1
40.7	33810	14.6	1.04	1.76	2.91	0.373	<0.1	2290	15.7	8.07	18040	1589	0.113	1877	5.90	15.2	237	6.18	<0.1
43.5	33030	11.6	1.42	1.77	3.63	0.312	<0.1	2404	11.2	7.05	18800	1253	0.269	2746	4.72	9.45	224	8.73	<0.1
27.0	24400	13.3	1.21	1.07	5.13	0.316	<0.1	1555	22.1	5.46	13610	860	<0.1	3212	3.23	13.9	141	7.52	<0.1
38.6	25570	9.48	0.687	1.20	5.97	0.280	<0.1	1183	19.9	4.39	11700	795	0.207	2093	3.38	11.9	188	5.11	<0.1
47.3	20690	13.0	0.683	0.873	14.9	0.125	<0.1	1996	6.34	10.0	17030	423	0.120	10184	1.56	5.03	167	4.54	<0.1
35.7	24250	8.92	0.684	1.10	13.3	0.193	<0.1	1687	6.59	3.37	16980	546	<0.1	5826	1.67	5.72	151	4.95	<0.1
7.98	13390	12.17	0.636	0.306	17.0	0.059	<0.1	1736	2.87	4.56	10140	390	<0.1	11024	0.384	2.37	46.0	8.58	<0.1
14.6	13350	9.95	0.582	0.401	13.3	0.100	<0.1	1706	7.30	3.89	12320	575	<0.1	7330	0.593	4.59	78.0	2.48	<0.1
17.3	19590	9.16	0.701	0.337	5.97	0.108	<0.1	1686	6.17	4.96	15440	1190	<0.1	7193	0.599	4.12	153	3.72	<0.1
16.1	18560	8.84	0.712	0.461	3.42	0.102	<0.1	2146	4.93	5.29	18080	932	<0.1	7416	0.653	3.63	109	3.57	<0.1
132	22960	11.8	0.745	0.706	12.8	0.172	<0.1	1569	13.0	3.15	20910	522	0.390	5904	1.50	7.87	429	30.0	<0.1
57.7	21340	8.59	0.703	0.938	5.80	0.163	<0.1	1248	14.4	4.86	19440	1054	0.200	7089	1.10	8.02	259	11.5	<0.1

Chemical elements: Ag, Al, As, Au, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe,Ga, Ge, Hg, Ho, In, Ir, K, La, Li, Mg, Mn, Mo, Na, Nb, Nd, Ni, Pb, Pt, Rb, Sb, Sc, Se, Si, Sn, Sr, Ta, Te, Th, Ti,
Instrument: ICP - MS
Documentation:

Authorised : E Kgosana
Date: 15.05.2012

Rb	Sb	Sc	Se	Si	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr	pH
mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	
< 0.001	< 0.001	< 0.001	< 0.001	< 0.05	< 0.001	< 0.001	< 0.001	< 0.001	< 0.0001	< 0.05	< 0.001	< 0.0001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	
< 0.001	< 0.001	0.002	< 0.001	2.50	< 0.001	0.046	< 0.001	< 0.001	< 0.0001	0.060	< 0.001	< 0.0001	< 0.001	< 0.001	< 0.001	0.003	< 0.001	7.76
< 0.001	< 0.001	0.002	< 0.001	2.39	< 0.001	0.046	< 0.001	< 0.001	< 0.0001	0.047	< 0.001	< 0.0001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	7.68
< 0.001	< 0.001	0.002	< 0.001	1.28	< 0.001	0.096	< 0.001	< 0.001	< 0.0001	0.012	< 0.001	< 0.0001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	7.84
< 0.001	< 0.001	0.002	< 0.001	2.21	< 0.001	0.037	< 0.001	< 0.001	< 0.0001	0.017	< 0.001	< 0.0001	< 0.001	< 0.001	< 0.001	0.008	< 0.001	7.93
< 0.001	< 0.001	0.002	< 0.001	3.87	< 0.001	0.022	< 0.001	< 0.001	< 0.0001	0.013	< 0.001	< 0.0001	< 0.001	< 0.001	< 0.001	0.001	< 0.001	8.04
< 0.001	< 0.001	0.003	< 0.001	4.10	< 0.001	0.023	< 0.001	< 0.001	< 0.0001	0.013	< 0.001	< 0.0001	< 0.001	< 0.001	< 0.001	0.005	< 0.001	8.83
< 0.001	< 0.001	0.001	< 0.001	2.36	< 0.001	0.019	< 0.001	< 0.001	< 0.0001	0.007	< 0.001	< 0.0001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	8.33
< 0.001	< 0.001	0.003	< 0.001	3.90	< 0.001	0.019	< 0.001	< 0.001	< 0.0001	0.012	< 0.001	< 0.0001	< 0.001	< 0.001	< 0.001	0.001	< 0.001	7.78

Rb	Sb	Sc	Se	Si	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.01	<0.1	<0.1	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1
17.4	<0.1	1.00	<0.1	226400	0.560	123	0.139	<0.1	5.36	1886	1.02	0.554	35.8	7.05	11.5	35.4	9.63
39.6	<0.1	1.17	<0.1	256600	0.901	107	<0.1	<0.1	12.03	2189	0.676	0.922	40.9	11.2	18.1	41.7	11.9
9.26	0.122	7.14	0.13	217800	0.905	108	1.26	0.117	4.34	1811	0.523	0.588	54.1	22.8	8.52	40.9	47.4
7.86	0.114	6.94	0.13	281900	0.97	94.0	0.756	0.141	4.17	2419	0.542	0.645	60.7	30.3	7.77	41.8	55.8
9.33	0.182	6.15	0.12	249600	1.58	102	0.513	0.131	3.22	1851	0.511	0.579	61.7	44.4	6.47	47.6	53.3
12.8	0.149	5.11	0.21	185700	1.05	143	0.444	0.122	4.18	1169	0.278	0.849	42.7	49.8	7.63	32.9	28.5
13.4	0.109	4.53	0.16	192700	0.680	78.0	0.363	0.106	3.07	1335	0.366	0.725	50.3	59.0	6.69	32.9	32.8
7.21	<0.1	5.18	0.13	227600	0.481	279	0.247	0.145	1.393	892	0.290	0.249	38.4	148	2.52	30.0	23.8
1.49	0.117	0.60	<0.1	218800	0.550	213	0.184	<0.1	2.05	1010	0.337	0.411	42.3	121	3.82	56.9	29.4
7.67	<0.1	3.94	0.12	219700	0.394	289	0.117	0.158	0.463	483	0.282	0.301	35.2	168	1.02	31.8	8.40
8.30	<0.1	4.96	0.19	213700	0.327	256	0.125	0.148	0.870	476	0.292	0.191	20.8	124	1.82	26.7	10.6
4.89	<0.1	1.60	<0.1	218900	0.816	264	<0.1	<0.1	0.745	579	0.294	0.378	34.6	58.6	2.11	24.4	8.26
5.76	0.128	1.50	<0.1	227200	0.457	225	<0.1	<0.1	1.172	510	0.300	0.358	25.7	31.5	1.88	22.6	12.0
9.26	0.501	4.63	0.16	204900	3.13	275	0.161	0.233	2.11	794	0.265	0.560	36.9	126	3.26	57.4	18.4
11.9	0.121	2.62	<0.1	194425	2.36	227	0.121	0.160	1.563	585	0.284	0.497	37.6	57.0	3.99	38.1	24.3

Tl, U, V, W, Y, Zn, Zr

WSP Environment & Energy South Africa
WSP House
Bryanston Place, 199 Bryanston Drive
Bryanston
2191
South Africa
Tel: +27 11 361 1399
Fax: +27 86 504 1033
www.wspenvironmental.co.za

Stakeholder Engagement

Appendix E1: Issues Trail

Issues Trail

Issue and Concerns	Commentator	Organisation	Source	Response
Authority Consultation				
Have the DMR had been informed about the project and the meeting?	Motshabi Mohlalisi	NW DEDECT	Authorities meeting	Brent Holme responded stating that the DMR had been informed of the meeting, by email and phone call, and of the project by the use of a BID. The DMR however could not attend the meeting but the comments, if any, from the DMR will be included in the BA report.
Motshabi Mohlalisi requested WSP to inform the waste department of the NW DEDECT during all correspondence with regards to the tar dams in the future.	Motshabi Mohlalisi	NW DEDECT	Authorities meeting	Noted.
Motshabi Mohlalisi stated that the individual from the waste department at NW DEDECT should attend a site visit.	Motshabi Mohlalisi	NW DEDECT	Authorities meeting	Andre Britz offered to accompany Motshabi Mohlalisi on a site visit at a later stage as the weather on the day of the meeting was not conducive to a site visit. Brent Holme indicated that he would offer an opportunity to attend a site visit to the NW DEDECT during the BA report review period.
Motshabi Mohlalisi queried the expected date of availability of the BA report for public / authority review.	Motshabi Mohlalisi	NW DEDECT	Authorities meeting	Brent Holme replied saying that the BA report is expected to be completed and available for review in May. Hermanus Prinsloo stated that RPM would like to remove the risk posed by the tar dams as quickly and efficiently as possible.
Please refer to Appendix E2 for the comment submitted by SAHRA	Andrew Salomon	SAHRA	Email	Noted.
Please accept our apology. We will not make it for tomorrow's meeting. Is it possible that we come on the 20th of	Shai Caroline	DWA	Email	WSP will send the draft Basic Assessment Report to the department for review once on public review.

Issue and Concerns	Commentator	Organisation	Source	Response
March, next week Tuesday. The responsible officer for your mine is Charles Nemutendani.				
“The unit: Integrated Environmental Management, can comment, once we have received the Basic Assessment Report, where the impacts with regard to the project are identified, and mitigation measures are to be put in place”.	Kelebogile Mekgoe	Rustenburg Local Municipality	Fax	WSP will inform the department once the Basic Assessment Report is on public review.
Reported that she was sick and thus could not attend the authorities meeting.	Kelebogile Mekgoe	Rustenburg Local Municipality	Telephone	WSP will send the draft Basic Assessment Report to the department for review once on public review.

Appendix E2: SAHRA letter response

SOUTH AFRICAN HERITAGE RESOURCES AGENCY

111 HARRINGTON STREET, CAPE TOWN, 8000
PO BOX 4637, CAPE TOWN, 8000
TEL: (021) 462 4502 FAX: (021) 462 4509

DATE: 27 March 2012
ENQUIRIES: Mr Andrew Salomon
Archaeology, Palaeontology and Meteorite Unit
E-mail: asalomon@sahra.org.za
Web site: www.sahra.org.za

Our Ref: 9/2/263/0018

WSP Environmental
Mr J O'Brien
Jared.obrien@wspgroup.co.za

RE: Decommissioning and remediation of the tar dams at Rustenburg Platinum Mines

Thank you for your indication that development is planned to take place in this area.

In terms of the National Heritage Resources Act, no 25 of 1999, heritage resources, including archaeological or palaeontological sites over 100 years old, graves older than 60 years, structures older than 60 years are protected. They may not be disturbed without a permit from the relevant heritage resources authority. This means that before such sites are disturbed by development it is incumbent on the developer to ensure that a **Heritage Impact Assessment** is done. This must include the archaeological component (Phase 1) and any other applicable heritage components. Appropriate (Phase 2) mitigation, which involves recording, sampling and dating sites that are to be destroyed, must be done as required.

The quickest process to follow for the archaeological component is to contract an accredited specialist (see the web site of the Association of Southern African Professional Archaeologists www.asapa.org.za) to provide a Phase 1 Archaeological Impact Assessment Report. This must be done before any large development takes place.

The Phase 1 Impact Assessment Report will identify the archaeological sites and assess their significance. It should also make recommendations (as indicated in section 38) about the process to be followed. For example, there may need to be a mitigation phase (Phase 2) where the specialist will collect or excavate material and date the site. At the end of the process the heritage authority may give permission for destruction of the sites.

Where bedrock is to be affected, or where there are coastal sediments, or marine or river terraces and in potentially fossiliferous superficial deposits, a Palaeontological Desk Top study must be undertaken to assess whether or not the development will impact upon palaeontological resources - or at least a letter of exemption from a Palaeontologist is needed to indicate that this is unnecessary. If the area is deemed sensitive, a full Phase 1 Palaeontological Impact Assessment will be required and if necessary a Phase 2 rescue operation might be necessary.

If the property is very small or disturbed and there is no significant site the heritage specialist may choose to send a letter to the heritage authority to indicate that there is no necessity for any further assessment.

Any other heritage resources that may be impacted such as built structures over 60 years old, sites of cultural significance associated with oral histories, burial grounds and graves, graves of victims of conflict, and cultural landscapes or viewscapes must also be assessed.

Yours sincerely

PP Colette Scheermeyer
SAHRA: Archaeology, Palaeontology and Meteorite Unit
For: CHIEF EXECUTIVE OFFICER

Appendix E3: Site notice photos

Tar Dam Site Notices

Site A (Marikana Road – adjacent to dam footprints A & B -25° 41’ 55.26’’ S 27° 21’ 30.00’’ E)

Site B (Entrance to tar dam Footprints A & B - 25° 41’ 51.72’’ S 27° 21’ 28.45’’ E)

Site C (Platinum Health Medical Centre Rustenburg- 25° 41’ 54.53’’ S 27° 21’ 22.20’’ E)

Site D (Stop Street – Marikana Road T-Junction -Moving Eastward- 25° 41' 58.13'' S 27° 21' 58.06'' E)

Site E (Stop Street – Marikana Road T-Junction- Moving Westward- 25° 41' 56.72'' S 27° 22' 00.07'' E)

	
Site F (Entrance to tar dam Footprints C & D- 25° 41’ 56.98’’ S 27° 22’ 07.06’’ E)	

Appendix E4: Newspaper adverts

RUSTENBURG - "Kom kyk gerus na die pragtige troeteldiere by die DBV wat op goeie huise en liefdevolle eienaars sit en wag. Ondersteun die DBV en al die verlore en verwaarloosde diere van Rustenburg. Alle donasies welkom, ou boeke, koerante, plastiese bottels, ensovoorts. Baie dankie aan Konrad (083 395 7648) en Engedi Elektries vir die installering van 'n "prepaid" kragboks. Dankie vir alle donasies en kos wat geskenk word".

SPCA

ECOPARTNERS (PTY) LTD NOTICE OF AUTHORISATION RECEIVED FOR THE CONSTRUCTION OF A LOADED EXPLOSIVES TRUCK PARK BAY ON MINE PROPERTY, WESTERN PLATINUM, MARIKANA, NORTH WEST
Ref NO: NWP/EIA/26/2011

Notice is given to all registered I&APs that the above mentioned project has been authorized by North West Department of Economic Development, Environment, Conservation and Tourism on 20 February 2012.

A copy of the authorization and reasons for the decision are available upon request from Ms San Oosthuizen at **EcoPartners (Pty) Ltd. Post:** PO Box 73513, Fairlands, 2170; **Tel:** 011-431 2251; **Fax:** 086 539 6127; **Email:** angela@ecopartners.co.za.

In terms of Regulation 60 of the Environmental Impact Assessment Regulations published in Government Notice R543 in Government Gazette No. 33306 of 18 June 2010, under Section 24(5) of the National Environmental Management Act, a person affected by the authorization who wish to appeal the decision must submit a notice of intention to appeal within 20 days after the date of the decision. Note that the appeal must be submitted within 30 days after the lapsing of the 20 days to submit an intention to appeal. Notice of intent to appeal and the appeal should be submitted to:
The Member of the Executive Council
Department of Economic Development, Environment, Concervation and Tourism
Private Bag x 15
MMABATHO, 2735
Tel No: 018-387 7995-7
Fax No: 086 666 0148

Further information on the appeal procedure is available from EcoPartners.

NOTICE OF ENVIRONMENTAL AUTHORISATION AND WASTE MANAGEMENT LICENSE FOR THE PROPOSED DECOMMISSIONING AND REMEDIATION OF THE TAR DAMS AT RUSTENBURG PLATINUM MINES

Notice is hereby given in terms of the National Environmental Management Act (No. 107 of 1998), as amended (NEMA), with specific reference to the Environmental Impact Assessment Regulations 2010, Government Notice Regulation (GNR.) 543 and 544, as well as the National Environmental Management: Waste Act (No. 59 of 2008) (NEM:WA), GNR. 718 with the intent to decommission and remediate the areas associated with the Bleskop and TEMSO Tar Dams at Rustenburg Platinum Mines Limited (RPM)

DESCRIPTION AND LOCATION

Rustenburg Platinum Mines Limited (RPM) has four existing empty tar dams within their mine lease area near Rustenburg, North West Province. The empty tar dams contained legacy residues that were generated from the gas fired smelter at Klipfontein, which existed more than 60 years ago. The tar residue from the smelter was stored in four separate clay-lined, soil compartments. Each empty tar dam is approximately 1800m² in size and contained an estimated 3200m³ of tar residue. Tar Dam footprints A and B (referred to as the Bleskop Tar Dams) are located between the Bleskop Stadium and the RPM Hospital, while Tar Dam footprints C and D (referred to as the TEMSO Tar Dams) are located north of the Klipfontein Concentrator, adjacent to the road to TEMSO.

The tar dams posed an environmental, health and safety risk and as a result, the tar residues were removed by an independent waste contractor to a permitted hazardous waste landfill site (Holfontein). Subsequent remediation of the underlying and surrounding contaminated soil is required. It is proposed that the contaminated soil will be remediated to a predetermined standard prior to being backfilled, shaped and grassed with indigenous self-sustaining grasses. Furthermore, as part of the project, the facilities (tar dams) will also be decommissioned.

ENVIRONMENTAL APPLICATION

The proposed project involves undertaking the following listed activity contained in the EIA NEMA Regulations GNR.544 of 2010:

- Activity 27 (iv)
  - The decommissioning of existing facilities or infrastructure for activities, where the facility or land on which it is located is contaminated.

The following waste management activities listed in the NEM:WA GNR.718 of 2009 are also considered relevant:

- Category A, Activity 12
  - The remediation of contaminated land.
- Category A, Activity 20

The decommissioning of activities listed in GNR.718 Category A.

As activities contained in GNR.544 and GNR.718 are triggered, a basic assessment (BA) process is required in order to receive environmental authorisation and a waste management license for the project. The BA process will be undertaken in a diligent manner in accordance with the NEMA EIA Regulations of 2010. An integrated BA and waste management license application form has been submitted, in terms of the NEMA and NEM:WA, to the Department of Environmental Affairs, who will be the competent authority for this project.

PUBLIC MEETING

Following the response from the public and stakeholders, a Public Meeting will be held at the RPM Sports and Recreation Club on 13 March 2012 from 16h00 17h00. Should you wish to attend the Public Meeting, please respond to Jared O'Brien before 12 March 2012.

NAME OF PROPONENT: Rustenburg Platinum Mines Limited
NAME OF CONSULTANT: WSP Environment and Energy
Contact Person: Jared O'Brien
Tel: +27 11 361 1396 or Fax 086 505 3939
E-mail: Jared.OBrien@WSPGroup.co.za
Address: PO Box 5384, Rivonia, 2128

WSP

REGISTER AS A STAKEHOLDER

In order to ensure that you are identified as a stakeholder, please submit your name, contact details and interest in the matter to the contact person provided above, by 28 March 2012.

xstrata alloys

MERAFE RESOURCES

MINING DIVISION: TENDER NOTIFICATION

Title: Hygiene Services for all Western Mining Operations
Tender No. XST10062

SCOPE OF TENDER
Invitation to tender for supplying and maintaining of all Hygiene Services at our operations

SITE MEETING
- Date: 08/03/2012
- Venue: Waterval East boardroom
- Time: 09:00

AGENDA
- Briefing on Tender Requirements and Handouts
- Closing date for tenders 29/03/2012
- Questions
- Closure

ENQUIRIES
- Name Martiens Prinsloo
- Tel: 014 597 8009
- Name Wessel Oosthuizen
- Tel: 014 597 8026

Appendix E5: Stakeholder database

Comprehensive Stakeholder Database

Name	Surname	Company	Designation
Mr Mentor	Applegreen	North West Provincial Government	Editor
Mr Christo	Badenhorst	Anglo Platinum	Mining Engineer
James	Baloyi		Baloyi Projects
Ms Rachel	Banda	Mafidikwe Community	Community member
Mr Bertus	Bierman	Anglo Platinum	Regional Engineering Advisor
Mr Joyleaf	Boase	COSATU	Face street flagger
Mr Pogiso	Bothomane	Boitekong Development Forum	Secretary
Ms Dineo	Boutlwanyi	Boitekong Community Library	Librarian
Mr André	Britz	Anglo Platinum	Chief Environmental Co-ordinator
Mr Steve	Bullock	Anglo Platinum	Head of Sustainable Development
Ms Olga	Chauke	Rustenburg Local Municipality	Councillor
Mr David	Coetzee	Boitekong Unemployment Forum	Chariperson
Dr A	Conradie	Modderfontein Irrigation Board	Secretary
Mr Neels	Cornelius	Xstrata South Africa (Pty) Ltd	Secretary
Mr John	Critchley	Rand Water	Chief Planning Engineer
Mr Stuart	Dangerfiled	Anglo Platinum	Senior Project Manager
Chris	de Bruyn	North West Ecoforum	Director
Mr Johan	de Bruyn	Arnoldistad Ontwikkelings Trust	Member
Sarel	de Jager	Anglo Platinum	Senior Metallurgist
Bertus	de Villiers	Anglo Platinum	Head of Smelting Operations
Mr Frank	Diale	Phothemfi Community Development	Member
Mr Malakia	Dire	Rustenburg Local Municipality	
Mmapula	Diutlwile	Rustenburg Local Municipality	Councillor
Mr Miguel	Dos Santos	Tenova Pyromet	Project Manager
Dr Rob	Dowdeswell	Anglo Platinum	Occupational Health Physician
Mr R C	du Preez	Rustenburg Local Municipality	Electricity
Ms Sanet	du Preez	Rustenburg Local Municipality	Rustenburg Local Municipality
Mrs Di	Duthe	SRK Consulting	Groundwater specialist
Arnold	Erasmus	Anglo Platinum	Chief Ventilation Engineer (Rust only)
Mr Alan	Forrester	Kelgran (Pty) Ltd	Kelgran (Pty) Ltd
Ms Durkjie	Gilfillan	Lrc	Attorney: Regional Director
FC	Graham	Impala Platinum	
Mr J A	Greyling	Rustenburg Local Municipality	Divisional Commander: Fire Safety & Training
Mr N	Grootboom-Mashile	Rustenburg Local Municipality	Manager: Satelite offices
Mr Shadrack	Gwebu	Community Development Committee	RDP Chairman
Mr Henry	Hartley	Rustenburg Local Municipality	Councillor
Mr Erich	Heymann	Anglo Platinum	Group Environmental Consultant

Mr F J	Heystek	Rustenburg Local Municipality	Disaster management
Alistair	Holden	Anglo Platinum	Consultant
Johannes	Huma	North East Regional Councilor Bafokeng	Councillor
Mr Eugene	Huma	Bafokeng Bleskop Business Forum	Shift supervisor
Mr Ben	Huma	Phothemfi	Community Developer
Dr Hein	Jantzen	Anglo Platinum	Program Manager
Ms Lydia	Kalayamotho	Sikhathi Basadi Cooperative	Member
Mr J M	Kekae	Rasimone Community	
Mrs	Kelobogile	Rustenburg Local Municipality	EIA
Mr Ernie	Kemm	Administrator	
Mr Job	Kgobane	Rustenburg Local Municipality	Councillor
David	Kgophane	Transporter	Kgophs Projects
Mr Aaron	Kharivhe	Department of Minerals and Energy	Director: Mine Environmental Management
Paula	Khomo	Photsaneng Consultative Forum	Member
Mr K P	Khunou	Rustenburg Local Municipality	Councillor
Mr George	Khunou	Photsaneng Community	Member
Mr Martin	Khunou	Photsaneng Community	Environmental Issues
Ms Grace	Khunou	Photsaneng Community, Developemnt	Member
Mr Patrick	Khunou	Photsaneng Consultative Forum	Member
Mr Philly	Khunou	Anglo Platinum	Socio-Economic Development
Mr Peter	Khunou		
Mr George	Khunou	Bafokeng Sports	Managing Director
Mr Thabo	Khutsoane	Tlhabane Community	Member
Mr George	King	Xstrata South Africa (Pty) Ltd	
Mr Pat	King	Royal Bafokeng Administration	Land Administrator
Livhuwani	Kutame	North West Department of Agriculture, Conservation & Environment	Environmental Officer
Roanne	Lahee	Anglo Platinum	Senior Process Engineer
Mr Ashley	Lalla	Anglo Platinum	Senior Project Manager
Mr Roelf	le Roux	Magalies Water Board	Member
Mr Marchand	le Roux	North West Department of Agriculture, Conservation & Environment	Compliance
Ms Mante	Lebotse	Rustenburg Local Municipality	Councillor
Ms Caroline	Ledingoane		
Mr Peter	Lekalakala	Boitekong Community	Member

Ms Basebi	Lekoro	Rustenburg Local Municipality	
Mr Seoka	Lekota	North West Department of Agriculture, Conservation & Environment	Environmental Officer
Mr Tshepo	Lenake	Rustenburg Local Municipality	Integrated Environmental Management
Mr T D	Lephogole	Rustenburg Local Municipality	Civil Facilities
Mr David	Lesejane	Boitekong Community	Member
Mr Godfrey	Lethuping	North West Ecoforum	Member
Mr Joseph	Letlhare	Boswatlhago Enviro-Friendly Solutions	
Mr M D	Letlhoo	Rustenburg Local Municipality	Councillor
Mr Kaizer	Letsholo	Boitekong Community	Member
Mr Sean	Lindsay	Magalies Water Board	Member
Mr Jacob	Litsine	Rustenburg Local Municipality	
Mr T D	Long	Anglo Platinum	Manager Engineering Services
Mr Guy	Longomo	Xstrata Alloys	Environmental Coordinator
Mr Pieter	Louw	Rustenburg Public Library	Librarian
Councillor Madoda	Lutshete	Rustenburg Local Municipality	Ward Councillor
Ms Sheila	Mabale-Huma	Rustenburg Local Municipality	Speaker
Mr Jooste	Maboa	Rustenburg Local Municipality	Ward Councillour
Ms Rosina	Maboe	Regional Youth with Purpose	
Mr Ezekiel	Mabule	Chaneng Environmental Forum	Additional Member
Menge	Madumo	Menge Communications	Director
Ms Francinah	Maema	Rustenburg Community Development Centre	Project Manager
Strike	Magolego	Department of Minerals and Energy	
Ms Vassie	Maharaj	Golder Associates Africa (Pty) Ltd	Golder Associates Africa (Pty) Ltd
Councillor Thabo	Makgale	Bafokeng Community: Land Affairs Department	Councillor
Mr Jacobus	Malan	Ecoserv	Gauteng Regional Manager
Piere	Malan	Anglo Platinum	Process Project Manager
Mr Martin	Malatsi	African National Congress (ANC)	Representative
Mumsy	Malebadi	Anglo Platinum	Environmental Coordinator Waterval Smelter
Mr Rocky	Malebana-Metsing	Councillor	Rustenburg Local Municipality
Mr Francois	Malherbe	Acoustic Consulting	Engineer
Ms Andy	Mannathoko	Rustenburg Local Municipality	Mine Coordinator

Mr Jan	Marais	DEAT	Chief: Air Pollution Control Officer and Clean Air
Ms Agnes	Mathule	Boitekong Community	
Damaria	Matshaba Maleshwane	Environmental Justice Networking Forum (EJNF)	Adminstrator
Mrs Kathleen	Matshidiso	Rustenburg Local Municipality	Local Economic Development
Ms Johanna Matyila	Matyila	ANC Youth Organisation	
Mr Gideon	Menoe	Boitekong Community	CPF Chairperson
Mr Bernard	Meyer	Anglo Platinum	Direct Contact to Engineering Manager
Mr E B	Mfolwe	Rustenburg Local Municipality	Emergency & Disaster Management
Mr Lazarus	Mfulwane	Unemployed	N/A
Mr Andy	Miles	Anglo Platinum	Manager: Property
Ms Daphney	Mmitsinyane	Paardekraal Ward 22	Community Member
Mr Joseph	Moabi	Phatsima Community	Community Member
Mr Michael	Moalosi	Boitekong Community	Community Member
Mr Bernard	Modiba	Bafokeng Bleskop Business Forum	Member
Mr Zacharia	Modibedi	Phatsima Community	Community Member
Ms Laura	Modimokwane	Photsaneng Consultative Forum	Member
Ms Doris	Modimokwane	Photsaneng Consultative Forum	Member
Mr Herbert	Modupi	Yamedupi	Public Participant Practioner
Mr Andrew	Mogander	Member	Youth Sunrise Ext 9
Mr K	Mogoera	Rustenburg Platinum Mines	Protection Services
Mr Lucky	Mogomotsi	Boitekong Community	Councillor
Ms Brenda	Moila	Kopanang Care Centre for People with Disabilities	
J.	Mokgethwa	Mfidikwe	
Ms Keitumetse	Mokgophe	South African Heritage Resource Agency	Provincial Manager: North West
Emelda	Mokoe	Rustenburg Local Municipality	Ward Councillor, Ward 20
Irene	Mokoka	Paardekraal/Boitekong Community	Paardekraal Ward 19
Mr Meshack	Mokonotela		Consultant
Mr L K	Mokotedi	Rustenburg Local Municipality	Community Development
Emelda	Mokowe	Rustenburg Local Municipality	Ward Councillor
Mr Levy	Mokwele	Rustenburg Local Municipality	Community Development
Ms Nadia	Mol	SRK Consulting	Environmental Consultant
Mogomotsi	Molefe	Bafokeng Bleskop Business Forum	Member
Mr Tidimalo	Molefe	Phothemfi Community Development	Chairperson
Mrs Jeanette	Molefe	Phothemfi Community	Education

Councilor	Molefe	Rustenburg Local Municipality	Ward Councillor
Ms Lisbeth	Molefe	Boitekong Community	Community Member
Tebogo	Molete	Rustenburg Local Municipality	Tourism Coordinator
Mr Cecil	Molotsane	Photsaneng Community	Community Member
Kgosi Maboti	Molotsane	Photsaneng Community, Lekoje	
Mr Boikanyo	Molotsane	Photsaneng Consultative Forum	
Mr Roney	Monageng	Thekwane Community	Deputy Headman Madibana
Mr Lawrence	Moogi	Bafokeng Bleskop Business Forum	Member
Ms Nono	Mosimane	Boitekong Community	Community Member
Mr Herman	Mothibedi	Mahube Trust	Facilitator
Mr Alfred	Motsi	Rustenburg Local Municipality	Councillor
Mr Moabi	Motsumi	Rustenburg Local Municipality	Councillor
Mr Boitomelo	Motswadi	Rustenburg Local Municipality	Councillor
Mr Daniel	Motswadi	Teb83 Moves Transport CC	Transporter
Ms Elizabeth	Mpane	Mfidikwe Community	Community Member
Ms Mary	Mphegele	Thekwane Community	Community Member
Mr Musiwalo	Mphepha	Rustenburg Local Municipality	Ward Councillor
Mrs Suan	Mulder	Impala Platinum	Environmental Manager
Barry	Murphy	Anglo Platinum	Process Project Manager
Mr Dan	Mutloane	Rustenburg Local Municipality	Rustenburg Emergency and Disater Managmenet
Eunice	Mvakwendlu	Rustenburg Local Municipality	Ward Councillor Ward 33
Mr Joshua	Nape	Thekwane Community	Community Member
Mr G A	Nape	Xstrata: Madibana Community Developmnent Committee	Community Secretary
Mr Orest	Nbeduwa	Wisco	CEO
Mr Billy	Ndlovu	Letlhabile Mining and Training	
Mrs Maria	Ndlovu	Boitekong Community	Community Member
Mr Elifas	Ngoepe	National Union of Mineworkers	Rustenburg Region
Mr Thabo	Ngondo	Phatsima Administration Office	Administrator
MA	Ngwane	Rustenburg Local Municipality	Ward Councillor Ward 35
Mr McDonald	Nkangalani	Townlands	
Mr Sandy	Nkgothwe	Environmental Justice Networking Forum (EJNF)	Administrator
Ms Julia	Nkwanyana	Rustenburg Local Municipality	Councillor
Ms Angie Nonovi	Nonovi	Rustenburg Local Municipality	Councillor
Mr Morris	Nte	Impala Platinum	Community Liaison Officer
Ms Jabulile	Nxumalo	Rustenburg Local Municipality	Councillor
Mr Lawrence	Pebe	Townlands	
Mr Karabo	Peele	Royal Bafokeng Administration	Chairman: Mining Commission
Dr Jan	Perold	Golder Associates Africa (Pty) Ltd	Social Economist
Joas B	Petlele	Bafokeng Policing Forum	Chairperson
Kgosana Jacob	Petlele	Kgosana, Madiba Mantsho, Thekwana Community	Community Member
Mr Molope	Petlele	Royal Bafokeng Nation	Headman
Mr Moses	Phakoe	Rustenburg Local Municipality	
Ms Refilwe	Phakwe	Mfidikwe Community	Community Member
Jarnett	Phiri	Rustenburg Local Municipality	
Mr Goitsemang	Phiri	Boitekong Community	
Ms Thabisile	Phumo	Anglo Platinum	Corporate Communication

Mr Jan	Pieters	Rustenburg Local Municipality	Planning
Toni	Pietersen	Golder Associates Africa (Pty) Ltd	
Mr Deon	Pistorius	Xstrata Alloys	Environmental Coordinator
Dr Julius	Pistorius	Heritage	Archaeologist
Ms Queen	Quando	Federated Mining and Allied Industries	General Secretary
Ms Welheminah	Radebe	Paardekraal/Boitekong Community	Community Member
Mr Hopewell	Radebe	Business Day	News Editor
Ms Elizabeth	Rakgomo	Mfidikwe Community	Community Member
Mogomotsi	Rakoma	Mfidikwe	
Wendy	Ralekoa	Department of Water Affairs	Director
Mr Kagiso	Ramasika		
Mr Solomon	Ramogale	Photsaneng Consultative Forum	
Mr Moses	Ramong	Rustenburg Local Municipality	Councillor
Enoch	Rampete	Youth Sunrise Ext 9	
Mr Gordon	Ramsay	Aquarius Platinum	Project Director
Papi	Rangwaga	Boitekong Ward 19	Community Member
Mr Marc	Rapoo	Rustenburg Local Municipality	Director
Mr Louis	Rathuloane	Photsaneng Consultative Forum	Member
Mr J B	Robinson	Anglo Platinum	Senior Project Manager
Mr Mark	Roebert	Anglo Platinum	Rustenburg Platinum Mines
Mr Charles	Sanbow	Wesizwe Platinum	Chief Operating Officer
Mr Bruno	Seabela	Royal Bafokeng Nation	Corporate Governance Executive
Paul	Sebegoe	Rustenburg Local Municipality	Director of Planning and Human Settlement (DP&HS)
Mr Willie	Sebolai	Mahube Trust	Marketing Director
Mr Stephen	Sedikwe	Boitekong Community	Community Member
Ms Dipuo	Seduke	Rustenburg Local Municipality	Councillor
Ms Joyce	Sedumedi	Tshepanang Basadi Cooperative	Member
Ms Mabel	Segale	Rustenburg Local Municipality	Councillor
Mr Harry	Segone	Mfidikwe M C D C	Member
Mr Ishmael	Sekano	Anglo Platinum, Rustenburg Section	Socio-Economic Development
Mr Rueben	Sekano	Chaneng Community	Community Member
Mr A S	Sematu	Rustenburg Local Municipality	Councillor
Ms Innocentia	Senna	Boitekong Community	Community Member
Mr Bashimane	Senne	Photsaneng Community	Community Member
Mr A P	Senne	Fike Trust, Photsaneng Village	Member
Mr Abednigo	Senne	Photsaneng Community	Community Member
Mr Hashley	Setshedi	Phothemfi Youth League (Buyo)	Member
Mr Joseph	Setshedi	Councillor	Rustenburg Local Municipality
Mr Fred	Setshoane	Photsaneng Consultative Forum	Member
Mrs Maria	Simango	Boitekong Community	
Mr Lucky	Sithole	SANCO	
Mr Freiderich	Slabbert	UWP Consulting	Consultant
Mr Winston	Smart	TWP Matomo	Project Manager
Ms Louise	Smith	Ass Country Women of the World	Activist
Mr David	Smith	Rustenburg Local Municipality	Councillor
Mr Andy	Smithen	SRK Consulting	Environmental Scientist
Mr F J	Snyman	Rustenburg Local Municipality, Roads	Department of Roads
Pule	Soaisa	Anglo Platinum	Environmental Coordinator PMR
Mrs Louisa/ Mr Petrus	Soko	Paardekraal/Boitekong Community	Community Members
B	Soulee	Mfidikwe	
Mr Adriaan	Stander	Afrox (Pty) Ltd	Sales Manager
Mr B P	Stols	Rustenburg Local Municipality	

Mr Manfred	Suhr	Kroondal Environmental Forum	Spokesperson: Environmental Matters
Mr T J	Suze	Rustenburg Public Library	Librarian
Ms N J P	Tabane	Rustenburg Local Municipality	Councillor
Mr Paris	Teme	Boitekong Community	Community Member
Mr R	Thekiso	Rustenburg Local Municipality	Water and Sanitation Section
Mr Mothanke	Tladi	Tsogo Distribution and Construction	
Mr Simon	Tladi		Thekwana Village Community
Ms Reotshepile	Tlhapane	Royal Bafokeng Holdings	Environmental Manager
Ms Itumeleng	Tsagae	Rustenburg Local Municipality	Councillor
Ms Agnes	Tsamai	Rustenburg Local Municipality	Councillor
Tyira	Tshego	Anglo Platinum	Chief Environmental Co-ordinator
Gerrit	van de Linde	Anglo Platinum	Process Project Manager
Adv Abrie	van der Nest	Neels van der Nest Beleggings BK	Advocate
Mr Neels	van der Nest	Neels van der Nest Beleggings BK	Managing Director
Mr Hennie	van der Walt	Rustenburg Local Municipality	Institutional Development Specialist
Ms Charmaine	van Heerden	Rustenburg Civic Centre	
Irene	van Zyl	Arnoldstad Ontw. Trust -	Secretary
Mr Andre	Venter	Rustenburg Local Municipality	Assistant Health Officer
Mr Louis	Viljoen	Arnoldistad Ontwikkelings Trust	Self Employed
Ms Alet	Visser	Golder Associates Africa (Pty) Ltd	Consultant
Paul	Viviers	Anglo Platinum	Lead Process Engineer
Mr Waldie	Volschenk	Rustenburg Herold	Reporter
Mr Robin	Wardle	Kopano Joit Venture	Engineering Manager
Ms Erika	Wenhold	Kroondal and Ward 31Environmental Forum	Member
Mr Matthews	Wolmarans	Rustenburg Local Municipality	Mayor
Ms Malmsey	Zitha	Socio-Economic Development: Northwest Province	Manager

Appendix E6: Letters distributed to stakeholders

Your reference: Rustenburg Platinum Mines – Tar Dam Remediation Project
Our reference: 23164

27 February 2012

Dear Stakeholder,

ENVIRONMENTAL AUTHORISATION PROCESS AND WASTE LICENSE APPLICATION FOR THE PROPOSED DECOMMISSIONING AND REMEDIATION OF THE TAR DAMS AT RUSTENBURG PLATINUM MINES

Rustenburg Platinum Mines Limited (RPM) has four existing tar dam footprints within their mine lease area near Rustenburg, North West Province. The tar dam footprints contained legacy residues that were generated from the gas fired smelter at Klipfontein, which existed more than 60 years ago. The tar residue from the smelter was stored in four separate clay-lined, soil compartments. Each tar dam footprint is approximately $1600m^2$ in size and contained an estimated $3200m^3$ of tar residue. Tar dam footprints A and B (referred to as the Bleskop tar dams) are located between the Bleskop Stadium and the RPM Hospital, while tar dam footprints C and D are located north of the Klipfontein Concentrator, adjacent to the road to TEMSO (Refer to attached BID locality map).

The tar dams posed an environmental, health and safety risk and as a result, the tar residues were removed by an independent waste contractor to a permitted hazardous waste landfill site (Holfontein). Subsequent remediation of the underlying and surrounding contaminated soil is required. It is proposed that the contaminated soil will be remediated to a predetermined standard prior to being backfilled, shaped and grassed with indigenous self-sustaining grasses. Furthermore, as part of the project, the facilities (tar dams) will also be decommissioned.

Notice is hereby given in terms of the National Environmental Management Act (No. 107 of 1998), as amended (NEMA), with specific reference to the Environmental Impact Assessment (EIA) Regulations of 2010, Government Notice Regulation (GNR.) 543 and 544, as well as the National Environmental Management Waste Act (No. 59 of 2008) (NEM:WA), GNR.718 of 2009 with the intent to decommission, and remediate the area associated with the Bleskop and TEMSO tar dams at RPM.

The project involves undertaking the following listed activity contained in the EIA NEMA Regulations GNR.544 of 2010:

- Activity 27(iv)
  - The decommissioning of existing facilities or infrastructure for activities, where the facility or land on which it is located is contaminated.

The following waste management activities listed in the NEM:WA GNR.718 of 2009 are also considered relevant:

- Category A, Activity 12
  - The remediation of contaminated land.
- Category A, Activity 20
  - The decommissioning of activities listed in GNR.718 Category A.

As activities contained in GNR.544 and GNR.718 are triggered, and in order for environmental authorisation and a waste management license to be granted, a basic assessment (BA) process is required in accordance with NEMA EIA Regulations. An integrated BA and waste management license application form has been submitted, in terms of the NEMA and NEM:WA, to the Department of Environmental Affairs (DEA), who will be the competent authority for this project.

WSP Environment and Energy (WSP) has been appointed to undertake the function of the independent environmental assessment practitioner to facilitate the stakeholder engagement process and undertake the necessary environmental authorisation in accordance with NEMA and NEM:WA. WSP will compile a draft BA Report and a draft Environmental Management Programme document which will be made available to stakeholders for review and comment for a period of 60 days.

Thereafter, WSP will include and respond to all comments received during the public review period prior to finalising and submitting the reports to the DEA for authorisation.

Please find attached the background information document which contains additional information regarding the decommissioning and remediation project. Please note that a Public Meeting will be held for the project, to determine the response from the public and stakeholders. The meeting will be held at the RPM Sports Club on 16 March 2012 from 16h00 – 17h00. Should you wish to attend the Public Meeting, please respond and submit your details to Jared O'Brien by 12 March 2012. If you would like to register as a stakeholder, please submit your details to Jared O'Brien by 28 March 2012.

Should you have any questions, please do not hesitate to contact the undersigned.

Regards,

Jared O'Brien

Assistant Environmental Consultant
Tel: (011) 361 1396
Fax: (086) 505 3939
Email: Jared.O'Brien@wspgroup.co.za

WSP Environmental
WSP House, Bryanston Place
199 Bryanston Drive
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Johannesburg
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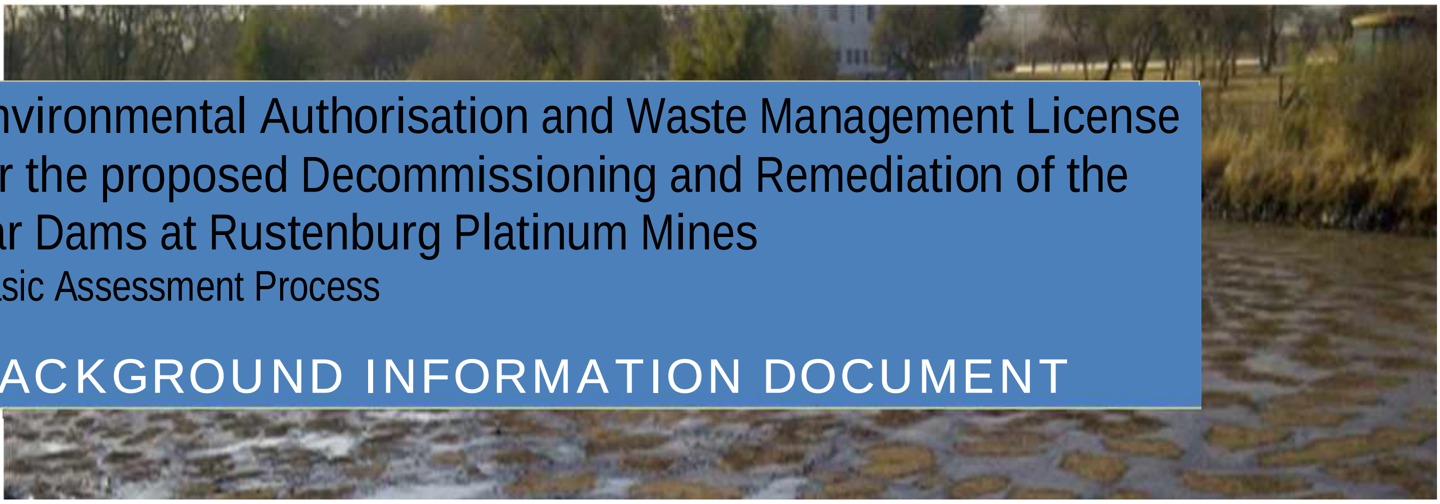
Tel: +27(0) 11 361 1380
Fax: +27(0) 11 361 1381
http://www.wspenvironmental.co.za
Reg. No: 1995/08790/07

WSP Group plc
Offices worldwide



Environmental Authorisation and Waste Management License for the proposed Decommissioning and Remediation of the Tar Dams at Rustenburg Platinum Mines

Basic Assessment Process

BACKGROUND INFORMATION DOCUMENT

Purpose of this document

This background information document (BID) introduces all stakeholders to the proposed decommissioning and remediation of the tar dams, within the mine lease area of Rustenburg Platinum Mines Limited (RPM), near Rustenburg, North West Province.

The BID provides a brief project description, the environmental authorisation process to be followed, and the role of stakeholders in the process including the opportunity for members of the public to register as stakeholders. Stakeholders are invited to participate in the environmental authorisation process by commenting on the project, asking questions and raising issues that will be included in the project documents. In addition to this document, at various stages of the environmental authorisation process, information and reports will be made available for registered stakeholders to comment on.

WSP Environment and Energy (WSP) has been appointed by RPM as the independent environmental assessment practitioner (EAP) to undertake the environmental authorisation and waste management license process for the project and to facilitate stakeholder engagement.

To become a registered stakeholder and ensure all comments and queries regarding this project are accurately documented and addressed, please forward your contact details and comments by the 28 March 2012 on the attached *response sheet* to:

Consultant:	Jared O'Brien
Company:	WSP Environment and Energy
Address:	P.O. Box 5384, Rivonia, 2128
Tel:	011 361 1396
Fax:	086 505 3939
Email:	Jared.O'Brien@wspgroup.co.za

Legal framework

Notice is hereby given in terms of the National Environmental Management Act (No. 107 of 1998), as amended (NEMA), with specific reference to the Environmental Impact Assessment Regulations (EIA) 2010, Government Notice Regulation (GNR.) 543 and 544, as well as the National Environmental Management Waste Act (No. 59 of 2008) (NEM:WA), GNR.718 of 2009 with the intent to decommission and remediate the area associated with the Bleskop and TEMSO Tar Dams at RPM.

The project involves undertaking the following listed activity contained in the EIA NEMA Regulations GNR.544 of 2010:

- Activity 27(iv)
  - The decommissioning of existing facilities or infrastructure for activities, where the facility or land on which it is located is contaminated.

The following waste management activities listed in the NEM:WA GNR.718 of 2009 are also considered relevant:

- Category A, Activity 12
  - The remediation of contaminated land.
- Category A, Activity 20
  - The decommissioning of activities listed in GNR.718 Category A.

As activities contained in GNR.544 and GNR.718 are triggered, and in order for environmental authorisation and a waste management license to be granted, a basic assessment (BA) process is required in accordance with NEMA EIA Regulations. An integrated BA and waste management license application form has been submitted, in terms of the NEMA and NEM:WA, to the Department of Environmental Affairs (DEA), who will be the competent authority for this project.

Stakeholder engagement process

The purpose of stakeholder engagement is to consult with interested and affected parties in the public and private sectors during the decision-making process on projects which may affect them. The process aims to develop and maintain open channels of communication between the project team and stakeholders. This process provides the public and stakeholders with the opportunity to openly express their views and concerns regarding the project through project correspondence. The EAP documents the comments of stakeholders, and makes the project team and relevant authority aware of issues that need to be considered during the compilation and evaluation of the potential risks and impacts associated with the project.

Detailed Project Description

Rustenburg Platinum Mines Limited (RPM) has four existing empty tar dams within their mine lease area near Rustenburg, North West Province. The empty tar dams contained legacy residues that were generated from the gas fired smelter at Klipfontein, which existed more than 60 years ago. The tar residue from the smelter was stored in four separate clay-lined, soil compartments. Each empty tar dam is approximately 1600m^2 in size and contained an estimated 3200m^3 of tar residue. Tar Dam footprints A and B (referred to as the Bleskop Tar Dams) are located between the Bleskop Stadium and the RPM Hospital, while Tar Dam footprints C and D (referred to as the TEMSO Tar Dams) are located north of the Klipfontein Concentrator, adjacent to the road to TEMSO.

The tar dams posed an environmental, health and safety risk and as a result, the tar residues were removed by an independent waste contractor to a permitted hazardous waste landfill site (Holfontein). Subsequent remediation of the underlying and surrounding contaminated soil is required. It is proposed that the contaminated soil will be remediated to a predetermined standard prior to being backfilled, shaped and grassed with indigenous self-sustaining grasses. It has been proposed that the area associated with the Bleskop Tar Dams, once remediated, may be utilised for a Heat Tolerance Test Centre, although additional stability studies will be required prior to construction. It must be noted that the facilities (tar dams) will also be decommissioned as part of the project.

Due to the hazardous classification of the tar residue in the dams, a decision was made by RPM in 2003 to recover the material from Tar Dam D at the TEMSO site. Initially, the residue was removed and transported to a cement kiln in Lichtenburg to be used as an alternative fuel reserve (AFR), as previous studies indicated that the residue had sufficient calorific value to be used as an alternate fuel after the necessary legal permits were obtained. However, as the tar was fed into the kiln, the residue solidified in the unheated transfer lines.

Due to the material handling issues, and issues associated with the transportation to Lichtenburg, the project was unsuccessful. As a result, the tar residue and contaminated undercut was removed and transported for disposal at Holfontein's H:H hazardous landfill site.

A number of specialist studies were undertaken for the tar dams including: surface and groundwater monitoring, air quality monitoring, soil sampling and a toxicological investigation. Following the findings of the specialist studies, it was indicated that the tar dams may be impacting on the surrounding and downstream environment. During the third quarter of 2011, RPM decided to remove the remaining residues from Tar Dams A, B and C in order to reduce the risks associated with the tar dams, as detailed in Section 28 of the NEMA (Duty of Care). The removal prevented potential pollution from continuing within the area, and was deemed to be a 'reasonable measure' in accordance with the Duty of Care Principles. The tar residues were removed and transported for disposal at Holfontein by a registered waste contractor. A remediation strategy will be developed by WSP in order to remediate the contaminated soil to an acceptable standard prior to the area being backfilled, shaped and grassed.

The findings of the specialist studies will be included in the BA report, with specific recommendations incorporated into the environmental management programme (EMP) report. The draft reports will be available for public and commenting authority review for a period of 60 days prior to being finalised and submitted to the DEA for authorisation.

The BA process involves the following:

- Compilation and submission of an integrated waste management license and BA application form for the DEA;
- Comprehensive and transparent stakeholder engagement process;
- Compilation of a BA report; and
- Development of an EMP report.

What does the stakeholder engagement process consist of?

Notification of Project

The first step is to notify the public through the following mediums:

- Newspaper advertisement:
  - The Rustenburg Herald – 23 February 2012.
- Site notices;
- Written notification letters to surrounding landowners and municipal ward councillors; and
- Distribution of the background information document (BID) to surrounding landowners and registered stakeholders.

Basic Assessment Report Review

A Public Meeting will be held on 16 March 2012 at the RPM Sports Club, to which all registered and any other stakeholders are invited. All comments will be recorded so that they can be addressed in an issues trail and response report, which will be included in the final BA report that will be submitted to the DEA.

PUBLIC MEETING

All stakeholders are invited to attend a Public Meeting:

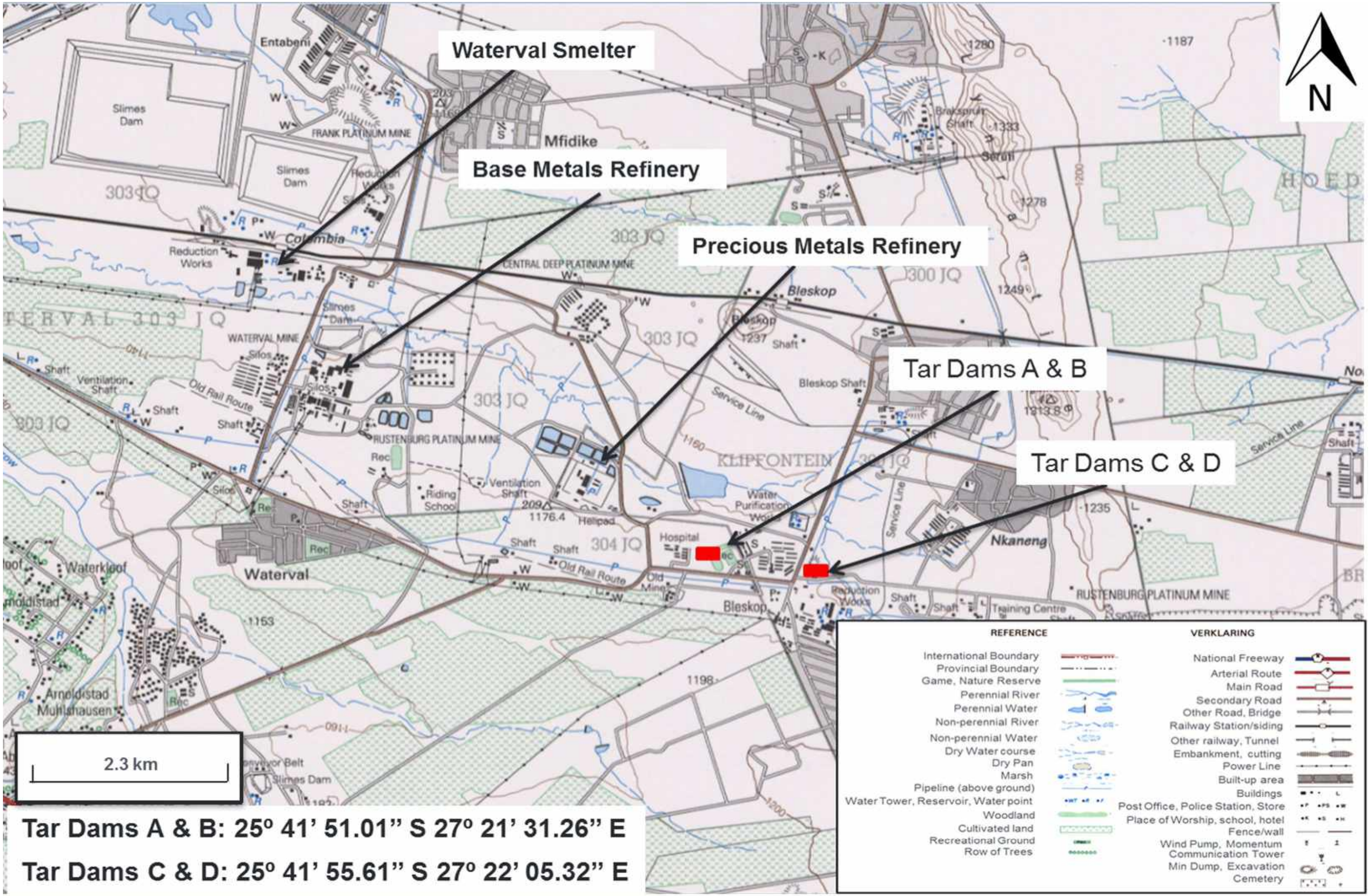
Date: 16 March 2012
Time: 16h00 – 17h00
Venue: RPM Sports and Recreation Club

Who is a stakeholder?

Any person, group of persons or organisation interested and/or affected by the proposed development.

Register your interest by completing the Registration and Comments Sheet attached to this document and send it to WSP.

Locality Map



Registration and Comments Sheet

To be a registered stakeholder and ensure all comments and queries regarding this project are accurately documented and addressed please forward your comments and contact details with the attached response sheet to:

Jared O'Brien
WSP Environmental (Pty) Ltd
Address: P.O. Box 5384, Rivonia, 2128
Tel: (011) 361 1396
Fax: (086) 505 3939
Email: Jared.O'Brien@wWSPgroup.co.za

Please insert your personal details below:

Name:	
Organisation & Designation:	
Address:	
Tel:	
Fax:	
E-mail:	

Please list your interest in the project and comments below:

Appendix E7: Letters distributed to Authorities

Your reference: Rustenburg Platinum Mines – Tar Dam Remediation Project
Our reference: 23164

27 February 2012

Dear Stakeholder,

ENVIRONMENTAL AUTHORISATION PROCESS AND WASTE LICENSE APPLICATION FOR THE PROPOSED DECOMMISSIONING AND REMEDIATION OF THE TAR DAMS AT RUSTENBURG PLATINUM MINES

Rustenburg Platinum Mines Limited (RPM) has four tar dam footprints within their mine lease area near Rustenburg, North West Province. The tar dam footprints contained legacy residues that were generated from the gas fired smelter at Klipfontein, which existed more than 60 years ago. The tar residue from the smelter was stored in four separate clay-lined, soil compartments. Each tar dam footprint is approximately 1600m^2 in size and contained an estimated 3200m^3 of tar residue. Tar dam footprints A and B (referred to as the Bleskop tar dams) are located between the Bleskop Stadium and the RPM Hospital, while tar dam footprints C and D (referred to as the TEMSO tar dams) are located north of the Klipfontein Concentrator, adjacent to the road to TEMSO (Refer the attached BID locality map).

The tar dams posed an environmental, health and safety risk and as a result, the tar residues were removed by an independent waste contractor to a permitted hazardous waste landfill site (Holfontein). Subsequent remediation of the underlying and surrounding contaminated soil is required. It is proposed that the contaminated soil will be remediated to a predetermined standard prior to being backfilled, shaped and grassed with indigenous self-sustaining grasses. Furthermore, as part of the project, the facilities (tar dams) will also be decommissioned.

Notice is hereby given in terms of the National Environmental Management Act (No. 107 of 1998), as amended (NEMA), with specific reference to the Environmental Impact Assessment (EIA) Regulations of 2010, Government Notice Regulation (GNR.) 543 and 544, as well as the National Environmental Management Waste Act (No. 59 of 2008) (NEM:WA), GNR.718 of 2009 with the intent to decommission, and remediate the area associated with the Bleskop and TEMSO tar dams at RPM.

The project involves undertaking the following listed activity contained in the EIA NEMA Regulations GNR.544 of 2010:

- Activity 27(iv)
  - The decommissioning of existing facilities or infrastructure for activities, where the facility or land on which it is located is contaminated.

The following waste management activities listed in the NEM:WA GNR.718 of 2009 are also considered relevant:

- Category A, Activity 12
  - The remediation of contaminated land.
- Category A, Activity 20
  - The decommissioning of activities listed in GNR.718 Category A.

As activities contained in GNR.544 and GNR.718 are triggered, and in order for environmental authorisation and a waste management license to be granted, a basic assessment (BA) process is required in accordance with NEMA EIA Regulations. An integrated BA and waste management license application form has been submitted, in terms of the NEMA and NEM:WA, to the Department of Environmental Affairs (DEA), who will be the competent authority for this project.

WSP Environment and Energy (WSP) has been appointed to undertake the function of the independent environmental assessment practitioner to facilitate the stakeholder engagement process and undertake the necessary environmental authorisation in accordance with NEMA and NEM:WA. WSP will compile a draft BA Report and a draft Environmental Management Programme document which will be made available to stakeholders for review and comment for a period of 60 days.

Thereafter, WSP will include and respond to all comments received during the public review period prior to finalising and submitting the reports to the DEA for authorisation.

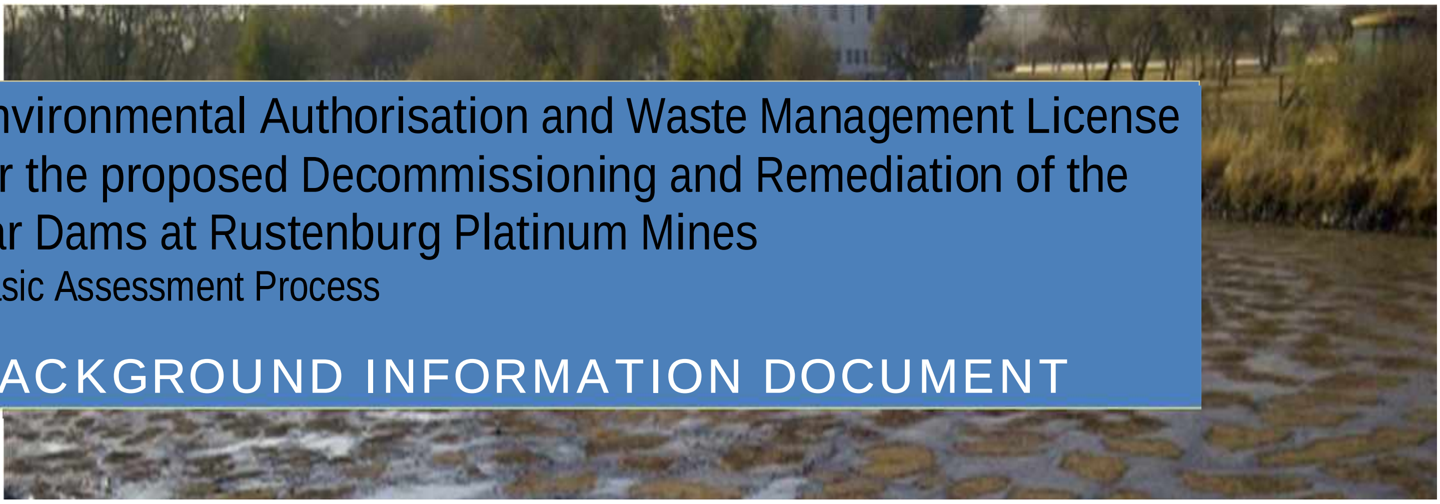
You are hereby cordially invited to attend an authorities meeting and site visit to the tar dams on 16 March 2012 at the RPM Sports Club from 10h30 – 12h00. WSP will present the project to the authorities and thereafter; all attendees will be invited for a site visit. Please note that hard hats, reflective vests and safety shoes will be required for the site visit. Please RSVP to the undersigned should you wish to attend the meeting and site visit by 12 March 2012.

Should you have any questions, please do not hesitate to contact the undersigned.

Regards,

Jared O'Brien

Assistant Environmental Consultant
Tel: (011) 361 1396
Fax: (086) 505 3939
Email: Jared.OBrien@WSPgroup.co.za



Environmental Authorisation and Waste Management License for the proposed Decommissioning and Remediation of the Tar Dams at Rustenburg Platinum Mines

Basic Assessment Process

BACKGROUND INFORMATION DOCUMENT

Purpose of this document

This background information document (BID) introduces all stakeholders to the proposed decommissioning and remediation of the tar dams, within the mine lease area of Rustenburg Platinum Mines Limited (RPM), near Rustenburg, North West Province.

The BID provides a brief project description, the environmental authorisation process to be followed, and the role of stakeholders in the process including the opportunity for members of the public to register as stakeholders. Stakeholders are invited to participate in the environmental authorisation process by commenting on the project, asking questions and raising issues that will be included in the project documents. In addition to this document, at various stages of the environmental authorisation process, information and reports will be made available for registered stakeholders to comment on.

WSP Environment and Energy (WSP) has been appointed by RPM as the independent environmental assessment practitioner (EAP) to undertake the environmental authorisation and waste management license process for the project and to facilitate stakeholder engagement.

To become a registered stakeholder and ensure all comments and queries regarding this project are accurately documented and addressed, please forward your contact details and comments by the 28 March 2012 on the attached *response sheet* to:

Consultant:	Jared O'Brien
Company:	WSP Environment and Energy
Address:	P.O. Box 5384, Rivonia, 2128
Tel:	011 361 1396
Fax:	086 505 3939
Email:	Jared.O'Brien@wspgroup.co.za

Legal framework

Notice is hereby given in terms of the National Environmental Management Act (No. 107 of 1998), as amended (NEMA), with specific reference to the Environmental Impact Assessment Regulations (EIA) 2010, Government Notice Regulation (GNR.) 543 and 544, as well as the National Environmental Management Waste Act (No. 59 of 2008) (NEM:WA), GNR.718 of 2009 with the intent to decommission and remediate the area associated with the Bleskop and TEMSO Tar Dams at RPM.

The project involves undertaking the following listed activity contained in the EIA NEMA Regulations GNR.544 of 2010:

- Activity 27(iv)
  - The decommissioning of existing facilities or infrastructure for activities, where the facility or land on which it is located is contaminated.

The following waste management activities listed in the NEM:WA GNR.718 of 2009 are also considered relevant:

- Category A, Activity 12
  - The remediation of contaminated land.
- Category A, Activity 20
  - The decommissioning of activities listed in GNR.718 Category A.

As activities contained in GNR.544 and GNR.718 are triggered, and in order for environmental authorisation and a waste management license to be granted, a basic assessment (BA) process is required in accordance with NEMA EIA Regulations. An integrated BA and waste management license application form has been submitted, in terms of the NEMA and NEM:WA, to the Department of Environmental Affairs (DEA), who will be the competent authority for this project.

Stakeholder engagement process

The purpose of stakeholder engagement is to consult with interested and affected parties in the public and private sectors during the decision-making process on projects which may affect them. The process aims to develop and maintain open channels of communication between the project team and stakeholders. This process provides the public and stakeholders with the opportunity to openly express their views and concerns regarding the project through project correspondence. The EAP documents the comments of stakeholders, and makes the project team and relevant authority aware of issues that need to be considered during the compilation and evaluation of the potential risks and impacts associated with the project.

Detailed Project Description

Rustenburg Platinum Mines Limited (RPM) has four existing empty tar dams within their mine lease area near Rustenburg, North West Province. The empty tar dams contained legacy residues that were generated from the gas fired smelter at Klipfontein, which existed more than 60 years ago. The tar residue from the smelter was stored in four separate clay-lined, soil compartments. Each empty tar dam is approximately 1600m^2 in size and contained an estimated 3200m^3 of tar residue. Tar Dam footprints A and B (referred to as the Bleskop Tar Dams) are located between the Bleskop Stadium and the RPM Hospital, while Tar Dam footprints C and D (referred to as the TEMSO Tar Dams) are located north of the Klipfontein Concentrator, adjacent to the road to TEMSO.

The tar dams posed an environmental, health and safety risk and as a result, the tar residues were removed by an independent waste contractor to a permitted hazardous waste landfill site (Holfontein). Subsequent remediation of the underlying and surrounding contaminated soil is required. It is proposed that the contaminated soil will be remediated to a predetermined standard prior to being backfilled, shaped and grassed with indigenous self-sustaining grasses. It has been proposed that the area associated with the Bleskop Tar Dams, once remediated, may be utilised for a Heat Tolerance Test Centre, although additional stability studies will be required prior to construction. It must be noted that the facilities (tar dams) will also be decommissioned as part of the project.

Due to the hazardous classification of the tar residue in the dams, a decision was made by RPM in 2003 to recover the material from Tar Dam D at the TEMSO site. Initially, the residue was removed and transported to a cement kiln in Lichtenburg to be used as an alternative fuel reserve (AFR), as previous studies indicated that the residue had sufficient calorific value to be used as an alternate fuel after the necessary legal permits were obtained. However, as the tar was fed into the kiln, the residue solidified in the unheated transfer lines.

Due to the material handling issues, and issues associated with the transportation to Lichtenburg, the project was unsuccessful. As a result, the tar residue and contaminated undercut was removed and transported for disposal at Holfontein's H:H hazardous landfill site.

A number of specialist studies were undertaken for the tar dams including: surface and groundwater monitoring, air quality monitoring, soil sampling and a toxicological investigation. Following the findings of the specialist studies, it was indicated that the tar dams may be impacting on the surrounding and downstream environment. During the third quarter of 2011, RPM decided to remove the remaining residues from Tar Dams A, B and C in order to reduce the risks associated with the tar dams, as detailed in Section 28 of the NEMA (Duty of Care). The removal prevented potential pollution from continuing within the area, and was deemed to be a 'reasonable measure' in accordance with the Duty of Care Principles. The tar residues were removed and transported for disposal at Holfontein by a registered waste contractor. A remediation strategy will be developed by WSP in order to remediate the contaminated soil to an acceptable standard prior to the area being backfilled, shaped and grassed.

The findings of the specialist studies will be included in the BA report, with specific recommendations incorporated into the environmental management programme (EMP) report. The draft reports will be available for public and commenting authority review for a period of 60 days prior to being finalised and submitted to the DEA for authorisation.

The BA process involves the following:

- Compilation and submission of an integrated waste management license and BA application form for the DEA;
- Comprehensive and transparent stakeholder engagement process;
- Compilation of a BA report; and
- Development of an EMP report.

What does the stakeholder engagement process consist of?

Notification of Project

The first step is to notify the public through the following mediums:

- Newspaper advertisement:
  - The Rustenburg Herald – 23 February 2012.
- Site notices;
- Written notification letters to surrounding landowners and municipal ward councillors; and
- Distribution of the background information document (BID) to surrounding landowners and registered stakeholders.

Basic Assessment Report Review

A Public Meeting will be held on 16 March 2012 at the RPM Sports Club, to which all registered and any other stakeholders are invited. All comments will be recorded so that they can be addressed in an issues trail and response report, which will be included in the final BA report that will be submitted to the DEA.

PUBLIC MEETING

All stakeholders are invited to attend a Public Meeting:

Date: 16 March 2012

Time: 16h00 – 17h00

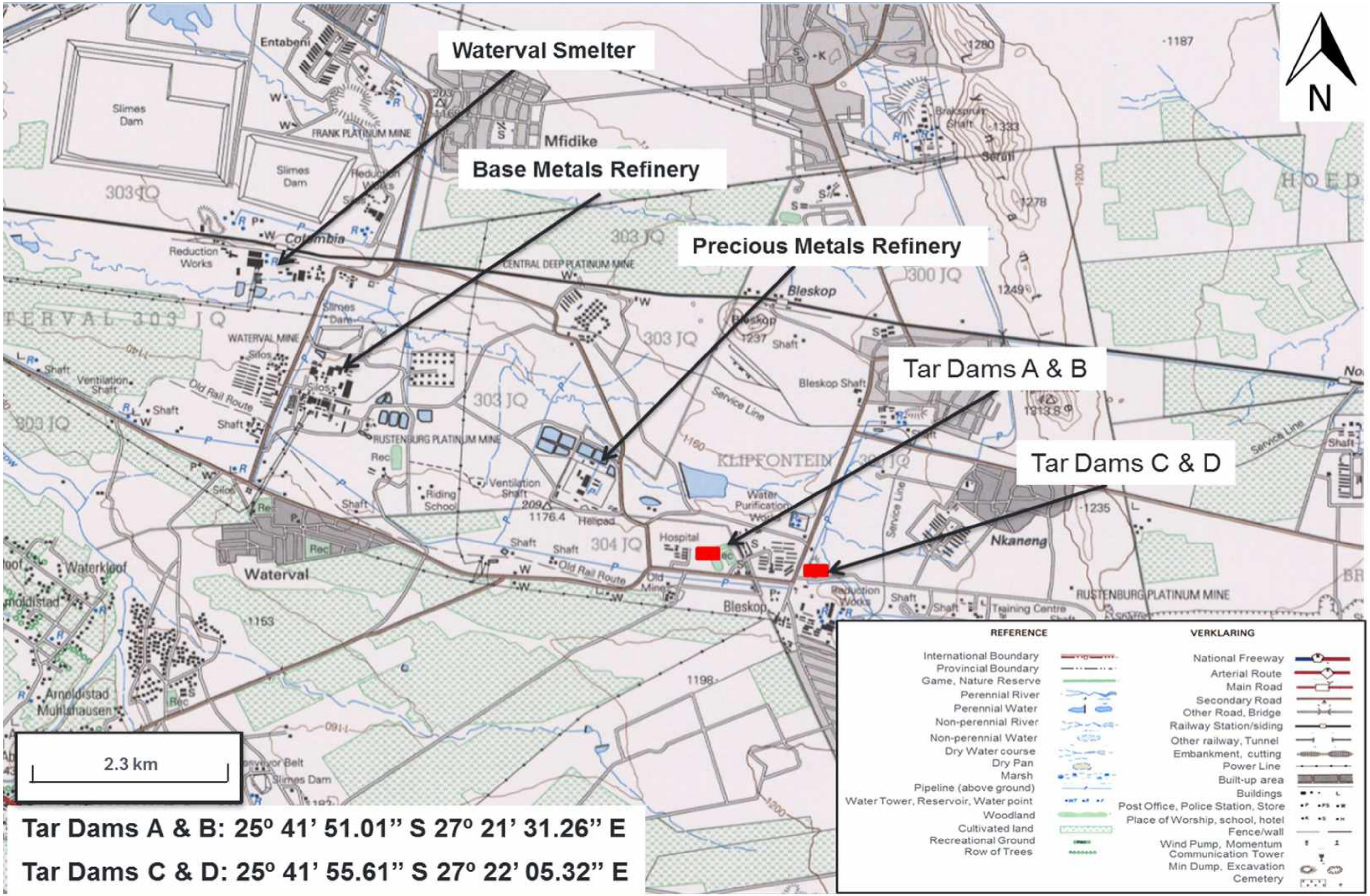
Venue: RPM Sports and Recreation Club

Who is a stakeholder?

Any person, group of persons or organisation interested and/or affected by the proposed development.

Register your interest by completing the Registration and Comments Sheet attached to this document and send it to WSP.

Locality Map



Registration and Comments Sheet

To be a registered stakeholder and ensure all comments and queries regarding this project are accurately documented and addressed please forward your comments and contact details with the attached response sheet to:

Jared O'Brien
WSP Environmental (Pty) Ltd
Address: P.O. Box 5384, Rivonia, 2128
Tel: (011) 361 1396
Fax: (086) 505 3939
Email: Jared.O'Brien@wWSPgroup.co.za

Please insert your personal details below:

Name:	
Organisation & Designation:	
Address:	
Tel:	
Fax:	
E-mail:	

Please list your interest in the project and comments below:

Appendix E8: Authorities Meeting

MEETING NOTES

Job Title	Environmental authorisation process and waste license application for the proposed decommissioning and remediation of the tar dams at Rustenburg Platinum Mines
Project Number	23164
Date	16 March 2012
Time	10h30 – 12h00
Venue	RPM Sports & Recreation Club (Wallace Lounge)
Subject	Authorities Meeting
Client	Anglo American Platinum Limited (Rustenburg Platinum Mines)
Present	Hermanus Prinsloo (HP), Andre Britz (AB), Hope Tyira (HT), Kgaugelo Mulchufi (KM), Solofelang Mocumi (SM), Motshabi Mohlalisi (MM), Kim Allan (KA), Brent Holme (BH), Jared O'Brien (JO).
Apologies	Kelebogile Mekgoe (KM) (Rustenburg Local Municipality)

MATTERS ARISING	
1	**<u>Welcome and Introduction</u>** BH thanked the attendees for attending the authorities meeting to discuss the proposed Tar Dam Decommissioning and Remediation project at Anglo American Platinum Limited: Rustenburg Platinum Mines (RPM). The attendees comprised HP, AB, HT, KM and SM from RRM; MM from the North West Department of Economic Development, Environment, Conservation and Tourism (NW DEDECT); and KA, JO and BH from WSP Environment and Energy (WSP). BH indicated that the purpose of the meeting was to introduce the attendees to the proposed project; provide information about the proposed project; provide opportunities for the attendees to raise issues, concerns and comments about the project; detail the proposed process to be followed; and indicate the way forward for the proposed project. BH specified that WSP had been appointed by RPM as the Independent Environmental Practitioner for the project. BH indicated that WSP has a vast amount of experience in undertaking environmental authorisations and waste management license processes.

2	**<u>Project Description</u>** BH indicated that RPM has four existing empty tar dams within their mine lease area near Rustenburg, North West Province. BH noted that the empty tar dams contained legacy residues that were generated from the gas fired smelter at Klipfontein, which existed more than 60 years ago. Tar dams A and B are referred to as the Bleskop Tar Dams, and tar dams C and D referred to as the TEMSO Tar Dams. BH emphasised that as a result of environmental, health and safety risks associated with the tar dams, the residues were removed from site and disposed of at a hazardous landfill site. It was noted that this was defined as a "reasonable measure" as defined in Section 28 of the National Environmental Management Act (no. 107 pf 1998). BH indicated that each empty tar dam is approximately 1600 m^2 in size and contained an estimated 3200 m^3 of tar residue. BH further specified that over 4000 tons of residue and contaminated soil had been removed from the tar dams. A project to remove the tar residue contained in Tar Dam C had been undertaken in 2003, where the residue was transported to a kiln near Lichtenburg as an alternative fuel source. AB indicated that the residue was heated during transportation to Lichtenburg, although as the residue was being transferred from the vehicle into the kiln, the material cooled and blocked the pipe. It was concluded that the residue was not feasible as an alternative fuel source and as a result, was transported to a registered hazardous landfill site for disposal. BH went on to state that the tar residue and contaminated undercut was removed during 2011. The process involved the use of super-suckers to remove contaminated surface water from the surface of the tar dams, and front-end loaders to remove the viscous tar residue and contaminated undercut. The material was transferred into vehicles and transported to a hazardous waste disposal site. It was noted that impermeable lining was placed covering the route from the tar dams to the transport vehicle to contain any potential spillage of tar residues. BH indicated that the tar dam footprints pose a minor environmental, health and safety risk to the surrounding community, and have no further use to RPM. The proposed project involves obtaining environmental authorisation for the decommissioning of the tar dams, and a waste management license for the remediation of contaminated land. It is proposed that once remediated, the land should not pose any risks to RPM. BH indicated that a remediation strategy of the remaining contaminated soil will need to be developed in order to adequately remediate the contaminated land. It was noted that WSP had been appointed to develop the remediation strategy for the project, which may include *in situ* treatment of the soil from mico-biological organisms. BH noted that a number of soil samples will be taken within the project site to identify the extent of soil contamination, thereafter; *in situ* treatment will be implemented. Once treatment is complete, additional soil samples will be taken to identify if the remediation of the contaminated soil succeeded. It was further stated that the area may be levelled and shaped prior to grassing with indigenous, self-sustaining grass.
	BH stated that the remediation strategy will be included into the basic assessment report, and recommendations incorporated into the environmental management programme. BH noted that informal graves had been identified, 50 m north of the Bleskop Tar Dams. BH emphasised that the decommissioning and remediation activities would not have an impact on the graves and that workers have been instructed not to enter the graveyard area.

3	**<u>Environmental Legal Framework</u>** BH noted that the proposed remediation and decommissioning activity involves the undertaking of the following listed activity contained in the EIA NEMA Regulations GNR.544 of 2010: ■ Activity 27(iv) - The decommissioning of existing facilities or infrastructure for activities, where the facility or land on which it is located is contaminated. The following waste management activities listed in the NEM:WA GNR.718 of 2009 are also considered relevant: ■ Category A, Activity 12 — The remediation of contaminated land. ■ Category A, Activity 20 — The decommissioning of activities listed in GNR.718 Category A. It was indicated that a BA process would need to be undertaken in order to receive environmental authorisation for the decommissioning of the tar dams and waste management license for the remediation activity. BH indicated that the BA process is being undertaken in accordance with GNR.543 of 2010.
4	**<u>Stakeholder Engagement Process</u>** BH indicated that the process which is being followed by WSP includes the submission of an integrated BA and waste management license application to the DEA, a comprehensive stakeholder engagement process, the compilation of a BA and EMP report, the development of a remediation strategy, public and state department review period (60 days) and the finalisation and submission of the BA report to Department of Environmental Affairs for authorisation. BH indicated that RPM have a comprehensive stakeholder database which WSP has made use of. Stakeholders have been informed of the proposed project via distribution of background information documents and letters of invite. A newspaper advert was developed and published in the Rustenburg Herald. WSP also erected site notices in and around the site providing background information about the project and inviting the public and stakeholders to a public meeting. BH stated that the public meeting will be held during the afternoon of 16 March 2012.
5	**<u>Way forward</u>** BH indicated that WSP intend to draft the BA and EMP reports by March 2012. WSP intend to place the draft reports on public review in May 2012. WSP plan to finalise the reports and submit the reports to the DEA in July 2012. WSP anticipate that environmental authorisation will be obtained during August 2012.
6	**<u>Close Out</u>** BH requested all attendees to sign the attendance register and indicated any comments or queries should be forwarded to either JO or BH. Thereafter, BH thanked the attendees for participating in the meeting and called the meeting closed.
Distribution: All present	

Appendix E9: Public Meeting

MEETING NOTES

Job Title	Environmental authorisation process and waste license application for the proposed decommissioning and remediation of the tar dams at Rustenburg Platinum Mines
Project Number	23164
Date	16 March 2012
Time	16h00 – 17h00
Venue	RPM Sports & Recreation Club (Wallace Lounge)
Subject	Public Meeting
Client	Anglo American Platinum Limited (Rustenburg Platinum Mines)
Present	Andre Britz (AB), Kim Allan (KA), Brent Holme (BH), Jared O'Brien (JO).
Apologies	N/A

Public Meeting

WSP, after notifying a vast number of stakeholders, received notification of attendance from Dan Molefe and Sizwe Nkontwnaa from OBD constructors however, the individuals unfortunately did not attend the meeting. WSP awaited the arrival of the individuals for 30 minutes after the official starting time of the meeting. The meeting was subsequently announced closed by BH (WSP) due to a lack of attendance.

Appendix F: Environmental Management Programme (EMPr)

THE PROPOSED DECOMMISSIONING AND REMEDIATION OF THE TAR DAMS AT RUSTENBURG PLATINUM MINES

Environmental Management Programme

2012/05/17

Revised: 2012/05/17
Confidentiality: Public

Quality Management

Issue/revision	Issue 1	Revision 1	Revision 2	Revision 3
Remarks	Draft			
Date	17/05/2012			
Prepared by	Jared O'Brien			
Signature				
Checked by	Janna Bedford-Owen			
Signature				
Authorised by	Brent Holme			
Signature				
Project number	23164			
Report number	Draft EMP			
File reference	23164/Tar Dams/Reports			

THE PROPOSED DECOMMISSIONING AND REMEDIATION OF THE TAR DAMS AT RUSTENBURG PLATINUM MINES

Environmental Management Programme

2012/05/17

Client

Anglo American Platinum Limited
Andre Britz
Land Management Manager
Rustenburg Platinum Mines Limited

Consultant

Jared O'Brien

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WSP House, Bryanston Place Office Park, 199
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Table of Contents

List of Figures

List of Tables

1 Background

1.1 Introduction and Project Location

Rustenburg Platinum Mines Limited (RPM) has four existing Tar Dam footprints within their mine lease area near Rustenburg, North West Province. The Tar Dam footprints contained legacy residues that were generated from the gas fired smelter at Klipfontein, which existed more than 60 years ago. The tar residue from the smelter was stored in four separate clay-lined, soil compartments. Each Tar Dam footprint is approximately 1600m^2 in size and contained an estimated 3200m^3 of tar residue. Tar Dam footprints A and B (referred to as the Bleskop Tar Dams) are located between the Bleskop Stadium and the RPM Hospital, while Tar Dam footprints C and D are located north of the Klipfontein Concentrator, adjacent to the road to TEMSO (Figure 1, 2 and 3 below). Table 1 outlines the relevant project location for both Tar Dams.

Table 1: Locations of the Tar Dams

Tar Dam footprint	Located	Province	Co-ordinates
Tar Dam footprints A and B	Located between the Bleskop Stadium and the RPM Hospital.	North West	25°41'51.01"S; 27°21'31.26"E
Tar Dam footprints C and D	Located north of the Klipfontein Concentrator, adjacent to the road to TEMSO.	North West	25°41'55.61"S; 27°22'05.32"E

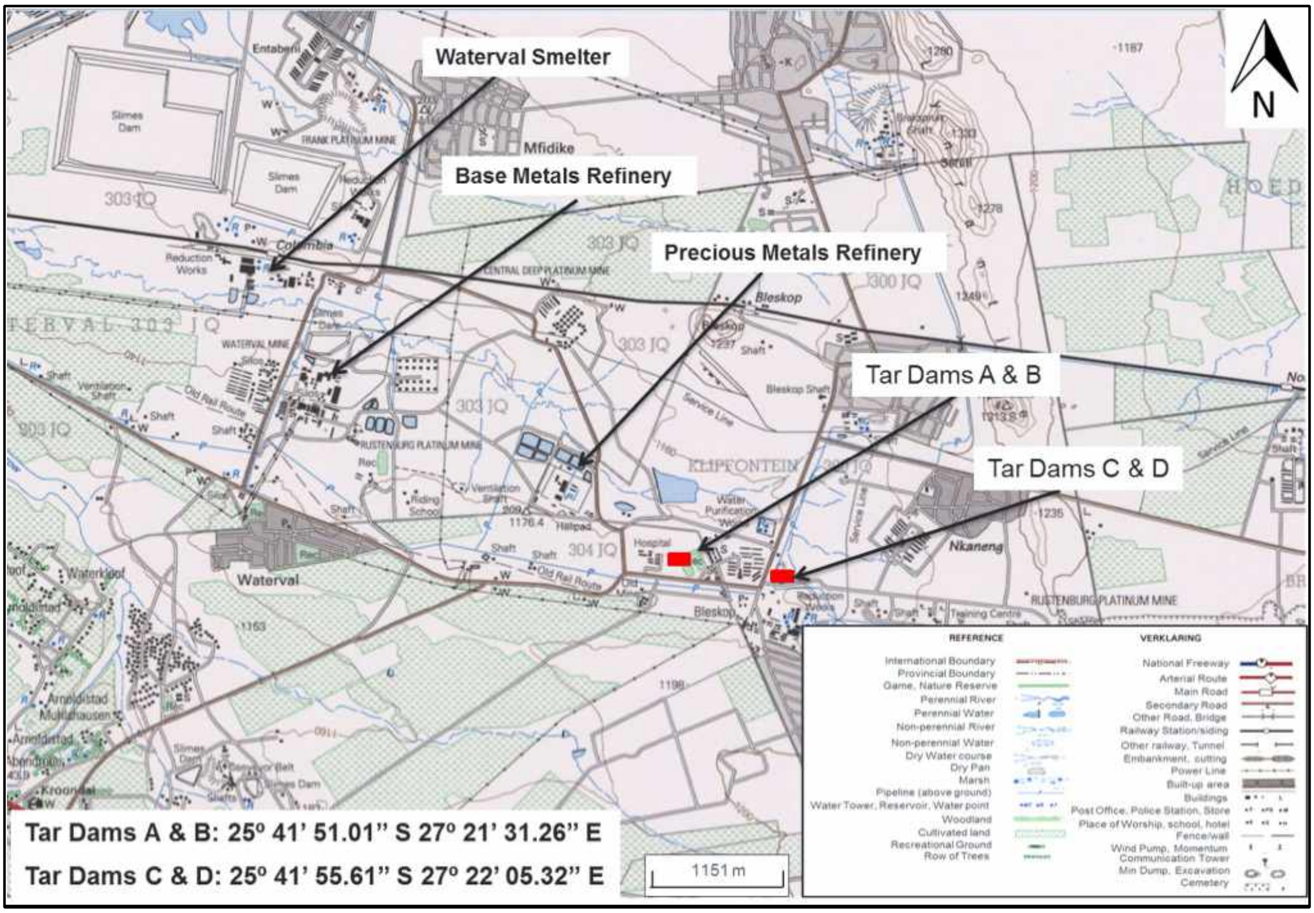

Figure 1: Topographical Map indicating Tar Dam Locations

Figure 2: Aerial Image illustrating Tar Dams A and B (Source: Google Earth, 2012)

Figure 3: Aerial Image illustrating Tar Dams C and C (Source: Google Earth, 2012)

It was noted that the Tar Dams posed an environmental, health and safety risk and as a result, the tar residues were removed by an independent waste contractor to a permitted hazardous waste landfill site (Holfontein). Subsequent remediation of the underlying and surrounding contaminated soil is required. It is proposed that the contaminated soil be screened in order to separate the soil from the heavy fractioned tar residues. Following successful remediation, the voids being backfilled, levelled and shaped with topsoil and grassed with indigenous self-sustaining grasses. Furthermore, as part of the project, the facilities (Tar Dams) will also be decommissioned.

1.2 Project Motivation

It has been noted that the Tar Dams created a visual disturbance, as well as a potential health, safety and biophysical hazard on the surrounding environment, and have been removed. In order to ensure best practice and legal compliance, RPM has appointed WSP to undertake the necessary environmental authorisation required for the remediation and decommissioning project in accordance with the National Environmental Management Act (No. 107 of 1998) (NEMA) and the National Environmental Management Waste Act (No. 59 of 2008) (NEMWA). Please note that the tar residues and contaminated undercut (soil) have already been removed from the sites as this was deemed a ‘reasonable measure’ under Section 28 of the NEMA (Duty of Care).

WSP undertook an environmental authorisation process in order to assess the potential environmental and socio-economic impacts originating from the tar dams project. The environmental management programme (EMP) document contains the management and mitigation measures that are to be followed in remediating and rehabilitating the site to ensure associated impacts are minimised.

The project will alleviate the potential environmental, health and safety risks associated with the Tar Dams. The remediation of the contaminated stockpile onsite will ensure that potential surface water, groundwater, air, and soil contamination will not occur in the future, thus improving the land use potential. Reduced environmental risks and improved land use opportunities will be made as a result of the project. It is anticipated that the remediation activity will also set the precedent for similar environmental remediation activities in the area.

1.3 Terms of Reference

The NEMA is South Africa's overarching environmental legislation and refers to Environmental Impact Assessment (EIA) Regulations of 2010, which contain listed activities that require environmental authorisation. Government Notice Regulation (GNR) 544 of 2010 list specific activities that require an environmental authorisation in the form of a basic assessment (BA) process (outlined in GNR.543 of 2010). The project triggers the following activity contain in NEMA:

- GNR.544 of 2010, Activity 27:
  - The decommissioning of existing activities or infrastructure for (iv) activities where the facility is located or the land on which it is located is contaminated.

Furthermore, the NEMWA also contains a number of waste management activities that require environmental authorisation prior to being granted a waste management license. The following activity is noted as relevant for the project:

- GNR.718 of 2010, Category B Activity 12:
  - The remediation of contaminated land.

Although it has been identified that the remediation activities associated with the Tar Dams can be defined as 'reasonable measures' under Section 28 of the NEMA, the authorisation process is being undertaken to ensure compliance with best practice and South African legislation. It has been noted that authorisation to decommission the facility will need to be obtained from the North West Department of Economic Development, Environment, Conservation and Tourism (NWDEDECT) and authorisation to undertake the remediation of the contaminated soil stockpiles from the Department of Environmental Affairs (DEA). The following was undertaken as part of the BA process:

- Compilation and submission of a waste management license form to DEA;
- Compilation and submission of an application to undertake environmental authorisation to the NWDEDECT;
- Transparent and comprehensive stakeholder engagement process, including the distribution of stakeholder notification material, public meeting and an authorities meeting;
- Geo-environmental assessment of the tar dam area;
- Compilation of a BA report and accompanying documentation;
- Compilation of a draft EMP;
- Public and state department review of the relevant documentation associated with the project; and
- Soil screening exercise, where the tar residues will be separated from the contaminated soil and disposed of. The soil will undergo analysis to identify the effectiveness of the remediation activity.

A BA process has been undertaken and environmental and socio-economic impacts have been identified and assessed in order to identify significant impacts associated with the project.

It is expected that the contractor be conversant with all legislation pertaining to the environment, including provisional and local government ordinances, which may be applicable to the contract. Some of the environmental legislation application to the project include, but are not limited to, the following:

- The South African Constitution (No. 108 of 1996);
- NEMA;
- NEM:WA
- National Water Act (No. 36 of 1998);
- The National Heritage Resources Act (No. 25 of 1999);
- National Environmental Management: Biodiversity Act (No. 10 of 2004);
- National Environmental Management: Air Quality Management Act (No. 39 of 2004); and
- Hazardous Substances Act (No. 15 of 1973).

1.4 Project Proponent/ Applicant

RPM appointed WSP to undertake the BA process in accordance with the NEMA. The relevant details of the proponent (RPM) and applicant are as follows:

Table 2: Project Applicant

Project Applicant	Rustenburg Platinum Mine
Contact Person	Andre Britz
Postal Address	Anglo Platinum Limited, Central Services, Klipfontein Main Offices, Bleskop Road, Rustenburg, 0300.
Telephone Number	+27 014 598 1109
Fax Number	+27 014 598 1153
Email	andre.britz@angloamerican.com

1.5 Independent Environmental Assessment Practitioner

WSP were appointed by RPM to undertake the function of an independent environmental assessment practitioner (EAP) to facilitate the BA process. WSP is a leading international environmental consultancy with a broad range of expertise in the environmental industry. WSP is a subsidiary of WSP Group plc, a global consultancy which is listed on the London Stock Exchange. WSP has successfully project managed a number of high profile environmental projects in South Africa over the past 20 years.

Table 3: Independent Environmental Assessment Practitioner

Environmental Assessment Practitioner	WSP Environment and Energy
Contact Person	Brent Holme/ Jared O'Brien
Postal Address	P O Box 5384,

Environmental Assessment Practitioner	WSP Environment and Energy
	Rivonia, 2128, South Africa.
Telephone Number	+27 011 361 1389/ +27 011 361 1396
Fax Number	+27 086 532 8685/ +27 086 505 3939
Email	brent.holme@wspgroup.co.za/ jared.obrien@wspgroup.co.za

1.6 Methodology Applied to the draft EMP Process

The draft EMP provides the actions for the management of potential environmental impacts associated with the Tar Dams project, as identified and recorded in the BA report. The EMP will provide a detailed outline of the implementation programme to minimise and/or eliminate the anticipated negative environmental impacts and enhance the positive impacts associated with the project. The draft EMP will provide strategies to be used to address the roles and responsibilities of environmental management personnel onsite, as well as a framework for environmental compliance and monitoring.

This draft EMP, which forms an integral part of the contract documents, informs the contractor as to his/ her duties in the fulfilment of the project objectives with particular reference to the prevention and mitigation of environmental impacts caused by activities associated with the project. The contractor should note that obligations imposed by the EMP are binding in terms of the conditions of the contract that pertain to the project.

This draft EMP has been compiled for the decommissioning, remediation and rehabilitation phases of the Tar Dams project. The draft EMP includes the following:

- Details and expertise of the person who prepared the draft EMP;
- Information on proposed management or mitigation measures that will be taken to address the environmental impacts that have been identified in the BA report, including environmental impacts or objectives in respect of all project phases;
- A description of the aspects of the activity that are covered by the draft EMP;
- An identification of the persons who will be responsible for the implementation of the mitigation measures;
- Proposed mechanisms for monitoring compliance with the draft EMP and reporting thereto;
- Measures to rehabilitate the environment affected by the proposed project (as far as possible);
- Timeframes for which the proposed mitigation measures should be implemented;
- The process for managing any environmental damage associated with the proposed project; and
- An environmental awareness plan.

The draft EMP has been compiled in conjunction with the BA report and will be submitted to DEA as an appendix to the BAR. The draft EMP has been developed in accordance with minimum legal requirements of Section 33 of the NEMA.

2 Environmental Management Programme

2.1 Objectives of the draft EMP

The draft EMP has been developed under the requirements of the NEMA EIA Regulations to ensure that RPM adopts a sound environmental management approach during the remediation and rehabilitation of the Tar Dam project, and also provides a framework for environmental monitoring throughout the project activities. The EMP includes management and mitigation measures to be implemented during the remediation, rehabilitation and decommissioning phases and defines the roles and responsibilities of personnel involved in the EMP implementation.

The objectives of the EMP are to:

- Encourage good management practices through planning and commitment to environmental issues;
- Reduce or mitigate environmental impacts and risk associated with the decommissioning anf remediation activities;
- Define how the management of the environment is reported and performance evaluated;
- Provide rational and practical environmental guidelines to:
  - Minimise disturbance of the natural environment;
  - Minimise disturbance on the local social and economic environs;
  - Ensure water and water resource protection;
  - Prevent or minimise all forms of pollution;
  - Protect indigenous flora and fauna; and
  - Prevent soil erosion and facilitate revegetation of affected areas;
- Comply with all applicable laws, regulations, standards and guidelines for the protection of the environment;
- Develop waste management practices based on prevention, minimisation, recycling, treatment or disposal of waste;
- Provide a monitoring and auditing framework from which to identify impacts on the environment and measure the effectiveness of management and mitigation measures; and
- Train employees and contractor/s with regards to their environmental obligations.

2.2 Definition of Roles and Responsibilities

The draft EMP is to be implemented by RPM to ensure compliance for the day-to-day activities associated with the project. The provisions of this draft EMP are binding on RPM during the life of the project. The draft EMP is to be read in conjunction with all the documentation that comprises the suite of documents for this project and the project's environmental authorisation process. Relevant personnel referred to in the draft EMP are defined in Table 4 below.

Table 4: Roles and Responsibilities

Designation	Contact Person	Role
RPM	The RPM land manager or an individual appointed by RPM.	RPM is ultimately responsible for the remediation, rehabilitation and decommissioning operations onsite.

Designation	Contact Person	Role
Designated Environmental Officer	Preferably a member of the site personnel or contractor's staff.	Daily implementation of the EMP and record keeping. The DEO will be responsible for weekly reporting to the contractor, Safety Officer and the ECO during site audits.
Environmental Control Officer	Preferably a member of RPM that will ensure ongoing compliance to the commitments contained in the EMP.	Daily implementation of the EMP and record keeping. The DEO will be responsible for weekly reporting to the contractor, safety officer and relevant personnel at RPM.
Contractor	As appointed by RPM.	The contractor will be responsible for liaising with DEO during audits, as well as ensuring the EMP is being adhered to. The contractor will report to RPM directly.
Employee	As appointed by the Contractor.	The employees will need to be made aware of the commitments contained in this draft EMP and ensure compliance thereof.

2.3 Structure of the draft EMP

The draft EMP contains recommended mitigation measures in order to ensure that the Tar Dams project is undertaken in a sustainable manner, minimising the potential impacts on the socio-economic and biophysical environment. Aspects that comprise the structure of the draft EMP have been address in Table 5 below.

Table 5: Structure of the draft EMP

Section	Description
Impact	Indicates what the potential impact associated with the activity is on the environment.
Mitigation Measure	The recommended management actions required to either prevent and/ or minimise the potential impact on the environment.
Environment	Indicates what aspect of the environment the impact/ mitigation measures are referring to.
Project Phase	Refers to the project phase in which the management measure should be implemented.
Responsibility	Recommends the relevant personnel responsible for either ensuring the management measure is implemented, or ensuring the compliance to the recommended management measure contained in the draft EMP.

3 Environmental Management Programme for the Tar Dams Project

Ref	Impact	Mitigation Measure	Environment																		Project Phase			Responsibility			
			Topography	Geology	Soil	Land use	Land capability	Air	Surface water	Groundwater	Fauna	Flora	Noise	Visual aspect	Waste Management	Traffic	Cultural & Heritage	Health & Safety	Employment	Climate	Decommissioning	Remediation	Rehabilitation	DEO	Contractor	RPM	Employees
1	The disturbance of the contaminated soil and pathway exposure to the underlying soil layer, thereby causing potential impacts to soils, surface water, groundwater, flora and fauna, etc.	Following the geo-environmental assessment, it was noted that the dams are lined with a clay liner and underlain with norite. No anticipated exposure is expected.			X	X	X		X	X	X	X										X	X	X	X	X	
2	The removal of vegetation may lead to the erosion of the soil directly adjacent to the Tar Dams.	As little vegetation as possible should be removed from the site in order to reduce erosion and reduce the impact on vegetation.			X	X	X		X	X	X	X										X	X	X	X	X	
3	Potential contamination to soil, surface water, groundwater, and the surrounding environment due to potential leakages and spillages, of the tar residue and hydrocarbons, during remediation activities.	When undergoing the soil screening exercise, impermeable plastic sheeting should be placed under the screen in order to ensure no additional soil becomes contaminated with tar residues. Tar residues separated from the screening process should be stored in an impermeable receptacle. The receptacle is to be collected and disposed of as hazardous waste.			X	X	X		X	X	X	X			X							X		X	X		
		Develop an emergency response plan detailing actions to be undertaken for potential contaminated soil spills onsite or in the case of a truck accident en-route to the registered landfill site.			X	X	X		X	X	X	X			X			X				X		X	X	X	
		Contractors and employees should be informed (via site induction training) that dumping of the hazardous waste material may not take place onsite or along the route used to transport the material to the hazardous waste disposal site.			X	X	X		X	X	X	X			X			X				X		X	X		
4	Potential hydrocarbon spillages from equipment, machinery and vehicle storage may lead to contamination of the soil in and around the site.	Equipment, machinery and vehicles should be serviced regularly at an offsite location, and daily inspections should be conducted to ensure that the equipment, vehicles and machinery are performing at optimum performance standards and to ensure that there are no leakages of vehicle fuel/ oil tanks.			X	X	X		X	X	X	X										X	X		X	X	
5	The remediation of contaminated soil and backfilling with clean soil.	Prior to infilling, ensure soil in the surrounding area is uncontaminated (included in WSPs remediation assessment).			x	x	x		X	X	X	X						X	X			X		X	X	X	

WSP

Ref	Impact	Mitigation Measure	Environment																		Project Phase			Responsibility			
			Topography	Geology	Soil	Land use	Land capability	Air	Surface water	Groundwater	Fauna	Flora	Noise	Visual aspect	Waste Management	Traffic	Cultural & Heritage	Health & Safety	Employment	Climate	Decommissioning	Remediation	Rehabilitation	DEO	Contractor	RPM	Employees
6	The remediation of contaminated soil.	Contaminated soil is to be screened during clear, hot days. It is understood that when the tar residues are tepid, the residue will become viscous and will not pass through the soil screen. Tar residues are to be stored in an impermeable receptacle and disposed of as hazardous waste. The resulting soil is to be analysed for contamination before being stockpiled, tilled and/ or supplemented with an environmentally friendly bio-remediation agent.			X	X	X		X	X	X	X										X		X			
7	Generation of fumes from equipment, machinery and vehicle emissions and the burning of waste onsite.	All vehicles and machinery onsite should be maintained to ensure that emissions being created are not in excess of the manufacturer's specifications of exhaust CO_2 output.						X			X			X				X		X	X	X	X		X	X	X
		No burning of waste should be permitted onsite.						X						X	X			X		X	X	X	X	X	X		
8	Generation of dust by vehicles, equipment and machinery operating onsite.	Tarpaulins should be used to cover material being removed from site to prevent the production of airborne contaminated dust material.						X	X					X				X		X	X	X	X		X		X
		If the access roads are dry, then the roads should be sprayed with clean water (or a dust suppressant chemical) to prevent dust production.			X			X						X				X		X	X	X		X	X		X
9	The contaminated soil may be disturbed during the excavation and screening of polluted undercut and may lead to the potential release of contaminants (PAHs, volatile substances, Phenol, etc.) into the air as a result.	All employees undertaking the remediation activities are to be supplied with personal protective equipment (dust masks, eye protection, etc.). Screening should not be undertaken during windy conditions.			X			X			X				X			X		X	X			X	X	X	
10	The fauna in and around the site may be disturbed as a result of noise levels created during remediation activities.	The vehicles and machinery utilised onsite should be fitted with silencer devices.									X		X									X	X	X	X	X	
11	Fauna naturally occurring in the area may be harmed should they fall into the empty Tar Dam pit during remediation and decommissioning works.	A temporary fence should be erected around the perimeter of the site and it should be ensured that no fauna species remain within the site boundary.									X							X				X		X	X	X	
12	Fauna occurring naturally in the area may be harmed by hunting or poaching.	A site induction presentation should be given to site remediation workers, which states that the hunting or poaching of animals is strictly forbidden.									X							X				X	X	X	X	X	
13	The risks associated with the Tar Dams being remediated and removed.	Remediation and decommissioning activities should only be conducted during daylight hours.									X						X	X			X	X	X	X	X		

Ref	Impact	Mitigation Measure	Environment																		Project Phase			Responsibility			
			Topography	Geology	Soil	Land use	Land capability	Air	Surface water	Groundwater	Fauna	Flora	Noise	Visual aspect	Waste Management	Traffic	Cultural & Heritage	Health & Safety	Employment	Climate	Decommissioning	Remediation	Rehabilitation	DEO	Contractor	RPM	Employees
14	Flora around the Tar Dams may be removed in order to assess the underlying contaminated soil.	Only remove vegetation if considered absolutely necessary.			X	X	X		X			X		X								X		X	X		X
15	The movement of vehicles may lead to the destruction of vegetation around the Tar Dams.	Vehicles should only drive in permitted areas (the site plan should indicate the access route/ plan).				X					X	X				X		X				X	X	X	X		X
		The land area used for road access should be kept to a minimum.			X	X	X						X	X								X	X	X	X		
16	Impacts on flora will be eradicated with the removal of the contaminated soil.	If any alien plant species are discovered onsite they are to be removed and disposed of offsite.			X	X	X					X										X	X	X	X		X
17	Exotic Plant species may be introduced by contractors during the rehabilitation of the site.	No exotic species may be used for rehabilitation purposes.			X							X											X	X		X	
18	The contaminated soil waste, if stored inadequately, may lead to the contamination of the surrounding environment.	According to the geo-environmental assessment, the contaminants associated with the tar dams have been contained within the clay liner and due to the characteristics of the underlying norite, no contamination of the surrounding environment is anticipated.			X	X	X		X	X	X	X			X			X					X	X	X		
		A spill kit should be available at all times during the remediation activities. Spills/ leakages of hydrocarbons from vehicles, equipment and machinery, as well as spillages of tar residues are to be cleaned up and disposed of as hazardous waste.			X	X	X		X	X					X			X				X		X	X		X
19	The general waste created by onsite workers may cause pollution in the form of litter.	There should be an adequate number of general waste receptacles onsite at any given time during remediation and rehabilitation.			X	X	X								X			X						X			X
		Central services should organise the collection and removal of waste receptacles when full.													X	X		X				X	X	X		X	
		Signage prohibiting littering and burning of waste onsite should be erected at strategic points around the site.													X			X				X	X	X	X		
20	The disposable materials used onsite, which come into contact with any hazardous substance, may cause pollution to the surrounding environment.	Ensure that only general waste is disposed of in general waste receptacles. No hazardous waste may be disposed of as general waste. If the general waste comes into contact with hazardous waste, all the waste should be disposed of as hazardous waste.													X			X				X		X	X		X
		Personal Protective Equipment (PPE) used onsite should be disposed of as hazardous waste.													X			X				X		X	X		X

Ref	Impact	Mitigation Measure	Environment																		Project Phase			Responsibility			
			Topography	Geology	Soil	Land use	Land capability	Air	Surface water	Groundwater	Fauna	Flora	Noise	Visual aspect	Waste Management	Traffic	Cultural & Heritage	Health & Safety	Employment	Climate	Decommissioning	Remediation	Rehabilitation	DEO	Contractor	RPM	Employees
		An adequate number of hazardous waste wheelie bins should be placed onsite.												X	X							X	X	X	X		
21	Potential hydrocarbon leakages from machinery, equipment and vehicles operating onsite.	Vehicles should be inspected on a daily basis.			X	X	X	X	X	X	X	X	X							X		X	X		X		X
		A spill response plan should be kept onsite at all times.			X	X	X	X	X	X	X	X		X	X			X				X		X	X		
		No fuel storage should be permitted onsite.			X	X	X	X	X	X	X	X			X			X			X	X	X		X		
22	The disposal trucks leaving the site at regular intervals may have an impact on traffic flow.	Trucks leaving the site should be scheduled at intervals and not more than two trucks should be allowed to leave the site at any given time.														X		X				X	X	X	X		X
23	The leakage of if hydrocarbon materials from the vehicles may result in the contamination of land en-route to the landfill site.	The vehicle to be used for transportation of tar residue should be fitted with a spill kit.			X	X	X	X	X	X	X	X			X							X		X	X		
		A spill response plan should be kept onsite at all times			X	X	X	X	X	X	X	X		X	X			X				X		X	X		
		Ensure that all vehicles transporting the hazardous material conform to SANS 10228. Vehicles are to have appropriate signage providing accurate information about the nature and properties of the load.														X		X			X	X			X	X	
24	The nearby graves (+/- 37m north of the Blesbok Tar Dams) may be disturbed by the movement of remediation workers, equipment, machinery, and vehicles.	The site should be demarcated to prevent employees from entering the graveyard site.															X				X	X	X	X	X	X	
		Signs prohibiting access onto the graveyard should be erected between the excavation site and the graveyard.															X				X	X	X	X		X	
		Awareness training should be provided to employees indicating that the graveyard adjacent to the contaminated site may not be entered unless authorised by management.															X				X	X	X	X	X	X	
25	Illnesses may be introduced to the surrounding areas by the contractors.	Due to the short timeframe and limited number of contractors required for the remediation activity, existing RPM standards and procedures should be complied with regarding employment and contractor safety.																X			X	X	X			X	
26	Contractors may be injured onsite, if the appropriate safety measures are not in place.	PPE should be worn onsite at all times (hard hat, dust mask, steel tip boots, gloves, eye protection, ear plugs when required, high visibility vests and an overall).																X				X		X	X		X
		A safety induction presentation should be undertaken by the employees before entering the site.																X				X	X	X	X	X	X
		Halt remediation work during heavy rain and strong windy conditions.			X													X				X	X	X	X		

Ref	Impact	Mitigation Measure	Environment																		Project Phase			Responsibility			
			Topography	Geology	Soil	Land use	Land capability	Air	Surface water	Groundwater	Fauna	Flora	Noise	Visual aspect	Waste Management	Traffic	Cultural & Heritage	Health & Safety	Employment	Climate	Decommissioning	Remediation	Rehabilitation	DEO	Contractor	RPM	Employees
		Toolbox talks should be held prior to each working day.													X			X				X		X	X		
		Ensure a person qualified in first aid is available throughout the remediation activities and retain a first aid kit onsite.																X				X		X	X		
27	The remediation workers will be exposed to the contaminated soil which may have health implications, such as respiratory difficulties.	Ensure that employees are wearing appropriate respiratory protection.																X				X		X	X		X
28	A fire event onsite may lead to serious injury.	Ensure a person qualified in fire fighting is available throughout the remediation activities.																X				X	X	X	X	X	
		Ensure that fire extinguishers are available at all times at strategic locations on the site during remedial works.																X				X	X	X		X	
	The release of airborne chemicals into the atmosphere during remediation works may result in a minor cumulative negative impact on Climate Change.	The contaminated soil should be remediated in a timeous manner.			X	X	X	X	X	X	X	X			X			X		X		X			X	X	X

4 Environmental Emergency and Response Procedure

Requested from Andre

5 Monitoring Programme

It is considered key to ensure that an efficient monitoring programme is implemented to ensure compliance to the draft EMP. The recommended frequency of inspections, monitoring activities and reporting for the decommissioning and remediation of the Tar Dams project are contained in Table 6.

To aid the monitoring programme, a checklist for inspections is included in Table 7. In order to report on findings, annual and quarterly inspections shall be facilitated through formal meetings. Representatives in such meetings should include a representative from RPM, DEO and (where applicable) contactor.

Table 6: Monitoring Programme

Responsible Personnel	Frequency	Guideline Comments
RPM	Once-off	Appoint DEO (appointment letter must be maintained)
	Once-off	Induction/ training register to be maintained
	Monthly	Compliance monitoring
	Monthly	Review, assess and close-out on incidents identified
	Ongoing	Comply to RPM awareness programme
	Ongoing	Comply to Environmental Emergency and Response Procedure
DEO	Monthly	Compliance monitoring
	Monthly	Compile monthly monitoring reports
	Ongoing	Comply to RPM awareness programme
Contractor	Once-off	Induction/ training register to be maintained
	Monthly	Compliance monitoring
	Ongoing	Comply to RPM awareness programme (Environmental Emergency and Response Procedure)

Table 7: Environmental Impacts Register/ Non-compliance Records

Nature of Incident	Date and Time	Contact Details	Response and Investigation Undertaken	Actions Taken (and by whom)	Formal Response Date

6 Environmental Awareness Plan

Requested from Andre

WSP Environment & Energy
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Appendix G: Other information

Appendix G1: Environmental Impact Assessment

Methodology Applied to the Impact Assessment

The significance of impacts are determined for each activity / facility by evaluating and ranking the severity and / or intensity of the potential environmental impacts of the proposed decommissioning and remediation of the Tar Dams and will be evaluated according to the severity, duration, extent and significance of the impact. The WSP Environment and Energy (Pty) Ltd Risk Assessment Methodology will be used for the ranking of the impacts.

This system derives environmental significance on the basis of the consequence of the impact on the environment and the likelihood of the impact occurring. Consequence is calculated as the average of the sum of the ratings of severity, duration and extent of the environmental impact. Likelihood considers the frequency of the activity together with the probability of an environmental impact occurring. The following tables describe the process in detail:

Consequence

Table 1: Assessment and Rating of Severity

Rating	Description
1	Negligible / non-harmful / minimal deterioration (0 – 20%)
2	Minor / potentially harmful / measurable deterioration (20 – 40%)
3	Moderate / harmful / moderate deterioration (40 – 60%)
4	Significant / very harmful / substantial deterioration (60 – 80%)
5	Irreversible / permanent / death (80 – 100%)

Table 2: Assessment and Rating of Duration

Rating	Description
1	Less than 1 month / quickly reversible
2	Less than 1 year / quickly reversible
3	More than 1 year / reversible over time
4	More than 10 years / reversible over time / life of project or facility
5	Beyond life of project of facility / permanent

Table 3: Assessment and Rating of Extent

Rating	Description
1	Within immediate area of activity
2	Surrounding area within project boundary
3	Beyond project boundary
4	Regional / provincial
5	National / international

Consequence is calculated as the average of the sum of the ratings of severity, duration and extent of the environmental impact.

Table 4: Determination of Consequence

Determination of Consequence (C)	(Severity + Duration + Extent) / 3
C =	$\frac{\text{severity} + \text{duration} + \text{extent}}{3}$

Likelihood

Table 5: Assessment and Rating of Frequency

Rating	Description
1	Less than once a year
2	Once in a year
3	Quarterly
4	Weekly
5	Daily

Table 6: Assessment and Rating of Probability

Rating	Description
1	Almost impossible
2	Unlikely
3	Probable
4	Highly likely
5	Definite

Likelihood considers the frequency of the activity together with the probability of the environmental impact associated with that activity occurring.

Table 7: Determination of Likelihood

Determination of Likelihood (L) =	(Frequency + Probability) / 2
L =	$\frac{frequency + probability}{2}$

Environmental Significance

Environmental significance is the product of the consequence and likelihood values.

Table 8: Determination of Environmental Significance

Environmental Significance (Impact) = C × L	Description
L (1 – 4.9)	Low environmental significance
LM (5 – 9.9)	Low to medium environmental significance
M (10 – 14.99)	Medium environmental significance
MH (15 – 19.9)	Medium to high environmental significance
H (20 – 25)	High environmental significance. Likely to be a fatal flaw.

The impact assessment considers excavation of the contaminated soil, removal of the contaminated soil and the rehabilitation phase. The impact assessment methodology is described below.

BIOPHYSICAL AND SOCIO-ECONOMIC ENVIRONMENT											
		A	B	C	D	E	F	G	(DxG)	(DxG)	H
Ref No.	Impact Description	Severity	Duration	Extent	Consequence (A+B+C)/3	Frequency	Probability	Likelihood (E+F)/2	Environmental Significance (Without Mitigation)	Environmental Significance (With Mitigation)	Positive (P) or negative (N)
Topography											
TO1	The land will be levelled, shaped to existing contour and re-vegetated (rehabilitated)	5.0	5.0	2.0	4.0	1.0	5.0	3.0	12.0		N
		5.0	5.0	2.0	4.0	1.0	5.0	3.0		12.0	P
Soil, land use and land capability											
S1	The disturbance of the contaminated soil and pathway exposure to the underlying soil layer.	4.0	2.0	1.0	2.3	2.0	2.0	2.0	4.7		N
		2.0	2.0	1.0	1.7	2.0	2.0	2.0		3.3	
S2	The removal of vegetation may lead to the erosion of the soil directly adjacent to the Tar Dams.	3.0	3.0	2.0	2.7	2.0	3.0	2.5	6.7		N
		1.0	2.0	1.0	1.3	2.0	2.0	2.0		2.7	
S3	In the case of a tar residue spillage, uncontaminated soil may become contaminated.	4.0	4.0	1.0	3.0	5.0	3.0	4.0	12.0		N
		1.0	1.0	1.0	1.0	4.0	3.0	3.5		3.5	

BIOPHYSICAL AND SOCIO-ECONOMIC ENVIRONMENT											
		A	B	C	D	E	F	G	(DxG)	(DxG)	H
Ref No.	**Impact Description**	**Severity**	**Duration**	**Extent**	**Consequence (A+B+C)/3**	**Frequency**	**Probability**	**Likelihood (E+F)/2**	**Environmental Significance (Without Mitigation)**	**Environmental Significance (With Mitigation)**	**Positive (P) or negative (N)**
S4	Potential hydrocarbon spillages from equipment, machinery and vehicles may lead to contamination of the soil in and around the site.	3.0	4.0	1.0	2.7	5.0	2.0	3.5	**9.3**		**N**
		2.0	1.0	1.0	1.3	4.0	2.0	3.0		**4.0**	
S5	The decommissioning (final infill, levelling and revetetation) of the area associated with the tar dams may succeed in transforming the land use back to grazing.	4.0	4.0	2.0	3.3	2.0	5.0	3.5	**12.0**		**N**
		5.0	5.0	2.0	4.0	2.0	5.0	3.5		**14.0**	**P**
Air											
A1	Generation of fumes from equipment, machinery and vehicle emissions onsite and during infill and levelling activities.	3.0	1.0	4.0	2.7	5.0	5.0	5.0	**13.5**		**N**
		2.0	1.0	4.0	2.3	5.0	2.0	3.5		**8.0**	

BIOPHYSICAL AND SOCIO-ECONOMIC ENVIRONMENT											
		A	B	C	D	E	F	G	(DxG)	(DxG)	H
Ref No.	**Impact Description**	**Severity**	**Duration**	**Extent**	**Consequence (A+B+C)/3**	**Frequency**	**Probability**	**Likelihood (E+F)/2**	**Environmental Significance (Without Mitigation)**	**Environmental Significance (With Mitigation)**	**Positive (P) or negative (N)**
A2	Generation of dust from decommissioning activities (including activities such as the burning of waste onsite).	2.0	1.0	2.0	1.7	5.0	5.0	5.0	**8.3**		**N**
		1.0	1.0	1.0	1.0	1.0	2.0	1.5		**1.5**	
A3	The contaminated soil may be disturbed during the ongoing decommissioning activities, leading to the potential release of contaminants (PAHs, volatile substances, Phenol, etc.).	3.0	1.0	3.0	2.3	5.0	5.0	5.0	**11.5**		**N**
		2.0	1.0	3.0	2.0	4.0	4.0	4.0		**8.0**	
Surface water											
SW1	Contamination of the soil and surface runoff from potential spillages and leakages of tar residues and hydrocarbons during decommissioning activities resulting in the degradation of surface water in the area.	2.0	3.0	2.0	2.3	4.0	3.0	3.5	**8.2**		**N**
		1.0	1.0	2.0	1.3	4.0	1.0	2.5		**3.3**	

BIOPHYSICAL AND SOCIO-ECONOMIC ENVIRONMENT											
		A	B	C	D	E	F	G	(DxG)	(DxG)	H
Ref No.	Impact Description	Severity	Duration	Extent	Consequence (A+B+C)/3	Frequency	Probability	Likelihood (E+F)/2	Environmental Significance (Without Mitigation)	Environmental Significance (With Mitigation)	Positive (P) or negative (N)
SW2	Incorrect management of contaminated soil stockpiles could cause contaminated surface water leaving the site boundary.	3.0	4.0	3.0	3.3	3.0	4.0	3.5	11.5		N
		2.0	2.0	2.0	2.0	2.0	3.0	2.5		5.0	
SW3	Incorrect disposal of contaminated tar residue could have an impact on the surrounding environment should the surface water become contaminated.	4.0	4.0	2.0	2.0	3.0	1.0	2.0	4.0		N
		2.0	1.0	1.0	1.3	1.0	1.0	1.0		1.3	
SW4	Potential contamination of surrounding surface water as a result of contaminated runoff during remediation activities.	2.0	3.0	2.0	2.3	4.0	3.0	3.5	8.2		N
		1.0	1.0	2.0	1.3	4.0	1.0	2.5		3.3	
Groundwater											
GW1	Potential contamination of runoff water ingress from the resulting contaminated soil may result in groundwater contamination.	3.0	2.0	3.0	2.7	4.0	3.0	3.5	9.3		N
		1.0	1.0	2.0	1.3	4.0	1.0	2.5		3.3	

Ref No.	Impact Description	A Severity	B Duration	C Extent	D Consequence (A+B+C)/3	E Frequency	F Probability	G Likelihood (E+F)/2	(DxG) Environmental Significance (Without Mitigation)	(DxG) Environmental Significance (With Mitigation)	H Positive (P) or negative (N)
BIOPHYSICAL AND SOCIO-ECONOMIC ENVIRONMENT											
GW2	Pollution plume associated with groundwater contamination may be extended with ingress of contaminated rainwater.	3.0	3.0	3.0	3.0	4.0	3.0	3.5	10.5		N
		1.0	1.0	2.0	1.3	4.0	1.0	2.5		3.3	
Fauna											
FA1	The fauna in and around the site may be disturbed as a result of noise levels created during decommissioning activities (infill, levelling and revetetation).	2.0	2.0	2.0	2.0	5.0	3.0	4.0	8.0		N
		1.0	2.0	2.0	1.7	5.0	2.0	3.5		5.8	
FA2	Fauna naturally occurring in the area may be harmed should they fall into the empty tar dam pit during decommissioning works.	4.0	2.0	2.0	2.7	4.0	2.0	3.0	8.0		N
		1.0	2.0	2.0	1.7	2.0	1.0	1.5		2.5	
FA3	Fauna occurring naturally in the area may be harmed by hunting or poaching from onsite employees.	2.0	2.0	3.0	2.3	4.0	2.0	3.0	7.0		N
		1.0	2.0	1.0	1.3	1.0	2.0	1.5		2.0	

BIOPHYSICAL AND SOCIO-ECONOMIC ENVIRONMENT											
		A	B	C	D	E	F	G	(DxG)	(DxG)	H
Ref No.	Impact Description	Severity	Duration	Extent	Consequence (A+B+C)/3	Frequency	Probability	Likelihood (E+F)/2	Environmental Significance (Without Mitigation)	Environmental Significance (With Mitigation)	Positive (P) or negative (N)
FA4	Potential risks on fauna originating from the tar dams will be removed.	5.0	5.0	2.0	4.0	2.0	5.0	3.5	14.0		N
		5.0	5.0	2.0	4.0	2.0	5.0	3.5		14.0	P
Flora											
FL1	The flora in and around the site may be disturbed as a result of noise levels created during decommissioning activities (infill, levelling and revetetation).	2.0	2.0	1.0	1.7	5.0	3.0	4.0	6.7		N
		2.0	2.0	1.0	1.7	5.0	2.0	3.5		5.8	
FL2	The movement of vehicles may lead to the destruction of vegetation around the Tar Dams.	2.0	2.0	2.0	2.0	5.0	3.0	4.0	8.0		N
		2.0	2.0	2.0	2.0	5.0	2.0	3.5		7.0	

BIOPHYSICAL AND SOCIO-ECONOMIC ENVIRONMENT											
		A	B	C	D	E	F	G	(DxG)	(DxG)	H
Ref No.	Impact Description	Severity	Duration	Extent	Consequence (A+B+C)/3	Frequency	Probability	Likelihood (E+F)/2	Environmental Significance (Without Mitigation)	Environmental Significance (With Mitigation)	Positive (P) or negative (N)
FL3	Potential risks on flora originating from the tar dams will be removed.	2.0	2.0	2.0	2.0	5.0	3.0	4.0	**8.0**		**N**
		5.0	2.0	2.0	3.0	5.0	2.0	3.5		**10.5**	**P**
FL4	Alien and invasive plant species may be introduced during the decommissioning and remediation activities.	5.0	5.0	3.0	4.3	5.0	2.0	3.5	**15.2**		**N**
		2.0	2.0	1.0	1.7	1.0	1.0	1.0		**1.7**	**N**
Noise											
N1	Noise nuisance may result from noise generated by equipment, machinery and vehicles during decommissioning	3.0	2.0	2.0	2.3	5.0	3.0	4.0	**9.3**		**N**
		2.0	2.0	2.0	2.0	5.0	2.0	3.5		**7.0**	

BIOPHYSICAL AND SOCIO-ECONOMIC ENVIRONMENT											
		A	B	C	D	E	F	G	(DxG)	(DxG)	H
Ref No.	Impact Description	Severity	Duration	Extent	Consequence (A+B+C)/3	Frequency	Probability	Likelihood (E+F)/2	Environmental Significance (Without Mitigation)	Environmental Significance (With Mitigation)	Positive (P) or negative (N)
Visual Aspects											
VA1	The removal of the Tar Dams and levelling of the void may improve the aesthetic impact on the immediate vicinity of the area.	3.0	2.0	2.0	2.3	5.0	5.0	5.0	11.7		N
		4.0	5.0	2.0	3.6	5.0	3.0	4.0		14.4	P
Waste Management											
WM1	Incorrect storage of contaminated material may pollute surrounding uncontaminated soil, resulting in additional volumes of waste to landfill.	3.0	3.0	1.0	2.3	4.0	3.0	3.5	8.2		N
		2.0	2.0	1.0	1.7	2.0	2.0	2.0		3.3	
WM2	General waste in the form of litter may be generated from onsite employees during the decommissioning activities.	2.0	2.0	1.0	1.7	5.0	4.0	4.5	7.5		N
		1.0	1.0	1.0	1.0	3.0	2.0	2.5		2.5	

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Ref No.	Impact Description	Severity	Duration	Extent	Consequence (A+B+C)/3	Frequency	Probability	Likelihood (E+F)/2	Environmental Significance (Without Mitigation)	Environmental Significance (With Mitigation)	Positive (P) or negative (N)
						Traffic					
T1	Waste contractor vehicles transporting residual tar residues to permitted hazardous landfill sites may impact on the traffic flow of the area.	3.0	2.0	2.0	2.3	5.0	3.0	4.0	**9.3**		**N**
		2.0	2.0	2.0	2.0	5.0	2.0	3.5		**7.0**	
T2	The leakage/ spillage of hazardous materials from the transport vehicles may result in the contamination of land en-route to the landfill site.	4.0	3.0	4.0	3.7	4.0	2.0	3.0	**11.0**		**N**
		2.0	1.0	4.0	2.3	4.0	2.0	3.0		**7.0**	
T4	Potential accidents resulting from transport vehicles could have an adverse impact on both the social and biophysical environment.	5.0	5.0	4.0	9.4	1.0	2.0	1.0	**9.4**		**N**
		3.0	3.0	4.0	3.3	1.0	1.0	1.0		**3.3**	

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Ref No.	Impact Description	Severity	Duration	Extent	Consequence (A+B+C)/3	Frequency	Probability	Likelihood (E+F)/2	Environmental Significance (Without Mitigation)	Environmental Significance (With Mitigation)	Positive (P) or negative (N)
Cultural and Heritage Impacts											
CH1	The nearby graves (+/- 37m north of the Blesbok Tar Dams) may be disturbed by the movement of remediation workers, equipment, machinery, and vehicles.	3.0	5.0	2.0	3.3	5.0	2.0	3.0	**9.9**		**N**
		1.0	1.0	2.0	1.3	2.0	2.0	2.0		**2.7**	
Health and Safety											
HS1	Social ills associated with the temporary influx of contractors and employees into the area.	3.0	4.0	3.0	3.3	5.0	3.0	4.0	**13.2**		**N**
		1.0	1.0	2.0	1.3	5.0	2.0	3.5		**4.7**	
HS2	Potential injury from onsite accidents from machinery, equipment or vehicles during decommissioning activities.	5.0	2.0	2.0	3.0	5.0	4.0	4.5	**13.5**		**N**
		2.0	2.0	2.0	2.0	1.0	2.0	1.5		**3.0**	

BIOPHYSICAL AND SOCIO-ECONOMIC ENVIRONMENT											
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Ref No.	**Impact Description**	**Severity**	**Duration**	**Extent**	**Consequence (A+B+C)/3**	**Frequency**	**Probability**	**Likelihood (E+F)/2**	**Environmental Significance (Without Mitigation)**	**Environmental Significance (With Mitigation)**	**Positive (P) or negative (N)**
HS3	Exposure of PAHs, volatile substances, Phenol, etc. during decommissioning activities.	4.0	4.0	4.0	4.0	5.0	3.0	2.6	**10.4**		**N**
		2.0	2.0	2.0	1.3	3.0	2.0	2.5		**3.3**	
HS5	Potential fires onsite may impact on onsite employee safety.	5.0	5.0	1.0	3.7	4.0	2.0	3.0	**11.1**		**N**
		2.0	2.0	1.0	1.7	2.0	2.0	2.0		**3.4**	
HS6	The remediation activity will remove the risk associated with the inhalation of hazardous airborne chemicals by the surrounding community members.	5.0	4.0	1.0	3.3	4.0	2.0	3.0	**10.0**		**N**
		5.0	4.0	1.0	3.3	2.0	2.0	2.0		**6.7**	**P**

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Employment											
E1	The remediation activity may result in temporary employment.	3.0	5.0	4.0	4.0	2.0	4.0	3.0	**12.0**		**P**
		3.0	5.0	4.0	4.0	2.0	4.0	3.0		**12.0**	
E2	The remediation activity may result in temporary skills development.	3.0	5.0	4.0	4.0	2.0	4.0	3.0	**12.0**		**P**
		3.0	5.0	4.0	4.0	2.0	4.0	3.0		**12.0**	