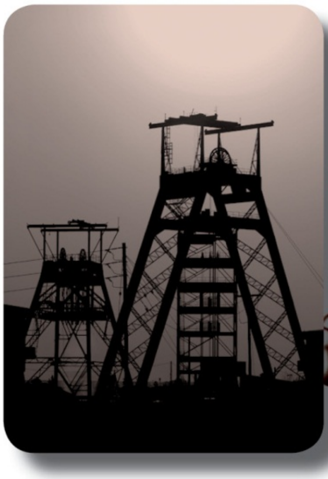


Water Resource Planning Systems Series

Water Quality Planning

Feasibility Study for a Long-Term Solution to address the Acid Mine Drainage associated with the East, Central and West Rand underground mining basins

Implementation Strategy and Action Plan

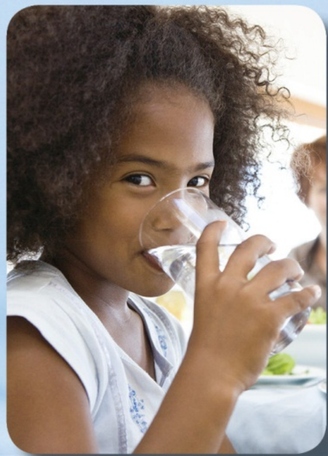
Study Report No. 8

P RSA 000/00/16812

July 2013

EDITION 1





water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF WATER AFFAIRS

Water Resource Planning Systems Series

Feasibility Study for a Long-Term Solution to address the Acid Mine Drainage associated with the East, Central and West Rand underground mining basins

Implementation Strategy and Action Plan

Study Report No. 8

[P RSA 000/00/16812]

Aurecon Report No. 6174

July 2013

EDITION 1

Published by

Department of Water Affairs
Private Bag X313
PRETORIA, 0001
Republic of South Africa

Tel: (012) 336 7500/ +27 12 336 7500
Fax: (012) 336 6731/ +27 12 336 6731

ISBN No. 978-0-621-41758-6

This report should be cited as:

Department of Water Affairs (DWA), 2013: Feasibility Study for a Long-Term Solution to address the Acid Mine Drainage associated with the East, Central and West Rand underground mining basins. Study Report No. 8: Implementation Strategy and Action Plan - DWA Report No.: P RSA 000/00/16812.

Disclaimer:

The study was very dynamic in nature and the available information is continuously being updated and expanded. It is confirmed that each report has been prepared for the purpose of the study using the information relevant and available at the time of compilation of the report. All necessary skill, care and diligence were exercised by the authors, contributors and reviewers during the compilation and approval of the reports. The reader needs to determine the relevance, reliability or usefulness of the information and data reported in this study, if it is used in whole or in part, for their own purpose. Reports should not be interpreted in isolation, but in the context of the study and all its deliverables as a whole.

The reader takes full responsibility for their use, interpretation or modification of the report and the information presented and will have no recourse to the Department of Water Affairs or the study team for any misinterpretation, misuse, or reuse of the report.

DOCUMENT INDEX

Reports as part of this study:

Study Report Number	DWA Report Number	Reports	SC	Conf.
1	P RSA 000/00/16112	Inception Report	1	
2	P RSA 000/00/16212	Status of Available Information	2	
3	P RSA 000/00/16312	Legal Considerations for Apportionment of Liabilities	3	#
4	P RSA 000/00/16412	Alternative Approaches for Apportioning Liabilities		#
5	P RSA 000/00/16512	Technical Prefeasibility Report	4	
5.1	P RSA 000/00/16512/1	Current Status of the Technical Management of Underground AMD		
5.2	P RSA 000/00/16512/2	Assessment of the Water Quantity and Quality of the Witwatersrand Mine Voids		
5.3	P RSA 000/00/16512/3	Options for Use or Discharge of Water		
5.4	P RSA 000/00/16512/4	Treatment Technology Options		
5.5	P RSA 000/00/16512/5	Options for the Sustainable Management and Use of Residue Products from the Treatment of AMD		
6	P RSA 000/00/16612	Concept Design	5	#
6.1	P RSA 000/00/16612/1	Concept Design: Drawings		#
6.2	P RSA 000/00/16612/2	Concept Design: Costing		#
7	P RSA 000/00/16712	Institutional, Procurement and Financing Options	6	#
8	P RSA 000/00/16812	Implementation Strategy and Action Plan	7	
9	P RSA 000/00/16912	Key Stakeholder Engagement and Communications	8	
9.1	P RSA 000/00/16912/1	Communication Strategy and Action Plan		
10	P RSA 000/00/17012	Feasibility Report		

SC: Study Component Conf: Indication of Confidentiality

\# - These reports will not be made available until the appropriate implementation process stages have been reached as they may potentially compromise future procurement and legal processes.

PREFACE

1. Background to the Study

Gold mining in the East, Central and West Rand underground mining basins of the Witwatersrand goldfields (hereafter referred to as the Eastern, Central and Western Basins) started in the late 1880s. It is estimated that in the 1920s approximately 50% of the world's gold production came from the Witwatersrand mining belt, while in the 1980s South Africa was still the largest gold producer in the world. The large-scale mining in South Africa, in particular on the Witwatersrand, has decreased since the 1990s, and underground mining on the Witwatersrand essentially ceased in 2010. The mines of the Western, Central and Eastern Basins have produced a total of approximately 15 600 tons of refined gold since mining commenced. While the mines were operating, they pumped water to the surface to dewater their mine workings, but since mining stopped, the underground voids that were left after the mining have been steadily filling with water. The water in the mine voids interacts with the exposed sulphide bearing minerals in the rock formations to form Acid Mine Drainage (AMD), also known internationally as Acid Rock Drainage (ARD). AMD is characterised by a low pH and an excessive concentration of dissolved metals and sulphate salts.

In the case of the Western Basin, the AMD gradually reached the surface and started to drain out (decant) into surface streams in 2002. The water in the mine voids of the Central and Eastern Basins is rising steadily and will continue to do so until the water is pumped from the voids. It is predicted that the critical water levels will be reached in the Central Basin in late 2013 and in the Eastern Basin in mid-2014. If nothing is done, the water is predicted to reach the surface and decant at the lowest points in the Central Basin in the second half of 2015 and to reach the surface and decant in the Eastern Basin in late 2016. Decant would be uncontrolled and is likely to occur at several identified points, as well as at unexpected locations across each basin, due to varying water levels and connectivity between the near-surface aquifers and the voids.

If AMD, which has not been desalinated, is discharged into the Vaal River System, the high salt load will require large dilution releases to be made from the Vaal Dam to achieve the fitness-for-use objectives set for the Vaal Barrage and further downstream. This would result in unusable surpluses developing in the Lower Vaal River. Moreover, if dilution releases are still required after 2015, the acceptable levels of assurance of water supply from the Vaal Dam would be threatened. This will mean that there would be an increasing risk of water restrictions in the Vaal River water supply area, which will have negative economic and social implications. These negative impacts will be much greater if the catchment of the Vaal River System enters a period of lower-than-average rainfall with drought conditions. Since decant started in the Western Basin in 2002 the continuous flow of untreated AMD, and now the salt load from the continuous flow of the neutralised AMD from the Western Basin, impact on the Crocodile (West) River System.

The importance of finding a solution to the rising AMD and the need for inter-departmental cooperation led to the establishment of an Inter-Ministerial Committee (IMC) on AMD, comprising the Ministers of Mineral Resources, Water and Environmental Affairs, and Science and Technology, and the Minister in the Presidency: National Planning Commission. The first meeting of the IMC took place in September 2010.

The IMC established a Technical Committee, co-chaired by the Directors-General of Mineral Resources and Water Affairs, which instructed a Team of Experts to prepare a report advising the IMC on solutions to control and manage AMD in the Witwatersrand goldfields. In February 2011, Cabinet considered the IMC report and instructed that the recommendations be implemented as a matter of urgency. Funds were then allocated to the Department of Water Affairs (DWA) by National Treasury with the purpose of implementing some of the IMC recommendations, namely to:

- Investigate and implement measures to pump the underground mine water in order to prevent the violation of the Environmental Critical Levels (ECLs), i.e. specific underground levels in each mining basin above which mine water should not be allowed to rise so as to prevent adverse environmental, social and economic impacts;
- Investigate and implement measures to neutralise AMD (pH correction and removal of heavy metals from AMD); and
- Initiate a Feasibility Study to address the medium- to long-term solution.

The investigations and implementation actions proposed in the first two recommendations commenced in April 2011, when the Minister of Water and Environmental Affairs issued a Directive to the Trans-Caledon Tunnel Authority (TCTA) to undertake “Emergency Works Water Management on the Witwatersrand Gold fields with special emphasis on AMD”:

When the proposed pumping and neutralisation commences in the Central and Eastern Basins the situation will be similar to that which prevailed when underground mining and dewatering of the mine voids, and partial treatment of the water, were being carried out by the active mining companies. The saline AMD will flow into the Vaal River System and specifically into the Vaal Barrage. The high salt load will have the same impact on the Vaal River System as described earlier.

The third recommendation resulted in the Terms of Reference (ToR) for this Feasibility Study (DWA 2011a) being issued in July 2011. The ToR noted that the IMC had recommended that a Feasibility Study should be initiated as soon as possible, since the Short-Term Interventions (STI) might influence the roll-out of the desired medium- to long-term solution.

In January 2012, DWA commissioned the Feasibility Study for the Long-Term Solution (LTS). The Study period was 18 months, with completion at the end of July 2013. It was emphasised that this Study was very urgent, would be in the public eye, and that recommendations to support informed decision-making by DWA were required. The recommended solution must support the Water Resource Strategies for the Vaal and Crocodile West River Systems and take account of the costs, social and environmental implications and public reaction to the various possible solutions.

The urgency of reducing salt loading on the Vaal River System and the relatively short study period for such a complex study means that implementation decisions have to be based on the current understanding of the best available information and technical analyses that have been completed by the time the decisions must be made. Thus, a precautionary and conservative approach was adopted during the Study.

Opportunities have been identified where the solutions that are implemented can be refined, during operation, as more information becomes available.

2. Integration with the Short-Term Intervention

The final TCTA Due Diligence Report (TCTA, 2011) was submitted to DWA in August 2011, and tenders for construction in all the basins were invited in November 2011. Immediate works were implemented in the Western Basin in 2012, and construction in the Central Basin commenced in January 2013. It is anticipated that construction of the Eastern Basin will commence in the first quarter of 2014.

The Scope of Work (SoW) of this Feasibility Study, with respect to the STI, is to understand the proposed STI in sufficient detail to:

- Undertake a Feasibility Study of all options, irrespective of the STI, in the interests of finding the best LTS;
- Determine how to integrate the STI and LTS, and influence the STI as far as appropriate or practical;
- Identify any potential long-term risks associated with the proposed STI, and propose prevention or mitigation measures; and
- Assess the implications of the proposed STI for the suggested institutional model for the implementation, operation, maintenance and/or management of the preferred LTS.

3. Approach to the Study

The focus areas of the Feasibility Study comprise technical, legal, institutional, financial/economic and environmental assessments, as well as public communication and key stakeholder engagement. The Feasibility Study comprises three phases; the Initiation, Prefeasibility and Feasibility Phases. The main components and key deliverables of each phase are shown in **Figure 1**, and each phase is discussed in more detail below.

The technical assessments run in parallel with the legal assessment, and both feed into the options assessment. The component on stakeholder engagement and communication was started early in the Study so that a stakeholder engagement and public communication strategy could be developed as soon as possible and be implemented throughout the Study.

The planning showed the Feasibility Phase as following the Prefeasibility Phase, but the short study period meant that it was necessary for the Feasibility Phase components to commence during the Prefeasibility Phase and run in parallel.

In conducting the Study, it was important that each component developed key information and recommendations, which were then used in subsequent components. The logical and timeous flow of information and recommendations was essential in order to develop solutions and meet the Study programme.

Figure 2 gives an overview of the technical, institutional/financial and implementation components and the flow of information throughout the Study. It can be seen how the fixed information (e.g. ECLs, raw water quality, ingress, etc.) and the decisions to be made, or the options to be investigated (e.g. abstraction points, qualities and quantities required by potential users, locations of users, treatment technologies) feed into the options assessment and identification of the Reference Project. The Reference Project will define the option that uses proven technologies, has the least associated risk, and is used for financial modelling and budgeting. It will probably not be the same as the option that is implemented, but constitutes the benchmark against which implementation proposals will be judged.

The Concept Design is based on the Reference Project and includes the costing and land requirements. This in turn provides input for the evaluation of the institutional procurement and financing options and the Implementation Strategy and Action Plan.

The phases of the Study, the key components and their inter-relationships are described below and illustrated in **Figures 1 and 2**.

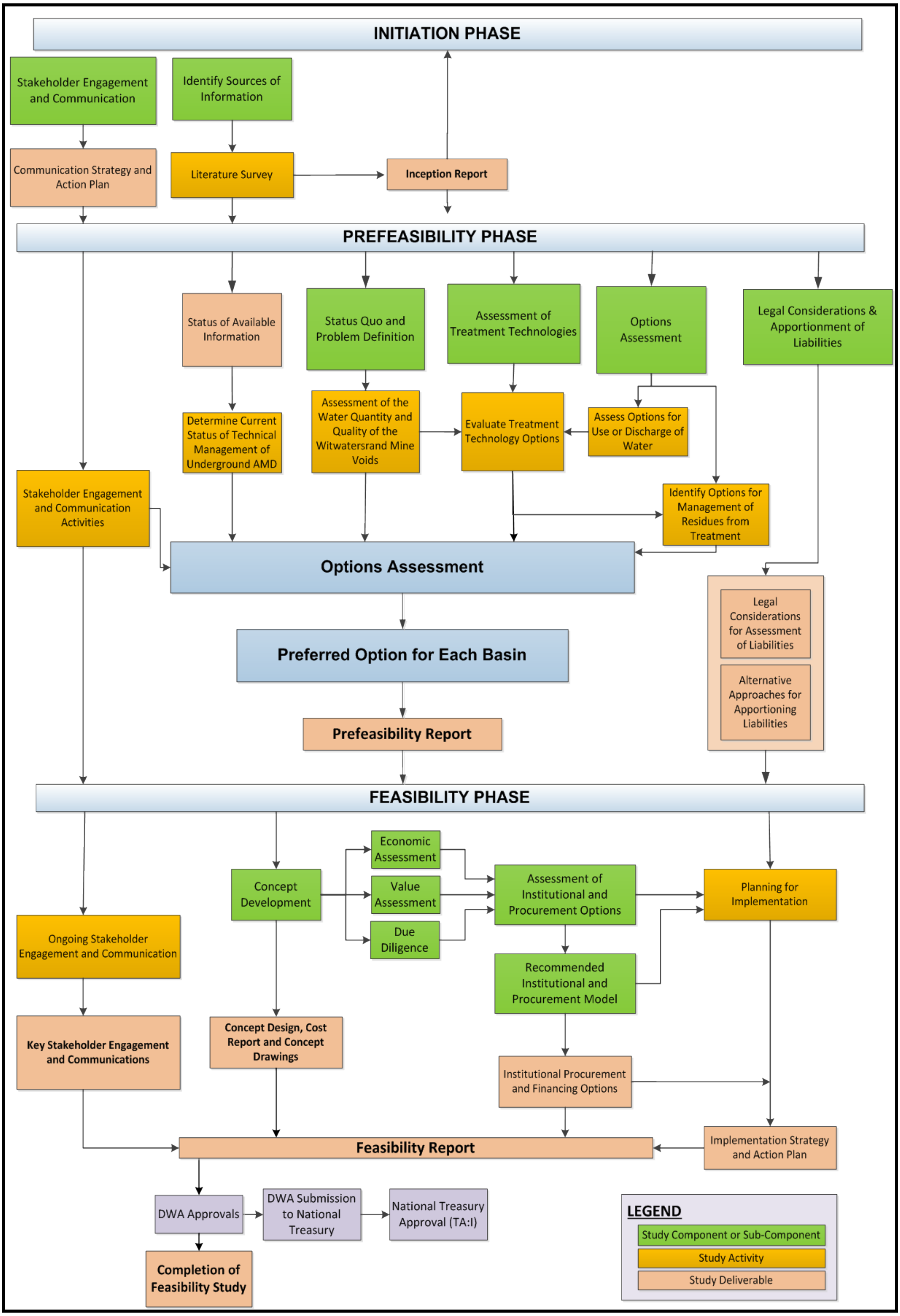


Figure 1: Study phases and components

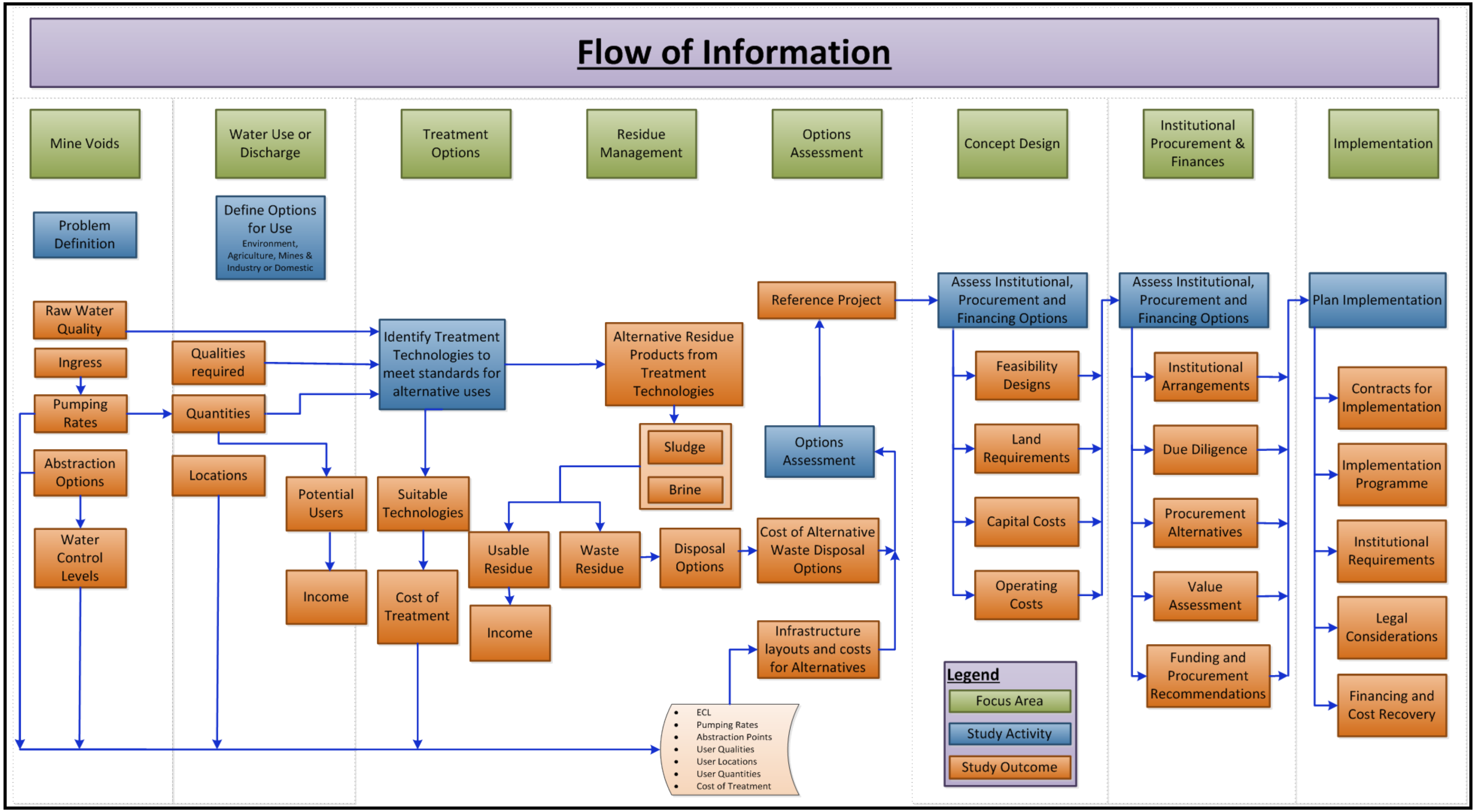


Figure 2: Flow of information throughout the Study

PHASE 1: Initiation

The objective of the Initiation Phase was to determine on the approach and principles for the Study and understand the work already done by others. Numerous reports from previous studies, maps and research findings, relating to all components of the Study, were collated and reviewed. The SoW, proposed approach and the study programme were reviewed after initial consideration of the available information. The study objectives and priorities were reviewed and the results are presented in Study Report No. 1: ***"Inception Report"***.

The results of the complete literature survey, which continued after the Initiation Phase, are presented in Study Report No. 2: ***"Status of Available Information"***.

The Study Report No. 9.1: ***"Communication Strategy and Action Plan"*** was prepared so that key stakeholder engagement and communicators could commence as soon as possible and continue throughout the Study.

PHASE 2: Prefeasibility

The purpose of this phase was to understand and describe the current status and the environment for managing AMD and then to identify all apparently viable alternative solutions and, from those, identify the more feasible options, on the basis of technical feasibility, social and environmental acceptability and cost effectiveness. These were then considered in more detail, and the most feasible options were investigated in the Feasibility Phase.

The assessment of the legal liabilities and mechanisms for the apportionment of liabilities is a key stand-alone component that was commenced in the Prefeasibility Phase and finalised in the Feasibility Phase. This work is described in the confidential Study Report No. 3: ***"Legal Considerations for Apportionment of Liabilities"*** and confidential Study Report No. 4: ***"Alternative Approaches for Apportioning Liabilities"***.

The objectives of the Prefeasibility Phase were to:

- Understand the status quo;
- Define the problem;
- Understand the quantity and quality of water in the mine voids and how fast is it rising in each basin;
- Identify possible uses for the water;
- Identify treatment technologies that can treat the necessary volumes of AMD to the standard required by various users;
- Understand the residues (or waste products) produced by each process and how they can be managed;
- Define a wide range of options for possible solutions by combining alternatives for abstraction, water use, treatment and management of residues;
- Screen the alternatives to identify viable options; and

- Carry out prefeasibility costing of the most viable options and identify the most appropriate option to be used as the Reference Project.

To achieve these objectives, the Prefeasibility Phase needed to provide the team with:

i. A sound understanding of the STI, how it can be integrated into the LTS, and the impact of the STI on the selection and procurement of the LTS. This is described in Study Report No. 5.1: ***"Current Status of Technical Management of Underground AMD"***.

ii. A sound understanding of the hydrogeology, underground water resources, sources of surface water ingress, spatial distribution and connectivity of mined voids; and the current water quality and projections of future volumes, levels and water qualities. This was based on the substantial information from previous studies and is presented in Study Report No. 5.2: ***"Assessment of the Water Quantity and Quality of the Witwatersrand Mine Voids"***.

iii. An understanding of the DWA Water Resource Management Strategies for the Vaal River System and Crocodile West River System. These strategies provided the framework within which to develop a range of possibilities for the use or discharge of raw, neutralised or desalinated AMD to meet the objective of reducing the salt load in the Vaal River System and associated catchments to acceptable levels without having an unacceptable social or environmental impact. These possibilities are described in Study Report No. 5.3: ***"Options for Use or Discharge of Water"***.

iv. An assessment of suitable technologies for treating either raw AMD or the discharges from the STI to standards that will not negatively impact on the environment and will be acceptable to a range of users. This assessment is described in Study Report No. 5.4: ***"Treatment Technology Options"***.

v. Locality plans for the possible disposal of waste, or potential uses for residue products generated by treatment processes. These plans are described in Study Report No. 5.5: ***"Options for the Sustainable Management and Use of Residue Products from the Treatment of AMD"***.

The knowledge and data from the Prefeasibility Phase were used to combine the alternative locations for the abstraction, treatment and use or discharge of water and the disposal of waste, as well as the layouts of the infrastructure required (including pipelines and pump stations), into a large number of options. The alternatives were screened at a high level to give a short-list of practical technical options.

The capital and operating costs of the short-listed options were determined to give a present value of lifetime cost. Social and environmental screening for fatal flaws was carried out, and possible financial benefits from the sale of water or waste were considered. The anticipated public reaction to the options was also considered. The identification of the Reference Project was then completed on the basis of the costs, benefits and impacts. The costs and implications of possible alternatives were also defined. The results and an overview of all the components of this Prefeasibility Phase are described in Study Report No. 5: ***"Technical Prefeasibility Report"***.

PHASE 3: Feasibility

The main objective of this phase was to carry out intensive feasibility level investigations and optimisation of the most feasible layouts for each basin and to select a preferred option to be used as a Reference Project for each basin. The requirements for implementation were also considered and evaluated.

The Feasibility Phase comprises a number of components that build on the results of the Prefeasibility Phase; the results of the various components are reported separately and then integrated in a Feasibility Report for the solution to AMD.

The components in this Phase comprise:

i. Concept Development:

Once the Reference Project for each basin had been agreed, the layout for the treatment works, pipelines and waste storage and disposal sites was planned and costed. Environmental screening was undertaken for each of the identified sites that form part of the Reference Project. The results are presented in the confidential Study Report No. 6: ***"Concept Design"***, the confidential Study Report No. 6.1: ***"Concept Design: Drawings"*** and the confidential Study Report No. 6.2: ***"Concept Design: Costing"***.

ii. Institutional Procurement and Financing Options:

The following alternative procurement models for implementation were evaluated:

- a 'traditional' Government-funded and a traditionally procured Employer Design, Procure, Construct and Operate solution, which is the Public Sector Comparator model (PSC);
- a Design, Build, Operate and Maintain (DBOM) scenario funded by an Implementing Agent, using Private Sector or Government funding, which is also a Public Sector Comparator model (PSC); and
- a private sector-funded Public–Private Partnership (PPP).

The approach included a detailed risk-adjusted value assessment of the PSC and PPP models for the Reference Project in each of the three basins. The possible institutional arrangements were assessed in terms of the roles and responsibilities of the responsible organisations.

A due diligence assessment was carried out to establish the legal mandates of the institutions, as well as ownership of the land required for the Reference Project. These assessments are described in the confidential Study Report No. 7: ***"Institutional, Procurement and Financing Options"***.

iii. Implementation Strategy and Action Plan:

Throughout the Study, the requirements for implementation were considered in developing an Implementation Plan. Where necessary, the activities required for implementation that must commence in parallel with this Study were identified. This included the preparation of a Request for Information (RfI), which initiated a process through which service providers could register their interest with DWA. All the requirements for implementation are described in Study Report No. 8: ***"Implementation Strategy and Action Plan"***.

iv. Key Stakeholder Engagement and Public Communication:

Engagement with key stakeholders and public communication were very important components of the Study and were on-going from the commencement of the Study to the completion of the work. Study Stakeholder Committee meetings, Focus Group meetings, an RfI, one-on-one meetings, newsletters and a website were key elements. The process and results are presented in Study Report No. 9: "***Key Stakeholder Engagement and Communications***".

The final deliverable, Study Report No. 10: ***"Feasibility Report",*** summarises the results of the Study.

The Prefeasibility Phase and Concept Development in the Feasibility Phase are typical components of many planning studies. Solving the technical issues is not normally the biggest challenge, although this project does have several unique aspects. However, the Feasibility Phase components that lead to recommendations for appropriate institutional, financial and procurement models for implementation, particularly the assessment of the options for procurement, are not common components of DWA studies and were the most challenging, and certainly as important for a sustainable solution as all the technical components combined.

4. Way Forward

Completion of the Study will provide all the information required for implementation to proceed, although DWA plans to start the preparations required for implementation in parallel with Phase 3 of this Study.

Following from the Feasibility Study, implementation should be carried out as soon as possible. The key activities required for implementation include the following:

- DWA submitting the Feasibility Study Reports to National Treasury for their review and approval. The project has been registered with National Treasury, and Treasury Approval 1 (TA 1) may be required before procurement can commence;
- Conducting an Environmental Impact Assessment (EIA); and
- The preparation of procurement documents.

If procurement is for a Design, Build, Operate and Maintain (DBOM) contract, the procurement documents will comprise:

- A Request for Qualifications (RfQ) to allow DWA to short-list suitably qualified service providers;

  This will allow any service provider, especially those with proprietary technologies that may well be more cost effective than that used as the reference technology, to submit detailed information. Those that best meet the selection criteria, which will have to be agreed, will be short-listed; and

- A Request for Proposals (RfP) to be issued to the short-listed service providers, inviting them to submit tenders to implement a project that will deliver water to the specified standards.

If procurement is to follow the traditional process (with three sequential tenders for a service provider to prepare design and tender documentation, followed by tenders for construction, and then tenders for operation and maintenance), then the two-phase RfQ and RfP route may also be followed, with appropriate requirements specified at each stage.

The Reference Project could be implemented, but may not be the most effective solution. It will provide the yardstick methodology and costing which will be used to evaluate the tenders which are submitted.

DWA will also need to source the technical and contractual expertise required to enable them to manage the implementation of the desired long-term solution in each of the three basins.

NOTE: A List of Acronyms and Glossary of Terms appear on pages "xlvi" and "l" respectively.

APPROVAL

TITLE:	Implementation Strategy and Action Plan
DATE:	July 2013
AUTHORS:	A Tanner, J Samuel, D Timm, V Maharaj, A Hindley, D Duthe, V Gajathar
INTERNAL REVIEWER:	F Vogel
LANGUAGE REVIEWER:	R Arnold
LEAD CONSULTANT:	Aurecon South Africa (Pty) Ltd
DWA FILE NO.:	14/15/13/3
DWA REPORT NO.:	P RSA 000/00/16812
AURECON REPORT NO.:	107748/Aurecon/6174
FORMAT:	MS Word and PDF
WEB ADDRESS:	www.dwa.gov.za/projects/AMDFSLTS

Approved for Aurecon South Africa (Pty) Ltd / Project Team:

Mr John Samuel
Institutional and Financial Advisor

Mr André Hindley
Legal Advisor

Mr Andrew Tanner
Lead Technical Advisor

Mr Fanie Vogel
Study Leader and Internal Reviewer

Approved for the Department of Water Affairs by:

Mr Jurgo van Wyk
Scientist Manager: Water Quality Planning: Central

Mr Pieter Viljoen
Scientist Manager: Water Quality Planning

Dr Beason Mwaka
Director: Water Resources Planning Systems

ACKNOWLEDGEMENTS

The following individuals and organisations are thanked for their contributions to the study:

Study Administration Committee (SAC)

Jurgo van Wyk	Department of Water Affairs (DWA): Water Resource Planning Systems (WRPS)	Chairman / Study Manager
Jacqueline Jay	DWA: WRPS	Member / Study co-ordinator
Peter Pyke	DWA: Options Analysis	Member
Seef Rademeyer	DWA: National Water Resource Planning	Member
Rod Schwab	DWA: WRPS	Member
Pieter Viljoen	DWA: WRPS	Study Deputy Director
Fanie Vogel	Aurecon SA (Pty) Ltd	Study Leader
Andrew Tanner	Aurecon SA (Pty) Ltd	Technical Advisor
Joanne Henrico	Aurecon SA (Pty) Ltd	Project Administrator
André Hindley	SRK Consulting SA (Pty) Ltd	Legal Advisor
John Samuel	Turner & Townsend (Pty) Ltd	Institutional and Financial Advisor

Study Management Committee (SMC)

Chairman and Co-Chairman:

Beason Mwaka	DWA: Water Resource Planning Systems	Study Director
Pieter Viljoen	DWA: Water Resource Planning Systems	Study Deputy Director

SAC plus the following members / alternative members:

Yacob Beletse	Agricultural Research Council (ARC)- Roodeplaat
Henk Coetzee	Council for Geoscience (CGS)
Fortress Netili	Council for Geoscience
Humberto Saeze	Council for Geoscience
Peter Kelly	Department of Mineral Resources (DMR)
Mahlori Mashimbye	Department of Science and Technology (DST)
Umeesha Naidoo	Department of Science and Technology
Shanna Nienaber	Department of Science and Technology
Henry J. Roman	Department of Science and Technology
Candice Willard	Department of Science and Technology
Nigel Adams	DWA: Compliance Monitoring and Enforcement
Kurt Fortuin	DWA: Capital Projects
Ernst Bertram	DWA: Hydrological Services
Nico de Meillon	DWA: Hydrological Services
Fanus Fourie	DWA: Water Resource Planning Systems
Bashan Govender	DWA: Gauteng Regional Office
Marius Keet	DWA: Gauteng Regional Office
Alice Mabasa	DWA: Hydrological Services
Dumisani Maluleke	DWA: Resource Protection and Waste
Zacharia Maswuma	DWA: Hydrological Services
Paul Meulenbeld	DWA: Water Abstraction and Instream Use
Nancy Motebe	DWA: Reserve Requirements
Thivhafuni Nemataheni	DWA: Resource Protection and Waste
Linda Page	DWA: Communication Services
Sputnik Ratau	DWA: Communication Services
Anil Singh	DWA: Legal Services
Eddie van Wyk	DWA: Hydrological Services
Maswuma Zacharia	DWA: Hydrological Services
Strover Maganedisa	National Treasury
Tawanda Nyandoro	Rand Water
Johann Claassens	Trans-Caledon Tunnel Authority (TCTA)
Craig Hasenjager	Trans-Caledon Tunnel Authority

Study Stakeholder Committee (SSC)

Chairman:

Solly Mabuda	DWA: Integrated Water Resource Planning	Chief Director

SMC plus the following members/ alternative members:

Meiring du Plessis	Agri Gauteng/ Private Consultant
Stephina Mudau	Chamber of Mines
Freddie Letsoko	City of Johannesburg Metropolitan Municipality (CoJ)
Pule Makena	City of Johannesburg Metropolitan Municipality
Antonino Manus	City of Johannesburg Metropolitan Municipality
Daniel Masemola	City of Johannesburg Metropolitan Municipality
Mukondi Masithi	City of Johannesburg Metropolitan Municipality
Dumisani Tinghitsi	City of Johannesburg Metropolitan Municipality
Keith Bristow	Commonwealth Scientific Industrial Research Organisation
Bettina Genthe	Council for Scientific and Industrial Research (CSIR)
Phil Hobbs	Council for Scientific and Industrial Research
Amanda Britz	Department of Environmental Affairs (DEA)
Pumeza Skepe-Mngcita	Department of Environmental Affairs
Mpho Litlhakanyane	Department of Mineral Resources (DMR)
Max Madubane	Department of Mineral Resources
Mashudu Maduka	Department of Mineral Resources
Susan Malebe	Department of Mineral Resources
Ethel Sinthumule	Department of Mineral Resources
Trevor Balzer	DWA: Chief Operations Officer
Herman Keuris	DWA: Information Programmes
Mbangiseni Nepfumbada	DWA: Water Resources Information Management
Pieter de Vries	Ekurhuleni Metropolitan Municipality
Sekhonyana Lerothi	Ekurhuleni Metropolitan Municipality
Elsabeth van der Merwe	Ekurhuleni Metropolitan Municipality
Mariette Liefferink	Federation for a Sustainable Environment (FSE)
Koos Pretorius	Federation for a Sustainable Environment
Vukosi Ndlopfu	Gauteng Department of Agriculture and Rural Development (GDARD)
Rina Taviv	Gauteng Department of Agriculture and Rural Development
Elias Sithole	Gauteng Department of Local Government and Housing
Ariel Mafejane	Johannesburg Water
Jones Mnisi	Johannesburg Water
Ntshavheni Mukwevho	Johannesburg Water
Stephan du Toit	Mogale City Local Municipality
Emily Mathe	Mogale City Local Municipality
Andy Mathibe	Mogale City Local Municipality
Jacques Hugo	National Economic Development and Labour Council (NEDLAC)
Sharna Johardien	National Economic Development and Labour Council
Tumi Monageng	National Economic Development and Labour Council
Mahandra Naidoo	National Economic Development and Labour Council
Petrus Matji	National Treasury
Tumisang Moleke	National Treasury
Nokwazi Ndlala	Randfontein Local Municipality
Madiba Ramatlhape	Randfontein Local Municipality
Reveck Hariram	Rand Water
Vusimuzi Khubeka	Rand Water
Percy Khumalo	Rand Water
Solomon Mathebula	Rand Water
Sipho Mosai	Rand Water
Trevor Stubbs	Save the Vaal
Angela Kariuki	South African Human Rights Commission (SAHRC)
Janet Love	South African Human Rights Commission
Delysia Weah	South African Human Rights Commission
William Moraka	South African Local Government Association (SALGA)
Jacky Samson	South African Local Government Association
Lulama Xongwana	South African Local Government Association

Immanda Louw	South African Nuclear Energy Corporation
Solwazi Majola	Technology Innovation Agency (TIA)
Lynette du Plessis	Transvaal Agricultural Union SA
Bennie van Zyl	Transvaal Agricultural Union SA
Richard Holden	Trans-Caledon Tunnel Authority (TCTA)
Sophia Tlale	Trans-Caledon Tunnel Authority
John Annandale	University of Pretoria
Wayne Truter	University of Pretoria
Michael van der Laan	University of Pretoria / Agri Gauteng
Zain Mohamed	Vaal Barrage Reservoir, Leeuspruit and Taaibosspruit Forum/ Sasol
Phineas Malapela	Vaal Environmental Justice Forum
Jo Burgess	Water Research Commission (WRC)
Zakhele Dlamini	West Rand District Municipality
Danny Govender	West Rand District Municipality
Herina Hamer	West Rand District Municipality
Susan Stoffberg	West Rand District Municipality
Musa Zwane	West Rand District Municipality
Johnny de Araujo	Witkoppie Farm
Mike Muller	Wits University School of Public and Development Management/ National Planning Commission
Manuel Marino	World Bank
David Sislen	World Bank
Marcus Wishart	World Bank

In addition to the contributions received from the study committees mentioned above, inputs were also received from the following broad groups and sectors through focused discussions (a more comprehensive list is available on the DWA AMD website):

Academic institutions;
Funding organisations;
Global perspectives on AMD management;
Environmental and conservation groups;
Independent individuals in their private capacity;
Institutions, parastatals and research facilities;
Local, provincial and national government;
Mining sector;
Non-governmental organisations;
Organised agriculture;
Organised business, industry and labour;
Other specialist fields/consultants;
Tourism and recreation;
Utilities/water service providers; and
Various technology providers who offered information.

Organisations that provided considerable data and inputs for assessment and consideration, including the but not limited to, FSE, The Centre for Environmental Rights, Sasol, DST, WRC, Ekhuruleni Municipality, Rand Water, GDARD, DEA, CGS, DMR as well as various individuals in their private capacity, are thanked for their contributions.

WISA Mine Water Division, a division of the Water Institute of Southern Africa, agreed to peer review selected key reports from the Feasibility Study for the Department of Water Affairs. The Division offered to identify and carry the cost of the appointment of the independent external experts. The assistance of WISA Mine Water Division and the inputs from their experts are duly appreciated and acknowledged. The comments and suggestions by the following experts contributed significantly to the quality of the study: Achim Wurster (Private Consultant), Ingrid Dennis (North-West University), André van Niekerk (Golder and Associates) and Phil Hobbs (CSIR).

The World Bank is thanked for the provision of their international expertise on a number of the reports in the Feasibility Study as well as for funding the appointment of independent external experts to peer review selected key reports from the Prefeasibility Study for the Department of Water Affairs. The comments and suggestions by the following experts contributed significantly to the quality of the study: Marcus Wishart, David Sislen, Manuel Marino, Joel Kolker, Wolfhart Pohl (World Bank); Christian Wolkersdorfer (International Mine Water Association) and Peter Camden-Smith (Camden Geoserve).

The firms comprising the Professional Services Provider team for this study were:

Aurecon South Africa (Pty) Ltd;
SRK Consulting (South Africa) (Pty) Ltd;
Turner & Townsend (Pty) Ltd;
Shango Solutions;
Ledwaba Mazwai Attorneys;
IGNIS Project & Finance Solutions (Pty) Ltd;
Kayamandi Development Services (Pty) Ltd;
Thompson & Thompson Consulting Engineers and Legal Services;
Shepstone & Wylie Attorneys; and
Various independent consultants, not mentioned separately.

EXECUTIVE SUMMARY

INTRODUCTION

The main objectives of this report are to provide the context for implementation, summarise the Reference Projects, describe the projects which are proposed for implementation and set out all the requirements and responsibilities for implementing the Long-Term Solution (LTS) for managing the Acid Mine Drainage (AMD) in the Western, Central and Eastern Basins.

The projects that will have to be implemented for the medium- and long-term management of AMD will be classified as Mega Projects, in terms of the Public Finance Management Act, 1999 (Act No. 1 of 1999) (PFMA (1:1999)) and a Feasibility Study was thus required. Since the "project" is registered with Treasury as a possible Public Private Partnership (PPP), Treasury Approval 1 (TA 1) or exemption is required before implementation can commence.

This report sets out the Implementation Plan for scrutiny and approval by the Department of Water Affairs (DWA) and National Treasury (NT). In addition to setting out a plan for providing the necessary infrastructure, it also identifies the roles, responsibilities and typical resources required by the organisations responsible for a wide range of activities.

It is important that the effectiveness of the projects in meeting their objectives, including protecting the near surface aquifers and the environment, is evaluated and monitored and this report describes the proposed monitoring. As implementation proceeds, the DWA will need to continue to communicate with the public and engage with key stakeholders and proposals are given for this activity.

SHORT-TERM INTERVENTION

On 6 April 2011, the Minister of Water Affairs issued a Directive to the TCTA to undertake "Emergency Water Works Management".

The works so far implemented by TCTA in the Western Basin are termed Immediate Works. The works being implemented in the Central and Eastern Basins are termed the Short-Term Interventions (STI).

TCTA implemented Immediate Works (IW) in the Western Basin, comprising the following:

- *Additional pumps installed in Rand Uranium No. 8 Shaft to give a total pumping capacity of 36 Mℓ/day (Mℓ/d); and*
- *Upgrading and expanding the existing Rand Uranium treatment works to a design capacity of 36 Mℓ/d.*

These IW were commissioned in April and May 2012. They have prevented the decant from the Western Basin during average conditions. Some decant may still occur after periods of above average ingress.

The construction of the STI in the Central Basin commenced on 8 January 2013 and commissioning is due to commence in November 2013 and the plant should be ready for operation (RfO) by April 2014. It consists of the following components:

- *The AMD abstraction pump station and treatment works located on the Western portion of the East Rand Proprietary Mines (ERPM) at South West Vertical (SWV) Shaft, situated about 1.8 km east of the Germiston Central Business District (CBD). TCTA/DWA have an agreement with Central Rand Gold (CRG) that the pumps and equipment ordered by CRG will be used for the STI.*
- *A new High Density Sludge (HDS) plant is being constructed on land owned by Durban Roodepoort Deep (DRD). The 72 Mℓ/19 hour day HDS treatment works will cover an area of approximately 4 hectares around the shaft.*
- *A 1.7 km long, 1 000 mm diameter concrete pipeline will discharge the neutralised water into the Elsburgspruit, which is within the Vaal River System*
- *Sludge disposal is still being addressed.*

The option proposed for the STI for the Eastern Basin comprises the following:

- *Three duty pumps will be installed at Grootvlei No. 3 Shaft located approximately 4.6 km due east of the Springs CBD (TCTA Due Diligence Report 2011).*
- *Construction of a new HDS treatment plant adjacent to the Grootvlei No. 3 Shaft, on the agricultural small holding site, south of the abstraction point, is planned. The 84 Mℓ/d treatment works will cover an area of approximately 4 hectares around the shaft.*
- *An existing 0.7 km long, 900 mm diameter concrete pipeline is proposed for discharging neutralised water into the Blesbokspruit.*
- *It is proposed that sludge be disposed of to a new Sludge Storage Facility (SSF) to the east of the Blesbokspruit.*

THE LONG-TERM SOLUTION

The Prefeasibility Study identified 49 different combinations of options for abstraction, treatment processes and locations, residue management and end users for the treated water. From these, 12 combinations were selected in an initial screening process for further assessment in terms of net present value of lifetime capital, operating and maintenance costs, and the discounted present volume of annual water deliveries for a 50-year period. These were used to derive Unit Reference Values (URVs) as an indicator of best economic value. This was used, together with potential social and environmental impacts, to select a preliminary Reference Project for each basin.

In the absence of detailed information, a conservative, precautionary approach was adopted in defining the preliminary Reference Projects. A Reference Project is one which has a low risk for Government, and thus uses proven technologies. The Reference Projects will not necessarily be implemented, but rather, are to be used as a baseline against which alternative proposals by technology providers and the private sector contractors, should be evaluated.

The Confidential Concept Design (DWA AMD FS 2013, Study Report No. 6) developed a more detailed layout and costing for each Reference Project and a conservative approach was also adopted. That report sets out for the design criteria, layout drawings and cost estimates.

PROPOSALS FOR IMPLEMENTAION

Western basin

The primary objective of the Implementation Plan is to ensure that the immediate solution continues to stop the decant and slowly reduces the level of water in the mine void to prevent further pollution and treat water to the acceptable standards. These objectives will be achieved by:

- *Upgrading the immediate interventions to 40 Mℓ/d and install a clarifier or implement the Mintails process in conjunction with Mogale Gold after conclusion of the necessary regulatory processes and agreements.*
- *Installing the STI (long-term) pumps with a 28 Mℓ/19 hours average capacity at a level to allow a TOL of 1 550 m amsl to be maintained, if desired.*
- *Reducing the level of water in the void to a TOL of 1 585 m amsl and maintain it at that level for 12 months, while monitoring surface and near surface water quality in areas previously contaminated by AMD.*
- *If pollution has ceased, maintain that level.*
- *If pollution of surface and near surface water resources is still evident after 12 months, reduce the TOL to 1 550 m amsl and continue monitoring.*
- *Adjusting the TOL based on the monitoring results.*

The secondary objective is to provide an opportunity for the development of promising technologies and this will be achieved by:

- *Defining the details of waste disposal, water delivery points and infrastructure which can be used by Pilot Treatment Plants (PTPs) and arranging that they be provided.*
- *Defining responsibilities for funding the Capital Expenditure (CAPEX) and Operating Expenditure (OPEX) for the PTPs and agree on a business model.*
- *Inviting proposals from the Private Sector to Design, Build, Operate and Maintain (DBOM) for a minimum period of 5 years, and possibly up to 10 years, PTPs which can treat, to the South African National Standards (SANS) 241 or better, a minimum of 5 Mℓ/d and a maximum of 10 Mℓ/d of incoming feed water comprising either:*
  - *Neutralised AMD delivered from the IW neutralisation plant; or*
  - *From the Mintails process; or*
  - *Raw AMD delivered from the "long-term" pumps.*
- *Monitoring the performance of the PTPs, and prequalifying those that prove to be acceptable to participate in the next procurement phase of managing AMD in any of the basins.*

The further objective is to procure a LTS for managing AMD. This will be achieved by:

- *When the PTPs have been running for long enough to assess the technologies, starting the process to procure long-term contracts for DBOM, using a then proven treatment process or bankable PPP processes, with lowest whole life costs for a period of 25 years; and*
- *After 25 years, procuring new contracts for another 25 years.*

Central Basin

The primary objective of the Implementation Plan is to ensure that the STI maintains the water level at the agreed TOL and neutralises the water. The LTS must then desalinate the water for consumptive use. These objectives will be achieved by:

- *Implementing and operating of the STI.*
- *Determining the funding.*
- *Agreeing the recipient for the water, recommended to be Rand Water, and agreeing the responsibilities for the delivery infrastructure and supply points.*
- *Inviting proposals from the private sector to DBOM and possibly finance DBOMF (PPP) a solution with proven or bankable technology that can treat the neutralised water to SANS 241 Standards or better under a contract with a 15 year operational period.*
- *During construction of the STI, review the current monitoring programme and recommend any required strengthening. It should include monitoring the water levels in the mine void at agreed locations across the basin and testing the water quality, including radioactivity at a range of depths, and establishing the hydraulic grade line.*
- *If found necessary, plan to abstract from boreholes at multiple locations.*

The long-term objective is the most cost effective management of AMD and this will be achieved by:

- *Before the end of the 15 year operational period, procuring a new contract (DBOM or DBOMF (PPP)) for a 25 year period. A solution with the lowest whole life costs, which may include or exclude all or any of the existing infrastructure, should be implemented. If found necessary, this could comprise abstracting from boreholes at multiple locations; and*
- *After 25 years, procuring a new contract. The Private Sector Contractor to design, build, operate and maintain and possibly finance the solution.*

Eastern Basin

The primary objective of the Implementation Plan is to ensure that the STI maintains the water level at the TOL and neutralises the water. The LTS must then desalinate the water for consumptive use. These objectives will be achieved by:

- *Implementing the STI in time to prevent water in the mine void rising any higher above the TOL at 1 280 m amsl than necessary.*
- *Considering modifications to the proposed STI that can benefit the LTS.*

- *Determining the funding.*
- *Agreeing the recipient for the water, recommended to be Rand Water, and agreeing the responsibilities for the delivery infrastructure and supply points.*
- *Inviting proposals from the Private Sector to DBOM and finance (DBOMF (PPP)) a solution with proven technology or bankable technology that can treat the neutralised water to SANS 241 Standards or better under a contract with a 15 year operational period.*
- *During construction of the STI, review the current monitoring programme and recommend any required strengthening. It should include monitoring the water levels in the mine void at agreed locations across the basin and testing the water quality, including radioactivity at a range of depths, and establishing the hydraulic grade line.*

The long-term objective is the most cost effective management of AMD and this will be achieved by:

- *Before the end of the 15 year operational period, inviting new tenders tor a DBOM or DBOMF (PPP), allowing recently proven technologies with lower operating costs to bid. It is possible that the incumbent contractor or another operator for the same plant will still be competitive because of the existing infrastructure; and*
- *After another 25 years, procuring a new contract.*

COSTS, FUNDING AND COST RECOVERY

The estimates of capital expenditure for the LTS in each basin are based on assumption that the capital cost of the IW and the STI, as planned by TCTA, are already provided for.

The cost estimates for the Reference Project for the LTS do include the following, related to the neutralisation works being provided under the STI:

- *The cost of the SSF to store both the HDS sludge and the desalination sludge, from the time of commissioning of the LTS.*
- *The operating costs of the STI from the date of commissioning the LTS in each basin.*

*The capital and annual lifecycle costs are summarised in **Table 1 and Table 2**. The capital and operating costs given below are those for the Reference Project, as determined in this Study.*

Table 1: Capital Costs

Description	Western Basin		Central Basin		Eastern Basin	
	R Million	% of CAPEX	R Million	% of CAPEX	R Million	% of CAPEX
CAPITAL COSTS (CAPEX) – LTS*						
Civil Works (Site works, Balancing Storage, Land)	*289*	*21*	*341*	*15*	*645*	*22*
Treatment (Ion Exchange, Desalination)	*438*	*31*	*708*	*31*	*1 148*	*39*
Residues Management (Brine Disposal, Sludge Disposal and Return Water Management)	*634*	*45*	*944*	*41*	*835*	*28*
Treated Water Delivery	*44*	*3*	*283*	*13*	*337*	*11*
Sub-Total for LTS	*1 410*	*100*	*2 280*	*100*	*2 970*	*100*
Grand Total for LTS	*R6 660 million*					

**Cost base date March 2012*

Table 2: Average Annual Lifecycle Costs

Description	Western Basin		Central Basin		Eastern Basin	
	R Million	% of OPEX	R Million	% of OPEX	R Million	% of OPEX
OPERATING COSTS (OPEX) – STI and LTS*						
Electricity	*36*	*21*	*40*	*15*	*54*	*17*
Chemicals	*59*	*35*	*122*	*47*	*125*	*40*
Sludge Disposal	*36*	*21*	*43*	*17*	*52*	*17*
Brine Disposal	*4*	*2*	*9*	*3*	*9*	*3*
General (includes labour)	*35*	*21*	*46*	*18*	*70*	*23*
Sub-Total for LTS	***170***	***100***	***260***	***100***	***310***	***100***
Scheduled Major Overhauls	***60***		***70***		***120***	
Average Annual O&M Costs	***230***		***330***		***430***	

**Cost base date March 2012*

It is recommended that Government take responsibility for arranging the funding of all of the works to avoid any delay to implementation. Procurement of funding should proceed as rapidly as possible. Implementation should not be linked to cost recovery and implementation should proceed whilst the cost recovery strategies are being finalised.

There are fundamentally two sources of funding; the Public Sector or loans from the Private Sector. A mix of these can provide a number of funding models. The sources of funding are:

- *Government from the Revenue Fund;*
- *Private Sector or International Funding Agencies directly to Government;*
- *Private Sector funding via loans to a Public Entity (State-Owned Entity (SOE)) or a Water Board), with an implicit or explicit Government guarantee; or*
- *Private Sector funding to a Private Sector Special Purpose Vehicle (SPV) or Service Provider, established to implement a DBOMF (PPP) project.*

Where public funds or private sector loans to a Government or a Public Entity are used, the payments will be to the Service Provider from the Implementer (DWA or an IA). Where commercial loan funding is sourced by a SPV, then the funding will flow directly from the commercial banks to the SPV.

In the Private Sector funded model, a Government contribution would be from the Implementer to the SPV, in parallel with the funding drawdown from the commercial banks.

Funding from Government from the Revenue Fund usually requires that provision is made in the MTEF budget for the required capital. DWA has funding allocated annually for capital works, which funding is advised to the Department with any associated conditions.

The availability of funding for implementation from the Fiscus, and approval of the degree to which implementation should be funded by government loans or private sector funding, need to be discussed by the DWA management with National Treasury (NT). If private sector funding is to be used, then it is possible that the project would be a DBOMF (PPP). Alternatively the procurement will be for a DBOM contract, which will be required to integrate and operate the LTS and the STI or possibly for a LTS technology that takes over the role of the STI.

The tender documentation will need to be flexible enough to protect possible Intellectual Property of tenderers, and provide for variations of DBOM. It is envisaged that DWA would wish to recover all or most of the cost of the capital and operating costs of the project from the polluters and the beneficiaries or users, in line with Government and Departmental Policy. However, it may fund some of the costs from its annual operating budget.

Government would manage the collection of the income streams from the different sources and ensure that the total income was equal to Government's project costs.

The opportunities or mechanisms for cost recovery are:

- *Polluters Pay:*
  - *Cost recovery from mines. Some mines are effectively providing some funding through the provision of land, infrastructure or other assets;*
  - *Contributions by the mines and direct recovery of costs from the mines need to be finalised during the negotiations with the mining sector and in accordance to the strategy to be put forward by the Enforcement Task Team.*
  - *Contributions from Mines' Trust Funds;*
  - *Cost recovery from the Waste Discharge Charge System (WDCS); and*
  - *Cost recovery from a possible future Environmental Levy or mining tax (to be investigated).*
- *Beneficiaries and Users Pay:*
  - *Cost recovery from the Vaal River Tariff (VRT)*
- *Income from the sale of raw AMD to Mintails;*

- *Sale of treated water to Rand Water; and/ or*
- *Sale of water direct to a large user, such as Sasol.*

The other possible income streams are from the sale of residue products which have a commercial value. These include:

- *Iron;*
- *Uranium; and*
- *Gypsum.*

The suitbility of these products for sale and their commercial value depends on the quality produced which is dependant on the treatment process selected and the operation of the process. It is thus recommended that any income from residue products be secured and retained by the DBOM or DBOMF (PPP) contractor, who can then offer a lower unitary fee or operating cost in their tender offer.

IMPLEMENTATION ACTIVITIES

The Environmental Impact Assessment for the Short-Term Intervention

The TCTA, as part of their responsibilities for implementing the IW and STI, started the required EIA process and, through their Professional Service Provider (PSP) contract with BKS (now AECOM), engaged Digby Wells and Associates (Pty) Ltd as EIA practitioner, to carry out an EIA for the STI in terms of Section 24L of the NEMA (107:1998) EIA regulations.

On 27 November 2012, DWA applied for an exemption to the Department of Environment Affairs (DEA), in terms of Section 24M of the NEMA (107:1998) and for authorisation to proceed with construction of the STI. At that time, the status of the EIA was as follows:

- *Registration: Complete*
- *Scoping: Complete: Final Scoping Report was not yet submitted to DEA*
- *Specialist Studies: In process, but since put on hold*

On 7 January 2013, the DEA granted the DWA exemption from the NEMA 2010 EIA regulations and authorisation in terms of NEMA and the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) (NEM:WA (59:2008)) for the Immediate Solution referred to elsewhere as the "Immediate Works" and for the STI.

The Environmental Impact Assessment for Long-Term Solution

It is expected that the total process from initiation to approval will take 18-24 months, excluding the appeals process.

It is recommended that the LTS for each of the three basins be registered as individual projects with the DEA. In this manner, localised challenges in each basin will not affect the other basins' proceeding. If a "class application" (i.e. all three basins in one application) is followed, process timing can become a challenge in that one phase (such as the Scoping Phase) cannot be completed due to a localised project challenge in one of the basins.

The EIA will need to be undertaken by an independent environmental practitioner as a PSP. DWA could appoint and supervise the EIA practitioner themselves or issue a directive to TCTA to undertake the EIA.

It is recommended that TCTA be directed to carry out the EIA, on behalf of DWA and that the same EIA practitioner who TCTA appointed for the STI should also be appointed to undertake the EIA for the LTS.

The planning of the distribution system will be the responsibility of the recipient of the treated water. It is anticipated that this will be Rand Water and all the required activities, including the EIA, should then be their responsibility.

Land and Land Rights Options and Access

During implementation, Government should take the responsibility to address all arrangements related to land and land rights (such as mineral rights, servitudes, etc.) and ownership arrangements, etc. which can be described as the Land and Land Rights Access Process (LLRAP).

The STI will have been constructed in terms of a directive issued to the TCTA by the Minister of Water and Environment Affairs. Infrastructure will have been constructed on land secured by TCTA. Some land to be utilised by the LTS for the treatment works may have been acquired by TCTA, as part of the STI as described above. The balance of the land has been identified and should be acquired through known processes.

Since the land acquisition overlaps with that of the STI it needs to be managed as an integrated process. It is recommended that a team be established jointly between DWA and TCTA to oversee and manage the land acquisition matters of the STI and LTS. This would be an activity that will need to be coordinated by the DWA Special Projects Unit (SPU) which is proposed. The clarity on the access to land for the supply of water to users is a key aspect of the required NT process to obtain TA 1 approval. It thus needs the necessary urgent attention and liaison with Rand Water.

Sufficient information pertaining to land and land right ownership should be made available to the tenderers as part of the LTS Request for Proposals (RfP), to give them confidence that there will not be any delays.

Procurement

On completion of the Feasibility Study, approval by the Department and inclusion in the Report the decisions by DWA on who will be responsible for land acquisition and procurement, as well as the proposed funding strategies, the Department should submit the Feasibility Report (DWA AMD Feasibility Study 2012, Study Report No. 10) and all the supporting reports, to NT and request Treasury Approval 1:A (TA: 1A). On obtaining TA:1A, the Department may proceed with the Procurement Phase of the project which generally commences with the appointment of a Transaction Advisor.

The procurement process will have the objective of securing the services of a Service Provider which has the competency and capability of providing a fully integrated treatment facility and service for AMD under a DBOM or DBOMF (PPP) contract. The design of the LTS, construction of the designed solution, supply of technology and the integration or replacement of the STI will be required so that the operation provides a sustainable treatment and waste management solution for AMD in the medium-term. The Service Provider will have to operate the infrastructure it provides under the LTS, as well as that provided under the STI which must be integrated into the LTS. The medium-term in this instance is defined as a period exceeding 10 years but probably not more than 15 years. The long-term horizon stretches over decades.

While the STI will have been designed, using robust technology and latest accepted design criteria, it is possible that the selected LTS Service Provider in a basin could have a technical solution which does not, for whatever reason, accommodate the STI technical solution. The procurement documentation will require that the successful bidder mothballs any portion of the STI that is surplus to requirements for future re-commissioning.

A two stage procurement process; Request for Qualifications (RfQ) to select a short list of pre-qualified bidders, followed by a RfP will be used. The Implementer, DWA or IA will appoint a PSP as Transaction Advisor which will be a multi-disciplinary team, to assist the Implementer in the procurement and negotiations process.

In both the RfQ and RfP documents that are issued, there will be evaluation criteria so that the bidders will clearly understand the criteria to be used in evaluating their submissions. Each of the procurement documents issued will also note the evaluation process to be used and the composition of the Evaluation Committee with the positions of the people who will evaluate the submissions and decide on the outcome of the submissions made.

In summary, the procurement process that will be required to achieve contract signature is:

- *Appointment of Transaction Advisor: 5 months*
- *RfQ: 9 months*
- *RfP: 14 months*
- *Negotiations: 5 Months*
- *Report and approval: TA III: 1 Month*
- *Signature of contract between DWA (or their IA) and the Service Provider.*

These timings are based on approvals being expedited timeously and not delayed.

ORGANISATIONAL STRUCTURE FOR IMPLEMENTATION

The DWA have overall responsibility for implementation of the management of AMD, as agreed by the IMC. They are currently overseeing the implementation of the STI by TCTA, managing this Feasibility Study, chairing the HMC and planning implementation of the LTS. They report directly to the Inter-Ministerial Committee (IMC) and chair the Intra-

Governmental Task Team (IGTT). They will need to establish formal agreements with the other public and private entities who will need to work together to achieve effective implementation.

It is recommended that DWA now establishes a dedicated Special Project Unit (SPU) to be responsible for the implementation of the LTS for AMD and coordinate all the other activities required for the effective long-term management of AMD in the Witwatersrand. The SPU should be headed by a dedicated Project Officer who will be a senior project manager/contracts engineer with direct access to DWA senior management and the authority to coordinate the activities of a number of line managers. The Project Officer needs the skills to manage and drive to completion a DBOM contract or a DBOMF (PPP) contract.

DWA's Infrastructure Branch is responsible for implementing infrastructure projects, such as the LTS for AMD. It should be responsible for establishing and resourcing the SPU.

The Department does not have the in-house management capacity or sufficient in-house expertise to support the SPU in executing all its responsibilities. In particular, the Department will require additional capacity to implement the procurement and monitor the operational performance of a project of this magnitude and complexity. It is recommended that, a Public Entity with appropriate experience and capacity, such as the TCTA or a Water Board, such as Rand Water, be directed to act on behalf of the Department.

It is recommended that the SPU appoint a PSP team to support it in fulfilling all its responsibilities as soon as possible. It will need to be a multi-disciplinary team with project management, technical, financial, legal and contract expertise.

In addition, PSPs will be required as Transaction Advisors, to be appointed by the entity responsible for procurement and as the independent Environmental Practitioners to conduct the EIAs.

In the Central and Eastern Basins, the detailed responsibilities within DWA and how they will secure the required resources must still be decided by DWA. The detailed requirements will vary according to the type of contract which is to be used (i.e. DBOM or DBOMF (PPP)). Two alternatives are shown in ***Figure 1*** *and* ***Figure 2****.*

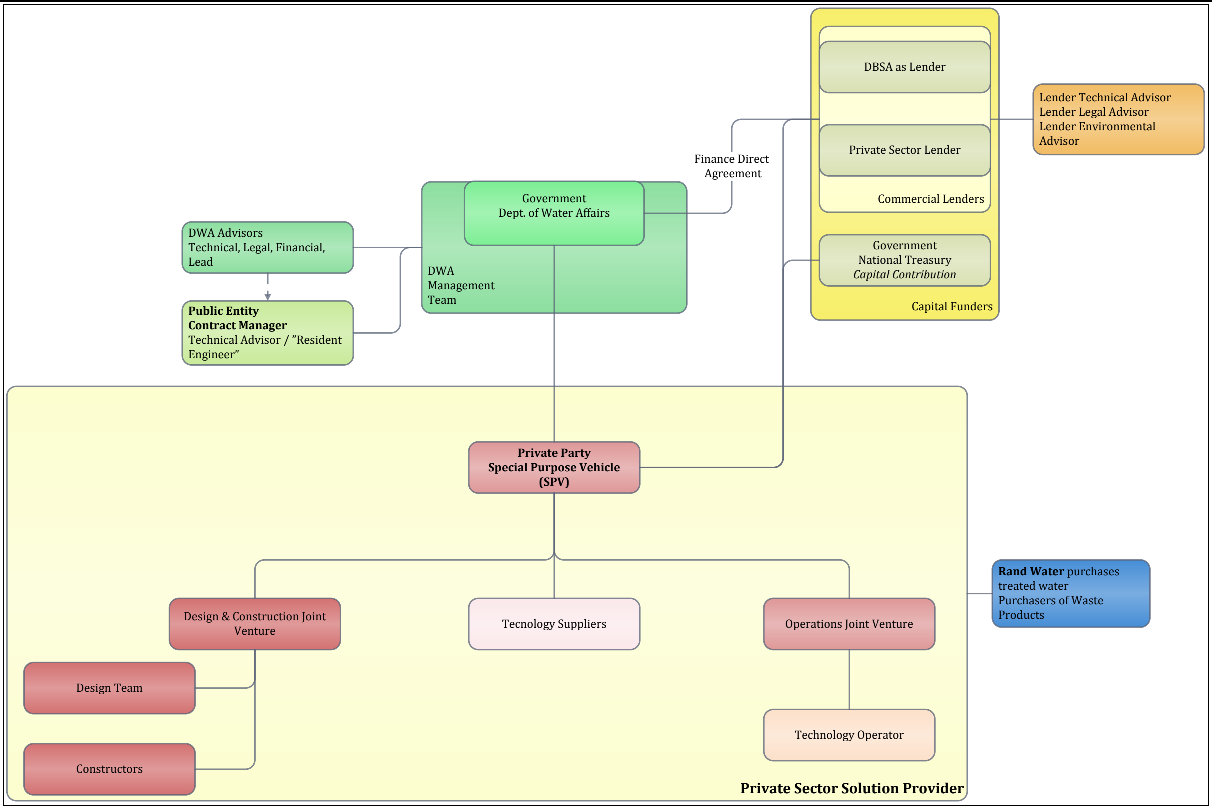


Figure 1: Design, Build/Construct, Operate, Maintain, Fund DBOMF (PPP)

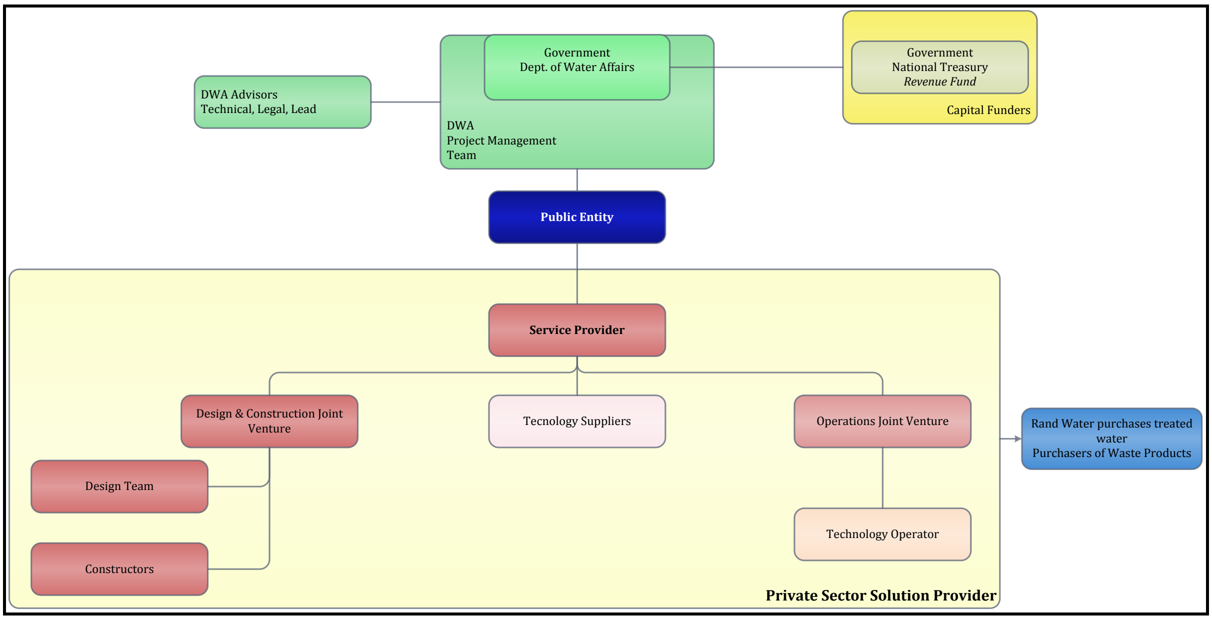


Figure 2: Design, Build/Construct, Operate, Maintain (DBOM) with a Public Entity as Implementing Agent.

*In the Western Basin, the detailed organisational structure must be appropriate for the implementation of the PTPs and a proposed structure is shown in **Figure 3**.*

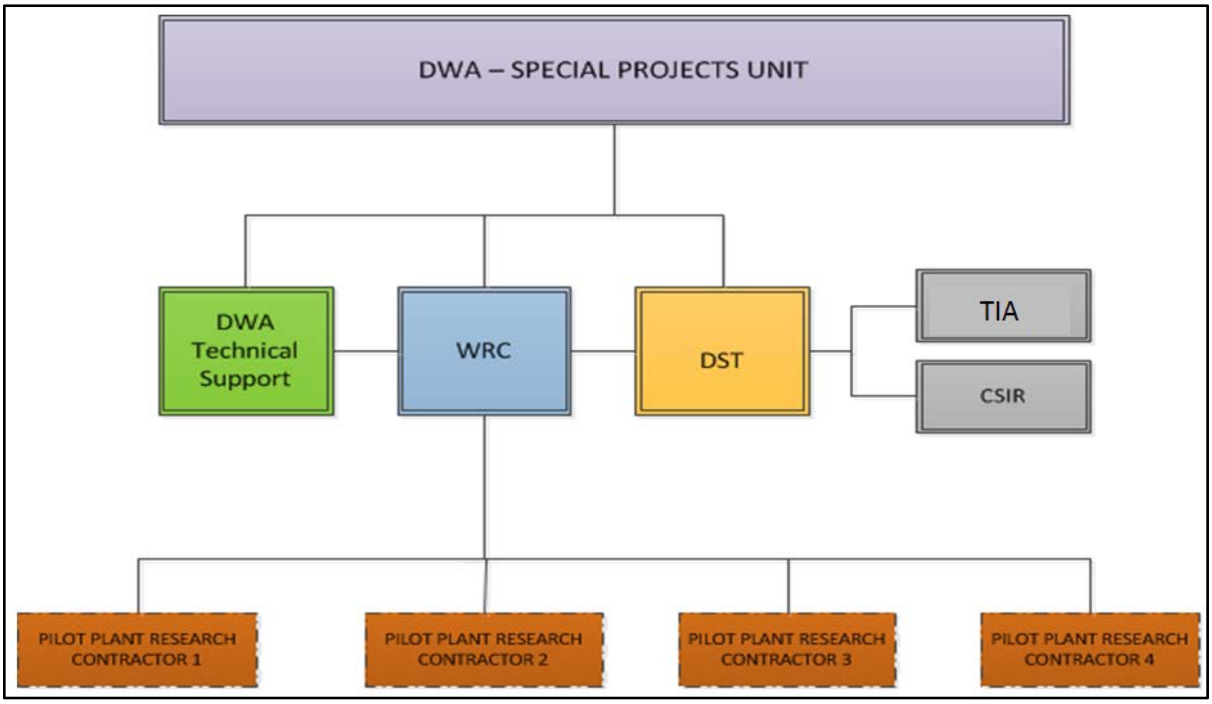


Figure 3: Western Basin – Proposed Organisational Structure

DWA Responsibilities

The following are the priority actions for DWA to establish and resource the required organisational structure.

- *Agree the institutional arrangements and responsibilities;*
- *Establish a SPU and define its responsibilities;*
- *Decide on the form of contract to be used, DBOM or DBOMF;*
- *Appoint the Head of the SPU;*
- *Issue Directives to Public Entities, if necessary; and*
- *Appointment of a PSP team to support the SPU.*

RISK MANAGEMENT

The intention of this Implementation Strategy and Action Plan is to identify the major risks and consider how they can be transferred to the entity best able to manage them. It is proposed that as much as possible of the technical risk be transferred to the Private Sector through a DBOM or a DBOMF (PPP) contract. The latter would also transfer some financial risk to the Private Sector. Transferring risk incurs a cost, but the Value for Money Assessment (VMA) has shown a DBOMF (PPP) to be cost effective, being marginally better than for DBOM with IA funding, which in turn was better Value for Money than a PSC contract.

A key part of the VMA was a detailed risk assessment of all the elements of the Reference Projects for each basin. In the Implementation Phase, a Risk Management Plan will be prepared as part of the Contract Management Plan.

PROCUREMENT PLAN FOR PILOT TTREATMETN PLANTS AND ASSOCIATED WORKS IN THE WESTERN BASIN

The Western Basin will be used to procure a number of Service Providers who have an emerging technology that has been shown to work, but not at the scale required to treat AMD in the Witwatersrand Gold Mining Basins. It is recommended that the Water Research Commission (WRC) be the lead agency for procuring, managing and testing the PTPs supported by DWA and Department of Science and Technology (DST) / Technology Innovation Agency (TIA). A Reference Group will be established to evaluate the proposals received and to oversee the performance of the contracts.

The following ancillary works will also be required:

- *Provision of collecting or balancing storage between the neutralisation works and the PTPs; and*
- *Facilities to manage the residue streams (sludge and brine) from each of the PTP.*

Two procurement processes will be required to implement the PTP programme:

- *Contracts for procurement and testing of PTPs.*
- *A Build, Own, Operate and Transfer (BOOT) contract or a DBOM contract for constructing the ancillary works and collecting and managing the residue products from the PTPs.*

The service providers with emerging technologies should be procured through a competitive process that will be structured to identify the technologies with the best chance of commercially treating AMD in a cost efficient manner. The contract will be an output based contract requiring the bidders to propose a PTP solution.

It is expected that up to four PTPs will be procured and will be funded through a combination of capital funding from the DST, DWA, WRC and Private Sector investors. Government should support the development of technologies since they will have long-term benefits for the country in the management of AMD, not only on the Witwatersrand. The development of technologies is a high-risk investment for the private sector and Government should provide incentives for them to participate. Furthermore, Government and parastatals (e.g. the WRC) already have structures in place to initiate and manage such development and the Technology Innovation Agency (TIA) is also mandated to stimulate and intensify technological innovation to improve economic growth and the quality of life of all South Africans.

There will be a period where the water is not treated to the required specification, but the water will eventually be treated to the required specification by the majority of the PTPs.

The PTP contracts will be for a minimum of 5 years and a maximum of 10 years. Before the end of those contracts the proven technologies will be encouraged to bid for a new DBOM or DBOMF (PPP) contract for the Western Basin. They would also be eligible for new contracts *for the Eastern and Central Basins, but it should be noted that not participating in the PTPs in the Western Basin will not preclude service providers from the RfQ for the other two basins.*

The financial arrangements for the ancillary infrastructure should be structured to:

- *Encourage the private sector to invest in technology development;*
- *Reimburse the DBOM contractor for capital works through milestone payments; and*
- *Reimburse the DBOM contractor on a monthly basis for satisfactory operation of the works.*

Government should fund enough of the Works to encourage private sector participation, but there is no obvious revenue stream. However, it is anticipated that the investment will show a long-term return through the availability of proven and more cost effective technologies.

PROCUREMENT PLAN: CENTRAL AND EASTERN BASINS

The contract in the Central and Eastern Basins should be either a DBOM or DBOMF (PPP), both of which transfer substantial technical risk to the private sector. The final decision on the form of contract rests with DWA.

The process for implementing the project will be:

- *Procuring an EIA practitioner;*
- *Completion of the EIA process for the basins. EIA approval will have to be achieved prior to any construction commencing;*
- *Procuring a PSP as Transaction Advisor;*
- *Procurement with RfQ and RfP stages;*
- *Negotiations to contract signature and Financial Close;*
- *Development, including design, construction of infrastructure, supply of technology, commissioning of plant and equipment and handover to the operations staff;*
- *Operations commencement and system balancing leading to full operations for the duration of the contract;*
- *Asset maintenance; and*
- *Contract conclusion activities.*

The works will be fully operational when the constructed infrastructure and supplied technology is integrated with the STI and producing the expected percentage of raw AMD as treated water to the required quality specification on a continual basis.

The basins have different sizes with differing raw water qualities. Therefore, it is recommended that implementation of each basin is through a separate contract with the Service Providers contracting to treat AMD to the required specification. While the basins will be separate contracts and will be bid as such, there will be no constraint on the same bidder being successful in the Central and or Eastern Basins and also having a PTP in the Western Basin.

The LTS for the treatment of AMD will need contracts for the foreseeable future, say 100 years. In considering the contract duration, it has been found that a medium-term contract with a 15-year operational period would be preferable to a longer contract. It will be of sufficient length to minimise the annual capital repayment and not so long that a new technology cannot be acquired within a reasonable period which can reduce the operational costs.

A significantly shorter contract would lead to a significant increase in the annual interest and redemption payments and a longer contract duration increases the risk of incurring unnecessarily high operating costs by not being able to replace the existing technology with newer more efficient technology.

Broad-Based Black Economic Empowerment (B-BBEE) is a fundamental component of any major infrastructure development in South Africa. The involvement of BEE companies and individuals will be achieved through appropriate wording in the procurement documentation and contract agreements. During construction, BEE contractors, both large and small, will be involved, with local operators and people involved in the operations and maintenance of the plants. While it is accepted that the plants are technologically advanced, there will be opportunities for skills transfer to BEE companies and individuals.

During the closing stages of negotiations, the Implementer (with its Transaction Advisors) will need to draft a Contract Management Plan (CMP). The objective of the CMP is to assist the Department in developing a good working relationship with the contracted Service Provider to achieve the projects' objectives in a sustainable manner within the contract.

OPERATION AND MAINTENANCE PHASE

The O&M Phase commences once the works are RfO. The key areas in this phase are:

- *Performance of the works to deliver water to the agreed standard;*
- *Residue management in accordance with the contract;*
- *Maintenance of the works in accordance with the contract;*
- *Compliance with the conditions of the EIA authorisation;*
- *Cost recovery; and*
- *Ensuring that all parallel activities are on programme.*

DWA will retain overall responsibility for a successful O&M Phase in all three basins. All the requirements for this phase will be described in detail in the Management Plan, which will have been produced by the Service Provider and approved by the Implementer.

IMPLEMENTATION PROGRAMME

*The detailed consolidated implementation programme for all the activities required, including implementation of the LTS in all three basins is given in **Appendix F**. The key dates for the Central and Eastern Basins are given in **Table 3**. The recommendations for implementation* *in the Western Basin are significantly different than for the other two basins and thus the implementation programme is not shown here (refer to Chapter 4, page 21).*

Table 3: Key dates for Implementation

Component	Activity completion dates	
	Central Basin	Eastern Basin
Transaction Advisor Mobilised	March 2014	April 2014
RFQ Issued	May 2014	June 2014
RFP Issued	October 2014	October 2014
Proposals received	April 2015	April 2015
Evaluation complete	June 2015	June 2015
Negotiations commence	July 2015	July 2015
Financial closure	April2016	April 2016
EIA consultant appointed	April 2014	April 2014
Authority review of EIA	March 2016	March 2016
Detail design commences	April 2016	April 2016
Construction commences	May 2016	May 2016
Desalination works commissioned	August 2017	January 2018

HYDROLOGICAL AND HYDROGEOLOGICAL MONITORING PLAN

Surface and groundwater monitoring is required so that the impact of any changes to the quantity and quality of surface and groundwater can be assessed and addressed as implementation of the STI and LTS proceeds.

The objectives of the hydrogeological and surface water monitoring are to:

- *Assess whether the implementation of the STI and LTS are achieving their objectives;*
- *Provide early warning of possible problems and identify areas where new interventions are required for effective management of the AMD in the mine voids;*
- *Provide data to assist in assessing the effectiveness of the ingress control measures, which may be implemented; and*
- *To refine our understanding of the response of the void water to rainfall.*

Three major aspects of the basins which should be monitored are:

- *Mine Void Water;*
- *Near Surface Aquifers; and*
- *Surface Water.*

The WITS AMD Hydrological Monitoring Committee (HMC) is currently responsible for hydrological monitoring in the three basins. It is chaired by DWA and comprises of officials from the DMR (including the Council for Geoscience (CGS)), DWA (including the TCTA), DST (including the CSIR) and Local Authorities.

Monitoring the re-watering and control of water levels in the three basins is a long-term commitment and requires Inter-Departmental collaboration, good coordination and management, together with support from mining and other private partners. Very large CAPEX and OPEX will be incurred in the implementation and operation of the STI and LTS. It is also anticipated that, in parallel, significant measures to reduce ingress and sources of pollution will be implemented. The most cost effective management of the three mine basins requires an expanded hydrological and hydrogeological monitoring assessment to support the correct timing and development of the proposed mine water pumping and treatment programmes. This can only be achieved by sustaining and expanding the HMC's program and capacity to support integration between water resources managers and well-maintained databases.

Operation of the STI and LTS, the hydrological and geographical monitoring and ingress control will each produce significant sets of monitoring and cost data. To obtain a better understanding of the mine voids, their water quality, connectivity, sources of ingress, effectiveness of pumping and the cost benefits of the expenditure, it is essential that the combined data sets are assessed and evaluated by a single experienced multi-disciplinary team, reporting to the IGTT.

Monitoring is especially necessary during the initial phases of pumping so as to establish the hydrogeological parameters of the void. On-going monitoring is necessary to provide information in changes in connectivity of the compartments, for example due to collapse in the void. In basins where the ECL is to be raised, monitoring of the shallow aquifers is essential to asses any impacts of the void water on the groundwater.

STAKEHOLDER ENGAGEMENT AND COMMUNICATION

Effective communications with the key stakeholders during the Feasibility Study has done much to improve Public Confidence in Government's management of the AMD on the Witwatersrand. It is critical that effective communications to the key stakeholders and the public are continued and expanded during the Implementation Phase as well as during the Operating Phase. As such, it is recommended that DWA:

- *Develops an overarching communication strategy and channel to ensure that communication activities around AMD related issues from the various initiatives are coordinated through a single entry point within the Department, with DWA Communications potentially playing a central role. This is to ensure that the messages received by the public shows the water sector speaking with "one voice" about all AMD related issues. The abovementioned could be achieved by developing and implementing a strategy which ensures that AMD related communications are aligned with and are co-*

ordinated between government departments, by means of exchange of inputs and feedback.

- *Undertakes a national public awareness raising and capacity building programme (including media coverage and proactive information dissemination). Awareness creation should be focussed on the "bigger picture" of AMD management – its challenges, the several initiatives by Government and others, driven by the DWA towards addressing AMD-related issues, etc.; and*
- *Continues to engage with stakeholder groups using the structures and processes that were used by the LTS Feasibility Study, such as regular newsletters, an AMD website, stakeholder committees, participation at catchment forums, as well as through newly established structures, i.e. Sector-based Liaison Forums.*
- *Reviews and regularly updates the stakeholder database used in this Study during the subsequent project phases for managing AMD in the East, Central and West Rand, in order to ensure that the correct stakeholders are involved and that new stakeholders are continually identified and engaged.*

It will also be important and very positive if the Mining sector is seen to be visible in taking proactive steps and taking responsibility for protecting the environment and the treatment of AMD.

RECOMMENDATIONS FOR INGRESS AND POLLUTION CONTROL

Keeping clean water clean, i.e. preventing unpolluted surface water from entering the mine voids and becoming acidic, and preventing as much ingress of any water as possible, is one of the most cost effective measures in the management of AMD.

The impact of surface water ingress directly into the underground workings is significant for all three basins. The bulk of the ingress cannot easily be controlled as there are many diffuse sources within the basins. Follow up studies are therefore required to establish both the practicality and cost effectiveness of controlling ingress from various sources and prioritise areas for action. CGS is completing such a study of 19 areas in the Eastern Basin. In the Central Basin, CGS has completed some studies and the design of three canals. However, a comprehensive ingress control and management strategy is required to reduce water ingress in all three basins. In the long-term, this could potentially reduce the required pumping rates and, hence, lower pumping, treatment and maintenance costs.

The ingress volumes which could possibly be controlled were estimated and it has been assumed that 50% of the possible ingress can be prevented. This reduction in ingress has been ignored in the sizing of infrastructure and in estimating long-term operating costs. However, the saving in operating costs which can be achieved by preventing 50% of the ingress, thus reducing the volumes of water that must be pumped and treated is estimated in ***Table 4****.*

Table 4: Possible Savings as a result of Ingress Control

Basin	Pumping	Treatment		Sludge Disposal	Treated Water Delivery	Combined Saving (R Million per Mℓ/d/a)	Assumed Ingress Reduction (Mℓ/d)	Total Saving (R million/a)
		HDS	RO					
Western	0.22	1.45	3.00	1.27	0.12	6.1	5	30.5
Central	0.24	1.39	3.35	0.83	0.20	6.0	10	60.0
Eastern	0.29	0.88	1.59	0.63	0.20	3.6	21	75.6
Total possible saving with assumed ingress control (R million/a)								166.1

Source: DWA AMD FS 2013, Study Report No. 5: ***"Technical Prefeasibility Report"***.

These savings exclude the cost of ingress control measures and are intended only to give an indication of how much money can be spent on such measures. However, when the possible savings are compared with the estimated capital cost of R 80 million of the three canals in the Central Basin, it seems that those measures will be very cost effective, and they should be constructed as a matter of urgency. Further studies and designs should also be carried out as soon as possible.

The Gauteng Department of Agriculture and Rural Development (GDARD) embarked on an initiative to enable the reclamation of mine residue areas for beneficial use. Reclamation is expected to have a significant positive effect on the AMD pollution from mine dumps. Also, considering that a significant number of informal settlements are happening in close proximity to mine dumps, the social impact of reclamation, and or rehabilitation of such land, will be important.

Amongst others, the GDARD embarked on a program of creating awareness, and investigation of ways and means of reclaiming such land. The latest feedback was that GDARD needs to review the expected outcomes and will in future ask for proposals.

REHABILITATION OF RIVERS

The effects of past uncontrolled AMD decant, and the effects of saline discharges by the STI must be assessed and possible rehabilitation measures planned. The cost of rehabilitation should be considered as part of the LTS and the possibility of cost recovery from the mines should be included in the negotiations on cost recovery, especially for the Western Basin.

FURTHER INVESTIGATIONS

It is recommended that further investigations be undertaken into the following:

- *Options for additional abstraction points in the Central Basin;*
- *Cost effective treatment options, including the assessment of Pilot Treatment Technologies;*
- *Feasibility of Tunnels in the Western Basin; and*
- *Underground storage of residue products, especially sludge.*

Table of Contents

Tables

Figures

Appendices

LIST OF ACRONYMS

AHP	Analytical Hierarchy Process
AMD	Acid Mine Drainage
AMEU	Association of Municipal Electricity Utilities
amsl	above mean sea level
B-BBEE	Broad-Based Black Economic Empowerment
BEE	Black Economic Empowerment
BRI	Black Reef Incline
CAPEX	Capital Expenditure
CB	Central Basin
CBD	Central Business District
CEA (91:1964)	Customs and Excise Act, 1964 (Act No. 91 of 1964)
CGS	Council for Geoscience
CMP	Contract Management Plan
CPI	Consumer Price Index
CRB	Central Rand Basin
CRG	Central Rand Gold
CSIR	Council for Scientific and Industrial Research
DBOM	Design, Build, Operate and Maintain
DBOMF	Design, Build, Operate, Maintain and Finance
DEA	Department of Environment Affairs
DEAT	Department of Environmental Affairs and Tourism
DMA (57:2002)	Disaster Management Act, 2002 (Act No. 57 of 2002)
DMR	Department of Mineral Resources
DOE	Department of Environment
DRA (47:1937)	Deeds Registries Act, 1937 (Act No. 47 of 1937)
DRD	Durban Roodepoort Deep
DST	Department of Science and Technology
DWA	Department of Water Affairs
EC	Electrical Conductivity
ECL	Environmental Critical Level
EIA	Environmental Impact Assessment
ERB	East Rand Basin
ERPM	East Rand Proprietary Mines
FWRB	Far West Rand Basin
GCC	General Conditions of Contract
GDARD	Gauteng Department of Agricultural and Rural Development
GIAMA (19:2007)	Government Immovable Asset Management,2007 (Act No. 19 of 2007)
GRCM	Gold Reef City Museum
GRCTF	Gold Reef City Tourist Facility
GWW	Government Water Works
HDPE	High-density Polyethylene
HDS	High Density Sludge
HMC	Hydrological Monitoring Committee
IA	Implementing Agent
IAP	Interested and Affected Parties
ICP	Inductivity Coupled Plasma

IGTT	Intra-Governmental Task Team
IMC	Inter-Ministerial Committee
IRP	Integrated Regulatory Process
IS	Immediate Solution
IWRP	Integrated Water Resource Planning
KGR	Krugersdorp Game Reserve
Km	kilometre
KOSH	Klerksdorp, Orkney, Stilfontein, Hartbeesfontein
LA	Local Authority
LHWP	Lesotho Highlands Water Project
LLRAP	Land and Land Rights Access Process
LLROP	Land and Land Rights Organisational Process
LSA (8:1997)	Land Survey Act, 1997 (Act No. 8 of 1997)
LTA	Lender Technical Advisor
LTS	Long-Term Solution
M	Metre
m amsl	metres above mean sea level
mbs	metres below surface
mm	Millimetre
MCDA	Multi-Criteria Decision Analysis
MEC	Member of Executive Committee
MHSA (29:1996)	Mine, Health and Safety Act, 1996 (Act No. 29 of 1996)
MMC	Member of Ministerial Committee
MPRDA (28:2002)	Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)
MRA	Mine Residue Area
MTEF	Medium-Term Expenditure Framework
NEMA (107:1998)	National Environment Management Act, 1998 (Act No. 107 of 1998)
NEM:WA (59:2008)	National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)
NGA	National Groundwater Archive
NNR	National Nuclear Regulator
NPV	Net Present Value
NRV	Non-Return Valve
NT	National Treasury
NWA (36:1998)	National Water Act, 1998 (Act No. 36 of 1998)
NWRIB	National Water Resource Infrastructure Branch
O&M	Operation and Maintenance
OPEX	Operating Expenditure
PAJA (3:2000)	Promotion of Administrative Justice Act, 2000 (Act No. 3 of 2000)
PES	Present Ecological State
PFMA (1:1999)	Public Finance Management Act, 1999 (Act No. 1 of 1999)
POCA (121:1998)	Prevention of Organised Crime Act, 1998 (Act No. 121 of 1998)
PPA (51:1977)	Procedural Procedure Act, 1977 (Act No. 51 of 1977)
PPP	Public Private Partnership
PPPA	Public Private Partnership Agreement
PSP	Professional Service Provider
QA	Quality Assurance
RfC	Ready for Commissioning
RfI	Request for Information

RfO	Ready for Operation
RfQ	Request for Qualifications
RfP	Request for Proposals
RMDEC	Regional Mining and Development Environmental Committee
RO	Reverse Osmosis
RW	Rand Water
RWQ	Resource Water Quality
RWQO	Resource Water Quality Objectives
SANS	South African National Standards
SARS	South African Revenue Services
SECL	Socio-Economic Critical Level
SOE	State-Owned Entity
SoW	Scope of Work
SPU	Special Project Unit
SPV	Special Purpose Vehicle
SSC	Study Stakeholder Committee
SSF	Sludge Storage Facility
STI	Short-Term Intervention
SWMP	Strategic Water Management Plan
SWV	South West Vertical
TA 1	Treasury Approval 1
TCTA	Trans-Caledon Tunnel Authority
TDF	Tailings Disposal Facility
TDS	Total Dissolved Solids
TOL	Target Operating Level
ToR	Terms of Reference
TSF	Tailings Storage Facility
TWP	Tugela Water Project
TWT	Tailings Water Treatment
URV	Unit Reference Value
VMA	Value for Money Assessment
VRT	Vaal River Tariff
VSD	Variable Speed Drive
WB	Western Basin
WCDM	Water Conservation and Demand Management
WDCS	Waste Discharge Charge System
WQM	Water Quality Management
WRB	Western Rand Basin
WRC	Water Research Commission
WSA (108:1997)	Water Services Act, 1997 (Act No. 108 of 1997)
WWP	West Wits Pit
WWTW	Waste Water Treatment Works

LIST OF CHEMICAL CONSTITUENTS

Al	Aluminium
Ca	Calcium
Cl	Chloride
CO_2	Carbon Dioxide
Fe	Iron
K	Potassium
Mg	Magnesium
Mn	Manganese
Na	Sodium
NO_3	Nitrate
SO_4	Sulphate
Th	Thorium
U	Uranium

UNITS OF MEASUREMENT

~	approximately
µg	microgram
µS	microsiemen
C	Celsius
cm	centimetre
d	day
ha	hectare
hr	hour
kℓ	kilolitre
kW	kilowatt
kWh	kilowatt hour
ℓ	litre
m	metre
m^3	cubic metre
mg	milligram
Mℓ	megalitre
mS	millisiemen
R	Rand
t	ton

GLOSSARY OF TERMS

Adit	An adit is an entrance to an underground mine which is horizontal or nearly horizontal, by which the mine can be entered, drained of water, and ventilated.
AMD	Acid mine drainage is formed when sulphide minerals in the geological strata, are exposed through mining activities and interact with oxygen and water to form a dilute solution of sulphuric acid and iron that leaches other metals from the material in which it forms. Acid mine drainage in the Witwatersrand typically has a pH value around 3 and is enriched in sulphate, iron and a number of metals, often including uranium.
Amphoteric	A molecule or ion that can react as an acid as well as a base.
Annexure	Documents produced by others attached to the report.
Appendix	Documents produced by the Feasibility Study attached to the report.
Aquifer	Zone below the surface capable of holding groundwater.
Avulsion	The rapid abandonment of a river channel and the formation of a new river channel. Avulsions occur as a result of channel slopes that are much lower than the slope that the river could travel if it took a new course.
Brownfields	Abandoned or underused industrial and commercial facilities available for re-use.
Central Basin	Central Rand underground mining basin.
Catchment Vision	The visioning process enables the DWA to formulate an initial statement (i.e. the catchment vision) about a desired future state of the water resource on behalf of the catchment community and other interested parties
Decant (surface)	Spontaneous surface discharge of water from underground mine workings.
Decant (subsurface)	Subsurface flow of water from one mine compartment or geological structure to another, typically occurring when underground mine voids fill and cascade consecutively from one underground compartment to another adjacent connected compartment.
Delict	A delict is a civil wrong in terms of which a person (legal or juristic) causes harm to another.
Discharge (groundwater)	Seepage of groundwater at the surface.
Dyke	Vertical, planar body of igneous rock formed by the solidification of molten rock in a crack.
Eastern Basin	East Rand underground mining basin.
Environmental Critical Level	The level above which the water in the mine voids at the critical locations (that is where the environmental features to be protected are at the lowest elevations) should not be allowed to rise, to protect specific environmental features, including groundwater resources.

Ettringite	A hydrous calcium aluminium sulphate mineral.
Fault	Crack in the earth along which differential movement of the rock mass has occurred.
Feasibility Study	An analysis and evaluation of a proposed project to determine if it is technically sound, socially acceptable, and economically and environmentally sustainable.
Fractured rock aquifer	A water-bearing rock mass (aquifer) in which the open spaces that accommodate the water are the result of cracks in the rock.
Freeboard	The vertical distance below the Socio Economic or Environmental Critical Level at the abstraction point, below which the water level should generally be maintained, to allow for hydraulic gradient across the basin, seasonal peak ingress, pump down time, and the like, i.e. to provide sufficient buffer capacity.
Greenfields	An undeveloped site, especially one being evaluated and considered for commercial development or exploitation.
Groundwater	Water occupying openings below surface
Gypsiferous Water	Water that is dominated by the presence of calcium and sulphate ions.
Head cut advance	Step-changes in bed surface elevation where intense, localized erosion takes place.
Immediate Solution	The temporary or “Immediate Works” being implemented by TCTA in the Western Basin to stop decant, to neutralise the AMD and to remove metals from the AMD.
The Implementer	The term “Implementer” is used to include the alternatives of implementation by DWA, together with a PSP support team and Contract Management team in the form of a Public Entity, or implementation by a Public Entity who are appointed as the Implementing Agent (IA).
Key stakeholder	Defined as directly affected parties, those who have a high level of negative or positive influence (in government and civil society domains, and on the direction and success of AMD long-term initiatives) and those whose input is critical to the study (for e.g., representatives of various National, Provincial, and Local Government, NGOs, organised business, mining, industry, labour, agriculture, affected mines, affected water utilities, community leaders, academics, etc.).
Layout	The arrangement or configuration (site layout, pipe route, etc.) of a specific option.
Long-Term Solution	A solution that is sustainable in the long-term with regards to the technical, ecological, legal, economic, financial and institutional aspects.
Mine plan	Accurate drawing showing the positions of mine excavations.
Option	One of a number of combinations of abstraction works, treatment processes, and solutions for the disposal of waste and utilisation of treated water.
Preferred option	The solution, or combination of solutions, for the three basins respectively and collectively, that will be selected for further investigation in the feasibility phase, and if found feasible, that would eventually be recommended for implementation.

Ramsar Convention	The Convention on Wetlands of International Importance, especially as Waterfowl Habitat - An international treaty for the conservation and sustainable utilization of wetlands, i.e., to stem the progressive encroachment on and loss of wetlands now and in the future, recognizing the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value. It is named after the town of Ramsar in Iran.
Ready for Operation	The milestone, after commissioning when a project is fully functional and can be put into service.
Reef	Term used on the Witwatersrand mines for conglomerate containing gold deposits.
Reference Project	The option which uses proven technologies, has minimum risk and which, is used for financial modelling and budgeting. It will probably not be the option which is implemented but is the benchmark against which implementation proposals will be judged.
Reserve	The quantity and quality of water required to satisfy basic human needs and to protect aquatic ecosystems in order to secure ecologically sustainable development and use of the relevant water resource.
Resource Classification	The Classification System provides guidelines and procedures for determining the different classes of water resources. There are three Management Classes, namely "minimally", "moderately", and "heavily used". They describe the desired condition of the water resource and the extent to which it can be utilised.
Resource Quality Objectives	Resource Quality Objectives (RQOs) capture the Management Class of the Classification System and the ecological needs determined in the Reserve into measurable management goals that give direction to resource managers as to how the resource needs to be managed. RQOs may relate to, the Reserve, the instream flow, the water level, the presence and concentration of particular substances in the water, the characteristics and quality of the water resource and the instream and riparian habitat, the characteristics and distribution of aquatic biota, the regulation or prohibition of instream or land-based activities which may affect the quantity of water in, or quality of the water resource; and any other characteristic, of the water resource in question.
Resource Water Quality Objectives	Is a numeric or descriptive instream (or in-aquifer) water quality objective, typically set at a finer resolution (spatial or temporal) than Resource Quality Objectives to provide greater detail upon which to base the management of water quality. (Resource Directed Management of Water Quality, 2007).
Request for Information	A Request for Service Providers to provide information (RFI) on their product or service, e.g. technologies. It is not part of a procurement process.
Request for Qualifications	A Request for Qualifications (RFQ) from Service Providers to allow a shortlist to be prepared. It is normally the first step in the procurement process.
Request for Proposals	A request for technical and financial proposals (RFP) in compliance with a defined Scope of Work (SoW) and adjudication criteria from (Pre-Qualified) bidders to allow one of the bidders to be appointed to provide an agreed service. Equivalent to Expression of Interest (EOI) but used in infrastructure projects
Scenarios	An alternative projection of the macro environment which affects AMD, such as climate change, electricity load shedding, and

	changes in quality or quantity of water ingress to the mine void.
Service Provider	The generic term for the Special Purposes Vehicle (SPU) or contracting consortium that will design, build, operate and maintain and possibly finance the works.
Short-Term Interventions (Short-Term Solution as stated in Terms of Reference)	Emergency measures that are being implemented by the TCTA in the short-term in all three the basins while the long-term Feasibility Study is undertaken to protect the ECL, to neutralise the AMD and to remove metals from the AMD.
Socio-Economic Critical Level	The level above which the water at the critical location in the mine void must not be allowed to rise, to protect specific social or economic features, such as the Gold Reef City museum and active or planned mining.
Target Operating Level	The level in the mine void at each abstraction point, at which the water level should generally be maintained by pumping or gravity flow to allow for hydraulic gradient across the underground mining basin, seasonal peak ingress, pump down time, and the like, i.e. to provide sufficient buffer capacity or freeboard required below the ECL or SECL across the basin.
Vadose zone	The zone in the soil profile between the surface and the water table.
Water table	The level in an aquifer below which the said aquifer are filled with water.
Western Basin	West Rand underground mining basin.

1. INTRODUCTION

1.1 Objective of this Report

The main objectives of this report are to provide the context for implementation, summarise the Reference Projects, describe the projects which are proposed for implementation and to set out all the requirements and responsibilities for implementing the Long-Term Solution (LTS) for managing the Acid Mine Drainage (AMD) in the Western, Central and Eastern Basins. The locality plan is shown in **Figure 1.1**.

The projects that will have to be implemented for the medium- and long-term management of AMD will be classified as Mega Projects, in terms of the Public Finance Management Act, 1999 (Act No. 1 of 1999) (PFMA (1:1999)) and a Feasibility Study was thus required. Since the “project” is registered with Treasury as a possible Public Private Partnership (PPP), Treasury Approval 1 (TA 1) or exemption is required before implementation can commence.

This report therefore sets out the Implementation Plan for scrutiny and approval by the Department of Water Affairs (DWA) and National Treasury (NT). In addition to setting out a plan for providing the necessary infrastructure, it also identifies the roles, responsibilities and typical resources required by the organisations responsible for a wide range of activities. It is important that the effectiveness of the projects in meeting their objectives, including protecting the near surface aquifers and the environment, is monitored and this report describes the proposed monitoring. As implementation proceeds, the DWA will need to continue to communicate with the public and engage with key stakeholders and proposals are given for this activity.

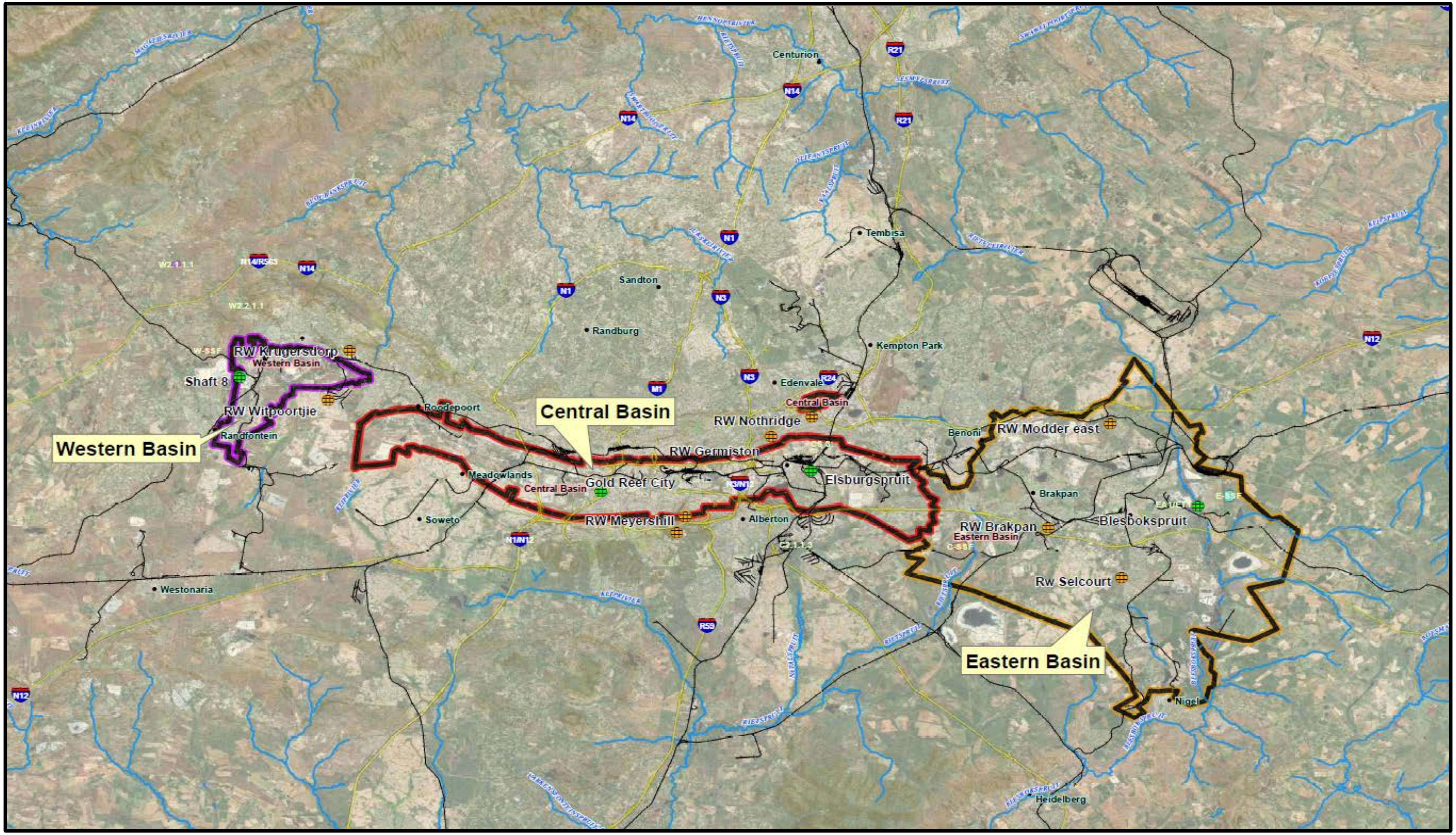


Figure 1.1: Locality Plan

1.2 Structure of the Report

This report is informed by all the preceding Study reports, as described in the Preface. They contain the need assessment, problem definition, option analysis, concept design and the institutional procurement and financing options.

The report is structured to cover the following aspects:

- Background and environment for implementation;
- The immediate works and Short-Term Intervention (STI) being implemented by the Trans-Caledon Tunnel Authority (TCTA);
- Legal considerations for implementation;
- The Reference Solution for each basin, being the benchmark solution against which alternatives will be evaluated;
- The proposals for implementation in each basin;
- Proposals for funding and cost recovery;
- The proposed organisational structure and the activities required for implemention;
- The proposed Procurement Plans;
- The programme for implementation;
- The Operation and Maintenance (O&M) Phase;
- Risk management;
- Hydrogeological and Water Resource Monitoring Proposals;
- Stakeholder Engagement and Communications;
- Recommendations for Ingress and Pollution Control;
- Recommendations for River Rehabilitation; and
- Recommendations for further investigations.

2 THE BACKGROUND TO IMPLEMENTATION OF THE LONG-TERM SOLUTION

2.1 Introduction

On 6 April 2011, the Minister of Water Affairs issued a Directive to the TCTA to undertake "Emergency Water Works Management".

The works so far implemented by TCTA in the Western Basin are termed Immediate Works. The works being implemented in the Central and Eastern Basins are termed the Short-Term Interventions (STI).

TCTA implemented Immediate Works in the Western Basin, comprising the following:

- Additional pumps installed in Rand Uranium Shaft No. 8 to give a total pumping capacity of 36 Mℓ/day (Mℓ/d); and
- Upgrading and expanding the existing Rand Uranium treatment works to a design capacity of 36 Mℓ/d.

These immediate works were commissioned in April and May 2012. They have the capacity to prevent the decant from the Western Basin during average conditions, and decant has been stopped. Some decant may still occur after periods of above average ingress.

The waste stream from the treatment works flows to the CPS pit, which acts as a settling facility. The sludge is then transferred to the West Wits Pit. The addition of a clarifier to the treatment works is proposed so that the CPS pit is no longer used.

The AMD that is pumped from Rand Uranium No. 8 Shaft is neutralised and most of the heavy metals are precipitated. Although there is a reduction in the sulphates during this process, the salt load of the neutralised water which is discharged to the Tweelopies Spruit is still high.

2.2 Short-Term Intervention

A Due Diligence Report (TCTA Due Diligence Report, 2011) was compiled with proposals for AMD abstraction, neutralisation, discharge of neutralised water and sludge disposal for each basin.

Tender documents (TCTA Tender Documents, 2011) were prepared and tenders were invited in mid-2012.

The information contained in the TCTA Due Diligence Report 2011, as well as in the tender documents is summarised below.

2.2.1 Western Basin

The option proposed for the STI in the Western Basin is described below. Implementation of the STI HDS treatment works and plans for long-term disposal of HDS sludge are currently on hold, while other alternatives are being investigated. These alternatives are described in Chapter 4.

a) Abstraction, Location and Method

Abstraction is proposed to take place from Rand Uranium No. 8 Shaft as for the Immediate Works, but is subject to checking the stability of the shaft. Alternative shafts are potentially available in the vicinity, if required. TCTA has ordered deep mine dewatering pumps under a supply and install contract. The pumps and equipment proposed for the Western Basin are:

- 2 x Ritz Model HDM 6737/3 submersible pumps, each with Non-Return Valve (NRV), cooling shroud and 250 m electrical cable;
- 2 x 250 m riser pipes, nominal length between 8 m and 12 m; and
- 2 x Variable Speed Drives (VSDs) (Allen Bradley).

Because the Western Basin was decanting, an initial pumping rate of 36 Mℓ/d should be maintained to draw the water level down to the Target Operating Level (TOL) to protect the Environmental Critical Level (ECL), whereas the average ingress rate was estimated at 27 Mℓ/d and this Study estimates the average at 23 Mℓ/d. The pumps will be able to pump the average ingress in 19hrs/day. The peak ingress is estimated to be 40 Mℓ/d.

b) Treatment

A new HDS neutralisation water treatment plant, to be located at Randfontein Estates (west of Azaadville) has been proposed. The proposed site for the works lies on Rand Uranium land and is accessible from Main Reef Road. It is bounded on the north by the Tailings Storage Facility (TSF) No. 38. The proposed treatment works with a peak capacity of 40 Mℓ/d, but planned to operate for 19 hours day, will cover an area of approximately 4 hectares. The procurement of this works is on hold, pending evaluation.

c) Water Use or Discharge

Treated water will be discharged via a 6.8 km long, 700 mm diameter High-Density Polyethylene (HDPE) pipeline into the Tweelopies Spruit, which flows into the Crocodile River (West). The treated AMD that is discharged must not, at any time, exceed the values given in **Table 2.1**, as per the DWA's directive to TCTA, dated 7 November 2011. Once the LTS becomes operational different parameters will be applied if water is to be discharged to the river.

Table 2.1: Tweelopies Spruit – Water Quality Parameters

Variable	Symbol	Unit	Value
pH	pH	pH units	6.5 – 9.5
Conductivity	EC	mS/m	< 350
Sulphate*	SO_4^{2-}	mg/ℓ	< 2 500
Aluminium*	Al	mg/ℓ	< 1
Manganese*	Mn	mg/ℓ	< 10
Iron*	Fe	mg/ℓ	< 1
Uranium*	U	mg/ℓ	< 0.05

** Dissolved*

d) Waste Disposal

Waste sludge that is being generated by the immediate works is being disposed of in Mogale Gold's West Wits Pit (WWP) via a 4.2 km long, 200 mm diameter HDPE pipeline. This site could be used for sludge from the STI HDS plant, if implemented, for 3 to 5 years.

- Potential Medium-Term:
  - Agreement with Mogale Gold / Mintails to co-dispose of sludge with tailings from their processes on a shared TSF.
- Long-Term:
  - Greenfields engineered disposal facility; or
  - Disposal into the Western Basin mine void.

2.2.2 Central Basin

The construction of the STI in the Central Basin commenced on 8 January 2013 and commissioning is due to commence in November 2013 and the plant should be ready for operation (RfO) in April 2014. The option proposed for STI in the Central Basin, which is being implemented at the date of this report and consists of the following components:

a) Abstraction, Location and Method

The AMD abstraction pump station and treatment works located on the Western portion of the East Rand Proprietary Mines (ERPM) at South West Vertical (SWV) Shaft, situated about 1.8 km east of the Germiston Central Business District (CBD), TCTA/DWA have an agreement with Central Rand Gold (CRG) that the pumps and equipment ordered by CRG will be used for the STI. They are:

- 2 x Ritz HDM 6737/3-15 submersible pumps each with a NRV, cooling shroud and 450 m electrical cable;
- 2 x 420 m riser pipes - nominal length between 8 and 12 m; and
- 2 x VSDs (Allen Bradley).

The pumps each have a capacity of 28 Mℓ/d (19 hour day) at a head of 427 m, or 36 Mℓ per 24 hour day.

The average ingress flow (and thus the average pumping rate) as per the TCTA Due Diligence Report (2011) for the Central Basin, is estimated at 57 Mℓ/d and the maximum ingress is estimated at 84 Mℓ/d. This Study estimated the average ingress to be 46 Mℓ/d and the peak to be 90 Mℓ/d.

b) Treatment

For the Central Basin, a new High Density Sludge (HDS) plant is being constructed on land owned by Durban Roodepoort Deep (DRD). The HDS treatment works with a capacity of 72 Mℓ/19 hour day will cover an area of approximately 4 hectares around the shaft.

c) Water Use or Discharge

A 1.7 km long, 1 000 mm diameter concrete pipeline will discharge the neutralised water into the Elsburgspruit, which is within the Vaal River System. The treated AMD must comply with the same standards as given in **Table 2.1**, once the LTS becomes operational when new parameters will be agreed if water is to be discharged to the river.

d) Waste Disposal

It was initially planned that sludge will be disposed of by means of a delivery pipeline that will transport the sludge from the HDS plant to the Brakpan TSF operated by ERGO. That is no longer possible and other options are being investigated.

2.2.3 Eastern Basin

The option proposed for the STI in the Eastern Basin comprises the following:

a) Abstraction, Location and Method

According to the TCTA Due Diligence Report 2011, three duty pumps will be installed at Grootvlei No. 3 Shaft located approximately 4.6 km due east of the Springs CBD. At the date of this report, no pumps have been ordered by either TCTA or the mines.

The average ingress flow (and thus the average pumping rate), as per the TCTA Due Diligence Report (2011), was estimated at 82 Mℓ/d and the maximum ingress is estimated at 110 Mℓ/d. This Study predicts an average rate of ingress of 80 Mℓ/d and the peak to be 100 Mℓ/d.

b) Treatment

Construction of a new HDS treatment plant adjacent to the Grootvlei No. 3 Shaft, on the agricultural small holding site, south of the abstraction point, is planned. The 84 Mℓ/19hr day treatment works will cover an area of approximately 4 hectares around the shaft.

c) Water Use or Discharge

An existing 0.7 km long, 900 mm diameter concrete pipeline is proposed for discharging neutralised water into the Blesbokspruit.

The treated AMD must conform to the same standards as given in **Table 2.1**, until the LTS becomes operational when new parameters will be agreed if water is to be discharged to the river.

d) Waste Disposal

It was originally proposed that sludge be disposed of by means of a 300 mm diameter, 15.3 km long HDPE sludge delivery pipeline to transport the sludge from the HDS treatment plant to the ERGO gold processing plant, before final disposal at the Brakpan TSF operated by ERGO. However, negotiations with ERGO have not been finalised and other options are being investigated.

2.3 The Technical Environment for implementing the Long-Term Solution

The Long-Term Solution needs to be planned and implemented on the premise that AMD from the Western, Central and Eastern Basins will need to be managed forever. However, the planning environment is always changing, and the following factors affecting the planning environment, need to be considered:

- Technologies are continuously developing and what are currently known, but unproven and possibly cost effective technologies, or totally new and cost effective solutions may be available in future;
- The realistic life of most civil infrastructure required will be about 50 years or less. Tunnels and some concrete structures would be a notable exception;
- Many mechanical components, particularly in an AMD environment, need significant maintenance and may need replacing at regular intervals;
- If O&M is to be contracted out, irrespective of whether or not it is linked to design and construction, a minimum contract period is probably 5 years, but preferably 10 years or more, to allow recovery of start-up costs. If O&M is linked to design and construction, a minimum operating contract period of 10 years, but probably 15 years is appropriate for an initial contract;
- The hydraulic gradient to the abstraction points, and the quantity and the quality of the water to be managed will vary with time, but are impossible to predict at present. Factors affecting the variability include:
- The success of measures to reduce ingress and contamination from surface sources of AMD;
- The connectivity of the mine voids which may change with time; and
- The flow patterns to the abstraction point and the depth from which water is drawn.

- The quality of the water being abstracted is expected to change (improve) significantly if water can be abstracted from relatively shallow depths and sources of surface pollution are reduced or eliminated;
- The extent of these uncertainties can only be reduced once pumping has been underway long enough for steady state conditions to be established and suitable monitoring and assessment programmes have been in place for a number of years;
- The economic future is uncertain and the value of gold fluctuates. The value of the remaining underground gold resources in the Witwatersrand basin is such that, at the right gold price, it may be economic to mine them, even at considerable depths. Dewatering below the ECL would then be economic and necessary, but for the account of such Private Sector interest.

In addition to the uncertainties described above, it is clear from the other Study reports that:

- Although there are a number of treatment technologies which may be able to treat AMD to the required standard, the only technologies which have been proven for similar environments and similar volumes are HDS for neutralisation, followed by conventional RO for desalination and Ion Exchange for Uranium removal;
- On the Western Basin Mintails are reclaiming mine dumps, recovering gold and testing a Tailings Water Treatment (TWT) process, which uses the raw AMD in the process and discharges neutralised water. They use less chemicals than HDS and produce a waste product, which is similar in character to tailings and can be disposed of on a TSF. The process is currently being tested, monitored and evaluated and may be a favourable option for up to 30 years;
- The cost of treating 1 Mℓ/d of AMD varies between R 3.6 million and R 6.1 million/annum. The cost effectiveness of measures to reduce ingress should be evaluated against these annual costs and cost effective measures should be implemented as soon as possible; and
- While capital costs will be high, the average annual lifecycle costs (O&M plus planned major overheads and replacements) are expected to be in the order of 11% of the capital cost and thus any treatment processes that can reduce any element of the operating costs and waste disposal will have significant economic benefits:
  - Pumping costs are about 3% to 7% of the operating costs, depending on the basin (mainly electricity);
  - Pumping 10 Mℓ/d through a head of 10 m costs R 585 000/annum at current electricity costs;
  - The cost of adequate monitoring, particularly of the near surface aquifers which are polluted, or are at risk of pollution, to allow the TOL to be optimised, should be considered against the cost of pumping.
  - About 23% to 34%(depending on the basin) of the operating costs comprise of cost of the chemicals for the HDS and Reverse Osmosis (RO) processes; and

- Between 16% to 32% (depending on the basin) of the operating costs are for the disposal of the sludge from the HDS and RO processes.

2.4 The Principles for Implementation for the Long-Term Solution

Given the environment described above, the following principles for implementation have been adopted:

- Treated AMD should preferably be used in the Vaal River water supply system:
  - A key overriding principle is that the salts from AMD, which could enter the Vaal River System, must be removed or suitably reduced from the system.
- The LTS should be planned to limit capital investment in long-term infrastructure which may be rendered obsolete because new processes with lower life time costs are available and can be implemented within its useful life;
- The LTS should not unnecessarily sterilise access to mineral resources;
- If Government is going to fund the solution, through a Design Build Operate and Maintain (DBOM) contract or through a Public Sector Comparator (PSC) Standard contract, then only technologies which Government considers proven should be accepted;
- If Private Sector finance is to be used through an Implementing Agent (IA), then technologies which the tenders consider proven, could be considered. If Private Sector finance is obtained through a Design, Build, Operate, Maintain and Finance (DBOMF) (PPP), the banks may make funding available for technologies currently considered to be at a pilot stage of development, some of which may already be used at large scale elsewhere in the world under different conditions. The DBOM option with Government funding, or a DBOMF (PPP) with Private Sector funding or joint Public-Private Sector funding constitute the preffered options;
- Any opportunities to link AMD treatment with parallel processes, such as removal of slimes and tailings dams, domestic sewage treatment, etc. should be explored in detail;
- Every opportunity should be taken to allow new technologies with lower operating costs to be tested and proved, without introducing unacceptable risks;
- Human health and safety considerations demand a conservative approach. Where necessary, Uranium should be removed so that the sludge has an acceptable radiological profile;
- Slimes dams should where possible not be replaced by SSFs, i.e. aesthetic impact / physical impact;
- Treatment technologies and the whole treatment works should include sufficient safeguards to ensure acceptable quality of the treated water; and
- There is potential risk to Government in reaching any agreements with the mines and it is important that these agreements are carefully constructed and that any exemptions or offsets that may be granted to the mines for potential liability are clearly defined and understood by both parties.

2.5 The Legal Environment for Implementation the Long-Term Solution

2.5.1 Relevant Legislation

Prominent legislation, which must be considered during implementation, is shown in **Table 2.2**.

Table 2.2: Legislation relevant to Implementation

Legislation	Possible Relevance
The Constitution	Foundational principles guiding all legislative and procedural interpretation and actions.
The National Water Act, 1998 (Act No. 36 of 1998) (NWA (36:1998))	Construction of Government Water Works, Licencing requirements, cost recovery.
The National Environment Management Act, 1998 (Act No. 107 of 1998) (NEMA (107:1998))	Requirements for Environmental Impact Assessment (EIA).
The Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA (28:2002))	Governs mining-related aspects relevant to the management of AMD.
The Promotion of Administrative Justice Act, 2000 (Act No. 3 of 2000) (PAJA (3:2000))	Requirements for administrative processes, etc.
Public Finance Management Act, 1999 (Act No. 1 of 1999) (PFMA (1:1999))	Management of Assets
The Government Immovable Assets Management Act, 2007 (Act No. 19 of 2007) (GIAMA 19:2007)	Management of Assets
Regulation 14 of the Regulations on Use of Water for Mining and Related Activities, GN 704, 1999	Procedures for and penalties.
The National Environmental Management Act: Air Quality (Act No. 39 of 2004) (NEMA (39:2004))	Regulating atmospheric emissions and related penalties.
The National Environmental Management Act: Biodiversity (Act No. 10 of 2004) (NEMA (10:2004))	Protecting biodiversity / indigenous biological resources.
The National Environmental Management Act: Waste (Act No. 59 of 2008) (NEMA (59:2008))	Waste management planning.
The Mine Health and Safety Act, 1996 (Act No. 29 of 1996) (MHSA (29:1996))	If any activities in implementation can be construed to fall under the ambit of this act – for example, during co-disposal at a TSF.
Town planning and land use ordinances	Change of land use and/or land use conditions.
The Disaster Management Act, 2002 (Act No. 57 of 2002) (DMA (57:2002))	If a ‘state of disaster’ may occur during implementation.
The Deeds Registries Act, 1937 (Act No. 47 of 1937) (DRA (47:1937))	Land or land rights transfers.
The Land Survey Act, 1997 (Act No. 8 of 1997) (LSA(8:1997))	Land surveying.
The Companies Act, 2008 (Act No. 71 of 2008)	Dealing with specific companies and directors.

2.5.2 Agreements

Pro-active legal advice should be sought on any form of uncertainty during implementation, due to the potential delaying impact that legal action could have.

There are already some agreements between DWA and mining companies on the use of their assets and land. Other agreements were being negotiated for the co-disposal of sludge from the HDS or RO processes with tailings, on a mine tailings dam.

3 THE LONG-TERM REFERENCE SOLUTION

3.1 Introduction

The process followed in the Study and the flow of information between the Study components is described in the Preface. This chapter summarises the approach adopted in the Prefeasibility Phase (DWA AMD FS 2013, Study Report No. 5: **"Technical Prefeasibility Report"**) to identify preferred options for each basin.

A Reference Project is one which has a low risk for Government, and thus uses proven technologies. The Reference Project will not necessary be built but provides a benchmark against which alternatives can be assessed and a cost estimate for use in financial planning. In the absence of detailed topographic and other information required for detailed planning and design, a conservative, pre-cautionary approach was adopted in refining the projects, as well as in the subsequent concept design of each Reference Project.

3.2 The Prefeasibility Phase

The Prefeasibility Study identified 49 different combinations of options for abstraction, treatment, processes and locations, residue management, as well as users and locations for the treated water. From these, 12 were selected in an initial screening process for further assessment in terms of net present value of lifetime capital, operating and maintenance costs, combined with discounted present volume of annual water deliveries for a 50-year period. These were used to derive Unit Reference Values (URVs) as an indicator of best economic value. This was used, together with potential social and environmental impacts to select preferred options or preliminary Reference Projects.

In each basin there was a clearly preferred option for abstraction, treatment and residue management, but more than one option for discharge or use of the water. All these options were considered in more detail during the concept design.

3.3 Concept Layout

The confidential DWA AMD FS 2013, Study Report No. 6: **"Concept Design"** developed a more detailed layout and costing for each of the Preliminary Reference Projects and a Reference Project was adopted for each basin. That report should be consulted for the design criteria, layout drawings and cost estimates.

A schematic layout of the components of the STI and LTS is shown on **Figure 3.1**.

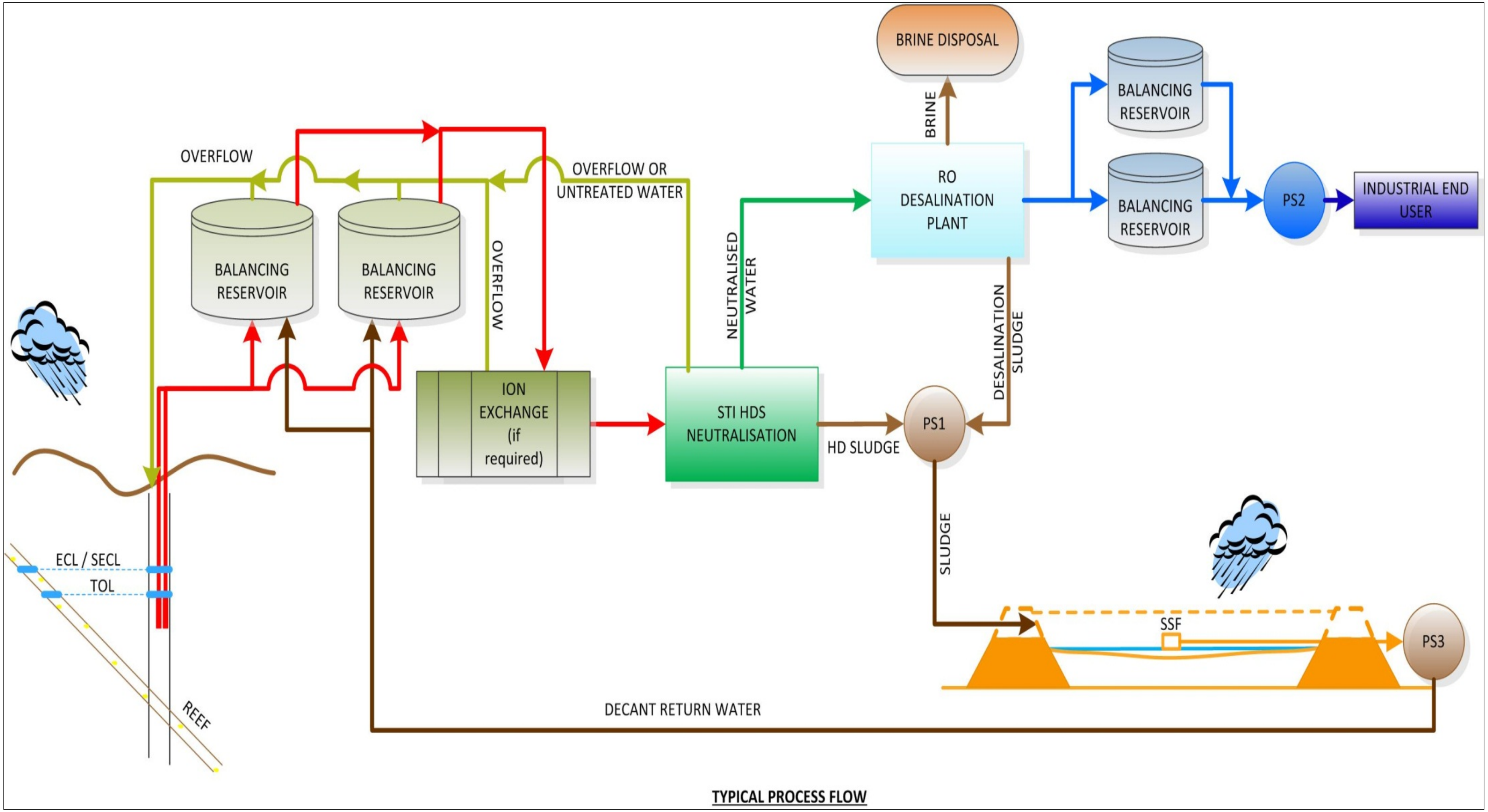


Figure 3.1: Schematic Layout of the Components of the STI and LTS

3.4 The Reference Solution for the Western Basin

In the Western Basin, the existing temporary pumps are located and the planned permanent pumps will be located at Rand Uranium No. 8 Shaft, or alternatively at Mintails No. 9 Shaft, which lies approximately 1.5 km to the west of the R28 (Main Reef Road), south of Rustenburg Road and east of North Way Road.

Rand Uranium No. 8 Shaft was used for the abstraction of mine water for many years. It has two conveyances of which one is currently occupied by pipes and temporary pumps for abstraction of AMD to the existing Rand Uranium treatment plant to the west of No. 8 Shaft. Subject to confirming the shaft stability the STI will install new permanent pumps in the remaining conveyance. The permanent pumps will each have a capacity of 33 Mℓ/19 hour day when pumping from the conservative TOL of 1 550 m amsl.

An Ion Exchange plant to remove the Uranium has been allowed for in the LTS between the abstraction shaft and the neutralisation plant, which would be provided as part of the STI.

Balancing storage reservoirs will be provided between the abstraction plant and the first stage of treatment neutralisation plant and desalination plant, storing 24 hours of water production in two lined earth dams each 60 m by 40 m and 5 m deep.

A RO desalination plant will be provided after the neutralisation plant, with further balancing storage for treated water, storing 16 hours of water production in a concrete reservoir with two compartments, measuring 45 m in diameter and 10 m deep.

A 600 mm diameter steel pipeline of 6.6 km long has been provided for and costed to deliver the treated water to the edge of the basin. It has been assumed that Rand Water, the recommended recipient, will take delivery of the water and make their own arrangements to transfer the water to their customers, the end-users.

Sludge from both the neutralisation plant and the desalination plant will be pumped to a new purpose built Sludge Storage Facility (SSF) through a 6.8 km long HDPE pipeline of 180 mm diameter. A 600 mm parallel HDPE return water pipe will be provided to return polluted rainwater falling on the SSF to the treatment works, and is sized to accommodate a 200-year recurrence interval storm event.

Brine from the desalination plant will be pumped to new evaporation ponds. Two ponds each of 82 000 m^2 by 2 m deep will be provided; the second being for use when the first is closed for salt removal, or for maintenance.

3.5 The Reference Solution for the Central Basin

In the Central Basin, the AMD abstraction pump station provided by the STI is located at SWV Shaft at ERPM.

Balancing storage reservoirs will be provided between the abstraction pumps and the first stage treatment works, storing 24 hours of water production in two lined earth dams, each 80 m by 60 m and 5 m deep.

An Ion Exchange plant for Uranium removal will be incorporated in the LTS between the abstraction shaft and the neutralisation plant, provided as part of the STI.

A RO desalination plant will be provided after the neutralisation plant with further balancing storage for treated water, storing 16 hours of water production in a concrete reservoir with two compartments, measuring 62.5 m in diameter and 10 m deep.

To make provision for the cost of possible delivery infrastructure, a 35.8 km long steel pipeline, with diameter ranging from 700 to 800 mm, has been provided to the Eastern Basin treatment site at Grootvlei No. 3 Shaft. In the Reference Project it is assumed that the recipient would then be responsible for any downstream infrastructure. However, it is recommended that Rand Water be the recipient of the treated water and that they be responsible for collecting the fully treated water at the Central Basin treatment works.

Sludge from both the neutralisation plant and the desalination plant will be pumped to a new purpose built SSF through a 17.8 km long HDPE pipeline of 180 mm diameter. A 600 mm parallel HDPE return water pipe will be provided to return polluted rainwater falling on the SSF to the treatment works, and is sized to accommodate a 200 year recurrence interval storm event.

Brine from the desalination plant will be pumped to new evaporation ponds. Two ponds each measuring 460 m by 340 m and 2 m deep are proposed, the second being used when the first is closed for salt removal, or for maintenance.

3.6 The Reference Solution for the Eastern Basin

In the Eastern Basin, the AMD abstraction pump station provided by the STI is located at Grootvlei No. 3 Shaft which has historically been used for this purpose by the mines.

Balancing storage reservoirs will be provided between the abstraction point and the first stage treatment works, storing 24 hours of water production in two lined earth dams each 100 m by 80 m and 5 m deep.

An Ion Exchange plant has been allowed for between the balancing storage and the neutralisation plant, provided as part of the STI.

A RO desalination plant will be provided after the neutralisation plant with further balancing storage for treated water, storing 16 hours of water production in a concrete reservoir with two compartments, measuring 82 m in diameter and 10 m deep.

To allow for the cost of bulk infrastructure to deliver the treated water to the recipient, a 10.6 km long steel pipeline of 1 300 mm in diameter has been provided to the edge of the basin. This pipeline has been sized to also convey the treated water from the Central Basin to the edge of the basin. Although the cost of this pipeline has been allowed for, Rand Water is the recommended recipient and they should be responsible for all infrastructure downstream of the treatment works.

Sludge from both the neutralisation plant and the desalination plant will be pumped to a new purpose built SSF through a 5 km long HDPE pipeline of 180 mm diameter. A 600 mm parallel HDPE return water pipe will be provided to return polluted rainwater falling on the SSF to the treatment works, and is sized to accommodate a 200-year recurrence interval storm event.

Brine from the desalination plant will be pumped to new evaporation ponds. Two ponds each 430 m by 300 m and 2 m deep are proposed, the second being used when the first is closed for salt removal, or for maintenance.

4 PROPOSALS FOR IMPLEMENTATION IN THE WESTERN BASIN

4.1 Introduction

While the Reference Project provides a low risk LTS there are benefits in considering an alternative approach to implementation because:

- The Immediate Works have stabilised the water level in the void and are neutralising the water pumped from the void.
- The AMD is not causing any new pollution. While the present situation is not sustainable in the long-term, there are no critical dates by which any new works must be commissioned.
- Apart from the abstraction works, no contracts have been awarded for construction.
- There are benefits to Government and industry if embryonic technologies for treating AMD can be tested and refined to widen the choice of proven technologies for future use.

It is therefore proposed that the Western Basin be used to test Pilot Treatment Technologies.

However, there are the following uncertainties relating to the environment for implementation in the Western Basin:

- A study is currently under way to set Resource Water Quality Objectives (RWQOs), which includes modelling the salt loads from AMD. That study has not yet been finalised, and the RWQOs have not been set. However, the anticipated RWQOs at the point of discharge are likely to be equivalent to potable water standards in respect of salinity, requiring desalination to make it acceptable to discharge AMD. The cost of treatment is such that it is uneconomic to discharge water of this quality into the environment, and it is recommended that, for the Reference Project, such water is supplied to Rand Water for use by their consumers, preferably their industrial consumers.
- In the Crocodile (West) River System, the water quality modelling carried out as part of the **"Implementation and Maintenance of the Reconciliation Strategy for the Crocodile West Water Supply System"** (DWA, August 2013) has shown that:
  - Discharge of saline AMD into the Tweelopies Spruit upstream of the dolomites will cause a significant increase in the TDS in the already highly saline dolomites and is not recommended; and
  - Discharge of saline AMD into the Tweelopies Spruit downstream of the dolomites or into a tributary downstream of Percy Steward Wastewater Treatment Works (WWTWs) would significantly increase the salinity in the receiving streams by 500 to 600 mg/ℓ, as well as increase the salinity in the Hartbeespoort Dam by up to 80 mg/ℓ. It is not recommended.
- In conclusion, the dolomites and river system have no assimilative capacity, and any of the scenarios for discharging saline AMD will lead to a marked increase in salinity in the

Hartbeespoort Dam. This Study thus recommends that the salts in the AMD be removed, or that the water be used in such a way that the salts will not enter the river system.

- The acceptability of the Mogale Gold/ Mintails TWT process for neutralisation of AMD is still being investigated. If it is suitable, and Mogale Gold obtain the necessary licences, it would be used for neutralisation, possibly for as long as 30 years. This would eliminate the need to add a clarifier to the existing Gold One plant.
- The short-term use of the West Wits Pit (WWP) for disposal of waste products, possibly including brine, has yet to be discussed with Mogale Gold/ Mintails.

If the Mintails TWT process is used then the residues from neutralisation would be disposed of by Mintails. There would then be an option to dispose of residues from desalination on a Mintails facility. It is unlikely that this would be an acceptable option for brine disposal.

These uncertainties all have implications for the implementation of the PTPs. A proposed process for addressing these uncertainties and reaching decisions is shown in **Figure 4.1**.

The proposals for implementation are described in the following sections.

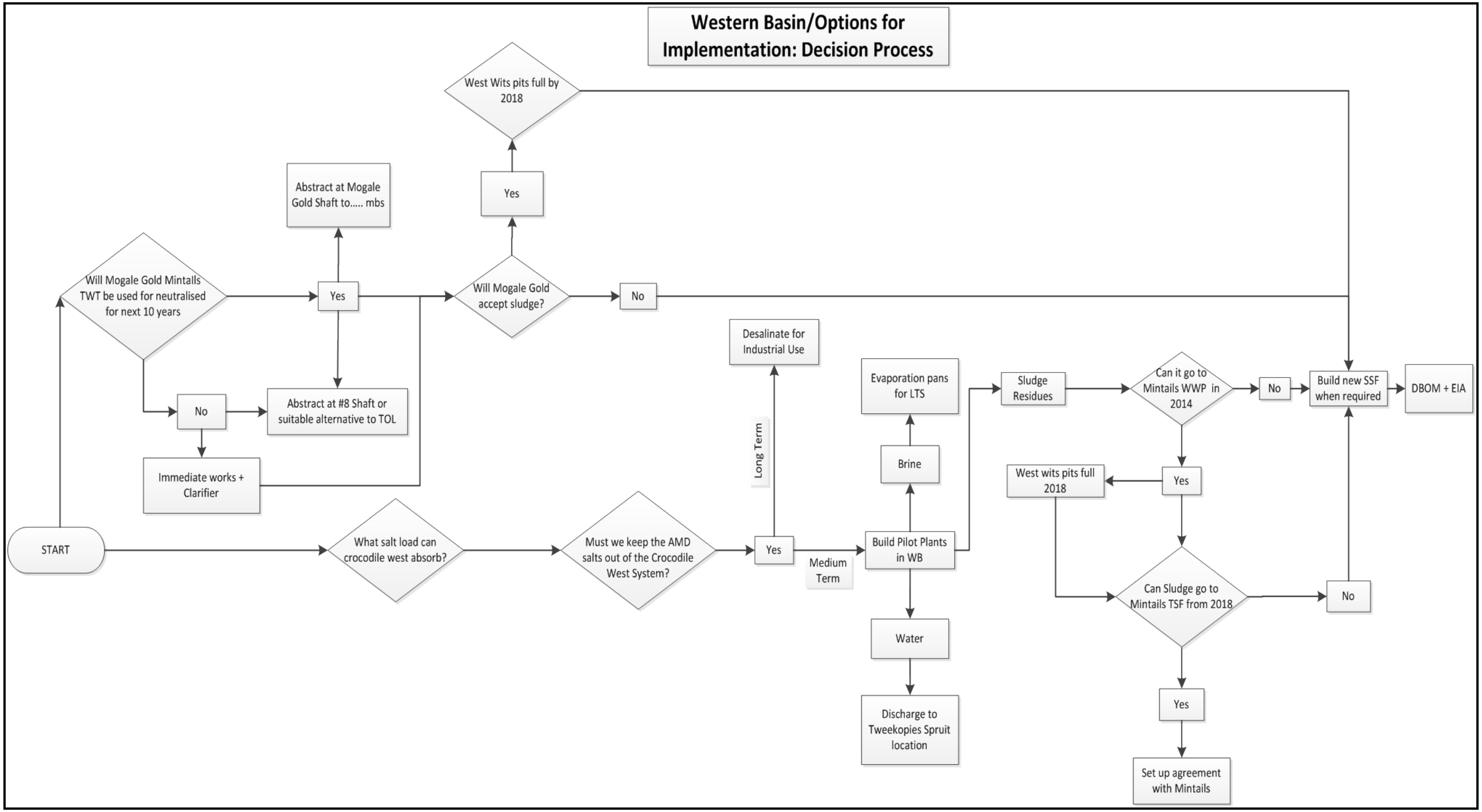


Figure 4.1: Proposed Process for Decision-making in the Western Basin

4.2 Critical Levels and Target Operating Levels

In the Western Basin where the mine void water is at or very close to surface at Black Reef Incline (BRI), the objective is to eliminate or reduce the risks of polluting the springs feeding of the Tweelopies Spruit and of polluting the subsurface flow to the Zwartkrans Compartment dolomite aquifer that hosts the Cradle of Humankind. It is anticipated that this will be achieved if the mine void water is prevented from entering the dolomite aquifer via the Black Reef Mine workings at approximately 1 610 m amsl. Therefore, an ECL of 1 600 m amsl is proposed. In the long-term, it is anticipated that a freeboard (or "buffer") of 15 m should be adequate and a TOL of 1 585 m amsl is recommended. The water should be held at that level for an appropriate duration to allow the water level in the entire void to drain down to that level and establish whether the water quality downstream in the Tweelopies Spruit is free of pollution from AMD. If leakage or direct pollution by AMD ceases and if the ECL has not been breached with a TOL of 1 585 m amsl, it should be maintained (i.e. the water could be held at this level). If the situation is not satisfactory, the level should be lowered further until the desired result is obtained. It is expected that at an ECL of 1 565 m amsl, which should be below the base of the dolomite outlier, all pollution will have ceased. In this case, the TOL is recommended to be at 1 550 m amsl, which is the same as the ECL proposed by the STI. No Socio-Economic Critical Level (SECL) is currently envisaged for the Western Basin, although Mintails may consider operations which would require the water level to be lower than that required for the ECL.

4.3 Abstraction Points and Pumping Rates

These capacities are in addition to the capacities of the existing pumps which will continue to be used in the short-term to draw down the water level to the TOL.

4.3.1 Abstraction Points

Rand Uranium No. 8 Shaft meets the required criteria, and was used to pump AMD water for a long time, using two submersible pumps with a capacity of 8 Mℓ/d each. The connectivity of No. 8 Shaft with the mine void has thus been proven. This study has concurred with the STI which concluded that the Rand Uranium No. 8 Shaft is suitably connected to the mine void, and if the recommended survey shows that it is in a good condition, it should be used for the LTS. If it is not in good condition there are other potentially suitable shafts in the vicinity.

4.3.2 Pumping Rates

Rand Uranium have been abstracting water from No. 8 Shaft and treating it at their adjacent neutralisation plant, using two submersible pumps with a capacity of 8 Mℓ/d each, but the capacity of their pumps and treatment works was inadequate to manage the total flow from the entire basin. The "Immediate Works" has increased the capacity of both pumps and neutralisation plant to approximately 36 Mℓ/d.

The TCTA has ordered two new Tinstall (a new Ritz Model) HDM 67 37.3/8 pumps to replace all the existing pumps once the water level has been reduced to the TOL.

There will be one duty pump and one standby pump, with the standby pump kept on surface. New pumps have been ordered and are expected to be commissioned in March 2014. The pumps will be operated for 19 hour day to avoid Eskom peak tariffs.

With the water level at the conservative TOL of 1 550 m amsl, the installed capacity of the single duty pump will be 33 Mℓ/19 hour day. At the proposed long-term TOL of 1 585 m amsl, the installed capacity will be 30 Mℓ/19 hours day. This installed capacity, operating 19 hours day is adequate to maintain the water level under average conditions and can be increased by about 25% by operating the pumps 24 hours/day, if necessary.

It is proposed that all the pumps and associated equipment be retained to form part of the LTS.

4.3.3 Possible Long-Term Alternative or Abstraction Method

In an attempt to identify an option for abstraction which would avoid the high electricity costs associated with pumping the AMD up a shaft, the DWA AMD FS 2013, Study Report No. 5: **"Technical Prefeasibility Study"**, considered the option of constructing a tunnel from just below the TOL to discharge by gravity. The most feasible option would be a 7.5 km long tunnel which would daylight close to the existing Percy Steward Waste Water Treatment Works (WWTWs). This would have had particular advantages if a biological treatment process was to be adopted, or if the treated water was to be supplied to users below this level and in the vicinity, or discharged to the local stream.

However, it is recommended that treated water be supplied to Rand Water, probably for supply to industrial users, whom may possibly be some distance away. Thus the energy used to raise the water up the shaft will not be wasted as it will contribute to the energy required to convey the treated water. There is therefore no cost saving to offset the high construction cost of the tunnel or of the STI infrastructure, particularly the pumps at the shaft, which would become redundant.

The tunnel option is therefore not recommended in the medium-term, but should be reconsidered when it has been decided:

- whether or not the Mintails TWT forms part of the solution;
- end users for the water are confirmed and
- if the biological treatment process is viable or not.

Depending if the answers to these questions are favourable for the tunnel option, a Feasibility Study should be commissioned.

4.4 Treatment

4.4.1 Pretreatment

In the long-term, neutralisation and heavy metals removal will be part of an integrated process procured under a DBOM contract, including neutralisation. However, pretreatment for neutralisation and metals removal will be required until a LTS is implemented, after the Pilot Plant testing phase is complete.

There are two possibilities. Either the Gold One plant, which is currently being upgraded by the TCTA to a capacity of 40 Mℓ/d, be operated for as long as possible, preferably until the LTS is commissioned, after the Pilot Plant phase. In this case, a further upgrade of adding a clarifier should be implemented.

Alternatively, the proposals by Mogale Gold/ Mintails to use the AMD in their TWT process can be adopted. The latter is preferred, pending the outcome of the tests.

4.4.2 Primary Treatment

In the Reference Solution, the desalination would have been by RO. However, it is proposed that in the medium-term, alternative technologies be tested as PTPs, and this is discussed below.

4.4.3 Technology Development through Pilot Plants

Notwithstanding the selection of a treatment technology for the Reference Project, as described in Chapter 3, there are a number of other technologies which have been identified, but have not been proven at a large enough scale or in a similar environment. If they were to be implemented now there would be significant risk. However, there could be significant cost savings if they can be proven to be acceptable.

It is therefore proposed that the Western Basin be used to test promising, but unproven technologies in a number of Pilot Treatment Plants (PTP), each with a capacity of between 5 and 10 Mℓ/d. A capacity of at least 8 Mℓ/d would be preferred. Three or more such plants could treat the long-term average of 23 Mℓ/d expected to be pumped from the Western Basin, while 4 plants of 10 Mℓ/d would be required to treat the 40 Mℓ/d, which is likely to be abstracted until the TOL is reached.

It is envisaged that, depending on their technology, these plants could treat either raw AMD, directly from the shaft, or neutralised AMD produced by either the Immediate Works or the Mintails TWT process or preferably both. Ideally, they should be tested, using a range of possible feed water. Because of the unproven nature of these technologies, it is envisaged that at least some of their treated water will not meet the specifications and should be discharged to the Tweelopies Spruit, until water of a consistent and acceptable quality is being produced. Thereafter it could be supplied to users.

These PTPs should operate for a minimum of 2 years, so that they can be tested with the varying water quality which will occur. Successful technologies should by then have been identified with confidence, and can be commissioned after a prequalification and tender process in which a range of technologies can compete against the reference design for a LTS. It is recommended that the PTPs be operated for at least 5 years to allow sufficient time for a new contract to be procured.

The possible process and responsibilities for procuring and managing the project have been discussed in principle with DWA, Water Research Commission (WRC) and the Department of Science and Technology (DST).

A draft Concept Note on the way forward is attached as **Appendix A** and the options for implementation are discussed in Chapter 11.

4.4.4 Research

There are a number of on-going research initiatives into the management of AMD and these should be encouraged.

In addition to the testing of PTPs, the Western Basin can provide opportunities for researchers, including those supported by the WRC, from Universities and international organisations. The research activities in this basin, or elsewhere, requiring access to the AMD from the basin, should be approved by DWA to ensure an orderly approach and appropriate safety measures are followed.

WRC is currently supporting the research initiatives related to AMD:

- The BIOSURE Process: A sustainable, long-term treatment option for AMD treatment with a 3-year duration (WRC 2013a); and
- A Feasibility Study on the use of irrigation as part of a long-term neutralised AMD management strategy in the Vaal Basin with a 2-year duration (WRC 2013b).

These and other researchers may request, and should be granted, access to the Western Basin facilities.

4.5 Water Use

The following water uses were considered:

a) Discharge to the environment

As discussed in Section 5.1 it is recommended that, if water is to be discharged to the environment, it be desalinated and the anticipated RWQO in the receiving stream would require a quality equivalent to potable water. The cost of treatment is such that it is uneconomic to discharge this quality water into the environment.

However, it is recommended that, while the PTPs are operating, the water is discharged to the environment downstream of the dolomites until a consistent and acceptable quality is produced. Thereafter it could be supplied to consumptive users.

b) Potable Water

While the proposed treatment process can easily produce water to potable standards, Rand Water have advised that they are concerned about mixing treated AMD into their potable water network, because of concerns about negative public perceptions.

c) Industrial Users

Rand Water have advised that they have existing users and that they have received applications for water from a number of industries and mines in the area, which together, can use more than the volume available from the Western Basin. Rand Water has indicated that they would wish to make the necessary arrangements to supply the water. This is the most economical option and would replace water which would otherwise be supplied from the Vaal River System.

The timing of implementing this option would depend on the quality of water from the PTPs. It is recommended that DWA negotiate an agreement with Rand Water under which they will purchase the treated water and collect it at the treatment works as soon as it is available.

The quality of the water required could influence the design of the treatment works for the LTS.

4.6 Residue Management

The main residues are expected to be sludge from the HDS plant and Pilot Plant process and brine from the Pilot Plant process. It is possible that some residues will have a commercial value and be sold to or at least collect by users.

TCTA have an agreement with Mogale Gold under which the sludge from the IS neutralisation plant is discharged into the West Wits Pit (WWP) via the CPS Pit, which acts as a settling dam. However, the WWP has limited capacity and is expected to beach at the end of 2014 and to fill in about 2018. The current agreement does not allow for the discharge of sludge or other residues from the proposed PTPs into the WWP, but this would be the most economic option. It is recommended that an agreement to allow this is negotiated with Mintails.

It is unlikely that Mintails would accept brine from the PTPs in the WWP and this it is undesirable because of the connectivity between the WWP and the void. It will therefore be necessary to construct the proposed LTS brine disposal facility. Evaporation ponds, which are low tech and having low operating costs, are recommended. Two ponds, each of 340 m by 240 m by 2 m deep, are proposed. These are sized to provide sufficient area for evaporation, 1 m depth for storage of accumulated salt and 1 m depth for balancing storage to accommodate periods of high rainfall. It is planned so that only one pond is used at any time, allowing the construction of one pond to be delayed till the first pond has accumulated 1 m of salt or requires major maintenance. The ponds can thereafter be used alternatively, allowing plenty of time for each pond to be emptied and/or its lining replaced.

Mintails will only be able to consider accepting sludge from the PTPs for a limited period, up to 2018 when the pit will be full.

If Mintails will not accept sludge from the PTPs, and when the WWP is full, an alternative will be required. One possibility would be co-disposal with the Mogale Gold tailings, on their proposed new TSF. The only other alternative would be a new SSF which is required in due course as part of the LTS. A number of possible sites have been identified, and what appears to be the most favourable site, has been provisionally selected. Based on the total volume of HDS sludge and from desalination which is expected to be produced over 45 years, the predicted final size of the SSF is 800 m by 660 m by 10 m high. However, this capacity would not be required if the HDS plant is not constructed.

The nature of the sludge from the PTPs is unknown, but it has been assumed that it is such that the solids do not settle and it remains gelatinous, unsuitable for constructing the perimeter wall of the SSF and waste rock will need to be imported for this purpose. The perimeter wall will typically be constructed in 3 m lifts by widening on the downstream side and can be raised as and when required.

It is assumed that the sludge will be classified as hazardous and that the SSF will be categorised as H:H in terms of **"Minimum Requirements for Waste Disposal by Landfill"** (DWA, 1998). This means that the site must be lined and a leachate management system is required. Leachate and supernatant, which does not evaporate, must be pumped back to the treatment works and recycled.

4.7 Dolomite Stability

The stability of the dolomites in the Western Basin is a concern when the water table is lowered through pumping the AMD from the voids. The main risk is the instability caused where dolomites aquifers are dewatered or water levels fluctuate as a result of pumping.

4.7.1 Extent of Risk

The dolomitic compartment (A in **Figure 4.2**) underlying the upper Tweelopies Spruit will be dewatered as a consequence of pumping in the Western Basin. There is therefore a very high risk of instability in this area. The area that will be affected is shown in blue in **Figure 4.2** and the roads of concern in this area are in in purple. One of the identified sites for a SSF (site 2) overlies this dolomitic compartment and the roads which are at risk in this area are indicated in purple.

To the west of the dolomitic compartment A, is compartment B (**Figure 4.2**). The connectivity of this compartment to the surrounding compartments is uncertain but it is considered unlikely to be dewatered in the pumping process as it appears to not be directly connected to compartment A or the mine void. However, due to the presence of a significant slimes dam situated directly on top of this dolomite, it is strongly believed that the water in this compartment is highly acidic. If the slimes dam was to be re-mined in the future, or water fluctuations in the dolomite occur, this area could potentially become highly unstable. The location of identified site 4 for the SSF is situated to the south of these slimes dams, and overlays this dolomitic compartment. However, it is not the recommended site.

Dolomitic compartment C lies to the north west of compartment A, and the connectivity of this compartment is unknown. However, it is unlikely that it will be significantly affected by the pumping of the mine void. This poses a lower risk for instability for the proposed SSF site 1.

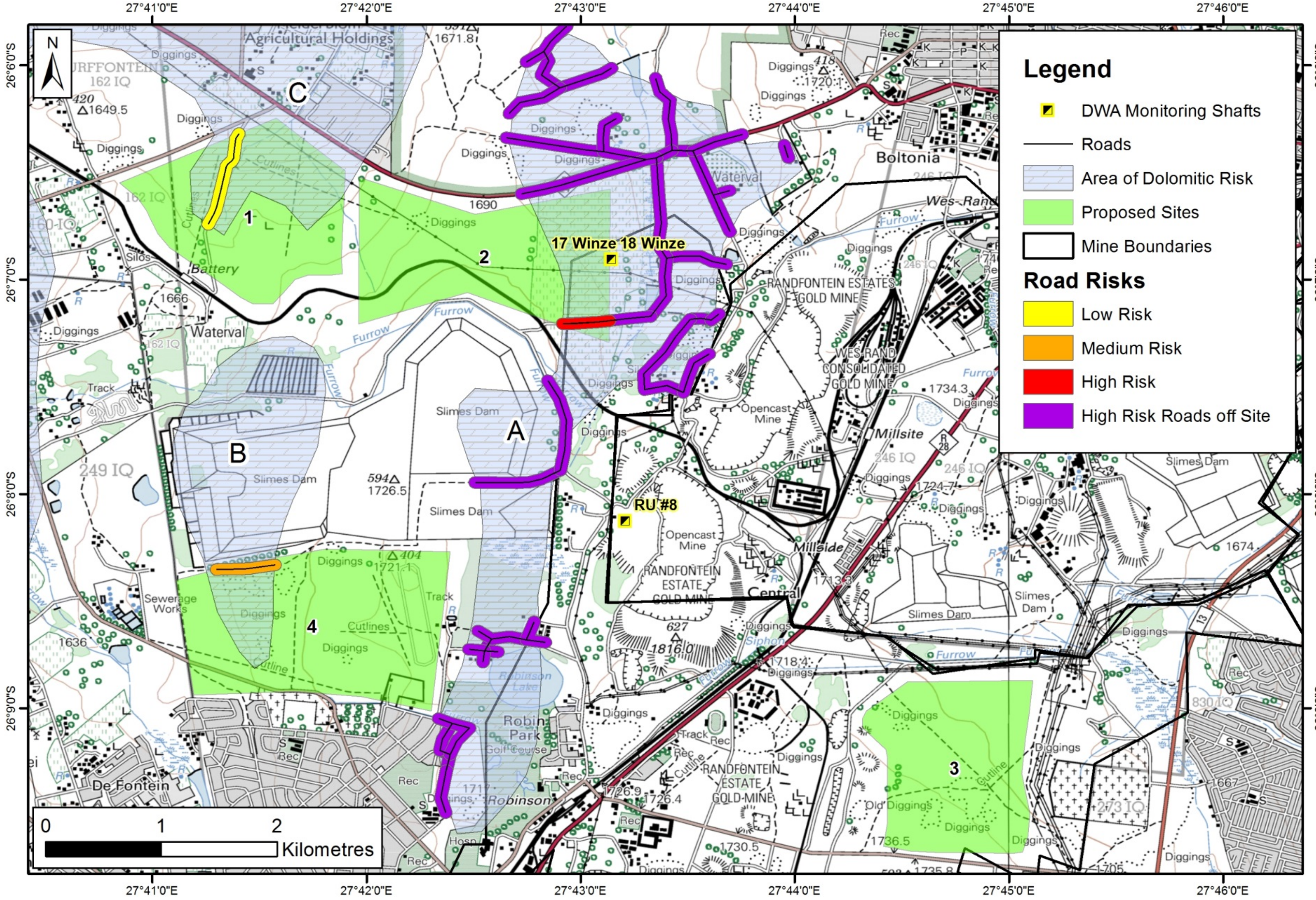


Figure 4.2: Western Basin: Dolomitic Risk

4.7.2 Surveys

It is recommended that a gravimetric survey be undertaken along all the major roads in the area of the Western Basin that are likely to be affected, whether high or low risk. These roads are shown in **Figure 4.2**. Where the gravity survey indicates possible karst development, percussion drilling is recommended to confirm the extent of the areas at risk.

Where the proposed SSF or any other construction sites overlay known occurrences of dolomite, it is recommended that drilling, testing and monitoring are carried out to understand the extent and characteristics of the dolomites and to monitor connectivity of these compartments to better identify and quantify associated risks.

4.7.1 Monitoring and Disaster Risk Management

Once the identification areas of risk relating to the dolomites are completed, monitoring of these areas can be established. If the problematic areas lie beneath infrastructure, suitable precautions should be taken, e.g. the R24 road may need to be reinforced or diverted around the high risk areas.

4.8 Summary

The primary objective of the Implementation Plan is to ensure that the IS continues to stop the decant and slowly reduces the level of water in the mine void to prevent further pollution and treat water to the acceptable standards. These objectives will be achieved by:

i) Upgrading the Immediate Works to 40 Mℓ/d and install a clarifier or implement the Mintails process in conjunction with Mogale Gold after conclusion of the necessary regulatory processes and agreements.

ii) Installing the STI (long-term) pumps with a 28 Mℓ/19 hours average capacity at a level to allow the TOL of 1 585 m amsl to be maintained, if desired.

iii) Reducing the level of water in the void to a TOL of 1 585 m amsl and maintain it at that level for 12 months, while monitoring surface and near surface water quality in areas previously contaminated by AMD.

iv) If pollution has ceased, maintain that level.

v) If pollution of surface and near surface water resources is still evident after 12 months, reduce the TOL to 1 550 m amsl and continue monitoring.

vi) Adjusting the TOL based on the monitoring results.

The secondary objective is to provide an opportunity for the development of promising technologies and this will be achieved by:

i) Defining the details of waste disposal and water delivery points which can be used by PTPs.

ii) Defining responsibilities for funding the Capital Expenditure (CAPEX) and Operating Expenditure (OPEX) for the PTPs and agree on a business model.

iii) Inviting proposals from the Private Sector to DBOM for a minimum period of 5 years, and possibly up to 10 years, Pilot Plants which can treat, to the South African National Standards (SANS) 241 or better a minimum of 5 Mℓ/d and a maximum of 10 Mℓ/d of better incoming feed water comprising either:

- Neutralised AMD delivered from the Immediate Works HDS plant; or
- From the Mintails process; or
- Raw AMD delivered from the “long-term” pumps.

iv) Monitoring the performance of the PTPs, and prequalify those that prove to be acceptable to participate in the next procurement phase of managing AMD in any of the basins.

v) The further objective is to procure a LTS for managing AMD. This will be achieved by:

- When the PTPs have been running for long enough to assess the technologies, starting the process to procure long-term contracts for DBOM, using a then proven treatment process or bankable PPP processes with lowest whole life costs for a period of 25 years; and
- After 25 years, procuring new contracts for another 25 years.

The proposals for implementation and the comparison with the Reference Solution, described in Chapter 3 are shown in **Table 4.1**.

Table 4.1: The Reference and Implementation Projects: Western Basin

Reference Project	Proposals for Implementation
Phase 1A - Immediate Intervention: from 2012 for as long as necessary • Upgrade neutralisation plant to 32 Mℓ/d.	**As Reference Project**
Phase 1B - STI: 2013 • Install 2 new permanent pumps, which are part of the STI, in No. 8 Shaft; • Either Upgrade neutralisation capacity to peak capacity of 40 Mℓ/d and add permanent clarifier; or • Implement joint neutralisation process with Mintails.	**As Reference Project**
Phase 2 – Pilot Treatment Plants: 2017 - 2032 • Additional abstraction from Mogale Gold Shaft for medium-term. • DBOM or PPP contract for 10 to 15 years with Ion Exchange and Conventional RO.	**Phase 2: Pilot Treatment Plants 2017 for 5 years - 2022** • 4 or 5 PTPs (each 8 to 10 Mℓ/d) with innovative technologies such as MiWaTek, Biosure, Paques, etc. • Co-dispose sludge at Wes Wits Pit until full then, new Sludge Storage Facilities or co-disposal with Mintails Tailings. • Brine evaporation ponds.

Reference Project	Proposals for Implementation
Phase 3 –2032 - 2057 • Procure new process and operating contract with lowest lifetime and operating costs. • Abstraction could be via tunnel.	**Phase 3: 2023 – 25 years - 2048** • Procure new process and operating contract with lowest lifetime and operating costs. • Abstraction could be via tunnel.
Phase 4 2057 – 25 years • Procure new process and operating contract with lowest lifetime and operating costs. • Abstraction could be via tunnel.	**Phase 4: 2048 – 25 years** • Procure new process and operating contract with lowest lifetime and operating costs. • Abstraction could be via tunnel if proved feasible.

Notes:
Dates and durations are years of operation, after procurement etc.

5 PROPOSALS FOR IMPLEMENTATION IN THE CENTRAL BASIN

5.1 Introduction

While the Reference Project provides a low risk project which could be implemented, the current situation is such that some minor adjustments are recommended for the actual works to be implemented. The proposals for implementation are described in the following sections.

5.2 Critical Water Levels and Target Operating Levels

For the Central Basin, the ECL is based on keeping the AMD at a depth of 100 m below surface at the anticipated decant points of ERPM, Cinderella East and Cinderella West at 1 620 m amsl to protect the shallow weathered aquifers and the ground water regime feeding springs and base flow in streams. A program of drilling and water quality testing in the ERPM area is recommended to improve definition of the depths of the shallow aquifer and provide baseline water quality data, which will enable a more accurate elevation to be determined for the ECL. Details are given in Chapter 15.

In the long-term a freeboard, or buffer, of 20 m is expected to be adequate to protect the ECL (1 520 m amsl). The recommended TOL is thus 1 500 m amsl. However, due to the size of the basin (55 km across) there are a number of unknowns, including how the water levels in the mine void will vary, both spatially and temporally, so an initial freeboard (buffer) of 50 m is recommended, with a TOL of 1 470 m amsl, which corresponds with the ECL (including a "buffer" of 50 m) of 1 467 m amsl proposed by the STI. However, the current estimate for the water levels in the Crown Mines No. 14 Shaft to reach the ECL, proposed by TCTA, (1 467 m amsl) is estimated at *ca.* November 2013 and the STI will only be RfO in February or March 2014, when the water level is expected to be at about 1 497 m amsl. Surface decant is estimated to occur sometime in 2015, if the STI was not being implemented. The freeboard and thus TOL should also be reviewed, based on the monitoring of the water levels in the void across the basin.

The Gold Reef City Tourist Facility (GRCTF) mine museum tourist attraction at 5 Level, (1 484 m amsl) in Crown Mines No. 14 (CM 14) Shaft was taken to be the critical factor in determining the Socio-Economic Critical Level (SECL) to ensure that the museum can still be visited as a heritage site. The SECL is set at an elevation of 1 474 m amsl to accommodate the lowering of the double decker conveyance and if the SECL is used, then the TOL must ensure that there is sufficient freeboard to allow for potential slow flow rates between Gold Reef City Museum (GRCM) and the pump site, and a TOL of 1 454 m amsl is proposed for the SECL, but this must be carefully monitored to see that it is achieving the objective. Since the museum will be flooded before the STI is operational the GRTTF will remove their equipment from the museum. The GRCTF are investigating the possible relocation of the museum facility from 5 Level to 2 Level (1 624 m amsl), or reinstating it on 5 Level after it is dewatered.

Alternative SECLS of 1 396 m amsl (250 metres below surface (mbs)) and 1 246 m amsl, about 400 mbs at SWV, are being considered to allow mining to those depths. If this takes place, then, before such mining operations close down again, the proposed ECL or the SECL for the GRCTF and associated TOL will have to be set before the water is allowed to rise.

Whatever levels are set, monitoring of the near surface aquifers of the basin is very important, as discussed in Chapter 15.

5.3 Abstraction Points and Pumping Rates

5.3.1 Abstraction Point

For the Central Basin, the SWV Shaft at ERPM was identified in the **TCTA (2011) Study** as the site where the pumps will be installed. A disadvantage of this shaft is that its shallowest connection with the ERPM mine void is at 24 Level, 1 080 mbs. The AMD from all the other compartments will decant from West to East through connections at relatively shallow depths. All the water will decant into the ERPM compartment at about 575 mbs. Thus, due to compartmentalisation of the Central Basin, it is likely that only relatively shallow water will be drawn towards ERPM from the west and the deep mine water in the west and central parts of the basin will remain undisturbed. The haulage at 24 Level will have to carry the entire void discharge and a collapse could restrict the flow. Water would then be drawn up the SWV Sub-shaft, which is connected to the void at the much deeper 30 Level and below. (DWA AMD FS 2013, Study Report No. 5.2: **"Assessment of the Water Quantity and Quality of the Witwatersrand Mine Voids"**). Water will then be drawn from considerable depth and the water quality would be adversely affected. However, this Study considers the SWV Shaft to be suitable for at least the medium-term (10 – 15 years).

5.3.2 Pumping Rates

The STI pumping plan is to operate the pumps and HDS plant for 19 hour day to avoid Eskom peak tariffs. However, this installed capacity, operating 19 hour day, is more than adequate to pump the predicted average ingress of 46 Mℓ/d under average conditions and can be increased by about 25% by operating the pumps 24 hours/day if necessary to manage short-term peaks of up to 90 Mℓ/d

There will be two duty pumps and one standby pump, with the standby pump kept on surface. With the water level at the long-term TOL (ECL) of 1 500 m amsl the installed capacity of each pump will be 34 Mℓ/19 hour day giving an installed capacity of 68 Mℓ/19 hour day. At the proposed TOL (SECL) of 1 454 m amsl to protect the SECL, the installed capacity will be 62 Mℓ/19 hour day.

The somewhat surprising result of the pumps having a greater capacity when pumping against lower heads is the result of the pumps having to operate at reduced speed and having decreased operating ranges. It should also be noted that for pump rates above 28 Mℓ/d, the pumps have a reduced operating efficiency.

5.3.3 Long-Term Risk Mitigation

The following specific risks and their implications have been identified in relation to abstraction at SWV Shaft:

- Although the water levels at the current monitoring points are all very similar, water levels in some compartments (not all of which are currently monitored) may remain several metres above the TOL at SWV, even under present day conditions;
- The pumps in SWV will be situated at one end of the 55 km strike length of the void, having only one dedicated pumping site for the entire basin. It has a risk that to protect the ECL throughout the basin, the TOL will have to be reduced substantially. Alternative options may be required in order to keep the void water below the ECL.
- Collapses may occur in the mine void, reducing the existing connectivity, but at the higher levels there are multiple connections between the compartments so this risk is not significant; and
- The SWV Shaft is only connected to the mine void in the ERPM workings at 24 Level, 1 080 m below surface. However, the main haulage at that level has multiple connections to the workings. The haulage had full rock support and is concrete lined. Thus, a collapse in the haulage is not very likely and would have to occur close to the shaft to affect the dewatering.

To mitigate the long-term risk that the effectiveness of abstraction at the SWV Shaft may, at some time be reduced, additional abstraction strategies have been identified and are discussed below. They should be investigated in more detail and a detailed Contingency Plan should be prepared by DWA.

In a LTS, other pumping strategies should be investigated which could involve supplementary or multiple extraction points which have greater connectivity with the void at a shallow level. A preferable long-term approach would be to abstract at SWV and several other locations and options are discussed below. Most of the vertical shafts which are still accessible today on the Central Rand intersect the void at considerable depth. The reason is that most of the shallower reefs were accessed by incline shafts, such as Cason Shaft.

a) Alternative Shafts

There is a ventilation shaft about 500 m north-west of the SWV Shaft, which could serve as back-up pumping location in the event of problems with SWV. Pumps in this shaft could be connected directly to the HDS plant relatively easily. This shaft was considered in the STI investigations, but was rejected because it was too small (it has a 6 m diameter) and was connected to the void by a single tunnel. However, it should be protected.

Vertical shafts are suitable for pump installation, but are generally only connected to the void at deeper levels.

Incline shafts generally have shallower connections, but there are significant technical challenges and uncertainties, as well as cost implications when installing high lift submersible pumps in an incline shaft and a detailed investigation of condition, alignment and cost would be required. The upper portions of these shafts are located on the reef layer and as a result are not regular but rather roll with the reef. There is also some risk regarding shaft stability, when considering incline shafts over vertical shafts. A detailed investigation of potential vertical shafts and incline shafts that may have greater interconnectivity would require a detailed study of multiple criteria and is beyond the scope of this study. Since dewatering through SWV Shaft is recommended, this avenue was not pursued further in this study.

b) Boreholes

As an alternative to pumping void water from a single, deep shaft, it has been suggested that a number of smaller distributed pumps could be installed. This will reduce the risk from failure of a pump shaft due to collapse of the shaft itself or underground haulages. In addition, pumping from shallower levels is likely to result in a more rapid improvement in the pumped water quality. Ideally, shafts that are better connected to the mine void at multiple and preferably shallow levels are recommended and incline shafts generally meet these criteria better than vertical shafts. In the Central Basin, there are numerous incline shafts across the length of the basin that could be investigated for their suitability as pump locations. However, many but not all of these have been filled.

Abstraction from a number of boreholes would have several advantages. The most suitable locations for boreholes would be those that intersect positions in incline shafts where large voids were made to accommodate pumping and other underground infrastructure. Most of the incline shafts are sealed near surface, but at the envisaged pumping depths, these shafts will almost certainly still be open. The boreholes could be either inclined or vertical, making for easier positioning in very developed areas. An example of an incline shaft that could be utilised initially to test the methodology is the Cason Incline Shaft in the Central Basin. Water pumped during the testing could be treated and disposed of via the SWV treatment facility.

The option of boreholes should be investigated as part of the contingency planning recommended above.

5.4 Treatment

5.4.1 Pretreatment

The 46 Mℓ/19 hour day HDS plant being constructed and commissioned by TCTA should be used for at least the medium-term (10 – 15 years).

5.4.2 Primary Treatment

It is recommended that the specifications for the proposed DBOM contract require a proven technology for desalination and it is anticipated that RO will be the core of most tenders. However, the specifications could be relaxed to allow other technologies to be accepted if the risks can be managed through suitable contractual requirements. If a DBOMF (PPP) contract is used, the restriction on acceptable technologies could be widened if the Private Sector is taking sufficient financial risk.

5.4.3 Secondary Treatment

Secondary treatment could comprise Ion Exchange and, depending on the user, chlorination. The inclusion of Ion Exchange technology by any tenderer is likely to be based on the economics. If Ion Exchange is used to treat the full flow of raw AMD, it will have a high cost, but all the Uranium will be removed and could have a commercial value. The residues derived from neutralisation and desalination will then be free of Uranium, which will make the waste disposal less expensive. The options should be allowed for in the tender process and economics will be the deciding factor.

5.4.4 Research

Institutions carrying out research may request, either batch samples or small flows of AMD at various stages of treatment, for their research. These requests should, wherever possible, be accommodated so that more viable technologies are available for use in future.

5.5 Water Use

It is recommended that the water be treated to a suitable standard and supplied to industry. The required quality will depend on the user and their application and on the Vaal Reconciliation Strategy's requirements for salts. Mining users can tolerate water of lower quality than South African National Standards (SANS 241), but other industrial users such as Sasol, would prefer lower salt content than SANS 241. The standard of potable water (specifically salt content) currently supplied by Rand Water is also better than SANS 241. Rand Water have verbally advised that they have current and potential industrial consumers to whom they will be able to sell the full volume of treated water from the basin. They have not specified the locations or quality requirements for the users, but Rand Water is the recommended recipient of the water. End quality for TDS probably needs to equate to Vaal Dam quality or better to satisfy the aims of the Vaal Reconciliation Strategy.

Sasol have indicated that they would like to take the full treated flow from the Central and Eastern Basins for their Sasolburg and/or Secunda plants, respectively at ~ 1 500 m amsl and 1 600 m amsl. Sasol have requested water of a quality significantly better, particularly lower Total Dissolved Solids (TDS) than current Rand Water domestic supplies. The quality required by Sasol can be produced by the proposed treatment works, although a larger volume of brine will be produced.

For the purpose of the cost estimate for the Reference Project, it has been assumed that water from the Central Basin (SWV Shaft at 1 646 m amsl) will be pumped to the Eastern Basin (Grootvlei No. 3 Shaft at 1 570 m amsl) treatment site from where the recipient will collect and distribute it to end-users.

It is recommended that DWA negotiate with Rand Water to secure an end-user agreement under which they would be responsible for collecting the water at the Central Basin Treatment Works and for the necessary distribution infrastructure.

5.6 Residue Management

The main residues are expected to be sludge from the HDS plant and RO process and brine from the RO process. It is possible that some residues will have a commercial value and be sold to or at least collect by users.

5.6.1 Sludge

The Reference Project provides for a dedicated SSF to be constructed as part of the LTS as described in DWA AMD FS 2013, Study Report No. 5.5: **“Options for the Sustainable Management and Use of Residue Products from the Treatment of AMD”**. A number of possible sites have been identified, and what appears to be the most favourable site has been provisionally selected. Based on the volume of sludge expected to be produced by the STI and LTS over 50 years, the predicted final size of the SSF is 1 090 m by 665 m by 14 m high. However, the site has not been approved by Ekurhuleni Metropolitan Municipality who are planning extensions to their urban area which may include the preferred site.

The STI had provisionally planned that neutralised sludge would be pumped to the existing ERGO regional TSF at Withok or at Daggafontein for co-disposal with their tailings. The desalination plant will produce a similar volume of sludge as the HDS plant. The volume of sludge from the LTS desalination plant had been provided to TCTA. However, ERGO has recently advised that they are not prepared to accept the sludge at any of their facilities. Co-disposal of all the sludge at the ERGO facility is no longer a possibility. It had been envisaged that a short sludge pipeline would be constructed from the desalination plant to the same injection point on the ERGO pipeline as for the STI. Sections of the ERGO pipeline would have required upgrading to transfer the HDS sludge and further upgrades would be required to transfer the HDS and RO sludge.

TCTA are considering the alternatives for sludge disposal, but the solution they may find for the STI are unlikely to be suitable for the LTS. Underground disposal may be viable if the mine void into which it is disposed of is isolated sufficiently from the main void.

5.6.2 Brine

Brine will also be produced and it is recommended that this be disposed of in lined evaporation ponds, being low tech and having low operating costs. Two ponds each 460 m by 340 m and 2 m deep are proposed. These are each sized to provide sufficient area for evaporation, 1 m depth for storage of accumulated salt and 1 m depth for balancing storage to accommodate periods of high rainfall. It is planned that only one pond is used at any time, allowing the commissioning of one pond to be delayed till the first pond has accumulated 1 m of salt or requires major maintenance. The ponds can thereafter be used alternatively, allowing plenty of time for each pond to be emptied and/or its lining replaced.

5.7 Potential Role of Package Plants

It has been suggested that RO package plants could be installed and commissioned downstream of the HDS plant in under 12 months. This would immediately reduce the salt load in the Vaal River System and reduce the risk of water restrictions from 2015, possibly 24 months before the LTS can be commissioned. RO package plants are relatively common and are factory fitted in shipping containers which can be transported to site and commissioned in a relatively short period. The plant can then also be moved from one site to another if necessary.

Enquiries have indicated that containerised package plants typically have a capacity of 2 Mℓ/d. The largest plant, which can be called a package plant, has a capacity of 10 Mℓ/d, but cannot fit into a container. Rather, it is only partially assembled in the factory, and then mounted onto concrete slabs on site, after which a steel shed is constructed around it. Up to 25 plants of 2 Mℓ/d capacity would be required for the Central Basin. Preliminary enquiries have indicated that containerised package plants would cost about twice as much as a permanent works. Single stage package plants normally produce up to 30% of the treated volumes as brine and sludge so very significant storage/ disposal facilities would be required unless the brine is processed through additional stages of RO, each preceded by gypsum precipitation. Thus, extensive site works cannot be avoided and possible subsequent uses for this many package plants, since they are not required for desalinating AMD, have not been considered.

The use of package plants is not recommended at this stage for the LTS, but a construction contract will have to be prepared and awarded for these facilities. If appropriate, DWA can direct the TCTA to carry out an assessment of the costs and availability of package plants, as well as an implementation programme to assess how much time can be gained and at what cost.

5.8 Summary

The primary objective of the Implementation Plan is to ensure that the STI maintains the water level at the TOL and neutralises the water. The LTS must then desalinate the water for consumptive use. These objectives will be achieved by:

i) Implementation and operation of the STI.

ii) Determining and provision of the business model, in terms of funding, to be determined.

iii) Defining options and responsibilities for the waste disposal, delivery infrastructure and supply points determined.

iv) Inviting proposals from the private sector to DBOM and possibly finance DBOMF (PPP) for a solution with proven or bankable technology that can treat the neutralised water to the standards agreed with Rand Water under a contract for a period of 10 - 15 years operation.

v) During construction of the STI, review the current monitoring programme and recommend any required strengthening. It should include monitoring the water levels in the mine void at agreed locations across the basin and testing the water quality, including radioactivity at a range of depths, and establishing the hydraulic grade line.

vi) If found necessary, plan to abstract from boreholes at multiple locations.

vii) The long-term objective is the most cost effective management of AMD and this will be achieved by:

- After 10 – 15 years, procure a new contract (DBOM or DBOMF (PPP)) for a 25 year period. A solution with the lowest whole life costs, which may include or exclude all or any of the existing infrastructure, should be implemented. If found necessary, this could comprise abstracting from boreholes at multiple locations; and
- After 25 years, procure a new contract. Technology provider to design, build and operate.

The comparison between the Reference Solution, described in Chapter 3, and the proposals for implementation are shown in **Table 5.1**. While the Reference Project provides a low risk project which could be implemented the current situation is such that some minor adjustments are recommended for the actual works to be implemented.

Table 5.1: The Reference and Implementation Projects: Central Basin

Reference Project	Proposals for Implementation
Phase 1: from 2013 for as long as required • New Ritz pumps at SWV shaft; • HDS for 46 Mℓ/d; and • Sludge disposal at Brakpan TSF operated by ERGO.	**Phase 1: From 2013 for as long as required** **As Reference Project** • Sludge disposal at Brakpan TSF operated by ERGO.
Phase 2 : 2017 to 2032 • DBOM or DBOMF (PPP) contract for 15 years with: – Ion Exchange; – Conventional RO; – Brine evaporation ponds; – New SSF.	**Phase 2: 2017 to 2032** **As Reference Project but** • May omit Ion Exchange.
Phase 3 – LTS_1: ± 2032 for 25 years • Procure new DBOM or DBOMF (PPP) for operating and process with lowest lifetime costs.	**As Reference Project plus** • Possible additional abstraction points and treatment works; and • New SSF.
Phase 4 – LTS_2: ± 2057 for 25 years • Procure new operating contract and process with lowest lifetime costs.	**As Reference Project**

Notes:
Dates and durations are years of operation, after procurement etc.

6 PROPOSALS FOR IMPLEMENTATION IN THE EASTERN BASIN

6.1 Introduction

While the Reference Project provides a low risk project which would be implemented, the current situation is such that some minor adjustments are recommended for the actual works to be implemented. The proposals for implementation are described in the following sections.

6.2 Critical Water Levels and Target Operating Levels

In the Eastern Basin, an ECL of 1 470 m amsl, about 100 m below the water table in the dolomitic aquifer, is expected to be low enough to protect the aquifer from pollution. A long-term freeboard of 20 m is proposed, giving a TOL of 1 450 m amsl. However, it is recommended that, initially an ECL of 1 280 m amsl at the base of the dolomite be adopted. This ECL, 190 m lower than the proposed long-term ECL, is considered to be conservative and no freeboard or buffer is proposed so the associated TOL is also 1 280 m amsl. This is also the ECL proposed by the STI, set to be at the bottom of the dolomite.

If adequate monitoring of the water quality in the dolomite has been established, and no pollution is observed at the TOL/ECL of 1 280 m amsl, the water level can be allowed to rise, in approximately 10-metre steps every three months, possibly as high as 1 450 m amsl, providing the recommended monitoring is carried out and does not detect any pollution from AMD.

No SECL is currently set for the Eastern Basin.

The conservative ECL in the Eastern Basin (1 280 m amsl) is estimated in this Study to be reached by the middle of 2014. The TCTA (2013, presentation to SSC on 16 May 2013) predicts that the ECL will be reached in August 2014, and these slight differences may be due to extrapolation issues with limited data.

6.3 Abstraction Points and Pumping Rates

6.3.1 Abstraction Point

In the Eastern Basin, Grootvlei No. 3 Shaft has been identified by the TCTA as a possible pumping shaft, as it has been utilised in the past and proved to be sufficiently connected to the void. It draws directly from the shallower Kimberley Reef void and only indirectly from the deeper Nigel Reef void (due to a plug in the shaft). Due to its proximity to the dolomites in the area, lack of space for the required infrastructure and the fact that the ground level at the shaft is below the 1:100 year floodline, suitable alternatives were sought and several considered. Based on an inventory of shafts in the Eastern Basin prepared by Gold One and a camera survey carried out by Mine Rescue Services, the Marievale No. 5 Shaft was identified as being the most suitable alternative. This shaft is located south of the dolomite and wetlands, and is connected to both the Kimberley Reef and the Nigel (Main) Reef via haulages. There is adequate space for infrastructure. After considering all the criteria, Grootvlei No. 3 Shaft is considered marginally superior to the Marievale No. 5 Shaft and has been confirmed as the abstraction shaft for the STI. However, Marievale No. 5 Shaft could be a suitable alternative should the need arise.

Since the recent insolvency of the mine, all surface infrastructures at Grootvlei has been sold and demolished and the steel works removed. The concrete and brick works are also being demolished and either levelled or removed.

The area surrounding the shaft where the STI and LTS works will be constructed is located below the 100-year flood line at 1 571 m amsl of the Blesbokspruit. The STI proposes to raise the shaft collar above the flood line and an extensive rock or earth platform to a level of 1 573 m amsl is proposed to raise the LTS works above the flood line. The impact of this fill on the flood line has been checked and shown to be negligible (DWA AMD FS 2013, Study Report No. 6: "**Concept Design"**). This area is already highly impacted by past mining activities and environmental impacts of the fill platform will not be significant.

At present elevated flows in the Blesbokspruit are impeded by a disused road bridge about 0.5 km downstream of Grootvlei No. 3 Shaft and also by a disused railway bridge about 0.4 km further downstream. In the flood line model, it has been assumed that at least the substructure of both bridges will have been removed and that demolition should be included in the construction contract for the STI. However, the piers of the road bridge should be retained for the required pipe bridges and access across the river.

6.3.2 Pumping Rates

The STI pumping plan is to operate the pumps and HDS plant for 19 hour day to avoid Eskom peak tariffs.

The AMD will need to be pumped at an average of 80 Mℓ/d by the pumps being procured by TCTA in the tender to be advertised at the end of June. There will be 3 duty pumps and 1 (one) standby pump (installed in the shaft / kept on surface). The installed capacity will be 80 Mℓ/19 hour day. This installed capacity, operating 19 hours per day, is adequate to maintain the water level under average conditions and can be increased by about 25% by operating the pumps 24 hours/day if necessary.

The area of the site is such that the area available near the shaft is only adequate for the treatment facilities, and the only sites identified for brine and sludge disposal are across the Blesbokspruit where suitable undeveloped land is available. This will result in three pipes, namely brine, sludge and supernatant return water, having to cross the environmentally sensitive wetland on a pipe bridge. These pipes could be mounted on the piers of a bridge to be demolished, with only the deck demolished and the piers raised to above the flood levels.

6.3.3 Long-Term Risk Mitigation

In the Eastern Basin, Grootvlei No. 3 Shaft has been selected. Should an unforeseen problem arise with abstraction at this shaft, alternatives would need to be considered. It is recommended that alternatives that have been or may in future be identified as suitable to use as pumping (or monitoring sites) should be secured for potential future use. Marievale No. 1 and Marievale No. 5 Shafts were investigated as alternative pumping shafts. Marievale No. 1 Shaft was found to be blocked. Marievale No. 5 Shaft was found to be down in excellent condition and open to at least 400 m below surface. It is also well connected to the Nigel Reef void via a tunnel on 14 Level (approximately 905 m amsl) and to the Kimberley Reef by a tunnel on 6 Level (approximately 1 270 m amsl), and an incline shaft (approximately 1 323 m amsl) on 5 Level. This shaft could be used in the long-term if unforeseen problems are encountered at Grootvlei No. 3 Shaft.

The mine void water level monitoring being carried out in the Eastern Basin has shown that in this basin the water levels in some of the sub-compartments of the basin are varying independently of the water level in the main void. (DWA AMD FS 2013: Study Report No. 5.2: "**Assessment of the Water Quantity and Quality of the Witwatersrand Mine Voids**"). In Chapter 15 recommendations are made for increasing the number of shafts to be monitored. All the mine void level data should be reviewed monthly to identify if there are potential pollution risks from the rising water levels in the isolated compartments. Additional abstraction sites may need to be identified and abstraction and treatment implemented.

The isolated mining pockets in the East Rand area that do not contribute to the overall water levels in the main void were not investigated in this Study. The location of these pockets is unknown, especially to the south of the basin where the void becomes more disconnected. Holfontein Shaft to the north in the East Rand Basin may also be an un-connected mine void area (number 9 in **Appendix 2**).

The water levels in all the shafts in the isolated compartments should be investigated to assess what should be done.

6.4 Treatment

6.4.1 Pretreatment

The HDS neutralisation plant with an average capacity of 80 Mℓ/19 hour day will be used.

6.4.2 Primary Treatment

It is recommended that the specifications for the proposed DBOM contract require a proven technology for desalination and it is anticipated that RO will be the core of most tenders. However the specifications could be relaxed to allow other technologies to be accepted if the risks can be managed through suitable contractual requirements.

If a DBOMF (PPP) contract is used, the restriction on acceptable technologies could be widened if the Private Sector is taking sufficient financial risk.

6.4.3 Secondary Treatment

Secondary treatment could comprise Ion Exchange, as discussed above and, depending on the user, chlorination.

The inclusion of Ion Exchange technology by any tenderer is likely to be based on the economics. If Ion Exchange is used to treat the full flow of raw AMD, it will have a high cost, but all (nearly all) the Uranium will be removed and could have a commercial value. The residues derived from neutralisation and desalination will then be free of Uranium, which may make the waste disposal less expensive. The options should be allowed in the tender process and economics will be the deciding factor.

6.5 Water Use

It is recommended that the water be treated to a suitable standard and supplied to industry. The required quality will depend on the user and their application and on the Vaal Reconciliation Strategy's requirements for salts. Mining users can tolerate water of lower quality than SANS 241, but other industrial users and potable users would prefer lower salt content than SANS 241. However, the Vaal Reconciliation Strategy probably requires salt concentrations equal to or better than Vaal Dam quality. Rand Water have verbally advised that they have current and potential industrial consumers to whom they will be able to sell the full volume of treated water from the basin. They have not specified the locations or quality requirements for the users.

Sasol have indicated that they would like to take the full treated flow from the Central and Eastern Basins for their Sasolburg and/or Secunda plants. Sasol have requested water of a quality significantly better, (particularly lower TDS) than current Rand Water domestic supplies. The quality required by Sasol can be produced by the proposed treatment works, although a larger volume of brine will be produced. Since the treated water from AMD is pumped to the surface at about 1 570 m amsl, the treated water cannot be supplied via a gravity pipeline to Secunda which is situated at ~ 1 600 m amsl.

It is recommended that DWA negotiate with Rand Water to secure an end user agreement under which they would be responsible for collecting the water at the treatment plant.

6.6 Residue Management

The main residues are expected to be sludge from the HDS plant and RO process and brine from the RO process. It is possible that some residues will have a commercial value and be sold to or at least collect by users.

6.6.1 Sludge

The STI had provisionally arranged that neutralised sludge would be pumped to the existing licenced regional TSF operated by ERGO for co-disposal with their tailings. Although the desalination plant will double the volume of sludge to be disposed of, it had been anticipated that the LTS sludge could have been disposed of at the ERGO with the HDS sludge.

However, in June 2013, ERGO advised they would not be able to accommodate any sludge from the Eastern Basin (HDS or RO) at their tailings storage facilities. They have offered to make land available adjacent to their planned Withok TSF for a dedicated SSF. That site is about 22 km west of Grootvlei No. 3 Shaft. They do not want to accept any AMD sludge for co-disposal at their planned Withok site. It would thus be necessary to construct a stand-alone SSF to accommodate both HDS and RO sludge.

The Reference Project for the LTS includes a SSF to manage both HDS and RO sludge waste streams. The preferred option is for this SSF to be constructed on the recommended site identified for the LTS (DWA AMD FS 2012, Study Report No. 5.5). Since the use of the Withok site would require significant pumping and pipelines, the STI should investigate this site and make the necessary arrangements to develop the site for use by the STI and LTS and transport the sludge to the site. The site is on the east side of the Blesbokspruit, slightly south of Grootvlei No. 3 Shaft.

Based on the volume of HDS and RO sludge expected to be produced over 45 years, the predicted final size of the SSF is 938 m by 613 m by 14 m high. Alternatively, underground disposal can be considered, pending further investigations, if the mine void into which it is disposed of is isolated sufficiently from the main void.

6.6.2 Brine

It is recommended that the brine which will be produced should be disposed of in lined evaporation ponds, being low tech and having low operating costs. Two ponds each of 430 m by 300 m by 2 m deep are proposed. These are sized to provide sufficient area for evaporation, 1 m depth for storage of accumulated salt and 1 m depth for balancing storage to accommodate periods of high rainfall. It is planned that only one pond is used at any time, allowing the commissioning of one pond to be delayed till the first pond has accumulated 1 m of salt or requires major maintenance. The ponds can thereafter be used alternatively, allowing plenty of time for each pond to be emptied and/or its lining replaced.

6.7 Potential Role of Package Plants

It has been suggested that RO package plants could be installed and commissioned downstream of the HDS plant in under 12 months. This would immediately reduce the salt load in the Vaal River System and reduce the risk of water restrictions from 2015, possibly 24 months before the LTS can be commissioned. This has been discussed in Section 5.7 and the same comments and recommendations apply, except that for 80 Mℓ/d a total of 40 plants of 2 Mℓ/d would be required.

Apart from the cost and logistical considerations, the HDS plant is likely to be fully operational in the beginning of 2015. It is possible that the long-term desalination plant could be operational by 2018, so the package plants would only be required for 3 years.

6.8 Summary

The primary objective of the Implementation Plan is to ensure that the STI maintains the water level at the TOL and neutralises the water. The LTS must then desalinate the water for consumptive use. These objectives will be achieved by:

i) Ensure that the STI is implemented as soon as possible to avoid the level rising too far above the conservative TOL at 1 280 m amsl.

ii) Invite proposals from the Private Sector to DBOM and finance (DBOMF (PPP)) a solution with proven technology or bankable technology that can treat the neutralised water to the standards agreed with Rand Water for a period of 10 – 15 years.

The details of and responsibilities for the waste disposal sites and associated infrastructure, which it is expected the STI will have developed, must be defined.

viii) During construction of the STI, review the current monitoring programme and recommend any required strengthening. It should include monitoring the water levels in the mine void at agreed locations across the basin and testing the water quality, including radioactivity at a range of depths, and establishing the hydraulic grade line.

ix) The long-term objective is the most cost effective management of AMD and this will be achieved by:

- After 10 – 15 years, invite new tenders tor a DBOM or DBOMF (PPP) allowing recently proven technologies with lower operating costs, to bid. It is possible that the incumbent contractor or another operator for the same plant will still be competitive because of existing infrastructure. Private Sector to DBOM or enter into a PPP contract; and
- After another 25 years, procure a new contract.

The comparison between the Reference Solution, described in Chapter 3 and the proposals for implementation are shown in **Table 6.1**. While the Reference Project provides a low risk project which could be implemented the current situation is such that some minor adjustments are recommended for the actual works to be implemented.

Table 6.1: The Reference and Implementation Projects: Eastern Basin

Reference Project	Proposals for Implementation
Phase 1: 2014 for as long as required • Install 2 new pumps in Grootvlei No. 3 Shaft; • Pump average of 80 Mℓ/d; • The HDS plant for 80 Mℓ/d; • Sludge disposal to new SSF suitable for LTS.	**Phase 1: from 2014 for as long as required** **As Reference Project**
Phase 2: 2017 • DBOM or DBOM (F) contract for 15 years with: – Ion Exchange; and – Conventional RO. • New Brine evaporation ponds;	**2018 – 2033 As Reference Project but** • May omit Ion Exchange.

Reference Project	Proposals for Implementation
• New SSF; • Water for Industrial use.	
Phase 3: ± 2032 for 25 years • Procure new DBOM or DBOMF (PPP) contract for process with lowest lifetime costs.	**As Reference Project**
Phase 4: ± 2057 for 25 years • Procure new operating contract and process with lowest lifetime costs.	**As Reference Project**

7 FUNDING AND COST RECOVERY

7.1 Introduction

The three key components considered in this chapter are:

- The cost of the project, both capital and operating;
- The alternative sources of funding for the costs; and
- The options that are available to recover the costs.

The costs considered in this Study are:

- Capital costs of the LTS (Reference Projects), including engineering design and construction superintendance;
- Lifecycle costs from the date of commissioning of the LTS and regular maintenance:
  - Operating costs for both the STI and LTS; and
  - Regular planned major maintenance and overheads for the STI and LTS.

The relationship between cost, sources of funding and options for cost recovery are shown in **Figure 7.1**.

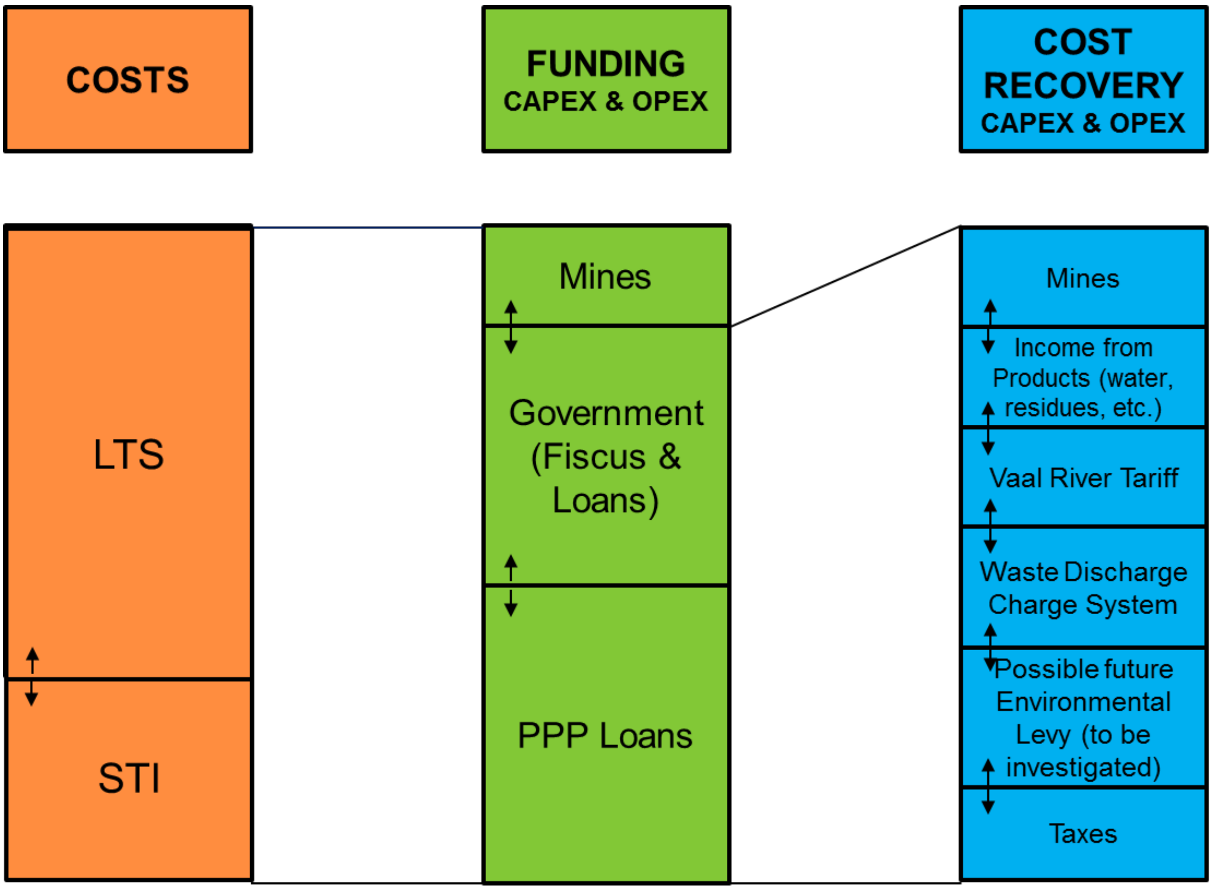


Figure 7.1: Costs, Funding and Cost Recovery

It is recommended that Government take responsibility for arranging the funding of all of the works without any delay to implementation. The recovery of the cost of the works and the funding should proceed as rapidly as possible, but implementation should not be linked to cost recovery whilst the cost recovery strategies are being finalised.

The availability of funding for implementation from the Fiscus, and approval of the degree to which implementation should be funded by loans or private sources need to be discussed by the DWA management with National Treasury (NT). The options are:

- NT provides funding;
- That a Public Entity (TCTA/Rand Water) provides loan funding; and
- The Private Sector provides funding through a DBOMF (PPP) Contract. Each of these sources could be used as the sole source, or used in combination.

Possible sources for the recovery of costs are broadly:

- The polluter;
- The beneficiaries, e.g. water users; and
- The taxpayers.

The mines are effectively providing funding through the provision of land, infrastructure or other assets.

7.2 Capital and Operating Costs

7.2.1 Introduction

The capital and operating costs given below are those for the Reference Project, as determined in this Study (DWA AMD FS 2012, Study Report No. 6: **"Concept Design"**).

In the preceding sections, the projects which are recommended to be implemented are described and the differences between those and the Reference Project for each basin are described.

The cost of the projects recommended for implementation in the Western (Pilot Projects) and Central Basins (reduced cost of sludge disposal) are expected to be less than the cost of the Reference Projects. In the Eastern Basin, it is expected that the implementation costs will be very similar to the Reference Project.

7.2.2 Financial Liabilities from Short-Term Intervention

The estimates of capital expenditure required for the LTS in each basin are based on assumption that the capital cost of the immediate works and the STI, as planned by TCTA, are provided from elsewhere.

The cost estimates for the Reference Project for the LTS include the following, related to the neutralisation works being provided under the STI:

- The cost of the SSF to store both the HDS sludge and the desalination sludge, from the time of commissioning of the LTS. Depending on the arrangements which can be negotiated with ERGO for co-disposal, particularly in the Central Basin, the SSF could be delayed and the cost of co-disposal for the medium-term will be less than has been allowed; and
- The operating costs of the STI from the date of commissioning the LTS in each basin.

7.2.3 Cost of the Long-Term Solution

The costs of the Reference Project for each basin are given in **Table 7.1** and **Table 7.2**.

The average annual costs comprise:

- The annual operating costs for items such as staff, electricity, chemicals, routine maintanance, etc.; and
- The average annual cost for scheduled major overhauls and planned maintenance. This expenditure is expected to occur at about 5 years' intervals with some items only being allowed for every 10 or 15 years.

The details of these costs are contained in the confidential Costing Report (DWA AMD FS 2013: Study Report No. 6.2: "**Concept Design: Costing"**).

Table 7.1: Reference Project's Estimated Capital Costs

Description	Western Basin		Central Basin		Eastern Basin	
	R Million	% of CAPEX	R Million	% of CAPEX	R Million	% of CAPEX
CAPITAL COSTS (CAPEX) – LTS*						
Civil Works (Site works, Balancing Storage, Land)	289	21	341	15	645	22
Treatment (Ion Exchange, Desalination)	438	31	708	31	1 148	39
Residues Management (Brine Disposal, Sludge Disposal and Return Water Management)	634	45	944	41	835	28
Treated Water Delivery	44	3	283	13	337	11
Sub-Total for LTS	**1 410**	100	**2 280**	100	**2 970**	100
Grand Total for LTS	**R6 660 million**					

**Cost base date March 2012*

Table 7.2: Reference Project's estimated Operating and combined lifecycle costs for the LTS and STI

Description	Western Basin		Central Basin		Eastern Basin	
	R Million	% of OPEX	R Million	% of OPEX	R Million	% of OPEX
OPERATING COSTS (OPEX) – STI and LTS*						
Electricity	36	21	40	15	54	17
Chemicals	59	35	122-	47	125	40
Sludge Disposal	36	21	43	17	52	17
Brine Disposal	4	2	9	3	9	3
General	35	21	46	18	70	23
Sub-Total for LTS	**170**	**100**	**260**	**100**	**310**	**100**
Scheduled Major Overhauls	**60**		**70**		**120**	
Average Annual O&M Costs	**230**		**330**		**430**	

**Cost base date March 2012*

7.3 Sources of Funding

7.3.1 Introduction

There are fundamentally two sources of funding; the Revenue Fund or loans from the Private Sector. A mix of these can provide a number of funding models. The sources of funding are:

- Government from the Revenue Fund;
- Private Sector or International Funding Agencies directly to Government;
- Private Sector funding via loans to a Public Entity (State-Owned Entity (SOE)) or a Water Board), with an implicit or explicit Government guarantee; or
- Private Sector funding to a Private Sector Special Purpose Vehicle (SPV) or Service Provider, established to implement a DBOMF (PPP) project.

Where public funds or sector loans to a Government or a Public Entity are used, the payments will be to the Service Provider from the Implementer (DWA or an IA). Where commercial loan funding is sourced by a SPV, then the funding will flow directly from the commercial banks to the SPV.

In the Private Sector funded model, a Government contribution would be from the Implementer to the SPV, in parallel with the funding drawdown from the commercial banks.

7.3.2 Provisions in the Current Medium-Term Expenditure Framework

- The Medium-Term Expenditure Framework (MTEF) allocation provided in the 2013 appropriation bill provides for the the amounts shown below for each MTEF:
  - 2013/14 year :- R 150 million
  - 2014/15 year :- R 150 million
  - 2015/16 year :- R 150 million

The budget for the MTEF period had R 450 million.

7.3.3 Public Sector Funding

Funding from Government from the Revenue Fund usually requires that provision is made in the MTEF budget for the required capital. DWA has funding allocated annually for capital works, which funding is advised to the Department with any associated conditions.

Capital funding provided through the annual budget has to be spent in the year in which it is allocated. While conditions to such expenditure can be stipulated, the procurement method is usually not a consideration. Funding from the annual budget where the Department is the Implementer with an IA, if utilised, does not result in substantial transfer of financial risk which is retained by Government.

Where a SOE or Public Entity is the IA, the budget can be transferred to that entity.

7.3.4 Private Sector Funding

The principle approach is that Government will have to ensure that the funding required for implementation is available and then recover the cost from various parties as timeously and effectively as possible.

If DWA uses an Implementer or procures a DBOMF (PPP) contract and irrespective of the sources of funding, it is envisaged that DWA will be paying the Implementer or the SPV, a unitary fee (R/m^3) to enable them to repay their loans and to cover their operating costs.

Where a public entity is the IA, acting on behalf of Government, they can obtain commercial loans from the Private Sector. Government would have to provide the Implementer with a guaranteed income stream such as a payment per cubic metre of water pumped and treated (a unitary fee). Government would thus be providing an implicit or explicit guarantee. A value for money test would usually show that capital funding sourced through NT is cheaper than commercially raised loans.

Private Sector non-recourse project finance, with the Private Sector shareholders to the SPV investing equity and a commercial bank lending project finance to the SPV does not directly impact the Government balance sheet. The loan is assessed against the credit worthiness of the contracting institution and the security of the revenue flow for the duration of the project. The contract would commit Government to make an agreed payment per cubic metre of water (Unitary Fee) delivered to specifications.

In the case of a national project, a non-recourse project finance contract with other than a National Government Department, could be bankable, but would attract a premium to the financing.

If the SPV collects the revenue from an institution, other than a National Department, the project risk increases. The nature of the revenue stream and parties involved paying the revenue, will affect the project and the cost of loans.

A combination of Private Sector finance, and a Government capital contribution, is a variation that has been used on other projects to reduce the unitary fee while maintaining the rigour brought to the project by commercial lenders. The use of Government capital as a contribution to the project would normally be limited to 50% of the loan or approximately 40 to 45% of the capital required.

Either of the Private Sector funding options can therefore be a model with 100% Private Sector funding or a model where Government makes a substantial, although minority funding contribution.

7.4 Cost Recovery

7.4.1 Introduction

It is envisaged that DWA would wish to recover all or most of the cost of the capital and operating costs of the project from the polluters and the beneficiaries or users, in line with Government and Departmental Policy. However, it may fund some of the costs from its annual operating budget. Government should manage the collection of the income streams from the different sources and ensure that the total income is adequate to repay its obligations from funding the project costs.

The opportunities or mechanisms for cost recovery are:

- Polluters Pay:
  - Cost recovery from mines;
  - Contributions from Mines' Trust Funds;
  - Cost recovery from the Waste Discharge Charge System (WDCS); and
  - Cost recovery from a possible future Environmental Levy or mining tax (to be investigated).
- Beneficiaries and Users Pay:
  - Cost recovery from the Vaal River Tariff (VRT).
- Income from the sale of AMD to Mintails;
- Sale of treated water to Rand Water or possibly directly from users.

The other possible income streams are from the sale of residue products which have a commercial value. These include:

- Iron;
- Uranium; and
- Gypsum.

The suitability of these products for sale and their commercial value depends on the quality produced which is dependent on the treatment process selected and the operation of the process. It is thus recommended that any income from residue products be secured and retained by the DBOM or DBOMF (PPP) contractor, who can then offer a lower unitary fee or operating cost in their tender offer.

7.4.2 Principles for cost allocation between polluters and users

The NWA (36:1998) provides that both the polluter and the water user can be required to contribute to the cost of any remedial action on AMD. The polluter (not necessarily restricted to only the mines) is obliged to contribute due to its liability and the water user can be required to contribute as they receive the benefit of the remedial action which includes postponing the next phase of the Tugela Water Project (TWP). There are no exact formulas for cost sharing but the following could be considered as input into the formulation of a strategy for sharing the cost.

It is useful to compare the current water supply by Rand Water from the Vaal River with water supply to consumers from the treated AMD from the perspective of the water user. It is fair to expect that the Vaal River water users pay for the supply of raw water at Vaal Dam quality plus the cost of pumping and treatment of the water they receive, irrespective of the source. In the current situation users pay the cost of making water available in the Vaal system, at river water quality (*i.e.* the Vaal River Tariff), plus the treatment to drinking water quality, plus pumping and distributing that treated water to the water user. In the case of supplying water from the mine void to water users, the process will normally be as follows:

Acidic water is pumped from the mine void to maintain the water level below the ECL. This water is then neutralised at surface works, then desalinated and distributed to users. Substantial volumes of waste are generated and disposed of in an environmentally safe manner. The components of supplying raw water, treating it to potable standard and pumping from Vaal River elevation to the users can be compared with that of the river water supply from the Vaal River System. The comparison is reflected in the diagram in **Figure 7.2**.

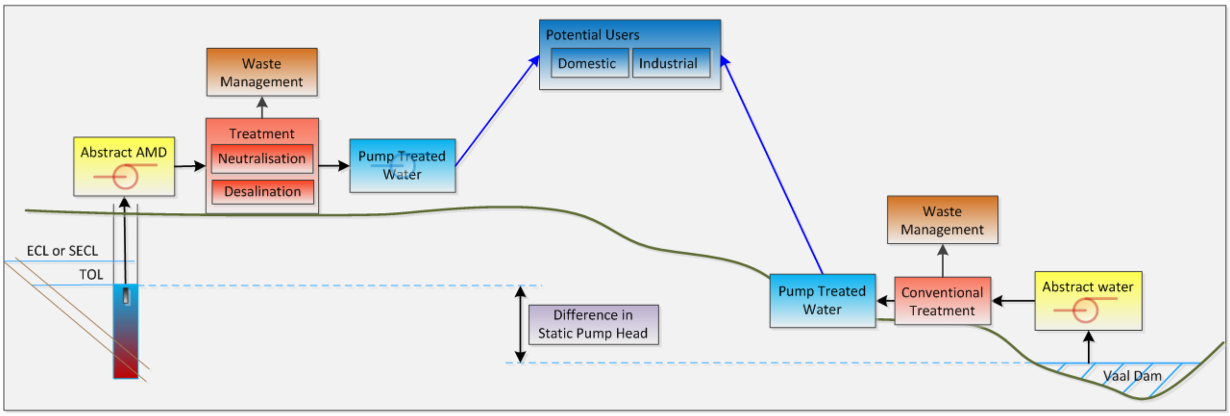


Figure 7.2. Diagram of water supply from mining void compared with water supply from the Vaal River.

Comparing water supply from the Vaal System to the supply from AMD the following observations can be made:

- The abstraction of the AMD is in closer proximity to the user than the raw water from the Vaal System;
- The neutralisation of the AMD does not deliver water to the equivalent quality as raw river water in the Vaal System (as it is more saline);
- Treated AMD water after desalination will deliver water at a quality better than treated "river" water from the Vaal System;
- Pumping the "river" water from Vaal System is more expensive than pumping water from AMD as the Vaal River is at a lower altitude than the TOL and needs shorter supply lines; and
- Waste disposed from AMD is more extensive and expensive compared with that of river water.

The components are compared in the **Table 7.3** where a possible allocation of cost is given.

Table 7.3: Comparison of water supply from Vaal Dam to water supply from AMD

No.	Component	From Vaal	From AMD	Remark	For the cost of
1.	**Pumping***	Pumping from level below 1 488 m amsl and over long distance	Pumping from TOL of 1 450 to 1 500 m amsl to treatment works over short distance	AMD cost saving associated with higher total pumping head	User
2.	**Neutralisation**	Not required	Required	Due to pollution	Polluter
3.	**Treatment to potable water standard**	Normal/ Conventional treatment cost	Desalination needed	River water treatment is cheaper than desalination. Extra cost to polluter	Shared by User and Polluter
4.	**Distribution to user**	May be longer distances	May be available close to user	Cost saving associated with shorter distribution lines	User
5.	**Availability of resource**	Augmentation required	Salts are removed from Vaal System	Benefit to the user	User
6	**Waste disposal**	Limited Sludge	Sludge from HDS and neutralisation and brine	SSF and evaporation ponds to be provided	Major component to the polluter

**Requirements from the Central Basin are used here for illustrative purposes.*

The philosophy is useful to establish principles for cost recovery.

7.4.3 Cost Recovery from Mines

It is clear that certain legal liabilities have been incurred, currently and/or historically by the mining sector, but how to utilise this information and how to apply and implement the law, to offset as much of the capital and operating costs to be incurred by Government, is dependent on a number of considerations. These considerations include the following:

- Certain persons/companies/institutions that may be legally liable may accept this liability and may wish to pro-actively and freely contribute to the solution, e.g. by providing land or land rights or access to land, providing materials, manpower, management responsibility, or funds, etc. This may occur through a negotiated agreement, which may entail practical or pragmatic negotiations or contributions not necessarily based on law; and
- Other persons/companies/institutions that may be legally liable may not, (or not to a reasonabe extent) accept this liability and thus not pro-actively and freely contribute to the solution. In this case, Government may decide to enforce the law.

The decision to enforce the law will have to be assessed and decided on a case-by-case basis.

The recommended approach to recovery of costs from the mining sector is described in the confidential reports on legal liabilities (DWA AMD FS 2013, Confidential Study Report No. 3: **"Legal Considerations for Apportionment of Liabilities"**) and on alternative approaches to apportioning liabilities (DWA AMD FS 2013, Confidential Study Report No. 4: **"Alternative Approaches for Apportioning Liabilities"**). Contributions by the mines and direct recovery of costs from the mines need to be finalised during the negotiations with the mining sector and in accordance to the strategy to be put forward by the Enforcement Task Team.

It is clear that recovering costs from the mining sector is likely to be a time consuming process and quantification of the contributions that will be obtained, is not possible at this stage. It should not be relied on for funding the project and at least initially it is not considered in estimating how the costs might be recovered from other sources.

It is strongly recommended that Government pursue the recovery of costs from the mines as a matter of priority.

7.4.4 Mines Trust Funds

Moneys set aside as provision for rehabilitation purposes can be utilised by the Minister for AMD purposes where holders of new order or old order prospecting or mining rights are liable to pay under certain circumstances.

These funds are not very large and are not envisaged to be a primary source of funding, but should not be ignored.

Recommendations in this regard are contained in DWA AMD FS 2013, Study Report No. 3: **"Legal Considerations for Apportionment of Liabilities"**.

7.4.5 Cost Recovery using the Vaal River Tariff

The VRT was originally introduced to repay the loans raised by South Africa, through the TCTA, to finance Phase I of the Lesotho Highlands Water Project (LHWP). It has since been expanded to recover the cost implementing, operating and maintaining other water resource projects in the Vaal River System. Since the water from the Central and Eastern Basins, and at least a part of the Western Basin, naturally forms part of the resources of the Vaal River System, the VRT can be used to recover the cost of managing AMD. The VRT is invoiced to users and collected by DWA who distribute the income to various "projects", including those undertaken by TCTA. The tariff is calculated by TCTA, based on data provided by or agreed with DWA. The model used for the current tariff calculations has been applied by TCTA, for the following alternative scenarios to illustrate the possible effects of recovering the cost of managing AMD in the Central and Eastern Basins.

- <u>Scenario 1</u> - Recovering the cost of managing the current funding of LHWP Phase I and other Vaal River project costs, and the estimated costs for the proposed LHWP Phase II, with no provision for recovering the cost of managing AMD. This is the baseline scenario.
- <u>Scenario 2</u> - Includes recovering the cost of the TWP, which is the next scheme planned to augment supplies to the Vaal River System.

  In one sub-scenario, Phase I of the TWP would be implemented in 2034. This VRT to recover that cost is an useful indicator of the cost of the next augmentation project.

  If AMD desalination is not implemented and if large water releases are made from the Vaal Dam to dilute the salt load from AMD to acceptable levels, the TWP Phases I and II (i.e. the whole project) would need to be implemented in two phases with Phase I implemented as soon as possible. It is assumed that the earliest the TWP Phase I could be implemented is 2025 and Phase II would follow. The VRT for this option is a useful benchmark.
- <u>Scenario 3</u> - Assumes that the AMD will be treated, using the Reference Projects described above, and various scenarios were analysed for various levels of cost recovery from other sources.

  A number of sub-scenarios for the proportion of the cost of AMD management to be recovered were analysed. Possible sources of income from water sales were considered.

DWA must now decide on how the VRT should be used for cost recovery.

7.4.6 Cost Recovery through Waste Discharge Charge System

The DWA has initiated the WDCS pilot investigations in the Vaal System. The WDCS is a tool that will be used to support existing water quality management initiatives, to promote waste reduction and water conservation. The WDCS has been developed around the polluter pays principle and the use of economic instruments aims to:

- promote the sustainable development and efficient use of water resources;
- promote the internalisation of environmental costs by polluters;
- create financial incentives for dischargers to reduce waste and use water resources in a more optimal way; and
- recover costs associated with mitigating water quality impacts of waste discharge.

The following principles outline the basis of applying the WDCS:

Principle 1: Resource water quality objectives/ Resource quality objectives

Resource Quality Objectives are the basis for the WDCS. The WDCS is focused on reducing discharge load in order to achieve or maintain RWQOs/ RQOs in a catchment. Where RWQOs/ RQOs are being met, the WDCS is not applied. Where RWQOs/ RQOs are exceeded or in threat of being exceeded, the WDCS may be applied as part of water quality management in the catchment.

Principle 2: The WDCS applies to surface water and groundwater resources

The WDCS applies to surface water and groundwater resources where Resource Quality Objectives (RQOs) have been defined and an adequate understanding of the resource supports the implementation of the system.

Principle 3: Catchment scale

The WDCS will be applied to a particular catchment area in which a water quality problem exists. This could be a whole catchment in which a widespread water quality problem occurs or a sub-catchment within a larger water basin.

Principle 4: Downstream/ upstream catchments

Where downstream RWQOs/ RQOs are more stringent than upstream RWQOs/ RQOs, and downstream RWQOs/ RQOs are exceeded or threatened, the WDCS may be applied in the upstream catchment even if the upstream RWQOs/ RQOs are achieved.

Principle 5: Charge based on load

The WDCS will be based on load discharged, the benefits of which are that (1) it avoids dischargers diluting their effluent to achieve cost reduction, (2) the approach does not disproportionately penalise small dischargers with relatively higher effluent concentrations and (3) it is simple to implement. The WDCS does not remove the requirement that effluent must comply with discharge standards.

Principle 6: Constant charge rate

The WDCS is based on a linear relationship between load and charge. In other words, the charge increases by constant increments with an increase in discharge load.

Principle 7: Subtraction of intake

Waste dischargers are liable only for their contribution to the water quality problem.

Principle 8: Minimum load thresholds

Based on an assessment in any given catchment, a minimum discharge load may be identified, below which the charge is waived, thereby simplifying the system and reducing management costs.

The WDCS consists of two charges:

- ***The Waste Discharge Levy*** seeks to change discharge behaviour and is an unrequited payment (in that it does not recover any direct costs and is not related to receiving a particular service). The Waste Discharge Levy is thus an environmental tax, which requires the promulgation of a Money Bill in terms of NT's environmental tax policy.
- ***The Waste Mitigation Charge*** is intended to cover the costs of mitigation measures undertaken in the water resource and will be applied in cases where it is more cost-effective to undertake joint measures for waste discharge mitigation.

There are four categories of mitigation measures:

- Mitigation through removal of load from the resource, including a regional mitigation scheme, infrastructure or project;
- Water resource system management to mitigate water quality problems;
- Mitigation to users for treatment costs downstream; and
- Treatment at source through funding from a consortium of dischargers.

The WDCS is being piloted in the Upper Olifants, Upper Vaal and Upper Crocodile catchments. The Waste Mitigation Charge could potentially support an AMD Environmental Levy; however, discussions on whether the additional levy would penalise those mines/companies that are already taking measures to mitigate the risks of AMD needs to be further discussed in the DWA and at NT.

7.4.7 Cost Recovery through Environmental Levy

The polluter pays principle is taken up in the NEMA (107:1998) principles:

- Section 2 (4) (p), "The costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects must be paid for by those responsible for harming the environment."

Further, the South African Revenue Services (SARS) in South Africa are responsible for the Association of Municipal Electricity Utilities' (AMEU) environmental levies in terms of the Schedules (Tariff Book) to the Customs and Excise Act, 1964 (Act No. 91 of 1964) (CEA (91:1964)), on the following activities listed in **Table 7.4**.

Table 7.4: South African Environmental Levies

Schedule	Description
Schedule No. 1 Part 3	Environmental Levy
Schedule No. 1 Part 3A	Environmental Levy on Plastic Bags
Schedule No. 1 Part 3B	Environmental Levy on Electricity Generated in the Republic
Schedule No. 1 Part 3C	Environmental Levy on Electric Filament Lamps
Schedule No. 1 Part 3D	Environmental Levy on Carbon Dioxide (CO_2) Emissions of Motor Vehicles

A potential disadvantage of levies collected by SARS is that they go into the general revenue fund and cannot easily be ring fenced for use on a particular project. This implies that NT, probably through DWA, would be responsible for financing the treatment of AMD and would run the risk of being under-funded or abandoned in favour of budgets seen as having a higher national priority.

A study into the viability of using an Environmental Levy to recover costs incurred in managing AMD is being carried out by WRC.

7.5 Recommendations

DWA should consider various combinations of the VRT and the WDCS and analyse the options to provide an income stream that can be used to recover the capital costs and operating costs of managing AMD. The results of the studies of the WDCS system and the VRT scenarios will be valuable inputs to the analysis which should identify any difficulties. The relevant forums on the Vaal River should be engaged in the process at the earliest appropriate time.

8 IMPLEMENTATION ACTIVITIES

The activities listed below are considered to be critical for the successful implementation of AMD management actions as recommended by this study.

8.1 Environmental Impact Assessment

8.1.1 The Environmental Impact Assessment for the Short-Term Intervention

The TCTA, as part of their responsibilities for implementing the STI, started the required EIA process and, through their Professional Service Provider (PSP) contract with BKS (now AECOM), engaged Digby Wells and Associates (Pty) Ltd as EIA practitioner, to carry out an EIA for the STI in terms of Section 24L of the NEMA (107:1998) EIA regulations.

On 27 November 2012, DWA applied for an exemption to the Department of Environment Affairs (DEA), in terms of Section 24M of the NEMA (107:1998) and for authorisation to proceed with construction of the STI. At that time, the status of the EIA was as follows:

- Registration: Complete
- Scoping: Complete: Final Scoping Report was not submitted to DEA
- Specialist Studies: In process, but since stopped

Since then, the Specialist Studies have been put on hold.

8.1.2 The Exemption granted to DWA for the Short-Term Intervention

On 7 January 2013, the DEA granted the DWA exemption from the NEMA 2010 EIA regulations and authorisation in terms of NEMA and the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) (NEM:WA (59:2008)) for the IS referred to elsewhere as the "Immediate Works" and STI. The exemption is included as **Appendix B**.

The authorisation contains general, as well as specific conditions relating to:

- Site security and access control;
- Permissible waste;
- Construction and commissioning of activities;
- Environmental auditing and reporting;
- Reporting of incidents; and
- General operation and impact management of waste management activities.

The authorisation makes no link to the LTS, and it is therefore assumed that the activities and infrastructure of the IS and STI do not require further authorisation or EIA.

However there is a public expectation that the EIA for the LTS will consider the STI works and that environmental management plans will be developed for all the activities. It is recommended that all the STI and LTS activities are considered, taking account of the EIA work already done for the STI.

8.1.3 The Environmental Impact Assessment for Long-Term Solution

a) Scope

The LTS in the Central and Eastern Basins will comprise existing activities (the STI), which are already authorised and new activities which are unique to the LTS. Authorisation will only need to be sought for new activities. The authorisation should ideally follow an Integrated Regulatory Process (IRP) where time and cost savings are achieved and stakeholder fatigue prevented.

In the Western Basin, the PTPs to be implemented in the medium-term for the LTS will utilise either the activities of the Immediate Works/IS or the Mogale Gold/ Mintails TWT gold processing plant or a combination of both. The IS are already authorised and the necessary approvals, authorisations and licenses for the Mogale Gold plant are their responsibility. However, it is important that, if the LTS is to link to the Mogale Gold plant, DWA ensures that it is compliant with all the applicable legislation to avoid any adverse public perceptions.

The new activities will include all desalinisation process components and residue management and disposal facilities, as described in Chapters 5, 6 and 7, of the DWA AMD FS 2013, Study Report No. 6: "**Concept Design**". New activities will also be deemed to be any significant changes to the original STI project description in all three basins for which authorisation was granted. The main activities envisaged in each basin are shown in **Table 8.1**.

Table 8.1: Activities for the Implementation of the LTS, listed in terms of NEMA (107:1998)

	Description		
Activity	Western Basin	Central Basin	Eastern Basin
AMD Treatment Plant (Ion Exchange, Desalination Plant, Balancing Storage Pipework)		46 Mℓ/d Capacity	80 Mℓ/d Capacity
PTPs	4 or 5 PTPs of 5-8 Mℓ/d each		
Brine Disposal Facility	Lined Evaporation Pond - Capacity 170 Mℓ	Lined Evaporation Pond - Capacity 280 Mℓ	Lined Evaporation Pond - Capacity 270 Mℓ
Sludge Disposal Facility	Downstream raised waste rock impoundment walls. Lined – 788 x 638 x 14 m high	Downstream raised waste rock impoundment walls. Lined – 1088 x 638 x 14 m high	Downstream raised waste rock impoundment walls. Lined – 1 240 x 690 x 10 m high
Return Water Pipeline	630 mm HDPE Pipe – 6.8 km	600 mm Steel Pipe – 17.8 km	630 mm HDPE Pipe – 5.0 km
End User Pipeline	600 mm dia Steel Pipe – 6.6 km long	800 mm dia Steel Pipe - 21.1 km long 700 mm dia Steel Pipe – 14.7 km long	1 300 mm dia Steel Pipe – 10.6 km long

Table 8.2: Activities for Implementation of the LTS which are not listed in terms of NEMA (107:1998)

	Description		
Activity	Western Basin	Central Basin	Eastern Basin
Brine Disposal Pipeline	On Treatment Plant Site	75 mm dia HDPE Pipe, 2.2 km	75 mm dia HDPE Pipe, 2.2 km Crosses the Blesbokspruit on pipe bridges
Sludge Pipeline	180 mm HDPE Pipe – 6.8 km Above ground installations	180 mm HDPE Pipe – 17.8 km Above ground Installation	180mm HDPE Pipe – 5.0 km Above ground Installation Crosses the Blesbokspruit on a pipe bridge

When considering the implications of using the existing STI infrastructure and the work done in this study, it may be beneficial to request exemption from certain parts of the process, such as the consideration of a broad scope of design, location and treatment alternatives. In the LTS Study, many alternatives have already been considered.

b) Timing

It is expected that the total process from initiation to approval will take 18-24 months, excluding the appeals process.

c) Process

The EIA time requirements are shown in **Table 8.3**. Some activities may commence while others are being completed.

Table 8.3: Summary of possible LLROP Approach

Activity	Duration
Register Project	3 Months
Scoping Study	8 Months
EIA Phase	15 Months

It is recommended that the LTS for all three basins be registered as individual projects with the DEA. In this manner, localised challenges in each basin will not affect the other basins' processing. If a "class application" (i.e. all three basins in one application) is followed, process timing can become a challenge in that one phase (such as the Scoping Phase) cannot be completed due to a localised project challenge in one of the basins.

d) Implementation of the EIA

The EIA will need to be undertaken by an independent environmental practitioner as a PSP. DWA could appoint and supervise the EIA practitioner themselves or issue a directive to TCTA to undertake the EIA.

It is recommended that TCTA be directed to carry out the EIA, on behalf of DWA and that the same EIA practitioner (Digby Wells and Associates (Pty) Ltd) who TCTA appointed for the STI should also be appointed to undertake the EIA for the LTS.

The advantages of this approach are:

- The TCTA can probably extend the existing contract with Digby Wells without a new procurement process;
- TCTA and Digby Wells are familiar with:
  - The issues surrounding AMD and the solutions for managing AMD;
  - The stakeholders in all three basins and their concerns; and
  - The responses that have already been given to stakeholdets during the Scoping Phase for the STI.

Stakeholder confusion and stakeholder fatique will thus be minimised.

In addition, the Scoping Study for the LTS will identify many issues in common with those from the STI, as well as new issues. It is also probable that there will be many common elements in the Specialist Studies, although some additional studies are anticipated.

It will thus be cost effective if the same PSP and management team carry out the EIA for the LTS, as was carrying out the EIA for the STI.

The process is also likely to take less time to complete, than if a new team undertakes the EIA, although the statutory time frames for comment, etc. will be the same.

Details of the treated water distribution pump stations and pipe network are not known since it is recommended that the planning of the distribution system will be the responsibility of the recipient of the treated water. It is anticipated that this will be Rand Water and all the required activities, including the EIA, should be their responsibility.

e) Land and Land Rights Options and Access

During implementation, Government should take the responsibility to address all arrangements related to land and land rights (such as mineral rights, servitudes, etc.), ownership arrangements, etc. which can be described as the Land and Land Rights Access Process (LLRAP).

The land acquisition overlaps with that of the STI and needs to be managed as an integrated process. It is recommended that a team be established jointly between DWA and TCTA to oversee and manage the land acquisition matters of the STI and LTS. This would be a matter that will need to be coordinated by the Special Projects Unit (SPU). The clarity on the access to land for the supply of water to users is a key aspect of the required NT process to obtain TA 1 approval. It thus needs the necessary urgent attention.

Sufficient information pertaining to land and land right ownership should be made available to the tenderers as part of the LTS Request for Proposals (RfP), to give them confidence that there will not be any delays.

The Scope of Work (SoW) for a Land and Land Rights Organisational Process (LLROP) team was provided to DWA and detailed investigations must commence.

A due diligence exercise on the availability of and access to land was carried out as part of this Study and the results are presented in the report on **"Institutional Procurement and Financing Options"** (DWA AMD FS 2013, Study Report No. 7). This exercise was based on the information on land ownership and servitudes that could be gathered within the Scope of this Study and from TCTA and their PSP for the implementation of the STI.

The LLROP will entail engagement with all land and land right owners, including mines, to finalise conditions for access to and/or utilisation of their land or obtaining land rights for purposes of implementing the LTS.

The methodology which is suggested for the task team, which DWA should establish to implement the LLROP, is given in **Table 8.4**.

Table 8.4: Summary of LLROP Methodology

Task	Indicative Time Frame
• Finalise scope, time, cost and implications for the process.	Two weeks
• Make arrangements for implementation, including a decision on who will do the implementation (implementing agent/ DWA section), process management and overview, support required, etc. • Reporting lines.	Two weeks
• Appoint / mandate implementing agent/DWA section.	Two weeks
• Finalise Project Plan and arrangements, including scope, time costs, contingencies, etc.	
• Finalise strategies for engagement.	Two weeks
• Implementation, including surveys, preparation of diagrams, valuations, obtaining way leaves, etc. and negotiations with land owners.	Four-eight months

Task	Indicative Time Frame
• Reporting.	Three months
• Conclude owner and /or mine agreements or obtaining land / access to land.	
• Registration of land	Four months

8.1.4 Important Considerations

The following need consideration and need to form an integrated part of the process to obtain access to the land.

a) General

- The approach and time frames are dependent on the number of properties on which access is required;
- Expropriation (ideally willingly) will possibly be required in certain instances;
- The formal process of engagement with landowners should start as soon as possible;
- TCTA has been ensuring the availability of land and access to land for the STI. The LTS treatment works and associated infrastructure are adjacent to the STI sites and some land owners will be the same. It is recommended that TCTA be directed to manage the LLRAP for at least the sites required for the LTS treatment facilities; and
- The locations of the distribution pipe system to deliver water from the treatment works to the end users is unknown, since the details of the probable users are only known to Rand Water. It is recommended that, in any agreement with Rand Water to purchase the treated AMD, they be made responsible for all aspects of the distribution downstream of the treatment works, including land.

b) Engagement with Mines

- This process should be owned and managed by an inter-departmental team;
- There must be coordination with the task team addressing the liabilities of mines since land could be offered by the mines as a contribution to offset potential liabilities; and
- Strategy for owner engagement and engagement with mines to be developed as part of the initial planning – will require DWA and Department of Mineral Resources (DMR) Legal Services (and possibly NT) support and inputs.

c) Prerequisites

Relevant land portions to be addressed have been identified and contained in the DWA AMD FS 2013, Study Report No. 6: **"Concept Design".**

The steps for the Feasibility Study are substantially complete and adequate information is available to proceed to the (Design) stage where the details can be finalised and owners can be engaged.

The routes for delivery pipelines for treated water must be determined in consultation with Rand Water who must obtain the necessary servitudes for their pipelines.

8.2 Procurement

8.2.1 Introduction

The procurement process will have the objective of securing the services of a Service Provider which has the competency and capability of providing a fully integrated treatment facility and service for AMD under a DBOM or DBOMF (PPP) contract. The design of the LTS, construction of the designed solution, supply of technology and the integration or replacement of the STI will be required so that the operation provides a sustainable treatment and waste management solution for AMD in the medium-term. The Service Provider will also have to be able to operate the infrastructure it provided under the LTS, as well as that provided under the STI and integrated into the LTS. The medium-term in this instance is defined as a period exceeding 10 years, but with a long-term horizon stretching over decades.

The STI will have been constructed in terms of a directive issued to the TCTA by the Minister of Water and Environment Affairs. Infrastructure will have been constructed on land secured by TCTA. Some land to be utilised by the LTS for the treatment works and may have been acquired by TCTA as part of the STI as described above. The balance of the land is identified and can be acquired through following known processes. While the STI will have been designed, using robust technology and latest accepted design criteria, it is possible that the selected LTS Service Provider in a basin would have a technical solution, which does not, for whatever reason, accommodate the STI technical solution. The procurement documentation will require of the successful bidder that any portion of the STI, that is surplus to requirements, will be mothballed for future re-commissioning.

The procurement will be for a DBOM contract, which will be required to integrate and operate the LTS and the STI or possibly have a LTS technology that takes over the role of the STI. The decision as to the source of capital funding has yet to be decided and if private sector funding is used, then it is possible that the project would be a DBOMF (PPP). The recommended institutional structure for a DBOM contract is shown in **Figure 8.1.**

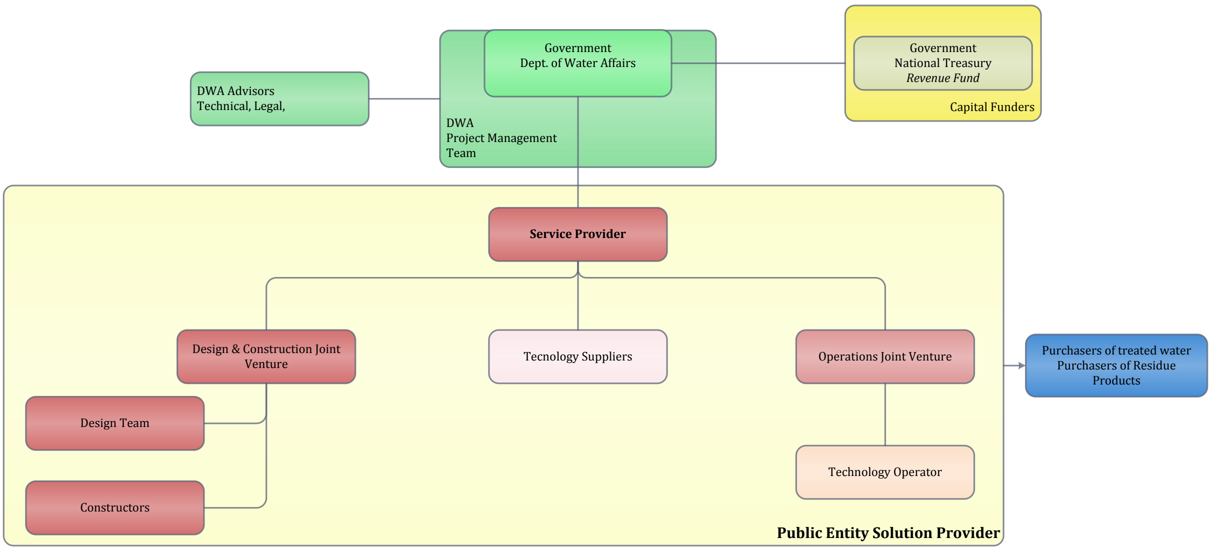


Figure 8.1: Proposed Institutional Structure for Implementation of DBOM Contract by DWA

8.2.2 Procurement Process

The tender documentation will need to be flexible enough to protect possible Intellectual Property of tenderers, and provide for variations of DBOM.

A two stage procurement process, Request for Qualifications (RfQ) to select a short list of pre-qualified bidders, followed by a RfP will be used. The DWA or IA will appoint a PSP as Transaction Advisor which will be a multi-disciplinary team, to assist the Department in the procurement and negotiations process. The Transaction Advisor will be procured prior to the commencement of the procurement process. Drafting, assessing and managing the two stage process will enable DWA to only issue RfP documents to bidders that have been assessed as competent to submit proposals. The two-stage procurement process will limit the number of proposals received, reducing the wasted effort by unsuccessful bidders and the time required for adjudication. The steps in the RfQ stage comprise:

- Drafting of the RfQ documentation, including the evaluation criteria;
- Establish evaluation criteria and evaluation process;
- Document approval – Treasury Approval IIa RfQ (TA II(a) RfQ);
- Establishment of the assessment team and Evaluation Committee;
- Issuing and response period;
- Bidder briefing;
- Receipt of RfQ responses;
- Drafting of the RfQ evaluation manual;
- Technical assessment;
- Evaluation and recommendation of the pre-qualified bidders; and
- Announcement of the pre qualified shortlist.

The RfQ stage will be followed by a RfP stage where the shortlisted bidders will be invited to respond to an output-based RfP. The steps of the RfP stage include:

- Consultation of the pre-qualified shortlist;
- Drafting of the RfP documentation, including the evaluation criteria;
- Establish evaluation criteria and evaluation process;
- Document approval: Treasury Approval IIa RfP (TA II(a) RfP);
- Establishment of the assessment team and Evaluation Committee;
- Issuing and response period;
- Bidder Briefing for shortlisted bidders;
- Individual bidder clarification meetings;
- Receipt of RfP responses;
- Drafting of the RfQ evaluation manual;
- Assessments:
- Technical assessment;
- Financial assessment;
- Legal assessment; and
- Black Economic Empowerment (BEE) assessment.
- Evaluation and rcommendation of the preferred bidder and reserve bidder;
- Preferred Bidder appointment agreed;
- Report and approval (TA II(b));
- Preferred Bidder and Reserve Bidder appointments notified;
- Negotiations;
- Negotiations conclusion;
- Report and approval: Treasury Approval IIIb (TA IIIb); and
- Contract Signature and Financial closure.

The RfQ documentation will comprise:

- Request document with scope description and invitation to qualify;
- Bidding conditions; and
- Response requirements.

The RfP documentation for a DBOM or DBOMF PPP will be "output" based as opposed to "input" based and will identify the outcomes that DWA or its appointed IA wish to achieve. The RfP documentation will comprise the following:

- Request document with the scope of the project;
- Bidding conditions;
- Response requirements;

- Draft Contract/Agreement;
- Schedules to the Agreement;
- Site description;
- STI infrastructure description;
- STI condition and operating assessment;
- Output Specifications;
- Service Level (performance) Specifications;
- Payment Mechanism and deductions regime; and
- Evaluation criteria.

The Procurement Phase includes the negotiations stage for which a negotiating strategy and list of negotiation issues will be developed at the time that the Preferred Bidder is appointed.

In both the RfQ and RfP documents that are issued, there will be evaluation criteria so that the bidders will clearly understand the criteria to be used in evaluating their submissions. Each of the procurement documents issued will also note the evaluation process to be used and the composition of the Evaluation Committee with the positions of the people who will evaluate the submissions and decide on the outcome of the submissions made.

8.2.3 Evaluation

The evaluation process for both stages will utilise a Technical Assessment Committee, comprising members of DWA, if they are not the IA, the IA or Contract Management organisation and the Transaction Advisors. The Assessment Committee will comprise five sub-groups:

i. Project Management team – a small team responsible for governance and the administration of the assessment and evaluation process.
ii. Technical team – an assessment team responsible for assessing the technical, integration management and methodology merits of the submission.
iii. Financial team – an assessment team who will assess the submission against the financial requirements of the request documents.
iv. Legal team – an assessment team that in the RfQ stage will review the legal structure and associated aspects of the RfQ response submitted, but for the RfP, response assessment will review in detail the mark-ups to the issued draft agreement documentation. This assessment critically assesses the risk transfer that has been achieved in the submission.
v. BEE team – an assessment team that will assess the BEE submission and its responsiveness to the issued documents.

The Project Management team will need to collate the team reports into a single assessments report that will be submitted to the Evaluation Committee for their consideration and recommendation.

The Evaluation Committee, comprising senior staff from the Implementer, the Department if not the Implementer and often NT and other stakeholders as required, will evaluate the bids submitted based on the assessment provided by the Assessment Committee and their own individually reading as necessary of the bidder documentation provided.

The Evaluation Committee will base their evaluation of the Assessment Report and bidder submissions deliberate and decide on a recommendation to be made. The recommendation arising from the RfQ process will be in respect of pre-qualifying a shortlist of bidders to whom RfP documents will be issued.

The objective for the evaluation of the RfQ submissions will be to achieve a shortlist of approximately three pre-qualified bidders who, in the opinion of the Evaluation Committee, will submit comprehensive and competitive bids that will meet the requirements of the documentation to be issued.

The objective of the RfP evaluation is to recommend the appointment of a preferred and reserve bidder, both of whom are in the opinion of the Evaluation Committee, capable of negotiating to closure a deal that will meet the requirements of the project, a deal that is affordable, provides value for money and has appropriate and substantial risk transfer from Government to the Private Sector.

Based on the evaluation criteria in the RfQ and RfP respectively, there will be an evaluation manual which will be for use by the technical assessment and the Evaluation Committees. The evaluation manual will provide guidance as to the mechanism and procedures to be used in the assessment and evaluation of the bids submitted.

The manual for both the RfQ and the RfP stages will identify:

- The composition, role and responsibility of the Assessment and Evaluation Committees;
- The process for assessment and evaluation;
- The assessment and evaluation procedures and the detail as to how bids are to be assessed by the technical, legal, financial and BEE teams. The Evaluation manual will detail:
  - The venue for the assessment and evaluation and the security and governance protocols;
  - The protocols for the receipt, compliance assessment, and storage of bids received;
  - The protocols for the issuing of documents and their management during assessment and evaluation;
  - The scoring mechanism and possible scores, weightings by required activity and the required commentary; and
  - The manual will guide the Evaluation Committee on the mechanism for announcing either the shortlisted bidders from the RfQ process or the preferred and reserve bidders from the RfP process.

8.2.4 Responsibilities

The DWA or its appointed IA will be responsible for implementing the Procurement Phase through to the signing of a contract and the release of funds for execution of the works.

The Department will be the Institution that will be accountable for procurement, but the execution of the procurement activities could be carried out by the Department or an appointed IA.

8.2.5 Timing

On completion of the Feasibility Study, approval by the Department and inclusion of the decisions by DWA on who will be responsible for land acquisition and procurement, as well as the proposed funding strategies, the Department will submit the Feasibility Report (DWA AMD FS 2013, Study Report No. 10) and all the supporting reports, to NT to obtain from them a Treasury Approval 1 (TA 1).

On obtaining TA:1, the Department may proceed with the Procurement Phase of the project which generally commences with the appointment of a Transaction Advisor. The procurement process that will be required to achieve contract signature is given in Chapter 10, but summarised here for ease of reference.

These timings are based on approvals being expedited timeously and not delayed.

- **Appointment of Transaction Advisor – estimated time (5 months):**
  - Draft ToR for Transaction Advisor (1 month)
  - Approval of TA ToR and procurement documents (1 month)
  - Response period for Transaction Advisor (1 month)
  - Evaluation of responses and approval (1.5 months)
  - Appointment of Transaction Advisor (2 week)
- **RfQ - (9 Months):**
  - Drafting (1 month)
  - Document approval (TA II(a) (RfQ) (1 month)
  - Issuing and response period (2 month)
  - Receipt
  - Evaluation criteria
  - Evaluation process (1 month)
  - Technical assessment (2 weeks)
  - Evaluation Committee (2 weeks)
  - Pre-qualified shortlist
- **RfP - (14 Months):**
  - Drafting (Started with the RfQ process) (5 months)

        - Response requirements;
        - Draft Contract/Agreement;
        - Schedules to the Agreement;
        - Site description;
        - STI infrastructure description;
        - STI condition and operating assessment;
        - Output Specifications;
        - Service Level (performance) Specifications;
        - Payment mechanism and deductions regime; and
        - Evaluation criteria.
    - RfP Approval (1 Month)
    - Issue of the RfP and response period, briefing session and clarification sessions; (6 months)
    - RfP Assessment and evaluation manual;
    - RfP assessment and evaluation; (1.5 months)
    - Preferred Bidder approval and appointment (2 weeks)
- **Negotiations - (5 Months)**
- **Report and approval: TA III - (1 Month)**
- **Signature of contract between DWA (or their IA) and the Service Provider.**

The term "Service Provider" is used as the generic term for the SPV or contracting consortium that will design, build operate and maintain and possibly finance the works.

The Process that has been shown above indicates the NT approvals required in terms of Regulation 16 of the PFMA (1:1999) for a PPP. It is likely that in the case of a DBOM funded from the Revenue Fund, that these formal approvals might not be required from NT, but would probably be required from the accountable DWA official.

8.3 Financial Control and Reporting

DWA has a number of reporting requirements that have to be complied with. The primary legislation requiring compliance where water assets are involved will be the NWA (36:1998), PFMA (1:1999), and the Government Immovable Asset Management Act, 2007 (Act No. 19 of 2007 (GIAMA 19:2007). DWA will have to report annually on the assets involved and budget for their operation, maintenance, refurbishment and replacement in the Medium-Term Expenditure Framework (MTEF).

The Service Provider, in addition to meeting its own corporate and legislative reporting obligations, will have to assist the DWA and IA (if appointed) in meeting their legislated and institutional reporting requirements. This responsibility will involve timeous reporting to the

Institution on various aspects of the operation, the capturing and management of data and the delivery of reports and data to the Implementer in a format that the Institutions can use.

If private sector funding is involved, then the lenders will appoint a Lender's Technical Advisor (LTA) who will be responsible for reviewing the major maintenance performance and major maintenance plan of the Service Provider. The report that this advisor creates is solely for the use of the lead commercial lender and those to whom the lead commercial lender distributes the report.

On the assumption that NT will at least initially, be making an annual operational contribution to the project to cover the shortfall between the revenue collected for the sale of the treated water and the cost of treatment and repayment of capital funding, NT will require, as part of the annual budgeting process, to understand the expenditure forecasts for the upcoming MTEF period and for the remainder of the contract and possibly even for a determined period thereafter.

The Project will have to provide for and meet budget requirement for payment of the milestone payments during construction or the agreed escalated unitary fee less the revenue forecast to be received for the treated water. The revenue for the treated water will be collected by the DWA in the Revenue Account from the recipients of the treated water and ring fenced for use to part fund the unitary fee. The unitary fee will escalate at Consumer Price Index (CPI) for the duration of the contract.

8.4 Complementary Activities

In addition to the main activities required for implementation of the LTS, significant complementary activities are recommended and outlined below. More details are provided in subsequent chapters.

8.4.1 Communications

Effective communications with the key stakeholders during the Feasibility Study has done much to improve Public Confidence in Government's management of the AMD on the Witwatersrand. It is critical that effective communications to the key stakeholders and the public are continued and expanded during the Implementation Phase and then during the Operating Phase. The proposals for an on-going communication strategy are described in Chapter 16.

In addition to the communications recommended in Chapter 16, the following formal communications are expected from the Service Provider during implementation:

- Annual report;
- Annual immovable asset plan in terms of GIAMA (19:2007);
- Monthly report to DWA from the IA, if appointed;
- Reports to Stakeholders of the Service Provider and IA; and
- Annual newsletter.

8.4.2 Hydrogeological Monitoring

Intensive monitoring is critical for the on-going effective management of AMD. The monitoring of the re-watering process of the basins is a long-term commitment and requires Inter-Governmental collaboration, good coordination and management, together with support from mining and other private partners.

Near-real time hydrological and hydrogeological data is a vital and on-going management of monitoring, requiring a controlling body like the WITS AMD Hydrological Monitoring Committee (HMC). It is currently responsible for hydrological monitoring in the three basins. It consists of officials from the DMR (including the Council for Geoscience (CGS)), DWA (including the TCTA), DST (including the CSIR) and Local Authorities (Mogale City Local Municipality).

The effective management of the three mine basins requires careful assessment of all the available hydrological and hydrogeological monitoring data. This can only be achieved by sustaining and expanding the HMC's program and dedicating resources to support integration between water resources managers and well-maintained databases.

The current monitoring programme and network is discussed in Chapter 15, and recommendations have been made with regards to additional monitoring. Evaluation of the Effectiveness, Costs and Benefits of Implementation.

The STI and LTS are being implemented to achieve the objectives of:

- Protecting the ECLs and SECLs; and
- Limiting the impact of the solutions on the environment.

There are a number of unknowns that affect the implementation, including:

- Whether the ECL/SECLs can be raised, saving costs, while still protecting the environment and socio-economic assets or whether they must be lowered to achieve the objective;
- How the water quality of the water abstracted from the void will change with time;
- How the water level in the void will vary across each basin; and
- The volume of water that will have to be pumped to maintain the TOLs and whether the proposed TOLs are far enough below the ECL/SECL to protect these levels.

Substantial CAPEX and OPEX will be incurred in the implementation and operation of the STI and LTS. The operational information from the STI and LTS infrastructure must be assessed and evaluated in a holistic manner with the objective of making regular recommendations for refined operating procedures or monitoring. In parallel with a very significant hydrological and hydrogeological monitoring programme, as described in Chapter 15, significant measures to reduce ingress and sources of pollution, as described in Chapter 17, will be implemented.

Each of these three initiatives will produce significant sets of monitoring and cost data. To obtain a better understanding of the mine voids, their water quality, connectivity, sources of ingress, effectiveness of pumping and the cost benefits of the expenditure, it is essential that the combined data sets are assessed and evaluated by a single multi-disciplinary team. The team must ensure that resources are assigned to set up the systems required and carry out the assessment and evaluations for at least the next 5 years to allow time for the effects of the LTS to be evaluated. They should formulate proposals for revised operating plans, as well as for new initiatives and plans for the longer term cost effective and environmentally sustainable management of AMD in the Witwatersrand. The lessons for other areas of the country should also be identified. The team should be part of, or work very closely with, the team charged with the detailed planning of the LTS and the operation of the STI and LTS.

The study results will inform the on-going DWA initiatives in the Vaal and Crocodile (West) River Systems.

9 ORGANISATIONAL STRUCTURE FOR IMPLEMENTATION

9.1 Introduction

The DWA have overall responsibility for implementation of the management of AMD, as agreed by the IMC. They report directly to the Inter-Ministerial Committee (IMC) and also to the Intra-Governmental Task Team (IGTT). They will need to establish formal agreements with the other public and private entities who will need to work together to achieve effective implementation.

In the Central and Eastern Basins, the detailed organisational structure must still be decided by DWA and the details will vary according to the type of contract which is to be used, DBOM or DBOMF (PPP). This has been discussed in previous sections, but does not affect the broader structure discussed in this chapter.

In the Western Basin, the detailed organisational structure must be appropriate for the implementation of the PTPs. Although the details of the organisational structure for managing the contracts will be different from the other basins, the overall principles do not change.

9.2 Western Basin

The organisational structure needs to be such as to ensure that research objectives of testing and if possible, proving, as yet unproven technologies in PTPs are achieved.

The WRC has indicated that they could take the lead, or a leading role and a Concept Note on possible arrangements is given in **Appendix A**. They would work closely with DWA, the DST and their SOEs. DWA should engage with WRC and DST to establish the detailed structure and responsibilities.

A provisional organisational structure is given in **Figure 9.1**.

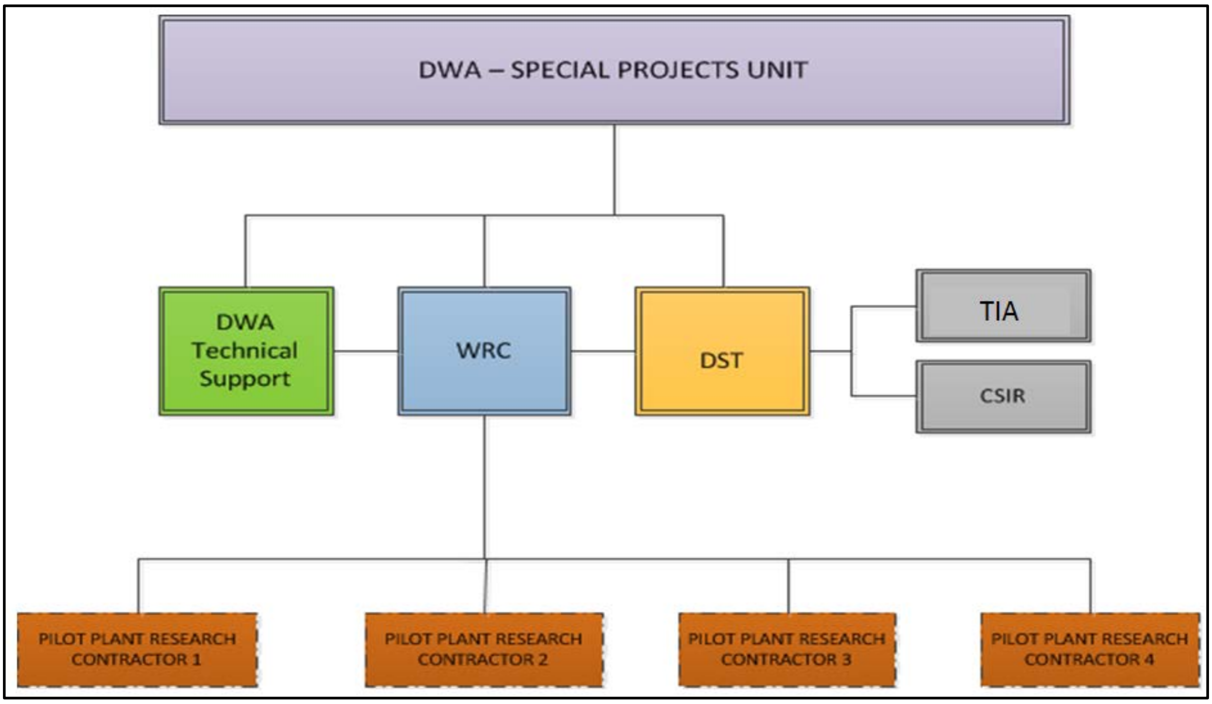


Figure 9.1: Provisional Organisational Structure for Implementing PTPs in the Western Basin

9.3 Central and Eastern Basins

If they do not utilise TCTA or Rand Water in either role, they would need to procure the resources they require from the Private Sector by appointing a PSP and the structure is shown in **Figure 9.2**.

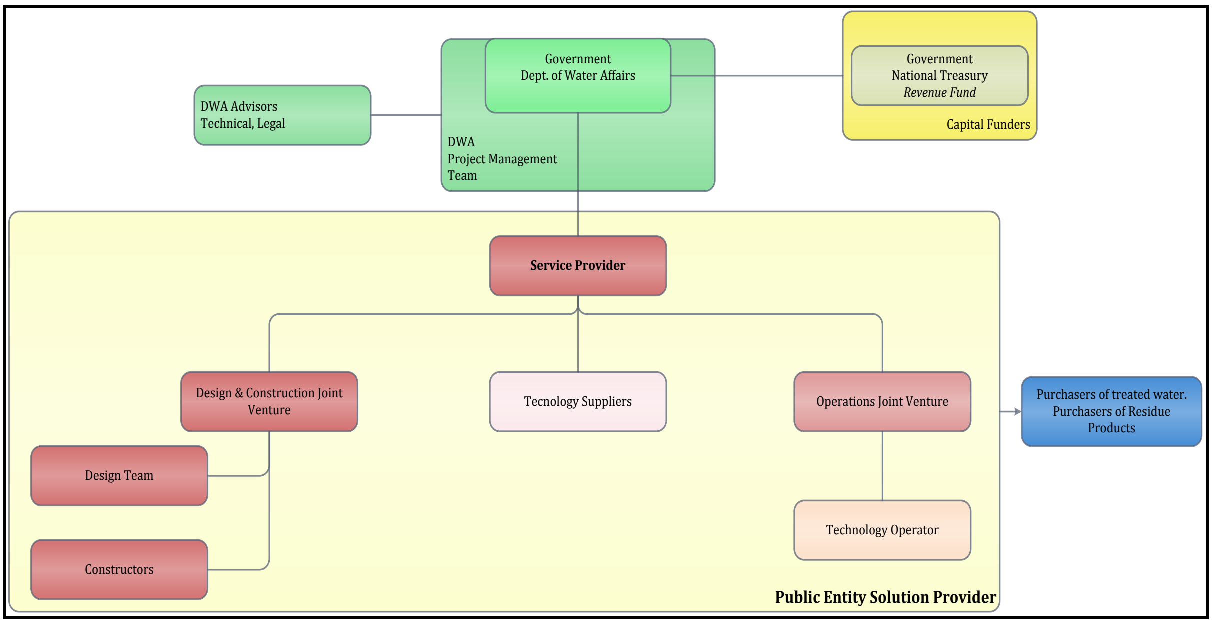


Figure 9.2: DBOM with the Department as Implementing Agent

The basic organisations structure, when DWA utilise a Public Entity as an IA, is shown in **Figure 9.3**. Irrespective of the structure selected by DWA, all the organisations involved will need to strengthen their in-house capacity and appoint PSPs to assist in various roles.

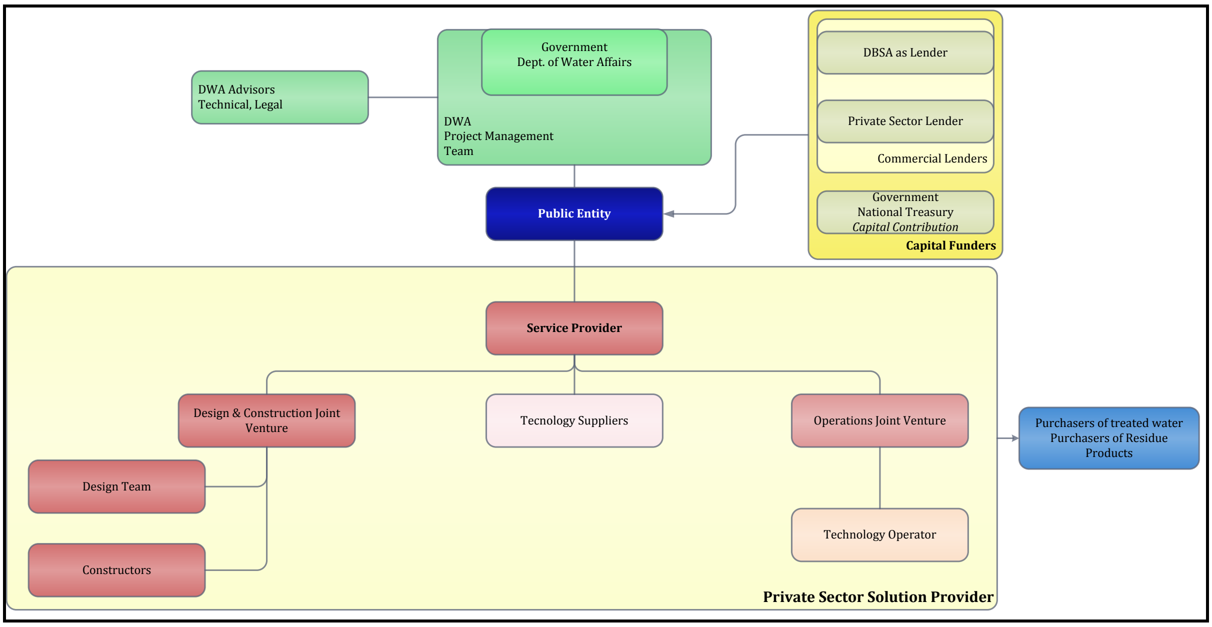


Figure 9.3: DBOM with a Public Entity as Implementing Agent

The basic structure when DWA uses a Public Entity as a Contract Management team is shown in **Figure 9.4**.

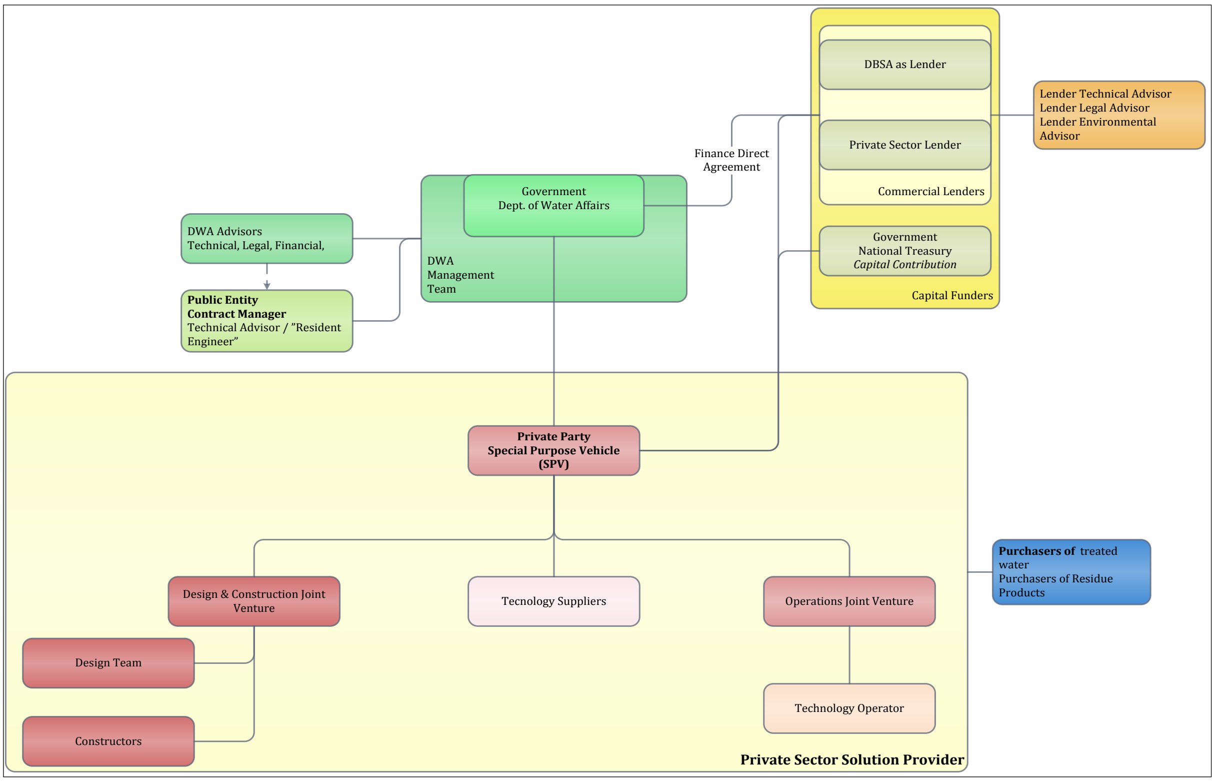


Figure 9.4: DBOMF (PPP)

9.4 Institutional Mandates and Capacity

9.4.1 Department of Water Affairs

In terms of the NWA (36:1998) the Department is the custodian of the water resources of the country. As such, it has the authority and responsibility over the sustainable use and protection of the water resources.

The Minister must ensure that water is inter alia protected, used, controlled in a sustainable manner, while upholding and promoting environmental values.

The Department through its National Water Resource Infrastructure Branch (NWRIB) is responsible for the establishment, as well as O&M of the national water resource infrastructure. The AMD works will be such infrastructure.

DWA administers the VRT, which includes:

- Selling the tariff;
- Invoicing users;
- Collecting the revenue; and
- Distributing funds to various accounts or agencies, which are due to receive funding.

The Regional Offices of DWA used to perform both a regulatory function, as well as the O&M of Government Water Works (GWW). This function was lately separated and the operation of GWW is now the responsibility of NWRIB, with the regulatory function being retained by the Regional Office.

The capacity of DWA's Head Office and Regional Offices is insufficient to fulfil its responsibilities, and extensive use is made of TCTA and PSPs to support it.

The implementation of a DBOM or a DBOMF (PPP) project will be a first for DWA and will require skills that are not currently available in DWA.

9.4.2 Department of Mineral Resources

DMR performs a regulatory role and need to be involved in the implementation of the AMD Works in order to ensure that the required regulatory conditions are met.

The CGS who are carrying out various relevant studies, are responsible to DMR.

9.4.3 Department of Environment Affairs

The DEA has the mandate to ensure that both the NEMA (107:1998) and the NEM:WA (59:2008) are adhered to.

They retain direct responsibility for projects implemented by National Government Departments.

9.4.4 TCTA

TCTA were established in 1996 in terms of the treaty to implement the Phase I of the LHWP. They were responsible for implementing the infrastructure in South Africa and procure finance for the entire water transfer infrastructure on behalf of South Africa. Subsequently, DWA have utilised the TCTA to manage the establishment of large infrastructure. The TCTA does not only perform the project management function, but also arranges Private Sector loans and negotiate agreements on behalf of the DWA. TCTA require a directive from the Minister of Water and Environment Affairs in order to undertake any activities on behalf of DWA.

The TCTA is well structured to take responsibility for implementing bulk water projects, which has been their core business since their establishment. Their in-house management teams are experienced at controlling the planning and implementation of large water infrastructure projects, as well as at procuring and managing the required finances. TCTA procure PSPs to prepare the necessary designs, tender and contract documents and to provide staff for construction superintendence and contract management.

TCTA are currently implementing the immediate works and the STI under a directive from the Minister of Water and Environment Affairs and supplementing directives (authorisations) from DWA to discharge water and dispose of waste. TCTA have not previously been responsible for the operation of projects, but will be responsible for the operation of the STI until the LTS is commissioned.

The implementation of a DBOM or a DBOMF (PPP) project will be a first for TCTA and additional skills and resources will be required. DWA have delegated the calculation of the VRT for scenarios determined by DWA to TCTA.

9.4.5 Water Boards

a) Rand Water

Rand Water is a water board in terms of the Water Services Act, 1997 (Act No. 108 of 1997) (WSA (108:1997)). They are responsible for abstracting water from the Vaal River System, treating it to potable standards and supply either directly or indirectly to Local Authorities, mines, industrial and domestic users.

The project area is situated in the Rand Water supply area. Rand Water is the bulk supplier of potable water. Rand Water can be appointed by Water Service Authorities as Water Service Provider on behalf of that Water Service authority, though this is not normally done. Johannesburg Water would be a Water Service Provider. Traditionally, Rand Water has supplied potable water on the basis of abstraction of raw water from Vaal Dam, treating and distributing it to bulk users and municipalities. They performed this function on the basis of agreements with the users and the Local Authorities. The DWA could use Rand Water to manage the operation and maintenance of AMD works if the primary contract was only for design and build.

A primary contract for DBOM, however, was recommended (as per DWA AMD FS 2013, Study Report No. 7: **"Institutional, Procurement and Financing Options"**) and not for design and build alone.

Rand Water could accept treated AMD and supply to either potable water users or industrial water users. Rand Water should urgently be engaged to establish an agreement under which they receive and pay for the treated AMD and supply that to users in their area of jurisdiction.

Arrangements also need to be agreed with Rand Water for at least an oversight role during all phases of the implementation to enable Rand Water to have confidence in the quality of water being supplied from the AMD treatment works.

b) Magalies Water

Magalies Water's area of jurisdiction is close to the Western Basin and they could be a purchaser of the treated water in the Western Basin. However, the preference is to supply Rand Water so that the AMD replaces water from the Vaal River System.

9.4.6 Local Authorities

All Local Authorities (LAs) should do whatever is required of them to facilitate the implementation of the STI and LTS for AMD. Where approvals are required, they should consider applications by DWA and process approvals expeditiously.

The following LAs have responsibilities in the three mining basins where the LTS will be implemented:

- Western Basin : Mogale City Local Municipality: Randfontein Local Municipality
- Central Basin : Johannesburg Metropolitan Municipality
- Eastern Basin : Johannesburg Metropolitan Municipality; Ekurhuleni Metropolitan Municipality

LAs have the following responsibilities that they must exercise in the implementation of the LTS:

- Land using zoning;
- Urban stormwater management;
- Approval of traffic planning;
- Compliance with building regulations

The LAs are also responsible for significant water and waste water infrastructure. It is estimated that the losses from the water networks are between 20% and 30%.

Leaks from sewer networks have not been quantified. Both networks are possible sources of ingress into the mine voids and should be reduced as far as possible.

9.5 DWA's Responsibilities and Organisational Requirements

9.5.1 DWA Responsibilities

DWA have overall responsibility for ensuring the successful implementation of the STI and LTS and other associated activities for the effective management of AMD. This includes the following:

- Determining the institutional and contractual arrangements for implementation;
- Procurement of funding;
- Obtaining NT approval of the Feasibility Study;
- Managing cost recovery;
- Completing the LLROP;
- Coordination of EIA;
- Procurement of Service Providers for a DBOM or DBOMF (PPP) contract in the Central and Eastern Basins;
- Overseeing the contracts for PTPs in the Western Basin;
- Management of construction, completion of the works and integration of the LTS with the STI;
- Operations and performance monitoring; and
- Fulfilling its regulatory functions in terms of the NWA (36:1998), including water use licenses, disharge approvals, etc.

9.5.2 Departmental Organisational Requirements

Whether the procurement process will be run by the Department, or by an IA, the procurement of the selected solution, which will follow on from the Feasibility Study, will require a management team in DWA. They will be required to manage the procurement process through to completion, including the contract signature, delivery of the infrastructure through the construction and commissioning stage for each basin and the monitoring of performance and the management of contracts in the operational stage.

It is recommended that DWA now establishes a SPU to implement the LTS for AMD and coordinate all the other activities required for the effective long-term management of AMD in the Witwatersrand. The SPU should be headed by a dedicated Project Officer who will be a senior project manager/contracts engineer with direct access to DWA senior management and the authority to coordinate the activities of a number of line managers. The Project Officer needs the skills to manage and drive to completion a DBOM contract or a DBOMF (PPP) contract.

The dedicated SPU should be responsible for:

- Ensuring that adequate funding is available before contracts are concluded;

- Determining the preferred sources of income (cost recovery mechanisms) to Government and overseeing implementation of the agreed tariffs/ charges;
- Managing the income stream from sources such as the VRT, WDCS or possible future Environmental Levy;
- Leading the negotiations with the mines to secure their contribution to the capital and/or operating costs of the solution to AMD;
- Concluding agreements on the contribution to be paid by the Private Sector (mines, Gold Reef City, etc.), who may wish the static water levels to be maintained below that the designated ECL. The TCTA already have an agreement with one mine in the Central Basin;
- Leading the process to ensure that agreements for access to the required land are concluded timeously;
- Coordinating the execution of an EIA for the LTS works in the Central and Eastern Basins and for the proposed PTPs and ancilliary works in the Western Basin;
- Managing all procurement, implementation and operational activities, irrespective of whether or not an IA is used;
- Managing the procurement, either a DBOM or DBOMF (PPP) process contract, for implementing the LTS in the Central Basin. Estimated capital cost of about R 2.1 billion;
- Managing procurement process for either a DBOM or DBOMF (PPP) contract for implementing the LTS in the Eastern Basin. Estimated capital cost of about R 2.6 billion;
- Managing the process for establishing PTPs and constructing ancilliary works in the Western Basin with an estimated capital cost of R 1.3 billion;
- Procuring the necessary PSP team(s) for preparing procurement documents and managing the procurement process through to contract award;
- Coordinating/ participate with the implementation of all measures to reduce ingress to the mine void;
- Coordinating expanded water quality and quantity monitoring programmes of surface and underground water resources; and
- Coordinating a pro-active communication strategy in addition to the EIA public participation on all underground AMD management initiatives in the three basins to maintain and improve the Department's positive profile with the stakeholders and public. This should link to/ support the communications strategy for implementing the Vaal River Strategies.

A possible structure for coordination of implementation is shown in **Figure 9.5**.

DWA's Infrastructure Branch is responsible for implementing infrastructure projects, such as the LTS for AMD. It should be responsible for establishing and resourcing the SPU and lead the organisational arrangement, which DWA selects, as described in Chapters 9.2 and 9.3.

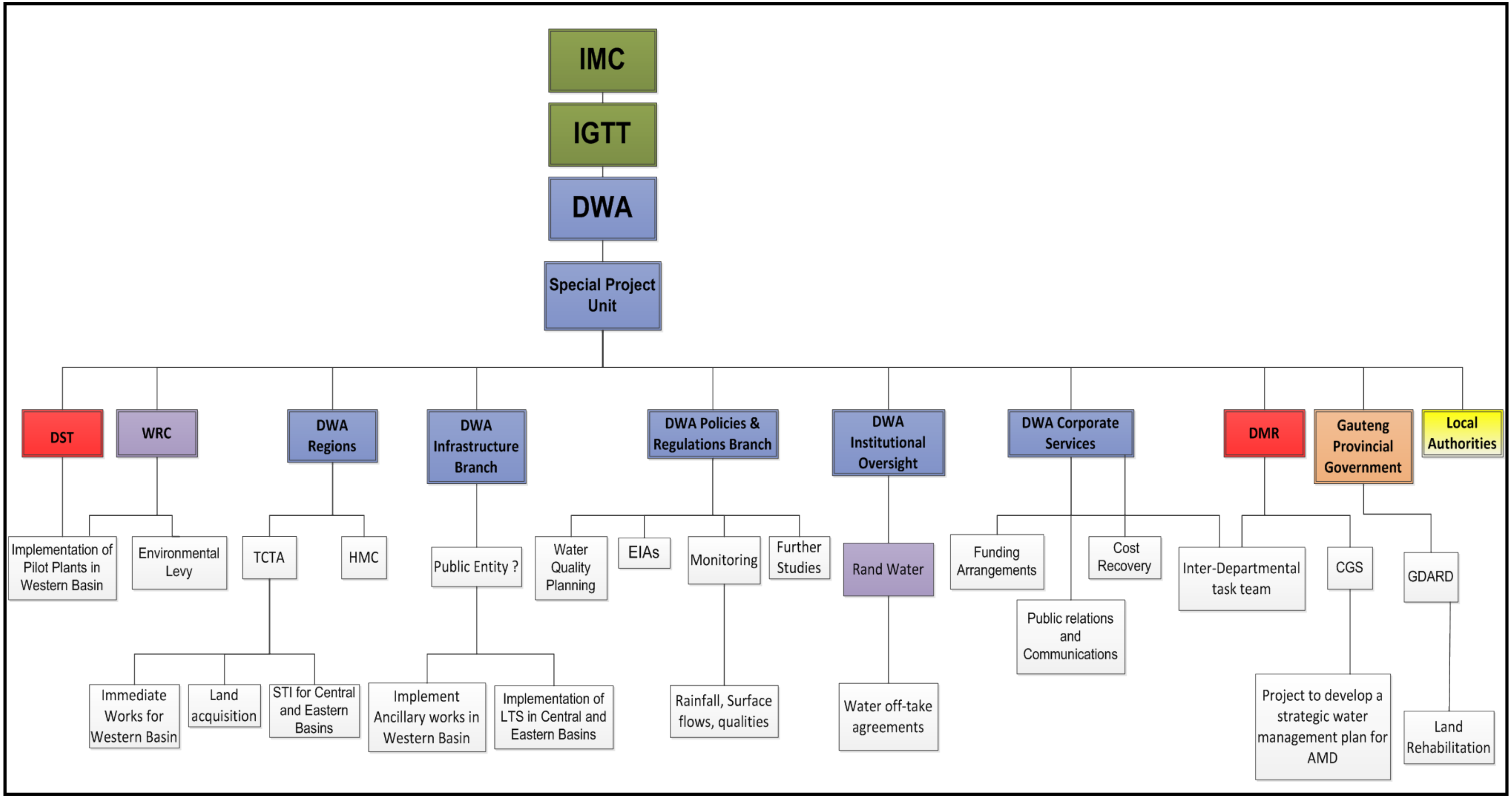


Figure 9.5: Possible Structure for Coordination of Implementation

Apart from the Directorates within the Infrastructure Branch, the following Directorates will have the responsibilities described below.

a) Regional Office

The Regional Office of DWA will be responsible for the DWA regulatory responsibilities, including i.e. the authorisations and licenses and the compliance monitoring. Regular monitoring of the implementation and operation will be required to ensure that the authorisation conditions, etc., are met.

b) Integrated Water Resource Planning

The Chief Directorate Integrated Water Resource Planning (IWRP) can provide the continuity required in the approach to AMD and should be responsible for the follow up studies and should also be responsible for a project to evaluate and review all the monitoring results and water quantity and quality data from operation of the abstraction works. This information would inform the Vaal River System and other strategies.

9.5.3 Departmental Responsibilities during Operation

The Contracts Director will be a person with a technical competency, as well as competencies in the management of contracts, DBOM or DBOMF (PPP), financial management and have sound interpersonal skills.

In the Procurement stage, the Project Officer will require who has the skills to manage and drive to completion a DBOM contract or a DBOMF (PPP). This person needs to have a good understanding of output-based contracts and their procurement. He or she will also require a sound grasp of the departmental and other procurement criteria within which the procurement and negotiations process must be completed.

On contract signature, the Project Officer's role will evolve to that of "Contracts Director" with the responsibility of delivering through the selected contractual process (DBOM or DBOMF (PPP)) the contracted infrastructure. The Contracts Manager will be required to manage up to three different contracts with Private Sector Providers who are well skilled and competent in the provision of services in terms of a complex contract. The Contracts Director will also have to interact and manage expectations and perceptions of civil society and interact with the senior management of DWA. They will manage the infrastructure delivery process through construction, commissioning to construction completion. The role requires that the person understands the contract that has been entered into DBOM or DBOMF (PPP) and the management of a contractor in a process based on turnkey design/construction delivery. The contract is likely to be a bespoke contract for the project.

Following construction completion, the Project Officer will be responsible for managing the successful commencement of the services and overseeing the performance monitoring regime for the three basins.

This project has been registered with NT as a possible DBOMF (PPP) project. This means that TA 1, which is issued after approval by NT of the DWA AMD FS 2013, Study Report No. 10: **"Feasibility Report"**, must be obtained before procurement can commence. Alternatively, an exemption from Section 16 of the PFMA (1:1999) could have been applied for.

Furthermore, the roles and responsibilities of all the DWA directorates and other Government Departments, as well as other Government and SOEs with each organisation must be agreed.

9.6 Options for DWA to Contract in Resources

9.6.1 Introduction

The Department does not have the in-house management capacity or sufficient in-house expertise to support the SPU in executing all its responsibilities. In particular, the Department will require additional capacity to implement the procurement and monitor the operational performance of a project of this magnitude and complexity. If the contracts are to be Government funded, it is recommended that a Public Entity with appropriate experience and capacity, such as the TCTA or a Water Board, such as Rand Water, be directed to act as the IA on behalf of the Department. If a DBOMF (PPP) contract is preferred, then DWA should be the contracting entity and a SOE, Water Board or PSP could be appointed by the Department as Contract Managers for the procurement and management of the contract, but should not be the IA. This model could also be used for Government funded contracts.

9.6.2 Implementing Agent

If the contract is to be DBOM, then DWA could contract with a SOE, TCTA being the obvious one, or to a Water Board, such as Rand Water to undertake most of the activities required for implementation to a SOE, TCTA being the obvious one, or to a Water Board, such as Rand Water. A combination of both organisations could be used in which case a specially formed Joint Venture should be appointed so as not to split responsibilities and leave DWA carrying unnecessary risk. Different options could be used in different basins.

DWA would retain its legislative responsibilities for policy, regulation and control.

The IA would then be responsible for all implementation activities, including:

- Procuring all the services required;
- Managing the LLROP; and/ or
- Raising all or some of the funding via loans from the Private Sector.

The IA could also be assigned responsibility for the EIAs.

9.6.3 Contract Management Support

If the contract with the Service Provider is to be a DBOMF (PPP), then Government, i.e. DWA, should be the contracting party, as discussed earlier. DWA would then retain responsibility for all the implementation activities, but could contract with a Public Entity or PSP to provide all the contract management support required.

9.6.4 Professional Service Providers

It is recommended that the SPU appoint a PSP team to support it in fulfilling all its responsibilities as soon as possible. It will need to be a multi-disciplinary team with project management, technical, financial, legal and contract expertise.

In addition, PSPs will be required as Transaction Advisors, to be appointed by the entity responsible for procurement and as the independent Environmental Practitioners to conduct the EIAs.

9.7 Actions to be taken by DWA

The following are the priority actions for DWA to establish and resource the required organisational structure.

- Agree the institutional arrangements and responsibilities;
- Establish a SPU and define its responsibilities;
- Decide on the form of contract to be used, DBOM or DBOMF;
- Appoint the Head of the SPU;
- Issue Directives to Public Entities, if necessary; and
- Appointment of a PSP team to support the SPU.

10 RISK MANAGEMENT

10.1 Introduction

The intention of this Implementation Strategy and Action Plan is to identify the major risks and consider how they can be transferred to the entity best able to manage them. This is most applicable to the Central and Eastern Basins, but is also important for the Western Basin.

It is proposed that as much as possible of the technical risk be transferred to the Private Sector through a DBOM contract. The most effective way to transfer risk to the Private Sector would be through a DBOMF (PPP) contract. Transferring risk incurs a cost, but the Value for Money Assessment (VMA) (DWA AMD FS 2013, Study Report No. 7: "**Institutional, Procurement and Financing Options"**) has shown it to be cost effective though marginally better than for DBOM with IA funding.

Whether or not to transfer financial risk to the Private Sector through a DBOMF (PPP) contract is linked to Government's policy decision on how to finance the implementation of the LTS.

10.2 Identified Risks

A key part of the VMA was a detailed risk assessment of all the elements of the Reference Projects for each basin. The size of the risk (value), the likelihood of it happening and the measures that should be put in place to minimise and manage the risk were described in Chapter 6 of the DWA AMD FS, 2013: Study Report No. 7: **"Institutional, Procurement and Financing Options"**.

The identified risks are given in **Appendix D**.

While a mitigation strategy was identified for each risk, in summary, these risks can be mitigated and managed by:

- Sound planning;
- Appropriate procurement documentation and procedures;
- Appropriate financial contract management procedures at all levels;
- Appropriate quality assurance and management processes, systems and procedures;
- Sound Contract Management and superintendence of the implementation by competent well-staffed teams using tested processes and procedures;
- Appropriate oversight by DWA and its support teams (PSP Advisors, Contract Manager); and
- Comprehensive monitoring plans and reporting procedures to identify and assess:
  - Compliance with specifications;
  - Monitor water levels in the mine void;

- Detect changes in the characteristics of the water in the mine void; and
- Detect changes in the characteristics of the water in the surface streams and near surface aquifers.

10.3 Risk Management

In the Implementation Phase, a Risk Management Plan will be prepared as part of the Contract Management Plan.

In addition to the implementation risks, there are a number of higher levels "Project Risks" that have been identified. These are summarised in **Appendix D**.

Several of the risks in **Appendix D** are risks to the reputation or credibility of DWA, and must be managed by DWA. However, many arise from areas where other Government departments, National, Provincial and Local Government are responsible.

It is very important that the responsible department are fully aware of their responsibility and are held accountable by the IGTT and IMC.

11 PROCUREMENT PLAN FOR PILOT PLANTS AND ASSOCIATED WORKS IN THE WESTERN BASIN

11.1 Introduction

The Western Basin will be used to procure a number of Service Providers who have an emerging technology that has been shown to work, but not at the scale required to treat AMD in the Witwatersrand Gold Mining Basins. The emerging technology Service Providers will be procured through a competitive process that will be structured to identify the technologies with the best chance of commercially treating AMD in a cost efficient manner.

It is expected that between four and eight PTPs will be procured and will be funded through a combination of capital funding from the DST, DWA, WRC and Private Sector investors. Government should support the development of technologies since they will have long-term benefits for the country in the management of AMD, not only on the Witwatersrand. The development of technologies is a high-risk investment for the private sector and Government should provide incentives for them to participate. Furthermore, Government and parastatals (*e.g.* the WRC) already have structures in place to initiate and manage such development and the Technology Innovation Agency (TIA) is also mandated to stimulate and intensify technological innovation to improve economic growth and the quality of life of all South Africans.

It is expected that there will be a period where the water is not to the required specification, but that the water will eventually be treated to the required specification at the majority of the pilot sites. The contract will be an output based contract requiring the bidders to propose a Pilot Plant solution.

The Pilot Plant will be contracted for about 15 years where after proven technologies will be encouraged to bid for the reissuing of the Eastern and Central Basins' contracts and also a section of the Western Basin.

Two procurement processes will be required to implement the Pilot Plant programme:

1. Contracts and procurement and testing of PTPs.
2. A process for collecting and managing the residue products from the PTPs. These are discussed separately in the following sections.

The physical layout and hence, some of the infrastructure requirements will depend on whether the medium-term plan for neutralisation is the immediate works at the Rand Uranium/ Gold One plant or Mogale Gold/Mintails TWT plant.

11.2 Pilot Plants

11.2.1 Introduction

It is recommended (Chapter 9) that the WRC be the lead agency for procuring, managing and testing the PTPs supported by DWA and DST/TIA.

The Form of Contract will be a standard WRC research contract with purpose designed financial arrangements.

11.2.2 Scope of Contracts

There will be a separate contract with each of the proprietors of the technology that are accepted for research.

Each WRC research contract will cover the following:

- Infrastructure required to collect the neutralised water from a balancing reservoir;
- Site works required for the Pilot Plant and connection to the source reservoir;
- Carrying out the agreed testing on the incoming water and all products from the plant;
- Infrastructure to take the three output streams, treated water, sludge and brine, to agreed collection points; and
- Reporting.

11.2.3 Contract Period

The contract period will be long enough to achieve the following objectives for each Pilot Plant:

- Establish the plants;
- Commission the plant;
- Test the operation for at least 48 months, to demonstrate sustainable performance with variations in feed water; and
- Provide operating desalination facilities until Phase II of the LTS can be implemented or until desalination is no longer required and can form part of the ongoing monitoring period.

11.2.4 Procurement Process

The established WRC process for receiving and assessing solicited research proposals would be followed.

A Reference Group will be established to evaluate the proposals received and to oversee the performance of the contracts.

11.2.5 Financial Arrangements

The financial arrangements for the PTPs will be structured to meet the following objectives:

- Encourage technology development (for managing AMD) for the long-term benefit of the country;
- Obtain Private Sector commitment of the best resources at their disposal to develop and prove their technologies;
- Government paying an appropriate tariff for water treated to an agreed standard;
- The Private Sector making investments in the development of their technology that are commensurate with their potential long-term benefits; and
- The Private Sector is not exposed to undue risk if the upstream processes and facilities do not perform within defined limits or to agreed standards.

11.3 Ancillary Works

11.3.1 Introduction

The following ancillary works will be required:

- Provision of collecting or balancing storage between the neutralisation works and the PTPs; and
- Facilities to manage the residue streams (sludge and brine) from each of the PTPs.

There are two options for the management of residues:

- If Mogale Gold / Mintails are providing the neutralisation process, including managing those residues, they could be contracted to manage the residues from the PTPs, possibly using the WWP for the sludge. The management of brine should be in a separate facililty. The contract could include the provision of other ancilliary facilities. This would not be an open procurement process, but should be considered; and
- A DBOM contract could be procured specifically to manage the residues from the PTPs, irrespective of the neutralisation process being used. It should include the other ancilliary facilities.

11.3.2 Scope of Contract and Duration

In either case, the scope of the contract would include:

- Providing a balancing reservoir and associated pumps and pipe lines between the neutralisation plant and the reservoir;
- Providing the infrastructure to receive the residue streams from each Pilot Plant; and
- Provide the infrastructure required, e.g. SSF and brine evaporation ponds to manage the residues.

The residue management facilities should be planned to manage the residues from a desalination process for 50 years. However, the construction of the SSF should be phased.

11.3.3 Procurement Process

Given the relatively specialist nature of designing, constructing, operating and maintaining, the envisaged residue management facilities, a single stage RfP procurement process is proposed.

The process and conditions would then be as described for the RfP stage in Chapter 10, except that the RfP would be advertised as an open tender.

11.3.4 Financial Arrangements

The financial arrangements for the ancillary infrastructure should be structured to:

- Reimburse the DBOM contractor for capital works through milestone payments ; and
- Reimburse the DBOM contractor on a monthly basis for satisfactory operation of the works.

At the time of the RfP, there will be significant uncertainties about the nature of the residue products.

Government or the Private Sector could fund the Works. There is no obvious revenue stream, but Government could pay on the basis of Rand/Mℓ of brine, which are managed according to the specification.

12 PROCUREMENT PLAN: CENTRAL AND EASTERN BASINS

12.1 Form of Contract

The contract in the Central and Eastern Basins should be either a DBOM or DBOMF (PPP), as decided by DWA. The advantages and disadvantages of each are discussed in the report on procurement alternatives (DWA AMD FS 2013, Study Report No. 7: **"Institutional Procurement and Financing Options"**). The key features of each are described below.

A DBOM contract would be an output specification based contract requiring the Service Provider to provide a fully integrated DBOM service. The contract will be drafted by the Department with the support of a legal advisor skilled in the drafting of output based DBOM contracts. The contract will be discussed and agreed by a team comprising the Transaction Advisor and DWA, and would benefit from inputs from NT.

The Agreement will comprise the main agreement and a number of schedules, the exact structure of which will be based on industry practice and the format used by the Legal Advisor appropriately adjusted for this particular project.

A PPP contract would be based on the Standardised PPP Provisions first issued in March 2004, as amended. The contract will be drafted by the Department with the support of a legal advisor skilled in the drafting of PPP contracts. The contract will be discussed and agreed to by a team comprising the Transaction Advisor, DWA and NT.

The PPP Agreement (PPPA) will comprise the main agreement and a number of schedules, the exact structure of which will be based on the Standardised Provisions and adjusted for this particular project.

12.1.1 Procurement Plan

The implementation of the project post the achieving of TA 1 will be:

- Procuring an EIA practitioner;
- Completion of the EIA process for the three basins. EIA approval will have to be achieved prior to any construction commencing;
- Procuring a Transaction Advisor;
- Procurement with RfQ and RfP stages;
- Negotiations to contract signature and financial close;
- Development, including design, construction of infrastructure, supply of technioclogy, commissioning of plant and equipment and handover to the Operations Sub-Contractor;
- Operations commencement and system balancing leading to full operations for the duration of the contract;

- Asset maintenance; and
- Contract expiry activities.

Implementation will be operational when the constructed infrastructure and supplied technology is integrated with the STI and producing the expected percentage of treated water to raw AMD to the required quality specification on a continual basis.

At the stage that the contract is signed and financial close has occurred, it is planned that the successful Service Provider will take over the operations of the STI and prepares that operation for the completion of the construction of the LTS and its operational commencement.

12.1.2 Process for Payment of Service Provider

Payment for construction activities will be based on work completed.

As the contract will be a fixed cost, fixed term contract, payment will be against interim milestones completed. Where the project is Government funded, the Implementer will appoint, with the approval of NT who will be the Funder, an Independent Engineer, which may be some organisation as the Transaction Advisor, who will be responsible for certifying progress and the release of capital funds.

Where Private Sector funding is involved, the Lenders will appoint a Lender's Technical Advisor (LTA) who will establish a milestone schedule against which payment will be made. If there is a Government contribution to the project, in addition to funding by the Private Sector, then the LTA will have a duty of care to Government during the certification process.

12.2 Scope of Contracts

12.2.1 Number of Contracts

There are three basins of varying sizes and with differing raw water qualities. It is recommended that implementation of each basin is through a separate contract with separate Service Providers contracting to treat AMD to the required specification. While the basins will be separate contracts and will be bid as such, there will be no constraint on the same bidder being successful in the Central and or Eastern Basins and also having a pilot technology in the Western Basin.

12.2.2 Scope of Work

The SoW is summarised as follows:

- Take over, operate, maintain and where required, refurbish and replace components of the STI;
- Design and construct the infrastructure, technology and operating process to treat raw AMD and manage the residues from the full process. It would be expected, but not required, that the STI infrastructure would be incorporated into the LTS in which case the

new treatment works would be for desalination. Should the STI not be incorporated into the LTS, then provision will be made for mothballing the components of the STI which are not required. The mothballing will be such that the mothballed plant can be recommissioned on the expiry of the contract should the need arise;

- Construct the infrastructure that has been designed and supply the required technology equipment and all associated plant and equipment;
- Commission the supplied plant and constructed infrastructure.
- Integrate the STI into the LTS and balance the system so that a continuous flow of treated AMD is achieved with the designed percentage or less of waste and brine;
- Operate all the works and residue management facilities for the duration of the contract providing and being reimbursed for producing treated water from the raw AMD.
- Produce where possible differentiated residues with a market value, market and sell these in an accountable and transparent manner;
- At about three years from the expiry of the contract support, the Department in securing a replacement Service Provider contract;
- At or about two years from the expiry of the contract, undertake a dilapidation survey of the project assets; and
- If required on contract expiry, hand the operational facility over to DWA.

12.2.3 Contract Duration

The LTS for the treatment of AMD will need contracts for the foreseeable future, say 100 years. In the process of researching the issue, it has been found that a shorter-term contract would be preferable to a long-term contract. It is proposed that the contract will be a 15-year operational contract, which will be of sufficient length to minimise the annual capital repayment and sufficiently short so that a new technology could be acquired that would reduce the operational costs.

A contract significantly shorter would lead to an annual increase in the interest and redemption payments and a longer contract duration increases the risk of incurring unnecessary high operating costs by not being able to replace the existing technology with newer more efficient technology.

12.2.4 General Conditions of Contract

It is proposed that the contract be based on FIDIC General Conditions of Contract.

12.3 Approach to B-BBEE

Broad-Based Black Economic Empowerment (B-BBEE) is a fundamental component of any major infrastructure development in South Africa. The Economic Assessment (as per DWA AMD FS 2013, Study Report No. 7: **"Institutional, Procurement and Financing Options"**) has shown that there will be significant benefits to the Gauteng community from this project. During construction, BEE contractors, both large and small, will be involved, with local operators and people involved in the operations and maintenance of the plants. While it is accepted that the plants are technologically advanced, there will be opportunities for skills transfer to BEE companies and individuals.

The involvement of BEE companies and individuals will be achieved through appropriate wording in the procurement documentation and contract agreements. Execution of the requirements will be monitored by the Performance Monitoring Team that will be monitoring the performance of each of the Service Providers in the three basins.

12.4 Contract Management

12.4.1 Contract Management Plan

During the closing stages of negotiations, the Department or its IA (with its Transaction Advisors) will need to draft a Contract Management Plan (CMP). The objective of the CMP is to assist the Department in developing a good working relationship with the contracted Service Provider to achieve the projects' objectives in a sustainable manner within the contract. The main purpose of the CMP is to:

- demonstrate (to Treasury in the case of a regulated project) the capacity of the Implementer to effectively implement and enforce the agreement for the duration of the agreement;
- provide a strategic management tool to guide the contract management;
- activities that DWA, their Advisors and IA, and the Service Provider will undertake during each stage of the project;
- clarify the key institution roles and responsibilities of DWA and the IA during each stage of the project and identify the resources that the Department will require to undertake these responsibilities;
- provide information on the contract management approach and agreement management arrangements, which can be used to assess the performance of the Department in discharging its obligations and responsibilities, as set out in the Contract Agreement, and as may be required by Government legislation, such as the PFMA (1:1999); and
- provide a vehicle for addressing issues that cannot be dealt with adequately in the Contract Agreement (such as attitudes and behaviours).

The CMP will form part of the Contract Management Manual, which will contain as a minimum:

- The CMP;
- The Contract Agreement;
- All schedules to the Agreement;
- Any Financing Agreements;
- The Financial Model;

- The Close-Out Report with special focus on lessons learnt and aspects to note for the future on this project;
- Variation procedures;
- Meeting protocol for development and delivery phases;
- Access and inspection protocols for the development and delivery phases; and
- Reporting requirements for the development/construction phase:
  - Progress against programme and any plans required to accelerate back to the programme;
  - Cost to date against planned cash flow;
  - Forecast of the planned cash flow to completion;
  - Activities in the past reporting period and planned for the upcoming three reporting periods;
  - Completion plan and completion planning updates;
  - Any changes and or variations;
  - Design submissions for review;
  - Comments on reviews in the past period;
  - Long lead technology or equipment from local suppliers and overseas suppliers;
  - Compliance with the BEE, local socio-economic development targets, job creation and skills development and training; and
  - Safety report for the period.
- Reporting requirements for the delivery/operations phase:
  - Annual reports:
    - Revision to the asset register;
    - BEE, skills development and training report;
    - Staffing report;
    - Environmental report;
    - Financial statements of the Service Provider, if it is a SPV for the project;
    - Annual performance report on trend of quantity and quality of raw AMD, trend and quantity and quality of treated water delivered, waste pumped and total waste managed;
    - Annual utility usage report with indices cost/Mℓ, usage/Mℓ and trends – by rational area, e.g. abstraction, pretreatment, desalination, waste pumping, brine pumping, treated water delivery, etc.;
    - Safety report;
    - Revenue and profit on waste sales; and
    - Changes and Variations.

- Monthly or “period” reporting:
  - The planned or programmed maintenance annually and for a determined period into the future;
  - Actual maintenance performed and the performance of the various components of the infrastructure (pipes, pumps, mechanical plant, electrical equipment and technology plant and equipment);
  - Provision for an annual revision to the replacement schedule and programmed long-term maintenance schedule;
  - Quality and quantity of raw AMD abstracted;
  - Quality and performance in the delivery of treated water;
  - Quality and performance in the management of waste and brine;
  - Quantity of water within specification for the period and year to date for the financial year;
  - Quantity of water outside specification for the period and year to date for the financial year. Report as to how treated water outside specification was managed and any impacts for the future;
  - The invoice for the period with the treated water delivered and rate, any deductions, pass through costs, additional costs, fixed charge, variable charges;
  - Performance deductions report for the period;
  - Utility Usage report for the period with indices cost/ Mℓ, usage/Mℓ, etc.;
  - Revenue and profit on waste sales;
  - Safety report for the period;
  - Any environmental advisory for the period;
  - Compliance with the BEE, local socio-economic development targets, job creation and skills development and training; and
  - Notification or process or approval outcome of changes and variations.
- Performance monitoring protocols and procedures for the delivery phase. The Plan will identify the performance monitoring role of the Department, the locations where monitoring will be effected and frequency, including as to whether the monitoring will be to a schedule or random and ad-hoc;
- For the development and delivery phases, the names, roles and contact details of key individuals in the Department, the Service Provider, any third parties, end user organisations (such as Rand Water), and other stakeholder groups; and
- All other documentation relating to the contract agreement.

12.4.2 Institutional Management Arrangements

It is recommended that DWA establish a SPU that will be responsible for the contracts with the Transaction Advisor and the Service Provider. They can either manage these contracts directly, i.e. be the Implementer or utilise a Public Entity as an IA where a DBOM contract is between the Public Entity and Service Provider or as the Contract Management team for a DBOMF (PPP) where the contract is between the DWA and the Service Provider. The institutional arrangement for the Development / Construction Phases and Operation Phase will be similar.

12.4.3 Private Sector Management Structure

The Service Provider will establish a team with a management structure to manage the Development/Construction Phase and probably a somewhat different structure to manage the Delivery/Operations Phase. The Implementer (DWA/IA) will require that, during the Development Phase, a representative of the technology supplier and the operator is present at "site" meetings, which will be held at least monthly. This requirement will be to ensure that the design and construction during the Development Phase has an outcome that is optimally operable. The Department does not want a least capital cost solution that is not optimal from an operations point of view, but requires a solution that has a least whole life cost.

The Implementer will only formally interface with the lead Service Provider, while operationally and informally the Implementer may interface with sub-contractors to the Service Provider.

12.4.4 Meetings

The following meetings are required:

- Formal meetings will be chaired by the Implementer at a frequency that the attendees find suitable. It would be expected during the Development Phase, that meetings would be fortnightly and one meeting a month being the formal monthly meeting and the interim meeting being a less formal project meeting.
- During the monthly meeting, the monthly report will be tabled and discussed and if appropriate, accepted. During the interim meeting, progress for the two weeks will be tabled, as well as any progress issues.
- As Chair of the meeting, it will be the responsibility of the Department/IA to set the agenda, take minutes and attend to the formalities of the meeting.

12.4.5 Progress Control

Progress of the construction works will be an aspect of the Works that the Implementer will monitor closely. The DWA will need to understand when completion will be achieved and when treated water will be available to the recipient.

12.4.6 Quality Assurance

The responsibilities for Quality Assurance (QA) are slightly different in a DBOM and DBOMF (PPP) contract and are described below.

- In a DBOM type contract, the Service Provider and in particular, the member of the SPV responsible for operation, will be key in the design and implementation of the QA system.

They will ensure that there is adequate monitoring of the design, technology installation and construction to ensure that the required functionality is achieved.

- The DWA or IA, as well as any funders requiring repayment will also have their own inspection regime to ensure that the requisite level of functionality is achieved.
- A DBOMF (PPP) contract passes a level of risk to the Service Provider to ensure that the plant that is being designed and constructed and technology being supplied, will deliver the outputs expected. As the operational revenue will be based on a mechanism whereby the Service Provider is paid for treated water supplied, it will be in the interests of the Service Provider and the Funder to ensure that the functionality required is actually being delivered. The Funder will implement their own QA systems since poor or out of specification performances will attract penalties and the revenue flow will be negatively impacted. A reduction or total cessation of revenue places the Funder at risk as there is then no funding stream to repay any loans made.
- The Service Provider and Implementer may agree that they will both use the same independent agencies for same quality control testing such as:
  - Non-destructive testing;
  - Materials testing; and
  - Water quality testing.

12.5 Development Supervision

The CMP will identify the structures and process to be used for the management of the contract during the development/ construction stage. This will include the monitoring of the design, selection and procurement of the selected technology, construction of infrastructure, installation of plant and equipment. When this is complete, the works will be certified as Ready for Commissioning (RfC). Thereafter, the commissioning, testing and the integration of the STI infrastructure into the LTS infrastructure will be carried out. Once commissioning has been completed, the LTS and integrated STI infrastructure can be certified as RfO.

A key aspect of the process that will have to be planned will be the integration of the existing operation of the STI infrastructure into the new desalination infrastructure. The entire take-over and integration of an existing operation will have to be completed so that the required outputs of the STI are achieved and that there are no environmental mishaps.

The role of the Implementer during the development stage will be to monitor progress against the programme, agree any changes proposed by either the Service Provider or the Implementer, monitor the quality on behalf of Government, monitor quality as the eventual custodian of the assets being procured or constructed in a manner that does not take back any already transferred risk and does not intrude on the obligations, responsibilities or rights of the Service Provider. The defining of the rights, roles and responsibilities will have been detailed in the contract with any areas requiring clarification, having to be negotiated between the parties in the interests of the project in the spirit of, and within the prescripts of the contract. Any unilateral actions by either party will not be in the long-term interests of the project and will in all probability be outside either or both the spirit and prescripts of the contract.

The close of the development stage will be marked by the issuing of a completion, or RfO certificate by the authorised party. The certificate will certify that the infrastructure that was agreed in the contract to be provided has been provided and commissioned. This point is the end of the construction and commissioning stage and the time for services to commence.

12.6 Operational and Performance Monitoring

The CMP will identify the institutional arrangements and protocols for the management of the contract during the services delivery or O&M stage. The formal completion of construction on the issuing of the RfO certificate will also permit the commencement of services delivery and the payment for treated water delivered. The operation will be managed by the Service Provider who will be responsible for:

- Abstraction of AMD from the void to maintain the TOL;
- Operation of the STI and LTS plant to treat AMD and deliver treated water to the agreed delivery point to the agreed quality;
- Maintenance of the STI and LTS infrastructure, plant and equipment over the life of the contract to the agreed standards;
- Monitoring and reporting on the quality and quantity of the raw AMD, treated water, waste streams and environmental impacts or potential impacts to the agreed standards for the duration of the contract;
- Participation in the Implementer's Contract Management team processes for managing the contract;
- Provision of access to the Implementer's Contract Management team for them to carry out their duties;
- The selling of waste products and the collection of and accounting for the revenue;
- The reporting to the Implementer's Contract Manager on the agreed frequency to the agreed format and quality;
- Maintaining an asset register of all moveable and immovable assets that are project assets;
- Collecting and holding the LTS' performance data in a format that can be transferred to the Implementer on contract expiry;
- An annual maintenance and lifecycle plan that will:
  - Review maintenance performance for the past twelve months;
  - Review maintenance performance for contract period to date;
  - Forecast with cash flows and a commentary, the planned maintenance and lifecycle replacement for the next twelve months;

  - Forecast with cash flows and a commentary, the planned maintenance and lifecycle replacement for the remainder of the contract period; and
  - Identify any lifecycle risks that may exist and that could materialise within the remainder of the contract or thereafter.
- Assisting with the dilapidation survey carried out towards the expiry of the contract; and
- At about three years prior to the expiry of the contract, assisting the Implementer's Contract Manager with contract expiry activities and possible handover to another service provider.

The Implementer and Service Provider might appoint an Independent Monitor to independently monitor and report on the quality of the treated water and also the maintenance and preservation of the assets provided under the contract. This monitor will provide an independent review of the service delivery performance of the Service Provider.

13 OPERATION AND MAINTENANCE PHASE

13.1 Introduction

The O&M Phase commence once the works are RfO. The key areas in this phase are:

- Performance of the works to deliver water to the agreed standard;
- Residue management in accordance with the contract;
- Maintenance of the works in accordance with the contract;
- Compliance with the conditions of the EIA authorisation;
- Cost recovery; and
- Ensuring that all parallel activities are on programme.

DWA will retain overall responsibility for a successful O&M Phase in all three basins.

All the requirements for this phase will be described in detail in the Management Plan, which will have been produced by the Service Provider and approved by the Implementer.

13.2 Responsibilities of DWA

DWA will retain overall responsibility in this phase, although they may use an IA or Contract Management team to ensure that the conditions of the DBOM or DBOMF (PPP) contract are to adhered to. The main focus areas are described below.

13.2.1 Water Delivery

The key aspects are:

- That the quality of water produced by the Service Provider meets the specifications; and
- That the quantities of water delivered are in accordance with the end user agreement.

When the quality of the water is not according to specification, it is important that it is not supplied to the end user, but recycled for re-treatment.

Record keeping must be in accordance with the approved Management Plan.

13.2.2 Residue Management

The key aspects are:

- Ensuring compliance with the contract conditions;
- Ensuring compliance with the conditions of the EIA Authorisation;
- Ensuring that there is always adequate capacity.

It will also be important to monitor any contracts the Service Provider enters into for the sale of residue products.

13.2.3 Maintenance of the Works

Maintenance of the works, as specified in the contract and to the required standards, is essential for both the operating of the works, but especially for ensuring that there is the expected residual value at the end of the Service Providers' contract.

13.2.4 Compliance with the EIA

The EIA Authorisation will have been granted to DWA. They will thus be responsible for ensuring that all the conditions are met.

13.2.5 Cost Recovery

DWA will have committed to certain cost recovery targets when making the funding arrangements. These must be monitored and reviewed on an on-going basis.

13.3 Preparing for subsequent Implementation

Planning the second phase contracts with inputs from the first phase of O&M includes the following aspects discussed under this section.

13.3.1 Lessons Learnt

These must be carefully documented to guide the preparation of new tender documents. Of particular importance will be the changing water quantity and quality being abstracted and produced in each step of the treatment process.

13.3.2 Condition of Assets

The condition of the assets at the end of the implementer's contract will have a significant effect on the cost of the subsequent phase. The Service Provider will be required to maintain an asset register and complete a final number of assets.

13.3.3 Alternatives to be considered

Technology developments must be monitored throughout the O&M period.

13.4 Responsibilities of the Service Provider

The service providers' responsibilities will be defined in the contract and are discussed in Chapter 9.

14 IMPLEMENTATION PROGRAMME

14.1 Introduction

The detailed consolidated implementation programme for all the activities required, including implementation of the LTS in all three basins is given in **Appendix F**. The programme is based on the following assumptions:

- DWA will establish a SPU to be responsible for all the activities required for implementing AMD (discussed in Chapter 9). They should also coordinate other activities;
- The SPU will appoint an IA and/or PSP to assist them in fulfilling their responsibilities and fulfilling their coordination role;
- DWA will decide to use a DBOM contract and not the PSC alternative;
- DWA will be the Implementer for a DBOMF (PPP) contract. The process for a DBOM contract should be slightly shorter. The assumption is thus conservative; and
- The SPU will appoint a separate PSP as Transaction Advisor.

The alternative, which is also shown, but not limited to the rest of the programme would be that, in parallel with establishing the SPU and appointing a PSP for support, DWA directs a Public Entity to act as IA for a DBOM or as contract managers for a DBOMF (PPP).

These early and overarching activities are shown in **Figure 14.1**.

The alternative of a sequential PSC procurement process is not recommended, as discussed in the report on procurement (DWA AMD FS 2013, Study Report No. 7: **"Institutional Procurement and Financing Options"**). The sequential PSC procurement option has not been considered in the programme, but would take longer.

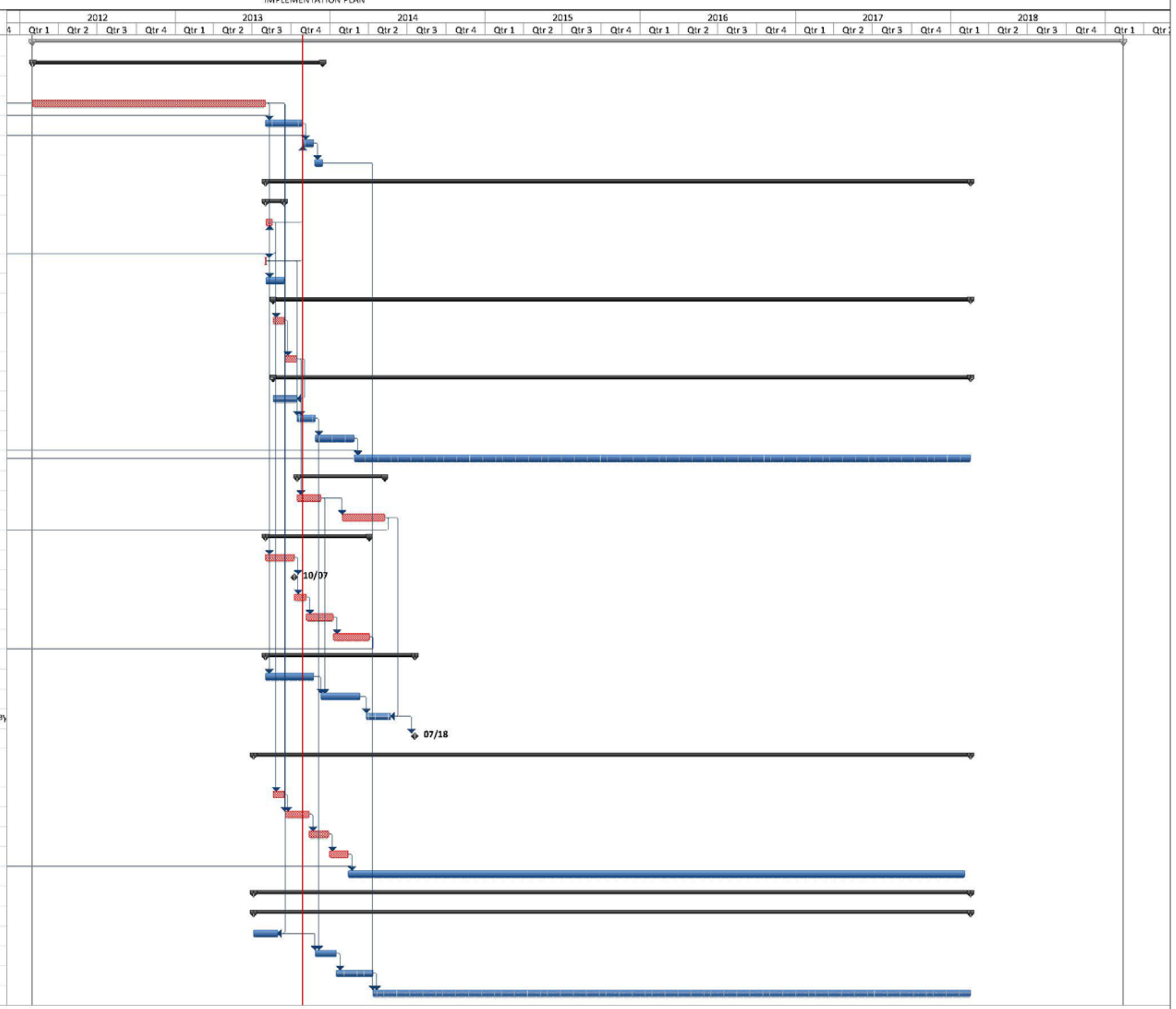
The summary implementation programmes for each basin (derived from the consolidated programme), together with key dates, are given in the following sections.

In the Central and Eastern Basins, the consolidated programme shows the activities up to the RfQ, milestone in each basin. The operations are anticipated to continue for at least 10 and up to 15 years.

In the Western Basin, a new implementation process will need to be started timeously to ensure continuity of treatment after the PTPs. It is recommended that the PTPs should be required to operate for at least five years to allow time for the pilot technologies to be proved and operated for two years before commencement of a new procurement process, which will take at least 3 years before new infrastructure is commissioned.

AMD FEASIBILITY STUDY
IMPLEMENTATION PLAN

ID	Task Name	Duration	Start	Finish	Predecessors
0	**AMD Implementation Plan**	**1764 days?**	**2012/01/30**	**2019/02/11**	
1	**FEASIBILITY STUDY**	**472 days**	**2012/01/31**	**2013/12/13**	
2	Project Start	0 days	2012/01/31	2012/01/31	
3	Feasibility Study	377 days	2012/01/31	2013/07/31	
4	DWA Approval	60 days	2013/08/01	2013/10/25	3
5	DWA Submit FS to National Treasury (NT)	20 days	2013/10/28	2013/11/22	4,10,9
6	NT Approval (TA1)	15 days	2013/11/25	2013/12/13	5
7	**DWA IMPLEMENTATION RESPONSIBILITIES**	**1141 days**	**2013/08/01**	**2018/02/16**	
8	**Confirm Principals**	**31 days**	**2013/08/01**	**2013/09/13**	
9	Confirm Institutional Structure and Responsibilities	10 days	2013/08/02	2013/08/16	10
10	Confirm\ of contract (DBOM or DBOMF)	1 day	2013/08/01	2013/08/01	3
11	Agree funding and cost recovery plan with NT	30 days	2013/08/02	2013/09/13	10
12	**Establish DWA Special Project Unit**	**1130 days**	**2013/08/19**	**2018/02/16**	
13	Draft terms of reference for Special Project Unit	20 days	2013/08/19	2013/09/13	9
14	Appoint Unit Head	20 days	2013/09/16	2013/10/14	13
15	**Procure PSP for support**	**1130 days**	**2013/08/19**	**2018/02/16**	
16	Scope of Work & RfP	40 days	2013/08/19	2013/10/14	14FF
17	Bid Period	30 days	2013/10/15	2013/11/25	16,10
18	Adjudication & Award	60 days	2013/11/26	2014/02/25	17
19	Contract Period	1000 days	2014/02/26	2018/02/16	18
20	**Establish off-take Agreements with Users**	**140 days**	**2013/10/15**	**2014/05/08**	
21	Agree MOU with Rand Water	40 days	2013/10/15	2013/12/09	14
22	Agree tariffs with Rand Water	70 days	2014/01/29	2014/05/08	21FS+30 days
23	**IMPLEMENT EIA for LTS**	**166 days**	**2013/08/01**	**2014/04/02**	
24	Prepare Directive to TCTA	46 days	2013/08/01	2013/10/07	3
25	Issue Directive	0 days	2013/10/07	2013/10/07	24
26	Scope of work & RfP	20 days	2013/10/08	2013/11/04	24
27	Bid Period	40 days	2013/11/05	2014/01/07	26
28	Adjudication & Award	60 days	2014/01/08	2014/04/02	27
29	**IMPLEMENT VAAL RIVER TARIFF**	**241 days**	**2013/08/01**	**2014/07/18**	
30	Agree Principles	80 days	2013/08/01	2013/11/22	3
31	Hold forum meetings	60 days	2013/12/10	2014/03/11	30,21
32	Issue formal notifications	40 days	2014/03/27	2014/05/22	31,22FF+10 day
33	Start collection	0 days	2014/07/18	2014/07/18	32FS+40 days
34	**PUBLIC ENTITY AS IMPLEMENTING AGENT OR CONTRACT MANAGERS**	**1161 days**	**2013/07/04**	**2018/02/16**	
35	DWA Issues directive	20 days	2013/08/19	2013/09/13	9
36	Scope of Work & RfP for TA	40 days	2013/09/16	2013/11/11	35,3
37	Bid Period	30 days	2013/11/12	2013/12/27	36
38	Adjudication & Award	30 days	2013/12/30	2014/02/11	37
39	TA Contract Period	1000 days	2014/02/12	2018/02/02	38
40	**ALTERNATIVE DWA Implements**	**1161 days**	**2013/07/04**	**2018/02/16**	
41	**Procure PSP as TA**	**1161 days**	**2013/07/04**	**2018/02/16**	
42	Scope of Work & RfP for TA	40 days	2013/07/04	2013/08/29	3FF+20 days
43	Bid Period	30 days	2013/11/26	2014/01/14	42,17
44	Adjudication and Award	60 days	2014/01/15	2014/04/10	43
45	TA Contract Period	970 days	2014/04/11	2018/02/16	44,6



Project: AMD Implementation Plan
Edition 1
Date: 31 July 2013

Task | Milestone | Summary | Project Summary | Progress | Critical Task

Implementation Plan - Edition 1.mpp | Print Date 2013/10/28

Figure 14.1: Summary Programme for Feasibility Study

For all three basins, the critical path runs through the following activities:

- DWA approving this Feasibility Study;
- DWA deciding on the Institutional structure and responsibilities for implementation;
- Determining the type of contract to be procured for the Central and Eastern Basins, DBOM or DBOMF (PPP). Agreeing the funding plan with NT;
- DWA submitting the Feasibility Study with their organisational structure for implementation and funding and cost recovery plan to NT.
- Determining whether the capacity that the Department requires to implement the project will be obtained by appointing a Public Entity as the IA; or
- If an IA or Contract Management team is to be engaged to support the Department, whether it will be TCTA, Rand Water, another organ of State or the Private Sector; and
- Completing the LLROP.

The EIA could be on the critical path if there are any delays in the process. The programmes show that if started timeously, the EIA can be completed, in parallel with the procurement process, with authorisation being received before financial closure.

It is clear from the programme that if TCTA is directed to implement the LTS, commissioning can take place up to 6 months or more earlier when compared with the programme if DWA is the Implementer. This is based on the TCTA procurement procedures which are quicker, at each stage, than the normal DWA procedures. No information is available about the time required for Rand Water or other organisations' procurement procedures to be followed.

14.2 Western Basin

In addition to the activities described above and once the required decisions, discussed in Chapter 4, have been made, the detailed arrangements for implementation are dependent on the results of on-going water resource assessments in the Crocodile (West) Basin and the plans for neutralisation in the basin, which are currently being assessed by TCTA.

Although the programme is based on the assumption that the Mogale Gold / Mintails TWT process will be used, it does not imply any preference for that option. The decision must be based on the assessment of the technical merits and regulatory requirements.

The critical activities are:

- Establishing DWA Special Projects Unit (SPU);
- Appointing DWA Transaction Advisor;
- Initiating an EIA for the works in the Western Basin; and
- Construction of the PTPs.

The critical activities for implementing PTPs are:

- Confirming if the Western Basin will be used for PTPs. The process for decision-makings is described in Chapter 13;

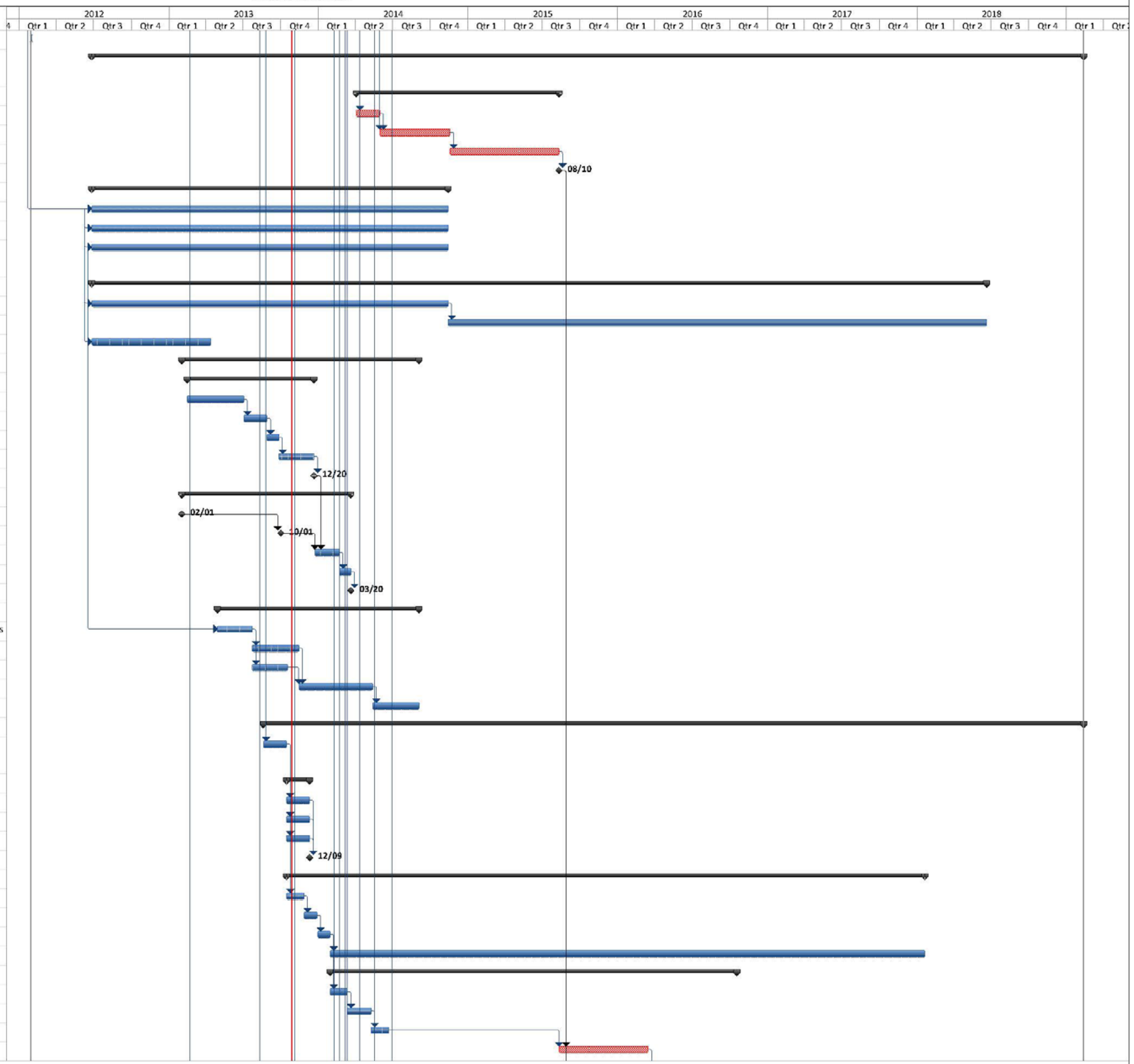
- Agreeing the institutional arrangement and responsibilities, implementation of PTPs and Ancilliary Works;
- Determining if the residue products can be disposed of in the WWP and for how long;
- Planning, design, construction and EIA for the Ancilliary Works; and
- Agreeining the business model to use.

If PTPs are not to be implemented in the Western Basin then determining the responsibilities for implementing the LTS will be the critical activity. The nature of the LTS will depend on the level of desalination to be implemented.

The programme for the Western Basin is shown in **Figure 14.2.** The full programme for all three basins is given in **Appendix F**.

AMD FEASIBILITY STUDY
IMPLEMENTATION PLAN

ID	Task Name	Duration	Start	Finish	Predecessors
46	**WESTERN BASIN**	1 day?	2012/01/30	2012/01/30	
47	**EIA for pilot plants and Ancillary Facilities (Western Basin)**	**1663 days**	**2012/06/26**	**2019/02/11**	
48	**EIA Contract Period**	**340 days**	**2014/04/03**	**2015/08/10**	
49	Registration of Project	40 days	2014/04/03	2014/05/29	28
50	Scoping phase of EIA	120 days	2014/05/30	2014/11/17	49,22
51	Impact Assessment phase of EIA	180 days	2014/11/18	2015/08/10	50
52	EIA Authorisations (assuming no appeals)	0 days	2015/08/10	2015/08/10	51
53	**Immediate Works**	**600 days**	**2012/06/26**	**2014/11/12**	
54	Gold one Neutralisation (24 Ml/d)	600 days	2012/06/26	2014/11/12	3SS+100 days
55	Pump @ Shaft 8 (24 Ml/d)	600 days	2012/06/26	2014/11/12	54SS
56	Surface Discharge/ Pump at 17 Winze (Approx. 13 Ml/d)	600 days	2012/06/26	2014/11/12	54SS
57	**Discharges to Westwits pits**	**1500 days**	**2012/06/26**	**2018/06/19**	
58	Westwits Pit Beaches	600 days	2012/06/26	2014/11/12	54SS
59	Westwits Pit Full	900 days	2014/11/13	2018/06/19	58
60	**Add clarifier @ Gold 1 if required**	**200 days**	**2012/06/26**	**2013/04/12**	**54SS**
61	**Shaft 8 LT pumping capacity 40Ml/d**	**399 days**	**2013/02/01**	**2014/09/02**	
62	**Civil Contract**	**215 days**	**2013/02/14**	**2013/12/20**	
63	Complete Civil Tender Documents	95 days	2013/02/14	2013/07/01	
64	Tender Period	40 days	2013/07/02	2013/08/27	63
65	Adjudication and Award	20 days	2013/08/28	2013/09/25	64
66	Construction	60 days	2013/09/26	2013/12/20	65
67	Civil Contract - Ready for Operation (RfO)	0 days	2013/12/20	2013/12/20	66
68	**Ritz Pumps**	**284 days**	**2013/02/01**	**2014/03/20**	
69	Pumps ordered	0 days	2013/02/01	2013/02/01	
70	Delivery	0 days	2013/10/01	2013/10/01	69
71	Installation	40 days	2013/12/23	2014/02/20	70,67
72	Commission	20 days	2014/02/21	2014/03/20	71
73	RfO	0 days	2014/03/20	2014/03/20	72
74	**Mogale Gold/Mintails TWT Process**	**340 days**	**2013/04/29**	**2014/09/02**	
75	Establish Process	60 days	2013/04/29	2013/07/22	56SS+210 days
76	Obtain licenses	80 days	2013/07/23	2013/11/13	75
77	Negotiate Agreement	60 days	2013/07/23	2013/10/16	75
78	Increase dewatering capacity to 20Ml/d	120 days	2013/11/14	2014/05/12	77,76
79	Increase dewatering capacity to 38Ml/d	80 days	2014/05/13	2014/09/02	78
80	**Pilot Plants**	**1375 days**	**2013/08/19**	**2019/02/11**	
81	Determine Institutional Arrangements with WRC and DST	40 days	2013/08/19	2013/10/14	9
82	**Procure funding**	**40 days**	**2013/10/15**	**2013/12/09**	
83	DWA	40 days	2013/10/15	2013/12/09	81
84	DST	40 days	2013/10/15	2013/12/09	81
85	Private Sector	40 days	2013/10/15	2013/12/09	81
86	Funding in Place	0 days	2013/12/09	2013/12/09	83,84,85
87	**Procure PSP support to WRC**	**1070 days**	**2013/10/15**	**2018/01/19**	
88	Scope of Work & RfP	30 days	2013/10/15	2013/11/25	81
89	Bid Period	20 days	2013/11/26	2013/12/27	88
90	Adjudication & Award	20 days	2013/12/30	2014/01/28	89
91	Contract Period	1000 days	2014/01/29	2018/01/19	90
92	**Procure Pilot Plants (WRC)**	**685 days**	**2014/01/29**	**2016/10/17**	
93	Prepare Tender Docs	30 days	2014/01/29	2014/03/11	90
94	Tender for Pilot Plants	40 days	2014/03/12	2014/05/08	93
95	Adjudicate & Award	30 days	2014/05/09	2014/06/20	94
96	Construction	150 days	2015/08/11	2016/03/14	95,52



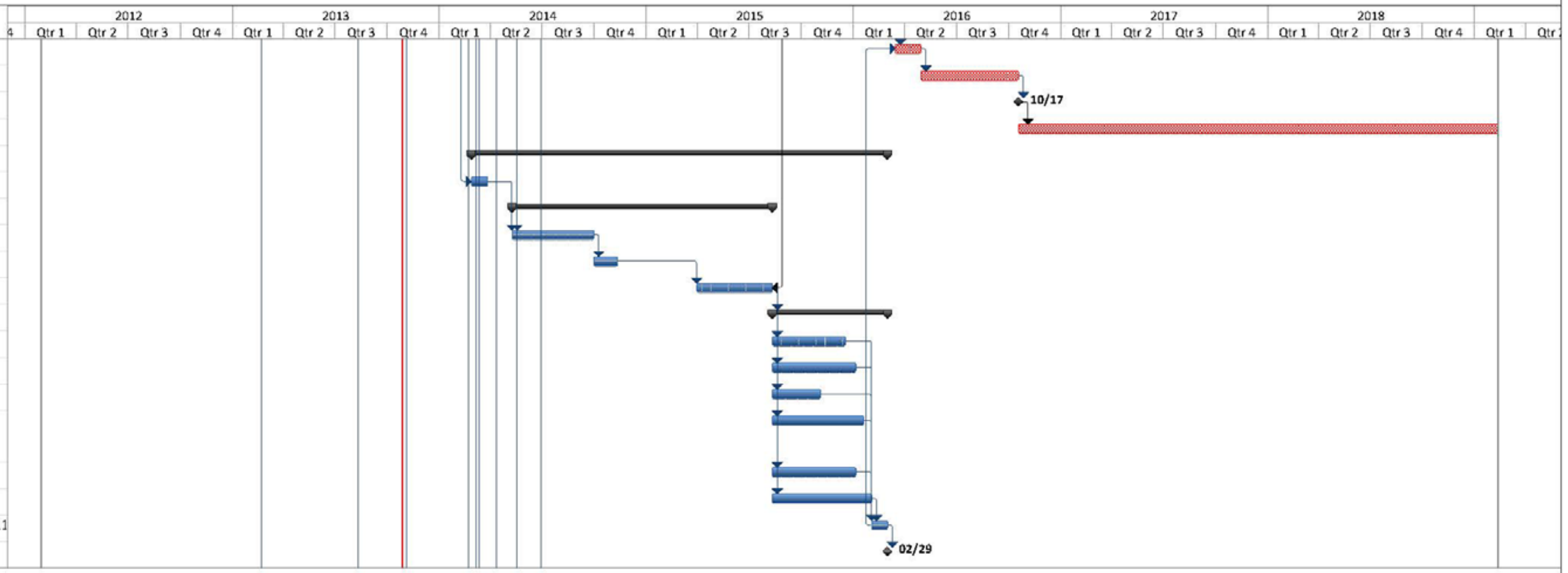
Project: AMD Implementation Plan
Edition 1
Date: 31 July 2013

Task | Milestone | Summary | Project Summary | Progress | Critical Task

Implementation Plan - Edition 1.mpp Print Date 2013/10/28

AMD FEASIBILITY STUDY
IMPLEMENTATION PLAN

ID	Task Name	Duration	Start	Finish	Predecessors
97	Commisioning	30 days	2016/03/15	2016/04/28	96,114SS
98	Trial Operation	120 days	2016/04/29	2016/10/17	97
99	RfO	0 days	2016/10/17	2016/10/17	98
100	**Delivery of water to users**	580 days	2016/10/18	2019/02/11	99
101	**Ancillary Facilities for Pilot Plants**	**505 days**	**2014/02/26**	**2016/02/29**	
102	**Mobilise DWA PSP**	20 days	2014/02/26	2014/03/26	19SS
103	**Procure Contractor**	**315 days**	**2014/05/09**	**2015/08/10**	
104	Prepare Tender Docs	100 days	2014/05/09	2014/09/29	102,22
105	Tender Period	30 days	2014/09/30	2014/11/10	104
106	Adjudicate & Award	90 days	2015/03/31	2015/08/10	105,52FF
107	**Construct Ancillary Works**	**140 days**	**2015/08/11**	**2016/02/29**	**106**
108	Balancing Storage for neutralised AMD	90 days	2015/08/11	2015/12/17	106
109	Balancing Storage for treated Water	100 days	2015/08/11	2016/01/04	106
110	Sludge pipeline to WWP	60 days	2015/08/11	2015/11/03	106
111	Construct discharge pipeline for treated water	110 days	2015/08/11	2016/01/18	106
112	Construct Brine Disposal Facility	100 days	2015/08/11	2016/01/04	106
113	Construct Sludge Storage Facility	120 days	2015/08/11	2016/02/01	106
114	Commissioning	20 days	2016/02/02	2016/02/29	113,112,111,11
115	**RfO**	0 days	2016/02/29	2016/02/29	114



Project: AMD Implementation Plan
Edition 1
Date: 31 July 2013

Task | Milestone | Summary | Project Summary | Progress | Critical Task

Implementation Plan - Edition 1.mpp | Print Date 2013/10/28

Figure 14.2: Summary Programme for Western Basin

14.3 Central Basin

The programme shows that the LTS will be RfO in August 2017.

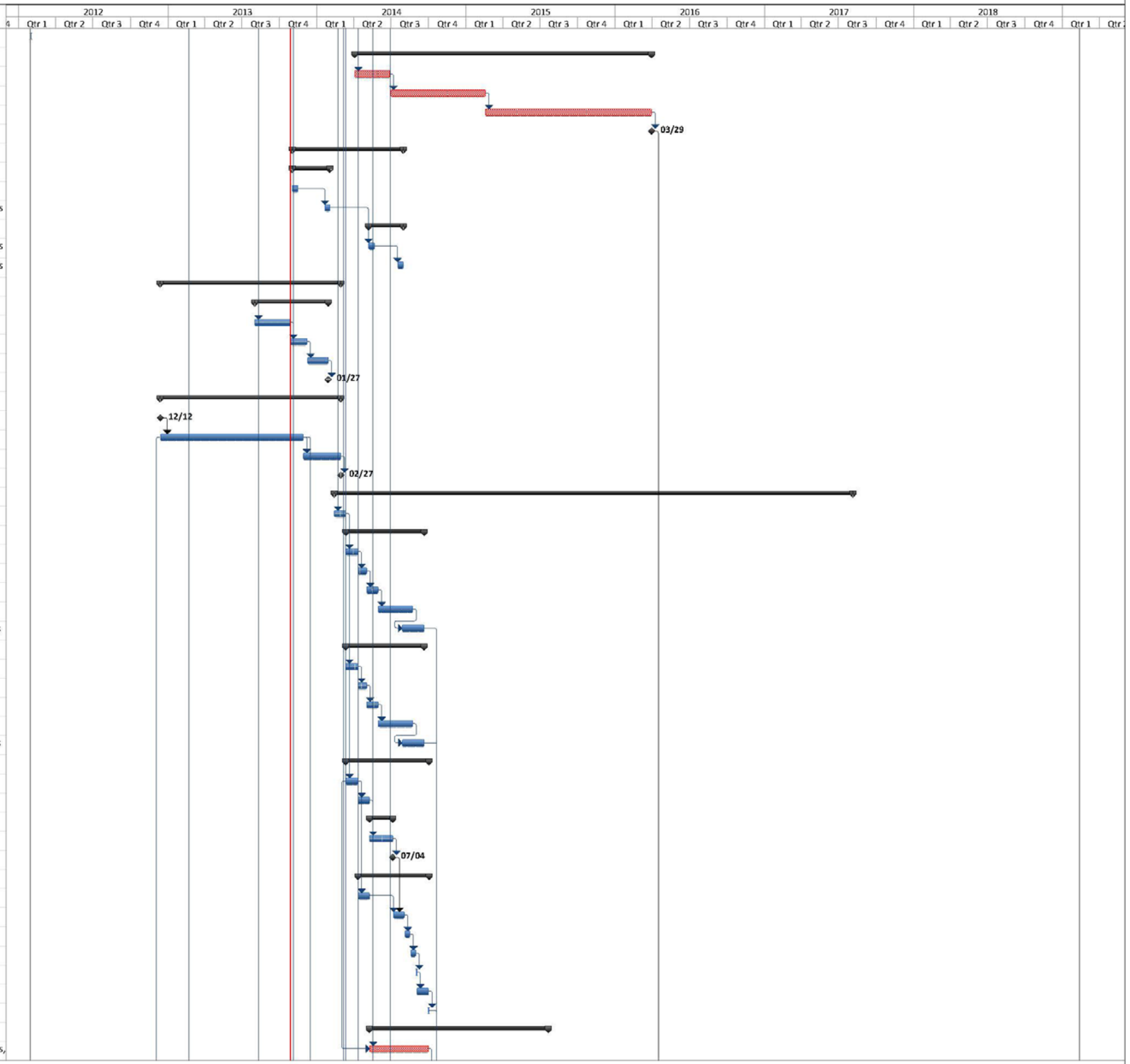
Once the institutional, contractual and funding arrangements are agreed, the critical activities are:

- Agreeing delivery points and tariffs with Rand Water;
- Initiating an EIA for the works;
- Establishing DWA SPU;
- Appointment of DWA Transaction Advisor;
- Prequalification and procurement of Contractor; and
- Detail design, construction and commissioning of works.

The programme is summarised in **Figure 14.3**.

AMD FEASIBILITY STUDY
IMPLEMENTATION PLAN

ID	Task Name	Duration	Start	Finish	Predecessors
116	**CENTRAL BASIN**	1 day?	2012/01/30	2012/01/30	
117	**EIA for LTS (Central Basin)**	**500 days**	**2014/04/03**	**2016/03/29**	
118	Registration of Project	60 days	2014/04/03	2014/06/27	28
119	Scoping phase of EIA	160 days	2014/06/30	2015/02/16	118
120	Impact Assessment phase of EIA	280 days	2015/02/17	2016/03/29	119
121	EIA Authorisations (assuming no appeals)	0 days	2016/03/29	2016/03/29	120
122	**Critical Water Levels**	**185 days**	**2013/11/01**	**2014/07/30**	
123	**SECL-GRCTF**	**60 days**	**2013/11/01**	**2014/01/31**	
124	TOL (1454M)	10 days	2013/11/01	2013/11/14	
125	SECL (1474M)	10 days	2014/01/20	2014/01/31	124FS+40 days
126	**ECL**	**60 days**	**2014/05/07**	**2014/07/30**	
127	TOL(1500M)	10 days	2014/05/07	2014/05/20	125FS+65 days
128	ECL(1520M)	10 days	2014/07/17	2014/07/30	127FS+40 days
129	**Short Term Interventions**	**301 days**	**2012/12/12**	**2014/02/27**	
130	**Ritz Pumps**	**120 days**	**2013/08/01**	**2014/01/27**	
131	Delivery	60 days	2013/08/01	2013/10/25	3
132	Installation	30 days	2013/10/28	2013/12/06	131
133	Commission	30 days	2013/12/09	2014/01/27	132
134	RfO	0 days	2014/01/27	2014/01/27	133
135	**HDS Construction**	**301 days**	**2012/12/12**	**2014/02/27**	
136	Tender approval	1 day	2012/12/12	2012/12/12	2FS+200 days
137	Construction	240 days	2012/12/13	2013/11/27	136
138	Commissioning	60 days	2013/11/28	2014/02/27	137
139	RfO	0 days	2014/02/27	2014/02/27	138
140	**Long term solution (SOE)**	**875 days**	**2014/02/12**	**2017/08/04**	
141	**Mobilisation of PSP as TA**	20 days	2014/02/12	2014/03/11	38
142	**Geotechnical Investigation**	**135 days**	**2014/03/12**	**2014/09/19**	
143	Prepare Tender Documents	20 days	2014/03/12	2014/04/10	141
144	Bid period	15 days	2014/04/11	2014/05/01	143
145	Adjudicate and award	20 days	2014/05/02	2014/05/29	144
146	Investigations and laboratory Testing	60 days	2014/05/30	2014/08/22	145
147	Reporting	40 days	2014/07/28	2014/09/19	146FS-20 days
148	**Topographical Surveys**	**135 days**	**2014/03/12**	**2014/09/19**	
149	Prepare Tender Documents	20 days	2014/03/12	2014/04/10	141
150	Bid period	15 days	2014/04/11	2014/05/01	149
151	Adjudicate and award	20 days	2014/05/02	2014/05/29	150
152	Survey work	60 days	2014/05/30	2014/08/22	151
153	Mapping and Reporting	40 days	2014/07/28	2014/09/19	152FS-20 days
154	**Request for Qualification**	**142 days**	**2014/03/12**	**2014/10/01**	
155	Drafting TfQ	20 days	2014/03/12	2014/04/10	141
156	Document approval (TA II(a) (RfQ)	20 days	2014/04/11	2014/05/08	155
157	**RFQ Exposure Period**	**40 days**	**2014/05/09**	**2014/07/04**	
158	Issuing and response period	40 days	2014/05/09	2014/07/04	156
159	Receipt	0 days	2014/07/04	2014/07/04	158
160	**RFQ Evaluation**	**122 days**	**2014/04/11**	**2014/10/01**	
161	Agree Evaluation Criteria	20 days	2014/04/11	2014/05/08	155
162	Evaluation process	20 days	2014/07/07	2014/08/01	161,159
163	Technical assessment	10 days	2014/08/04	2014/08/15	162
164	Evaluation Committee	10 days	2014/08/18	2014/08/29	163
165	Pre-qualified shortlist	1 day	2014/09/01	2014/09/01	164
166	RFQ Approvals	20 days	2014/09/02	2014/09/30	165
167	Shortlist Issued	1 day	2014/10/01	2014/10/01	166
168	**Request for Proposal**	**300 days**	**2014/05/09**	**2015/07/20**	
169	RFP Preparations	100 days	2014/05/09	2014/09/29	155SS+20 days,



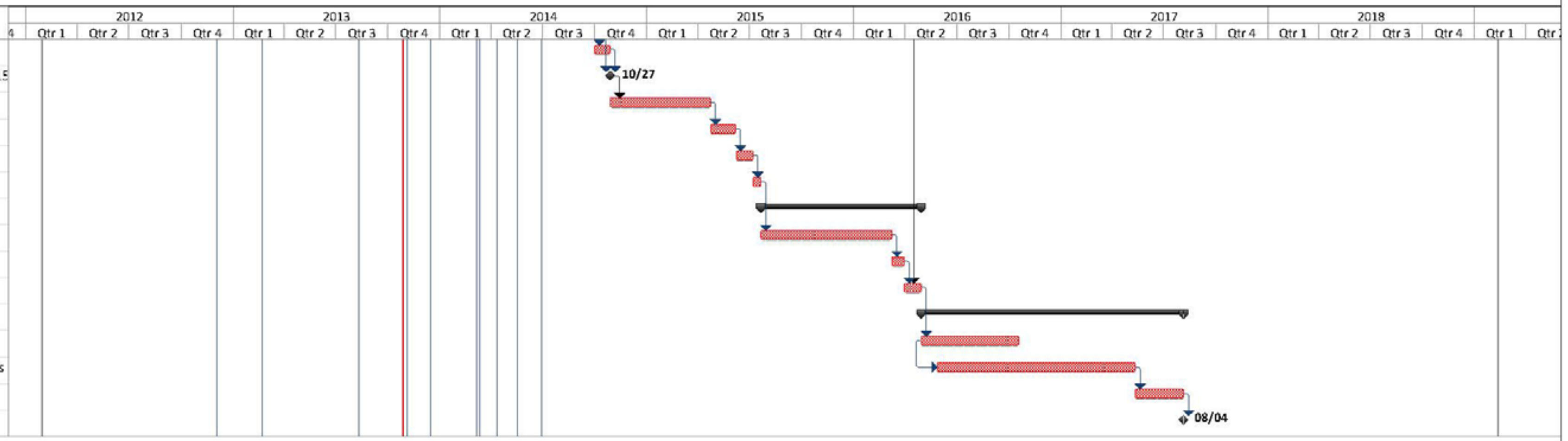
Project: AMD Implementation Plan
Edition 1
Date: 31 July 2013

Task | Milestone | Summary | Project Summary | Progress | Critical Task

Implementation Plan - Edition 1.mpp   Print Date 2013/10/28

AMD FEASIBILITY STUDY
IMPLEMENTATION PLAN

ID	Task Name	Duration	Start	Finish	Predecessors
170	RfP Approval	20 days	2014/09/30	2014/10/27	169
171	RFP Issue	0 days	2014/10/27	2014/10/27	170,167,147,15
172	RFP Competitive Period	120 days	2014/10/28	2015/04/22	171
173	Evaluation	30 days	2015/04/23	2015/06/05	172
174	Approvals	20 days	2015/06/08	2015/07/06	173
175	Preferred Bidder	10 days	2015/07/07	2015/07/20	174
176	**Contract Preparation**	**195 days**	**2015/07/21**	**2016/04/28**	
177	Negotiations	160 days	2015/07/21	2016/03/07	175
178	Report and Approval (TA III)	15 days	2016/03/08	2016/03/29	177
179	Financial Close	20 days	2016/03/30	2016/04/28	178,121
180	**Implementation**	**320 days**	**2016/04/29**	**2017/08/04**	
181	Detail Design	120 days	2016/04/29	2016/10/17	179
182	Construction	240 days	2016/05/27	2017/05/11	181SS+20 days
183	Commissioning	60 days	2017/05/12	2017/08/04	182
184	**RfO**	0 days	2017/08/04	2017/08/04	183



Project: AMD Implementation Plan
Edition 1
Date: 31 July 2013

Task | Milestone | Summary | Project Summary | Progress | Critical Task

Implementation Plan - Edition 1.mpp   Print Date 2013/10/28

Figure 14.3: Summary Programme for Central Basin

14.4 Eastern Basin

The programme shows that the LTS will be RfO in January 2018.

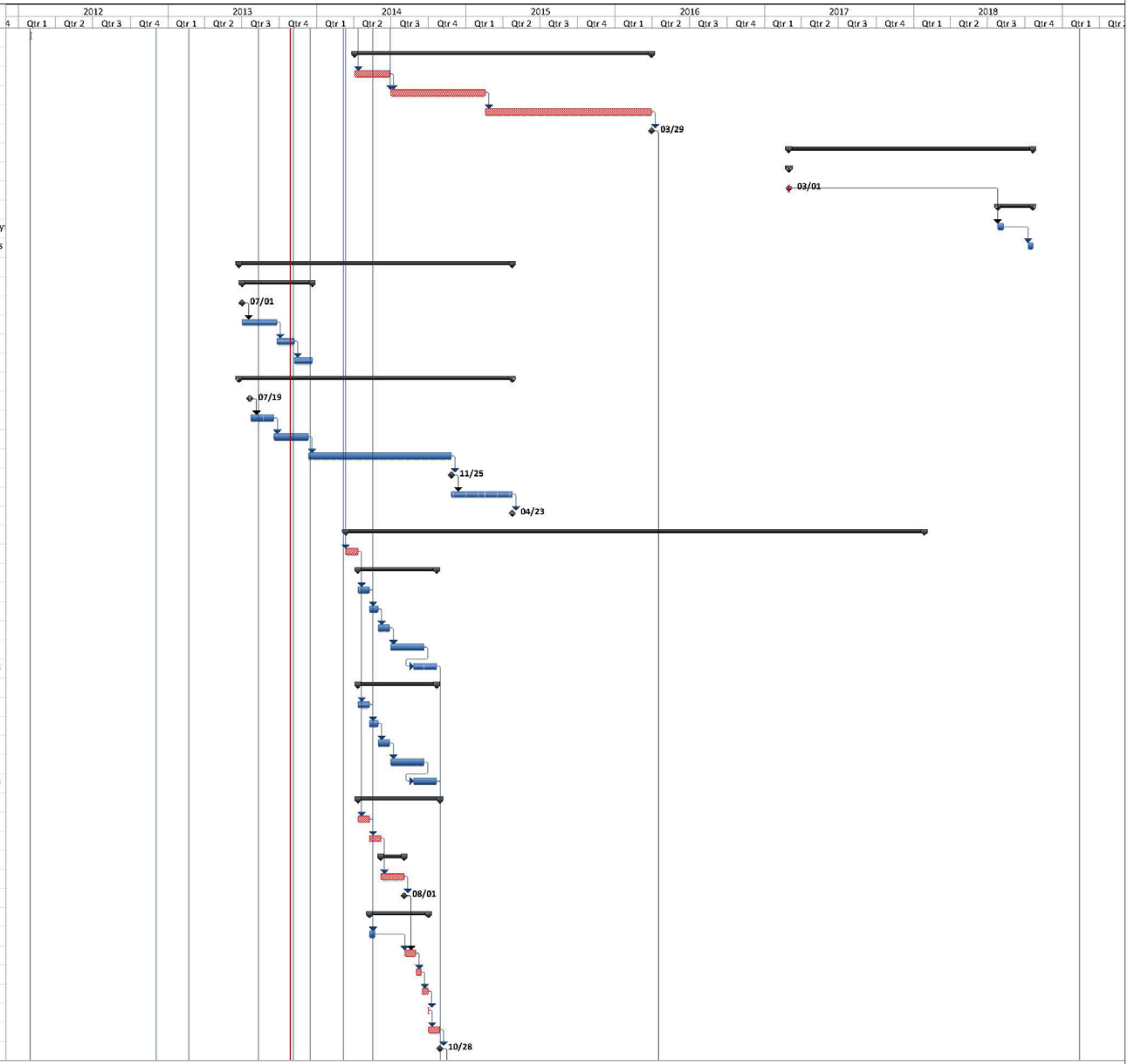
Once the institutional, contractual and funding arrangements are agreed, the critical activities are:

- Agreeing delivery points and tariffs with Rand Water;
- Initiating an EIA for the works;
- Establishing DWA SPU;
- Appointment of DWA Transaction Advisor;
- Prequalification and procurement of Contractor; and
- Detail design, construction and commissioning of works.

The programme is summarised in **Figure 14.4**.

AMD FEASIBILITY STUDY
IMPLEMENTATION PLAN

ID	Task Name	Duration	Start	Finish	Predecessors
185	**EASTERN BASIN**	1 day?	2012/01/30	2012/01/30	
186	**EIA for LTS (Eastern Basin)**	**500 days**	**2014/04/03**	**2016/03/29**	
187	Registration of Project	60 days	2014/04/03	2014/06/27	28
188	Scoping phase of EIA	160 days	2014/06/30	2015/02/16	187,22
189	Impact Assessment phase of EIA	280 days	2015/02/17	2016/03/29	188
190	EIA Authorisations (assuming no appeals)	0 days	2016/03/29	2016/03/29	189
191	**Critical water levels**	**411 days**	**2017/03/01**	**2018/10/19**	
192	**Conservative ECL**	**1 day**	**2017/03/01**	**2017/03/01**	
193	ECL + TOL (1280M)	1 day	2017/03/01	2017/03/01	
194	**Higher ECL**	**60 days**	**2018/07/26**	**2018/10/19**	
195	TOL (1450M)	10 days	2018/07/26	2018/08/08	193FS+350 day:
196	ECL (1470M)	10 days	2018/10/08	2018/10/19	195FS+40 days
197	**Short Term Interventions**	**460 days**	**2013/06/24**	**2015/04/23**	
198	**Ritz Pumps**	**120 days**	**2013/07/01**	**2013/12/19**	
199	Order Pumps	0 days	2013/07/01	2013/07/01	
200	Delivery	60 days	2013/07/01	2013/09/23	199
201	RfC	30 days	2013/09/25	2013/11/05	200
202	RfO	30 days	2013/11/06	2013/12/19	201
203	**HDS Construction**	**460 days**	**2013/06/24**	**2015/04/23**	
204	Tender advertised	20 days	2013/06/24	2013/07/19	
205	Tender period	40 days	2013/07/22	2013/09/16	204
206	Adjudicate & Award	60 days	2013/09/17	2013/12/10	205
207	Construction	240 days	2013/12/11	2014/11/25	206
208	RfC	0 days	2014/11/25	2014/11/25	207
209	Commissioning and Trial Operation	100 days	2014/11/26	2015/04/23	208
210	RfO	0 days	2015/04/23	2015/04/23	209
211	**Long term solution**	**975 days**	**2014/03/12**	**2018/01/26**	
212	**Mobilise PSP as TA**	20 days	2014/03/12	2014/04/10	38FS+20 days
213	**Geotechnical Investigation**	**135 days**	**2014/04/11**	**2014/10/20**	
214	Prepare Tender Documents	20 days	2014/04/11	2014/05/08	212
215	Bid period	15 days	2014/05/09	2014/05/29	214
216	Adjudicate and award	20 days	2014/05/30	2014/06/27	215
217	Investigations and laboratory Testing	60 days	2014/06/30	2014/09/19	216
218	Reporting	40 days	2014/08/25	2014/10/20	217FS-20 days
219	**Topographical Surveys**	**135 days**	**2014/04/11**	**2014/10/20**	
220	Prepare Tender Documents	20 days	2014/04/11	2014/05/08	212
221	Bid period	15 days	2014/05/09	2014/05/29	220
222	Adjudicate and award	20 days	2014/05/30	2014/06/27	221
223	Survey work	60 days	2014/06/30	2014/09/19	222
224	Mapping and Reporting	40 days	2014/08/25	2014/10/20	223FS-20 days
225	**Request For Qualifications**	**141 days**	**2014/04/11**	**2014/10/28**	
226	Drafting RfQ	20 days	2014/04/11	2014/05/08	212
227	Document approval (TA II(a) (RfQ)	20 days	2014/05/09	2014/06/05	226
228	**RFQ Exposure Period**	**40 days**	**2014/06/06**	**2014/08/01**	
229	Issuing and Response Period	40 days	2014/06/06	2014/08/01	227
230	Receipt	0 days	2014/08/01	2014/08/01	229
231	**RFQ Evaluation**	**101 days**	**2014/05/09**	**2014/09/30**	
232	Agree Evaluation Criteria	10 days	2014/05/09	2014/05/22	226
233	Evaluation Process	20 days	2014/08/04	2014/08/29	232,230
234	Technical assessment	10 days	2014/09/01	2014/09/12	233
235	Evaluation Committee	10 days	2014/09/15	2014/09/29	234
236	Pre-qualified shortlist	1 day	2014/09/30	2014/09/30	235
237	RFQ Approvals	20 days	2014/10/01	2014/10/28	236
238	Shortlist Issued	0 days	2014/10/28	2014/10/28	237



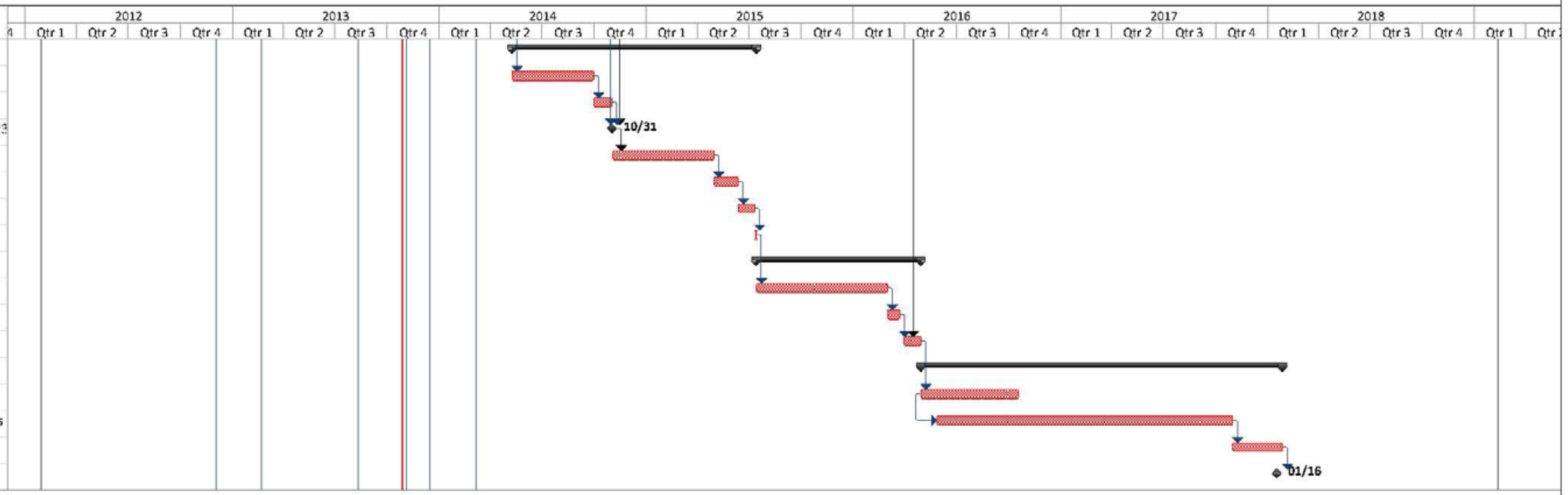
Project: AMD Implementation Plan
Edition 1
Date: 31 July 2013

Task | Milestone | Summary | Project Summary | Progress | Critical Task

Implementation Plan - Edition 1.mpp | Print Date 2013/10/28

AMD FEASIBILITY STUDY
IMPLEMENTATION PLAN

ID	Task Name	Duration	Start	Finish	Predecessors
239	**Request for Proposal**	**295 days**	**2014/05/09**	**2015/07/13**	
240	RFP Preparations	100 days	2014/05/09	2014/09/29	226,22
241	RfP Approval	24 days	2014/09/30	2014/10/31	240
242	RFP Issue	0 days	2014/10/31	2014/10/31	241,218,224,23
243	RFP Competitive Period	120 days	2014/11/03	2015/04/29	242
244	Evaluation	30 days	2015/04/30	2015/06/11	243
245	Approvals	20 days	2015/06/12	2015/07/10	244
246	Preferred Bidder	1 day	2015/07/13	2015/07/13	245
247	**Contract Preparation**	**200 days**	**2015/07/14**	**2016/04/28**	
248	Negotiations	160 days	2015/07/14	2016/02/29	246
249	Report and Approval (TA III)	15 days	2016/03/01	2016/03/22	248
250	Financial Close	20 days	2016/03/30	2016/04/28	249,190
251	**Implementation**	**440 days**	**2016/04/29**	**2018/01/26**	
252	Detail Design	120 days	2016/04/29	2016/10/17	250
253	Construction	360 days	2016/05/27	2017/10/30	252SS+20 days
254	Commissioning	60 days	2017/10/31	2018/01/26	253
255	**RfO**	0 days	2018/01/16	2018/01/16	254



Project: AMD Implementation Plan
Edition 1
Date: 31 July 2013

Task | Milestone | Summary | Project Summary | Progress | Critical Task

Implementation Plan - Edition 1.mpp | Print Date 2013/10/28

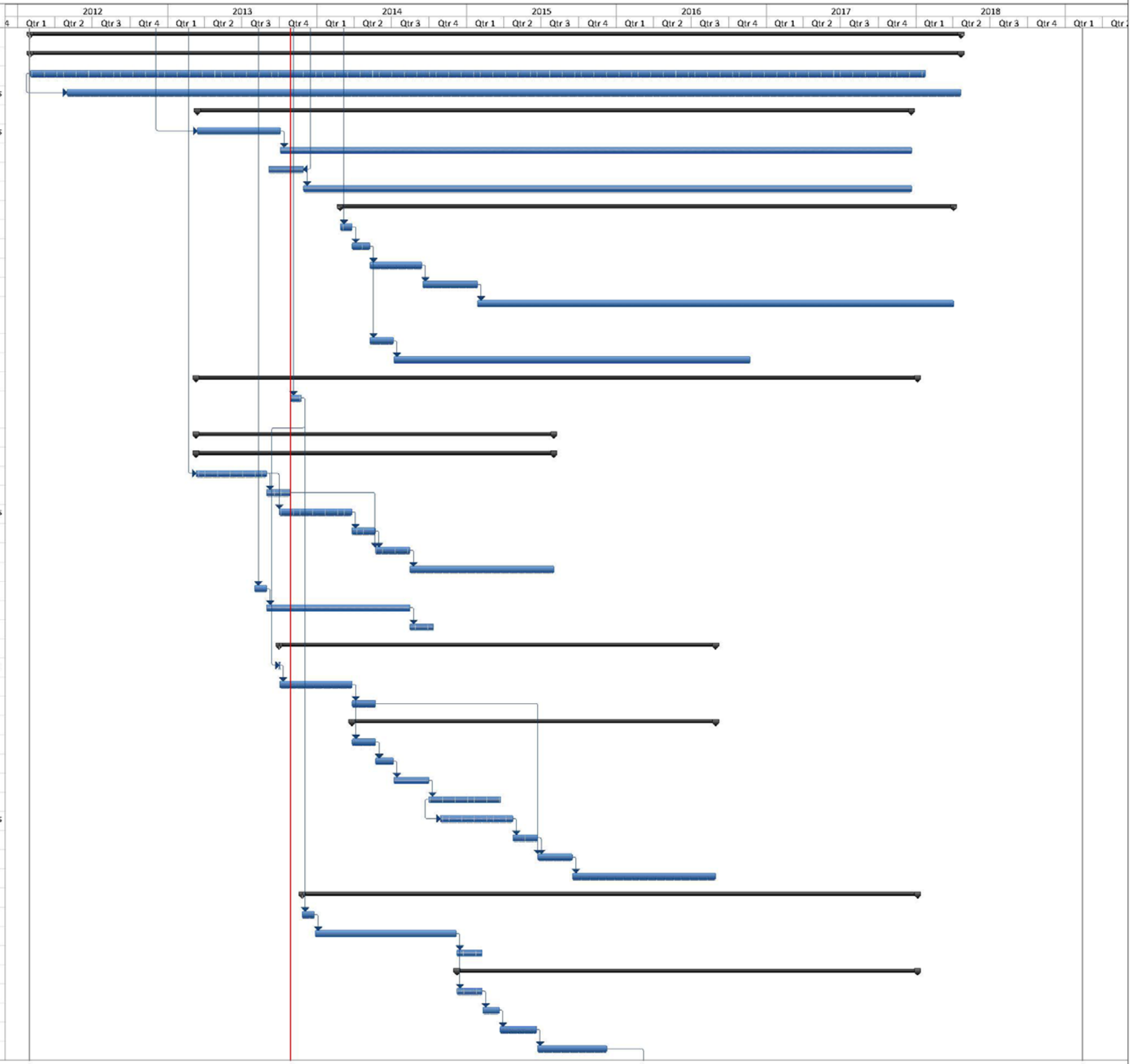
Figure 14.4: Summary Programme for Eastern Basin

14.5 Hydrogeological Monitoring and Ingress Control

The current understanding of the plans for ingress control, as well as the current planning and recommended action for monitoring are given in **Figure 14.5**.

AMD FEASIBILITY STUDY
IMPLEMENTATION PLAN

ID	Task Name	Duration	Start	Finish	Predecessors
256	**HYDROGEOLOGICAL MONITORING**	**1560 days**	**2012/01/31**	**2018/04/20**	
257	**EXISTING MONITORING PROGRAMME**	**1560 days**	**2012/01/31**	**2018/04/20**	
258	Monitoring	1500 days	2012/01/31	2018/01/23	2
259	Evaluation and Assessment	1500 days	2012/04/30	2018/04/20	258SS+60 days
260	**SHAFT MONITORING**	**1200 days**	**2013/03/14**	**2017/12/20**	
261	STI capping of shafts	140 days	2013/03/14	2013/10/02	137SS+60 days
262	Monitoring Commences	1060 days	2013/10/03	2017/12/20	261
263	LTS capping of shafts	60 days	2013/09/04	2013/11/27	137FF
264	Monitoring Commences	1020 days	2013/11/28	2017/12/20	263
265	**MONITORING, EVALUATION AND ASSESSMENT**	**1030 days**	**2014/02/26**	**2018/04/02**	
266	Mobilise PSP	20 days	2014/02/26	2014/03/26	18
267	Design Near Surface Monitoring Programme	30 days	2014/03/27	2014/05/08	266
268	Procure Drilling Contractor	90 days	2014/05/09	2014/09/12	267
269	Drill Monitoring holes	90 days	2014/09/15	2015/01/26	268
270	Aquifer Monitoring and Sampling Commences	800 days	2015/01/27	2018/04/02	269
271	Design Evaluation System for all monitoring	40 days	2014/05/09	2014/07/04	267
272	Produce Quarterly Reports	600 days	2014/07/07	2016/11/21	271
273	**INGRESS CONTROL**	**1210 days**	**2013/03/11**	**2018/01/04**	
274	Agree interdepartmental responsibility for additional measures	20 days	2013/10/28	2013/11/22	4
275	**CGS - Central Basin**	**600 days**	**2013/03/11**	**2015/07/31**	
276	**Design and tender of phase 1 canals**	**600 days**	**2013/03/11**	**2015/07/31**	
277	Detail Design	120 days	2013/03/11	2013/08/29	3FS-100 days
278	Procure funding for implementation	40 days	2013/08/30	2013/10/25	277
279	Prepare tender documents	120 days	2013/09/30	2014/03/25	277FS+20 days
280	Tender Period	40 days	2014/03/26	2014/05/21	279
281	Adjudicate & Award	60 days	2014/05/22	2014/08/14	280,278
282	Construction	240 days	2014/08/15	2015/07/31	281
283	Phase 2 FS	20 days	2013/08/01	2013/08/29	3
284	Detailed Feasibility Study - Phase 2	240 days	2013/08/30	2014/08/14	283
285	Procure funding for implementation	40 days	2014/08/15	2014/10/10	284
286	**CGS - Eastern Basin**	**731 days**	**2013/09/30**	**2016/08/29**	
287	Mobilise CGS for FS	1 day	2013/09/30	2013/09/30	274FS-40 days
288	Detailed Feasibility Study	120 days	2013/10/01	2014/03/26	287
289	Procure funding for implementation	40 days	2014/03/27	2014/05/22	288
290	**Procure PSP for design and tender**	**610 days**	**2014/03/27**	**2016/08/29**	
291	Scope of Work & RfP for PSP	40 days	2014/03/27	2014/05/22	288
292	Bid Period	30 days	2014/05/23	2014/07/04	291
293	Adjudication and Award	60 days	2014/07/07	2014/09/29	292
294	Detail Design	120 days	2014/09/30	2015/03/23	293
295	Prepare Tender Documents	120 days	2014/10/28	2015/04/22	294SS+20 days
296	Tender Period	40 days	2015/04/23	2015/06/22	295
297	Adjudicate & Award	60 days	2015/06/23	2015/09/14	296,289
298	Construction	240 days	2015/09/15	2016/08/29	297
299	**CGS - Western Basin**	**1030 days**	**2013/11/25**	**2018/01/04**	
300	Mobilise CGS for FS	20 days	2013/11/25	2013/12/24	274
301	Detailed Feasibility Study	240 days	2013/12/27	2014/12/05	300
302	Procure funding for implementation	40 days	2014/12/08	2015/02/06	301
303	**Procure PSP for design and tender**	**770 days**	**2014/12/08**	**2018/01/04**	
304	Scope of Work & RfP for PSP	40 days	2014/12/08	2015/02/06	301
305	Bid Period	30 days	2015/02/09	2015/03/20	304
306	Adjudication and Award	60 days	2015/03/23	2015/06/19	305
307	Detail Design	120 days	2015/06/22	2015/12/07	306



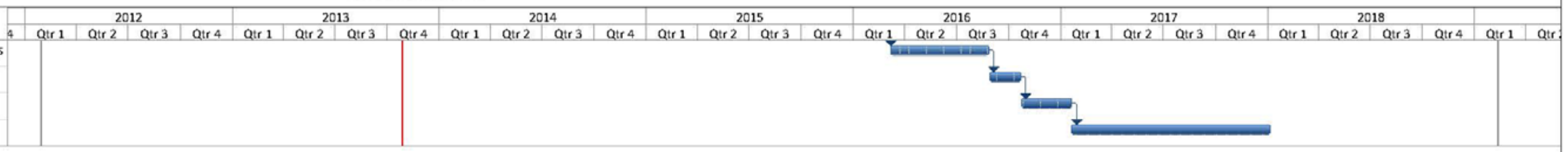
Project: AMD Implementation Plan
Edition 1
Date: 31 July 2013

Task | Milestone ◆ | Summary | Project Summary | Progress | Critical Task

Implementation Plan - Edition 1.mpp   Print Date 2013/10/28

AMD FEASIBILITY STUDY
IMPLEMENTATION PLAN

ID	Task Name	Duration	Start	Finish	Predecessors
308	Prepare Tender Documents	120 days	2016/03/07	2016/08/26	307FS+60 days
309	Tender Period	40 days	2016/08/29	2016/10/21	308
310	Adjudicate & Award	60 days	2016/10/24	2017/01/19	309
311	Construction	240 days	2017/01/20	2018/01/04	310



Project: AMD Implementation Plan
Edition 1
Date: 31 July 2013

Task | Milestone | Summary | Project Summary | Progress | Critical Task

Implementation Plan - Edition 1.mpp Print Date 2013/10/28

Figure 14.5: Summary Programme for Hydrogeological Monitoring

15 HYDROGEOLOGICAL AND WATER RESOURCE MONITORING PLAN

15.1 Introduction, Objectives and Scope

This section identifies the surface and groundwater monitoring that is required so that the impact of any changes to the quantity and quality of surface and groundwater can be assessed and addressed as implementation of the STI and LTS proceeds. Monitoring is especially necessary during the initial phases of pumping so as to establish the hydrogeological parameters of the void. On-going monitoring is necessary to provide information in changes in connectivity of the compartments, for example due to collapse in the void. In basins where the ECL is to be raised, monitoring is essential to asses any impacts of the void water on the groundwater.

The objectives of the hydrogeological and surface water monitoring are to:

- Assess whether the implementation of the STI and LTS are achieving their objectives;
- Provide early warning of possible problems and identify areas where new interventions are required for effective management of the AMD in the mine voids;
- Provide data to assist in assessing the effectiveness of the ingress control measures, which may be implemented; and
- To refine our understanding of the response of the void water to rainfall.

Three major aspects of the basins which should be monitored are:

- Mine Void Water:
  - Water level monitoring via shafts and deep boreholes to determine the water level across the voids, which will provide critical information on the mine void connectivity; and
  - Water quality monitoring, especially from deep boreholes, to assess changes in water quality with time and thus provide information on the flushing and stratification of the void.
- Near Surface Aquifers:
  - Water level and quality monitored through purpose drilled monitoring boreholes drilled to depths below the usual surface borehole depth; these will provide information on the quality of the deep groundwater;
  - Water levels and quality measured through water service boreholes; and
  - Monitoring of boreholes in the dolomites is of particular importance. Not only are they a major water resource, but also because changes in water level can lead to instability (sink holes).

- Surface Water:
  - Water quality monitoring along the rivers and streams, as well as at springs. Void water may appear at surface via springs rather than shafts;
  - Stream flow monitoring along critical river courses. This could also reveal discharge of void water into the base flow of the rivers

The rainfall over the Witwatersrand is quite diverse in terms of intensities, quantity and spatial distribution. Above-average rainfall could generate surface runoff and groundwater recharge, resulting in increasing water levels and decant, as observed in the Western Basin. An adequate spatial distribution of rainfall stations is required and the current South African Weather Services' coverage will need to be extended by adding rainfall stations in specific points in the catchment for each basin. It is envisaged that these stations will be real-time units.

Water samples taken should be tested for the following parameters:

- pH;
- TDS;
- EC,
- Total Alkalinity;
- Major anions and cations:
  - Magnesium (Mg);
  - Calcium (Ca);
  - Potassium (K);
  - Sodium (Na);
  - Sulphate (SO_4)
  - Nitrate (NO_3) and
  - Chloride (Cl).
- Inductively Coupled Plasma Mass Spectrometry (ICP) for dissolved metals, including Uranium (U) and Thorium(Th);
- Radioactivity of the sample; and
- Radon gas emission.

15.2 Hydrological Monitoring Committee

Managing the re-watering and potential decanting of AMD from the Western, Central and Eastern Basins poses challenges due to the recent and potential negative environmental impacts on surrounding groundwater and surface water resources. The effect of the uncontrolled decant from the Western Basin into the Tweelopies Spruit caused several cases of deterioration of surface and groundwater resources downstream of the decant point.

Monitoring the re-watering process of the basins is a long-term commitment and requires inter-governmental collaboration with support from mining and private partners. Intensive monitoring is critical for the effective planning and management of AMD.

Real-time hydrological and hydrogeological data are essential and the HMC with overarching protocols was established to develop and manage the monitoring networks to monitor the hydrological behaviour of the basins.

The Multi-Disciplinary Committee, consisting of officials from the DMR (including the CGS), DWA (including the TCTA), DST (including the Council for Scientific and Industrial Research (CSIR)) and LAs (Mogale City Local Municipality) was established as the “WITS AMD HMC” or HMC.

The HMC started operational activities in March 2011 and became a fully-functional committee in April 2011. The scope of the HMC is to:

- Address the design and implementation of an operational monitoring programme to generate a package of hydrological parameters on a prescribed time-interval principle. The focus of the HMC is to practice a specific hydro-geological assessment approach in terms of standardization and information dissemination in support of the public Interested and Affected Parties (IAPs), as well as reporting to the DWA WITS-AMD Project Steering and Executive Committees at monthly intervals, who report to the IMC and other Parliamentary Committees.
- Establish and manage a mine void water monitoring program focusing on infrastructure (network) development and maintenance, as well as human and financial resources. The data required is based on the physical and hydro-chemical conditions with reference to the mine-void water status (9 different disciplines).
- Facilitate collaboration between National Governmental (DWA, DMR and DST/TIA), Provincial Government (namely, Gauteng Department of Agricultural and Rural Development (GDARD) and for the Cradle of Humankind World Heritage Site Management Authority) and Local Government (Mogale City Local Municipality and Johannesburg Metropolitan Council). Officers from Provincial / Local Government have recently (November 2011) joined the HMC as permanent members.
- Provide logistical support and safety / regulatory aspects with specific relevance to a selection of mine shafts and physical monitoring of the water level elevation trend and mine-void water quality profile.

Proper data management and assessment of AMD probably represents the backbone of the HMC’s protocols.

The following is noted regarding the HMC’s monitoring program as well as future monitoring programs:

- Hydro-meteorological - The rainfall input over the Witwatersrand is quite diverse in terms of intensities, depths and special distribution. It is possible to have an above-average rainfall season (1 200 mm) over the latter part (January to March) of the hydrological cycle generating extraordinary surface runoff and groundwater recharge resulting in increased AMD decant in the Western Basin).

- Since the current South African Weather Services coverage is insufficient, the rainfall network will have to be enhanced by using rainfall stations erected in specific catchment points for each basin. It is envisaged that these stations will be real-time units operated.
- Surface water - With regard to surface water ingress and the discharge water quality into the Crocodile and Vaal River Systems, an expansion of the surface water monitoring infrastructure is urgently required. Estimations of salt loads are probably not correct or even available in some Witwatersrand area drainages.
- Planning and construction of three surface water gauging stations down the Tweelopies Spruit, receiving AMD from the Western Basin, is included in the current works by the TCTA. Site selection has been completed.
- Mine void water - The water level elevation and water quality profile of the mine voids is crucial for the long-term planning and management of AMD. The efficiency of water treatment facilities will deteriorate when the mine-void water quality varies – a phenomenon observed in the Western Basin, which is probably a result of an event-driven, diverse recharge mechanism. Monthly hand measurements of the water level elevation in the Central Basin are taken by officials from DRD Gold at five redundant mine shafts and reported to DWA via the DMR. Although the CGS has installed two real-time water level monitoring data loggers in two shafts of the Central Basin, the data response is quite poor and not standardized according to the monitoring equipment used by the DWA.
- Since October 2011, staff from the DWA initiated control measurements in the Central Basin at GRCM (Crown Mine No. 14 Shaft) on a three-weekly interval. A water level data logger has been installed, which records the water level response on an hourly interval; and
- Water level monitoring in the Eastern Basin was recorded by Gold One International until 4 November 2011 in the Sub-Nigel No. 1 Shaft. Operations at this shaft have since stopped. The water level in the Eastern Basin is deep (518 m below ground) at Sub-Nigel No. 1 Shaft and measurement from the surface is not possible. Staff from DWA recently altered conditions at the shaft and are using a deep borehole logging unit to measure the water level response.
- Hydrological data base - The DWA databases for groundwater monitoring and water quality analyses have been selected as the official Witwatersrand mine basins data platform. Special data / information security is available and interaction by un-classified external users can be prohibited. Information from several mineshafts have been collated from the DMR and uploaded into DWA's National Groundwater Archive. As water level and mine void water quality becomes available, the data is uploaded and verified. Geological information of the basins and surrounding features of geo-structural importance to the Witwatersrand mine basins are available and reside at the CGS.

- Management of information - Effective management of the three mine basins requires a dedicated hydrological assessment process to support the timing and development of the proposed mine water pumping and treatment. This can only be achieved by resourcing the HMC with staff and facilities to process the information and interface with those operating the dewatering and treatment facilities. The HMC must facilitate the integration between water resources managers and well-maintained databases.
- New equipment - DWA purchased water level data loggers for eight potential mine shafts earmarked as permanent hydrological monitoring stations. As soon as the infrastructure at these outstanding shafts have been rehabilitated according to the DWA's requirements (currently work being done by the TCTA), these instruments will be installed. Once operational, these instruments will submit daily water level information from all the Witwatersrand basins on a daily interval.

Recommendations for an expanded monitoring programme are given in the following sections.

15.3 Mine Void Water

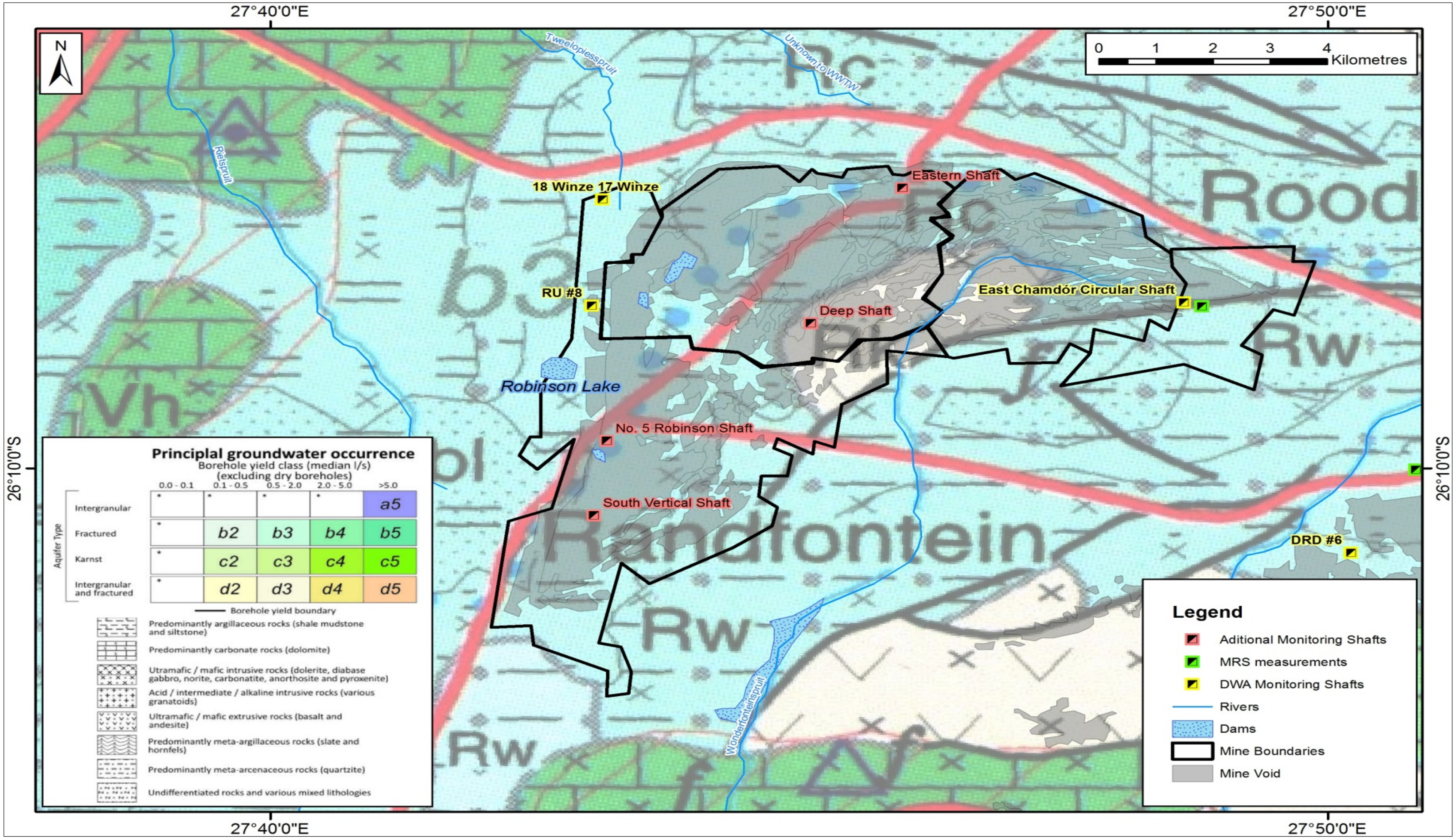
15.3.1 Introduction

The water level across each basin should be monitored regularly and the water quality determined. A water quality profile of the mine voids is vital for the long-term planning and management of the void water, as it could influence the operational plans or the effectiveness of the water treatment facility. This information may enable more cost effective management of the pumping and treatment operations.

Only the water level is being monitored at present although CGS has previously used a PSP to do water quality profiling to about 3 000 mbs. It is recommended that water quality samples are obtained and analysed before and during pumping, in order to evaluate the water qualities within the mine.

15.3.2 Western Basin

Four shafts are currently being monitored by DWA in the Western Basin; the No. 17 and No. 18 Winze Shafts; Rand Uranium No. 8 Shaft and East Chamdor Circular Shaft (**Figure 15.1**). These shafts cover the northern portion of the mine void. It is suggested that an additional shaft further south and a shaft in the centre of the basin be included in the monitoring program in order to provide a better understanding of the connectivity in the basin. **Figure 15.1** shows the location of shafts that are currently being monitored and shafts that could be possibly monitored in the future. However, if these shafts are not available, other shafts in those general locations would be acceptable.



	0.0 - 0.1	0.1 - 0.5	0.5 - 2.0	2.0 - 5.0	>5.0
Intergranular	*	*	*	*	a5
Fractured	*	b2	b3	b4	b5
Karnst	*	c2	c3	c4	c5
Intergranular and fractured	*	d2	d3	d4	d5

Figure 15.1: Western Basin: Locations of current and suggested additional monitoring shafts for monitoring

15.3.3 Central Basin

The shafts currently being monitored in the Central Basin are well spaced across the void, as shown in **Figure 15.2**. Since October 2011, staff from DWA implemented level measurements in the Central Basin at Gold Reef City (Crown Mine No. 14 Shaft) on a three-weekly interval. A water level data logger has also been installed which records the water level at an hourly interval. The staff at Gold Reef City measure water levels daily in No. 14 Shaft.

From current data, it is evident that the water levels throughout the basin are similar, differences between shafts being within one metre measurement error. The number of shafts being monitored at present is adequate to achieve the required objectives.

It is likely that there are some isolated compartments which are filling independently of the main void, such as that in the Kimberley Reef, which recently decanted into Crown Mines No. 14 Shaft. These are yet to be identified and it is suggested that the mine plans be examined to located such compartments and if necessary, establish additional monitoring points.

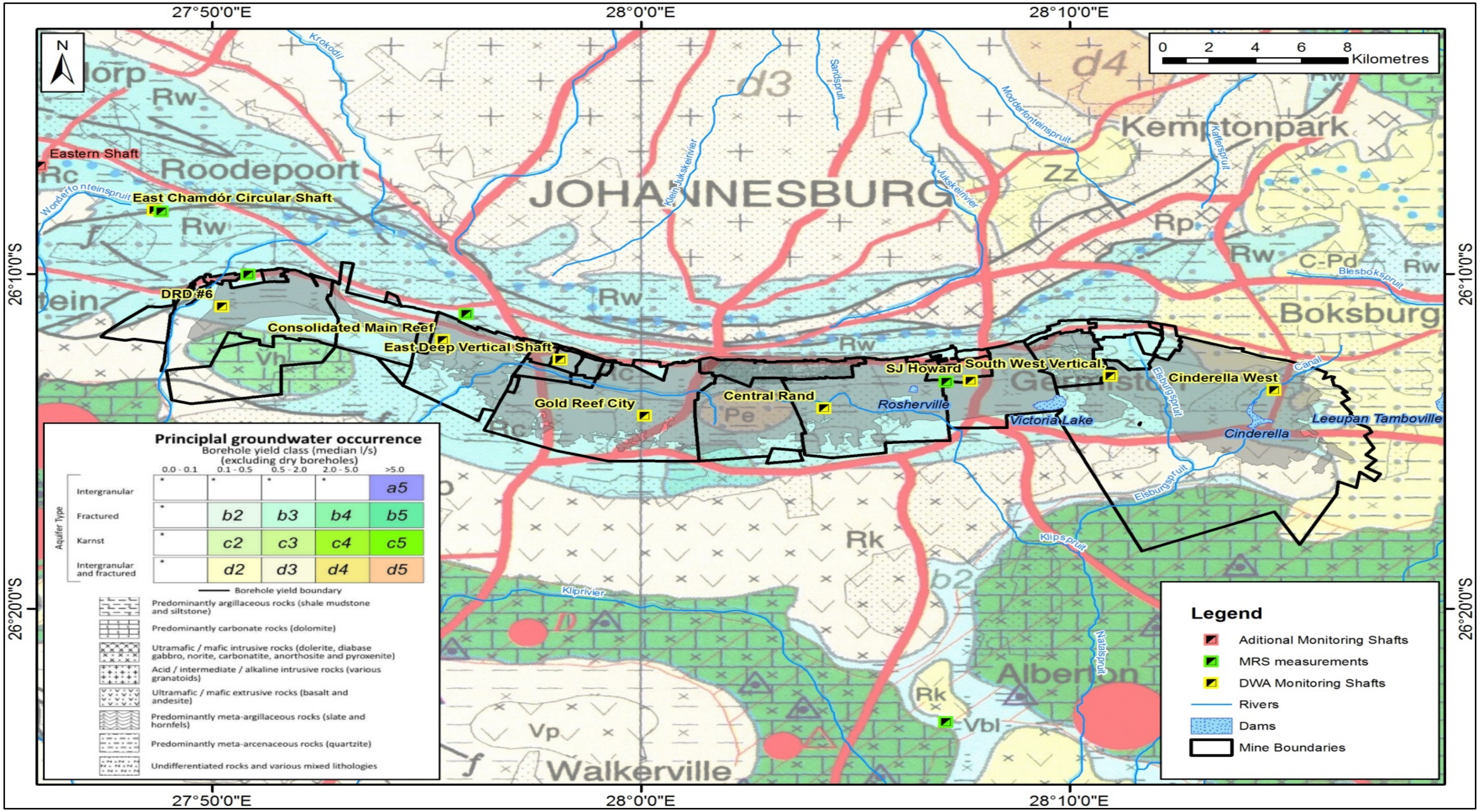


Figure 15.2: Central Basin: Locations of current monitoring shafts

15.3.4 Eastern Basin

The shafts being monitored in the Eastern Basin cover the perimeter of the main mine void, as well as the section to the west of the Springs Monocline where mining was more sporadic mined and is shown on **Figure 15.3**.

The water levels in the Eastern Basin were being recorded in the Sub-Nigel No. 1 Shaft by Gold One International until 4 November 2011. Operations at this shaft then ceased. DWA has recently installed a deep borehole logging unit in the shaft to monitor the water level.

The data for shafts which is currently available (supplied by DWA, is summarised in **Table 15.1**. It indicates that the water level across the basin varies substantially. However, three of these shafts are located in the area of sporadic mining west of the monocline and it is suspected that the Holfontein, Vlakfontein and Spaarwater Shafts are in isolated mine voids not connected to the main basin monitored at Sub Nigel No. 1. Therefore further results from additional shafts are required in order to establish a better database so as to assess the significance of the elevation variations in **Figure 15.3**.

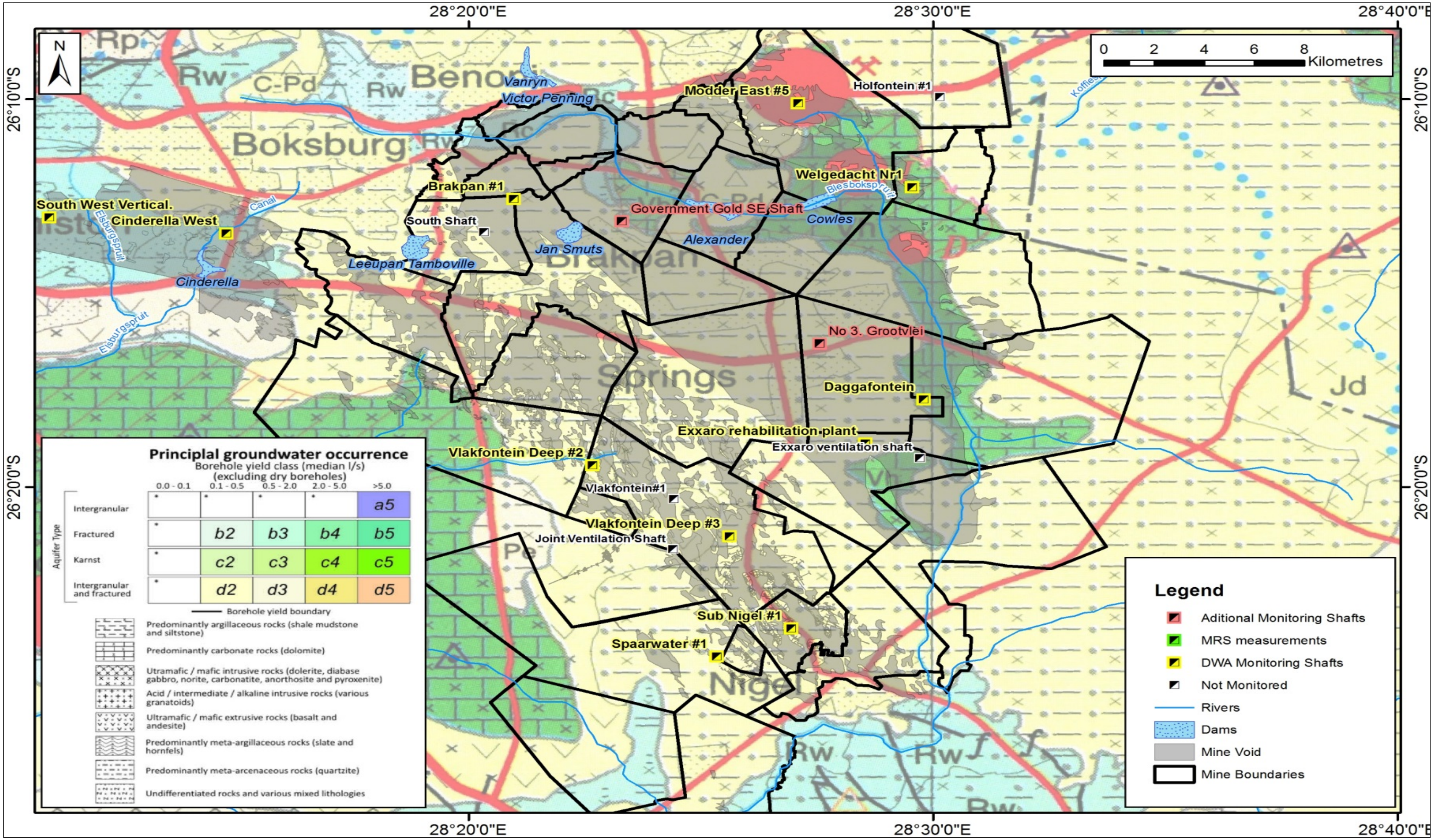


Figure 15.3: Eastern Basin: Locations of current and suggested additional monitoring shafts

Table 15.1: Eastern Basin: Shaft Water Levels, 2 April 2013

Shaft	Collar Elevation m amsl (DWA)	Depth to water (m)	Water level m amsl (DWAF)
Holfontein No. 1	1 626	-118	1 508
Sub-Nigel No. 1	1 586	-447	1 139
Vlakfontein Deep No. 1	1 626	-437	1 189
Vlakfontein Deep No. 2	-	-274	-
Spaarwater No. 1	1 610	-503	1 107

In addition to the shafts selected for monitoring by the DWA (**Figure 15.3**), it is recommended that Grootvlei No. 3 Shaft be monitored, as well as shafts to the north-west of Grootvlei on any one of the mines, New Modder, Government Gold Mining Areas, New State Areas or Geduld.

15.4 Near Surface Aquifers

The near surface aquifers that are vulnerable to pollution are those situated over the void where the base of the aquifer is closest to the ECL. Monitoring in these areas is thus the highest priority. Across all three basins the near surface aquifer in the vicinity of the mine tailings facilities has been severely polluted by plumes emanating from these dumps. This pollution is unrelated to the mine void water and must be taken into consideration when trying to establish the impact of mine void water on the shallow aquifer.

Interrogation of the National Groundwater Archive (NGA) shows that there are many water supply boreholes located above the mine voids, although the current status of these is unknown. Several of these are used for water quality monitoring which is undertaken by DWA. Unfortunately, monitoring is infrequent and the internet based databases are not updated regularly. In addition, many of these are relatively shallow, thus limiting their use to check for pollution of the deeper portions of the near surface aquifer.

It is recommended that a hydro-census be undertaken of all the existing boreholes within areas where the void is closest to surface to identify those which can be monitored specifically for this study, i.e. that have sufficient depth and are at a satisfactory location. The census will also identify locations where new dedicated boreholes can be drilled.

The monitoring of these boreholes should include water levels, as well as groundwater quality for pH, EC, TDS and heavy metals. The water quality sampling should be undertaken at least quarterly to establish baseline quality, but water levels should be monitored more frequently to establish the seasonal variations. Once the mine void water reaches the proposed TOL in each basin, monitoring should be increased to monthly for at least a year, to ensure that there is no mixing of the void waters with the shallow aquifer. Thereafter, if there is no deterioration in the water quality, monitoring could be reduced to quarterly. Increased monitoring is especially important in cases where the ECL is being raised.

15.4.1 Western Basin

The West Rand mines are situated on a fractured aquifer which has been polluted by mine tailing facilities. The service boreholes in this area are shown on **Figure 15.4**, and yield between 0.5 and 2 ℓ/s. The major concern for groundwater and shallow aquifer contamination in the Western Basin area lies in the dolomite outlier underlying the Tweelopies Spruit to the north-west of the mines, which is a karstic aquifer (> 5 ℓ/s yield). Ingress of void water into this aquifer has resulted in complete saturation and the polluted water is decanting via numerous springs into the Tweelopies Spruit. This discharges downstream across the Witwatersrand quartzites into the Swartkrans Dolomitic compartment in the Cradle of Humankind where sever pollution is taking place. This aquifer is an important supply of water for agriculture and local abstraction of more than 10 million m^3/a is used in commercial farming.

It is recommended that at least 5 monitoring boreholes be established in the dolomite outlier along the Tweelopies Spruit in order to monitor the changes associated with dewatering of this aquifer as the mine void water level is lowered. As the water level in the mine voids is lowered, its effect on the base flow of the Tweelopies Spruit will decrease and many of the springs will dry up. Surface recharge will dilute the polluted water in the aquifer and assist with flushing of the mine void. It is important to monitor these changes as there is a secondary source of pollution in the Tweelopies Spruit emanating from the tailings dumps in the catchment.

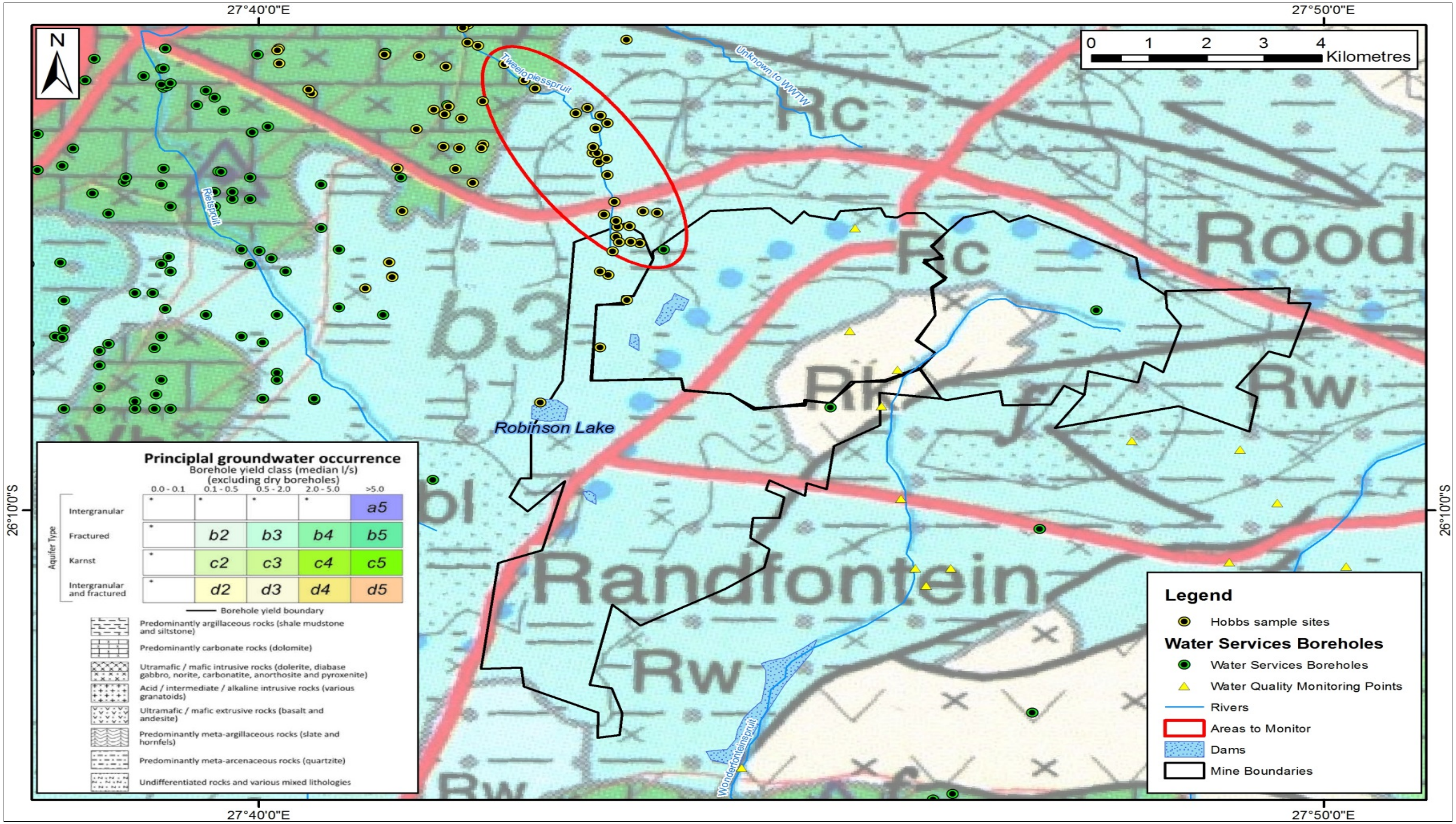


Figure 15.4: Western Basin: Location of water services boreholes (NGA) and areas to be investigated

15.4.2 Central Basin

The Central Basin mining is overlain by a fractured aquifer which has average yields of 0.5 – 2 ℓ/s. There are no major abstraction points located on the Witwatersrand Supergroup rocks in this area. However, there is significant abstraction from the aquifer in the dolomitic rocks to the south which overly the Witwatersrand Supergroup. This includes the Zuurbekom pump station near Lenasia. This aquifer lies well to the south of the mine void and is unlikely to be directly polluted by void water. However, seepage from mine tailings facilities has polluted the streams feeding this dolomitic aquifer from the north and it is already severely polluted. The DWA has adequate coverage of water quality monitoring points in the dolomitic aquifer along the rivers, as shown in **Figure 15.5**.

The critical area for monitoring the effect of mine void water on the shallow groundwater aquifer is in the area of ERPM mine where the surface elevation is at its lowest (**Figure 15.5**). There are currently no monitoring boreholes in this area and monitoring boreholes specifically for this monitoring program. The location of these boreholes will have to be chosen with care because the near surface aquifer in the area is probably severely polluted by plumes emanating from the many mine tailing facilities in the area.

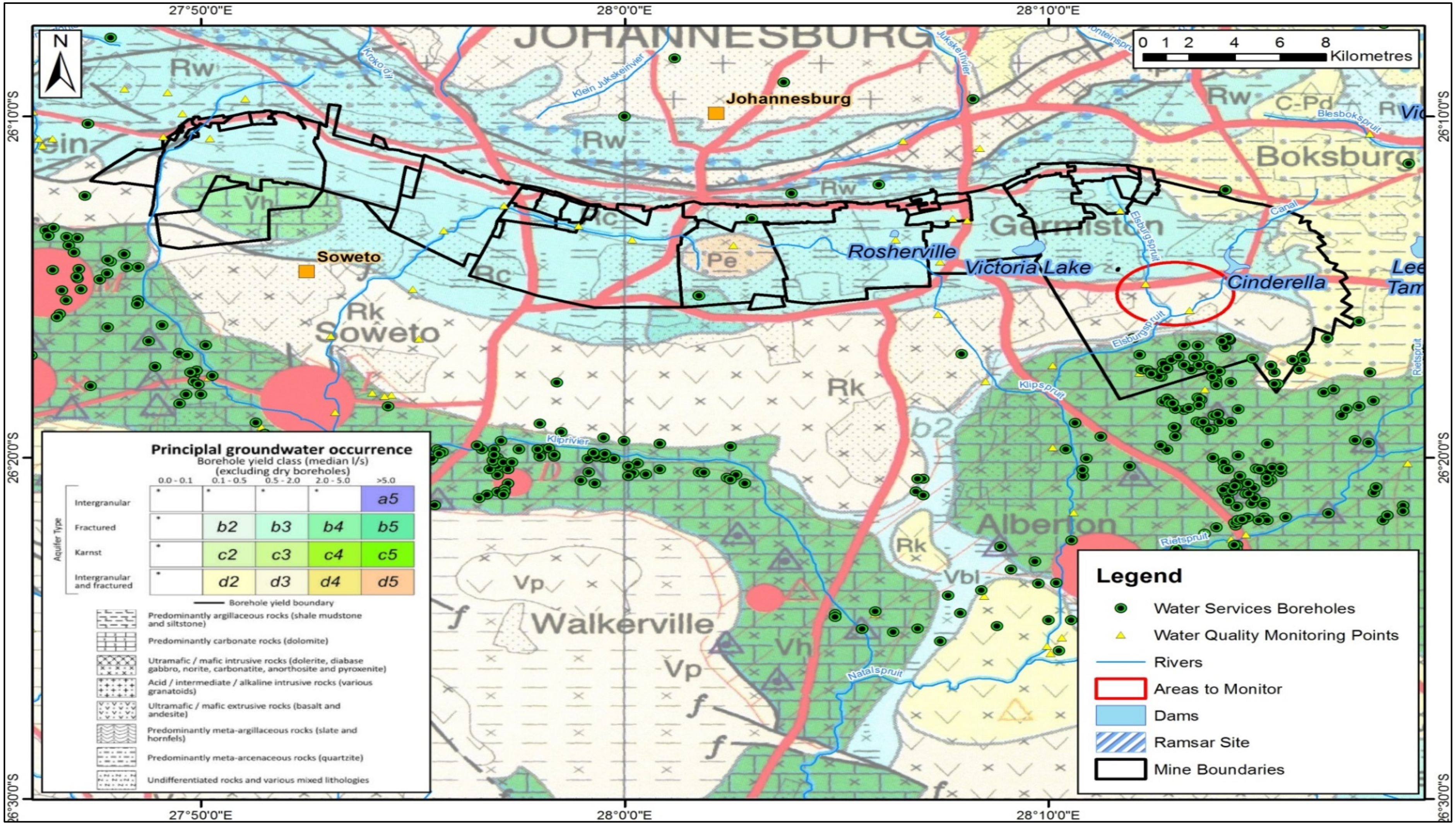


Figure 15.5: Central Basin: Location of water services boreholes (NGA) and areas to be investigated

15.4.3 Eastern Basin

There are two major aquifers occurring within the mine boundaries of the Eastern Basin, shown on **Figure 15.6**; the inter-granular and fractured aquifer of the Karoo Super Group sediments (average yield of 0.1 – 0.5 ℓ/s) and the karstic aquifer of the Chuniespoort Group dolomites (average yield of > 5 ℓ/s). It is the latter aquifer which is of most concern in this basin. However, there is extensive pollution of the near surface aquifer along the Blesbokspruit as a result of plumes from the tailings facilities and discharge of partially treated water from the mine void in the past. As in the other basins, great care must be taken to distinguish between pollution directly from the mine void and pollution from surface sources.

The monitoring must be done in the vicinity of the Blesbokspruit where the surface elevation is at its lowest and groundwater is at its shallowest. It is recommended that monitoring sites be chosen in areas which receive recharge from rainwater and are located away from tailings facilities. Suggested areas are shown in **Figure 15.6**, and it is recommended that 8 monitoring boreholes be established across these areas.

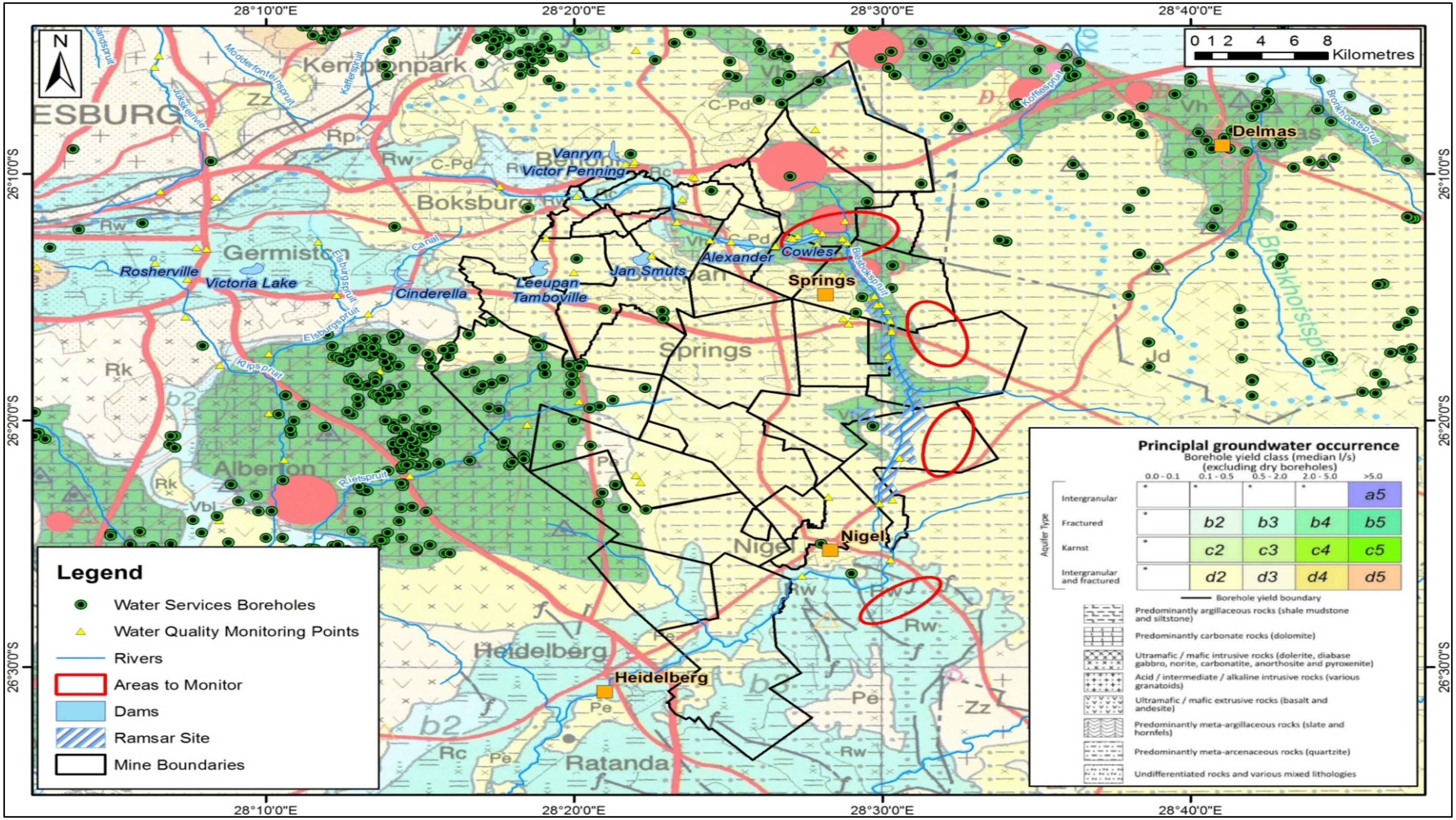


Figure 15.6: Eastern Basin: Location of water services boreholes (NGA) and areas to be investigated

15.5 Surface Water

Expansion of the monitoring of the flows and quality of the water in streams that have and could be affected by decant of AMD is recommended. It is noted that both DWA and Rand Water have extensive water quality monitoring programs in the affected areas, but flows are infrequently recorded. The majority of streams draining the basins are polluted by effluent from tailings facilities, as well as municipal sources. Therefore, knowledge of both flow and quality are essential in determining the effect of the mine void water decanting on surface or into the groundwater.

When CGS undertakes a Feasibility Study to prioritise sites for ingress control, they carry out short-term monitoring of flows across areas of interest. They also monitor flows following the construction of canals, such as that recently completed at Florida.

15.5.1 Western Basin

Planning and construction of three surface water gauging stations down the Tweelopies Spruit, receiving AMD from the Western Basin, is included in the current work by the TCTA. Additional sites are recommended in this Study. It is recommended that an additional monitoring site be established to the north of the dolomite outlier where the Tweelopies Spruit crosses the Witwatersrand Quartzites.

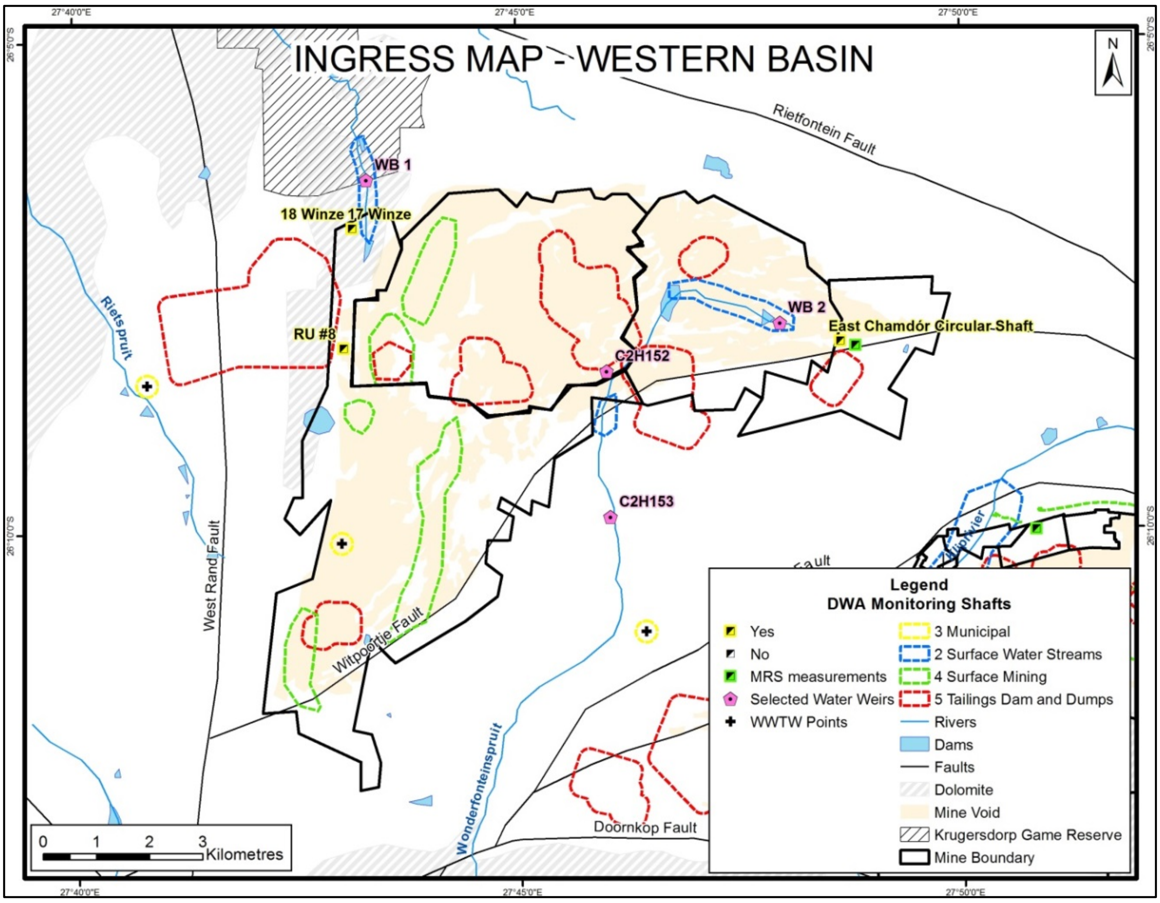


Figure 15.7: Western Basin: Existing flow gauging stations

Monitoring of the surface water can be done at the selected weirs indicated in **Figure 15.7**. An additional weir would need to be installed at the source of the Wonderfonteinspruit (WB 2 on **Figure 15.7**), upstream of the mine dumps in order to get baseline quality samples. Where the Wonderfonteinspruit traverses the Witpoortje fault, it is recommended that the two existing weirs, which are situated upstream (C2H152) and downstream (C2H153) of this intersection, are monitored for flow and sampled for water quality. By monitoring these weirs, one will be able to estimate whether there is water ingress into the mine void via the Witpoortje fault.

15.5.2 Central Basin

Within the Central Basin, streams originate in the W-E striking unmined Witwatersrand ridges of the West Rand Group and drain southwards in the Vaal River System. The Klip River and Klipspruit drain the western portion of the Central Basin. The central portion of the basin is drained by the Natalspruit, and the eastern portion of the basin by the Elsburgspruit. These rivers all flow into the Vaal River, below Vaal Dam and above the Vaal Barrage.

Surface monitoring of flow and water quality should be undertaken at weirs C2H230 and C2H231 to monitor flow rates in the Natalspruit and Elsburgspruit. These weir positions are indicated in **Figure 15.8**. The data resulting from this monitoring can assist in confirming whether there is contamination of AMD into the shallow aquifer, which serves as base flow for the Natalspruit and Elsburgspruit. C2H226 (located on a tributary of the Klipspruit) and C2H041 (located on the Klip River) should be similarly monitored as it is located in another potential decant area.

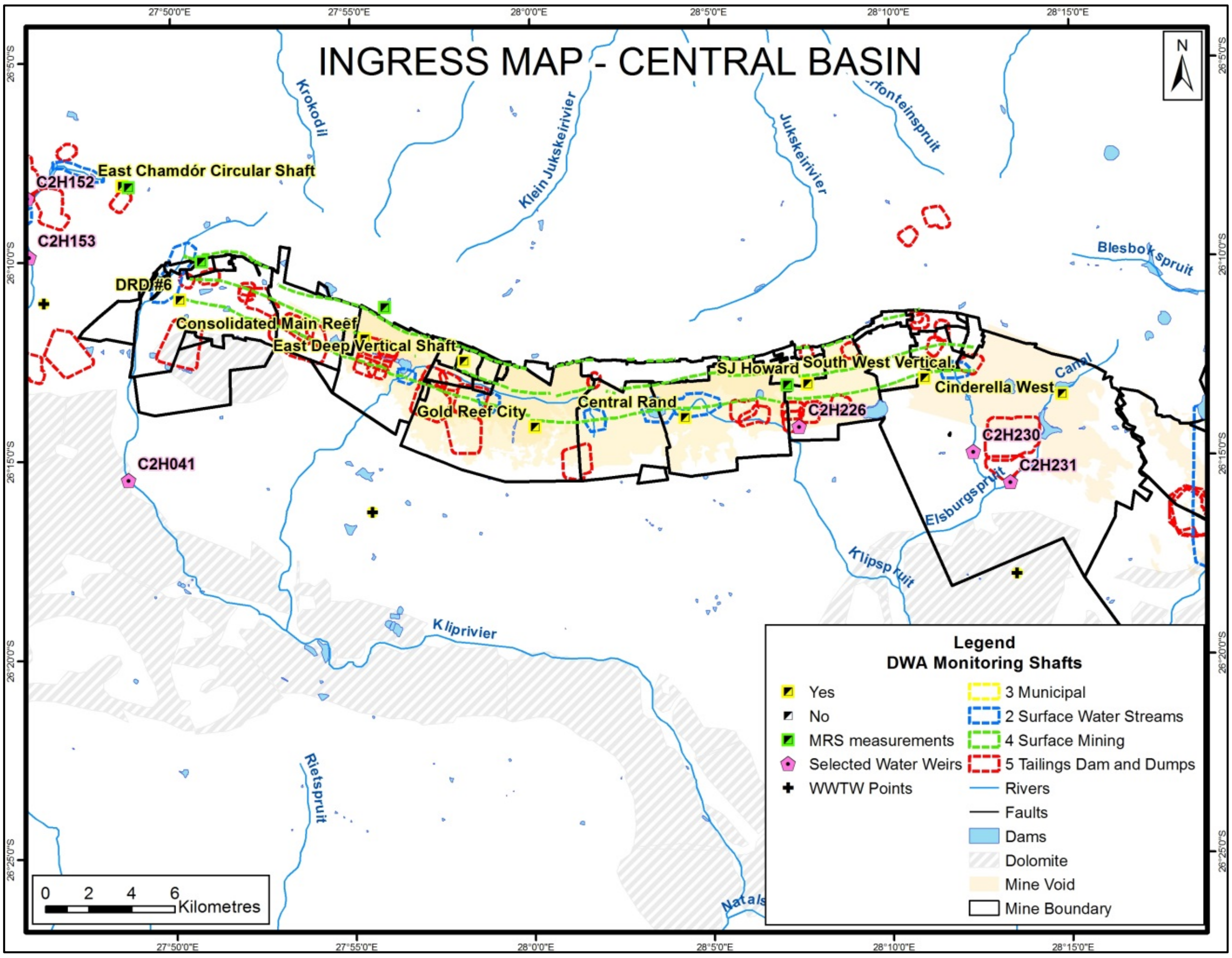


Figure 15.8: Central Basin: Existing flow gauging stations

15.5.3 Eastern Basin

The northern and eastern portions of the Eastern Basin are primarily drained by the Blesbokspruit, while the Rietspruit drains the central and western portions. Both rivers ultimately flow into the Vaal River below the Vaal Dam and above the Vaal Barrage.

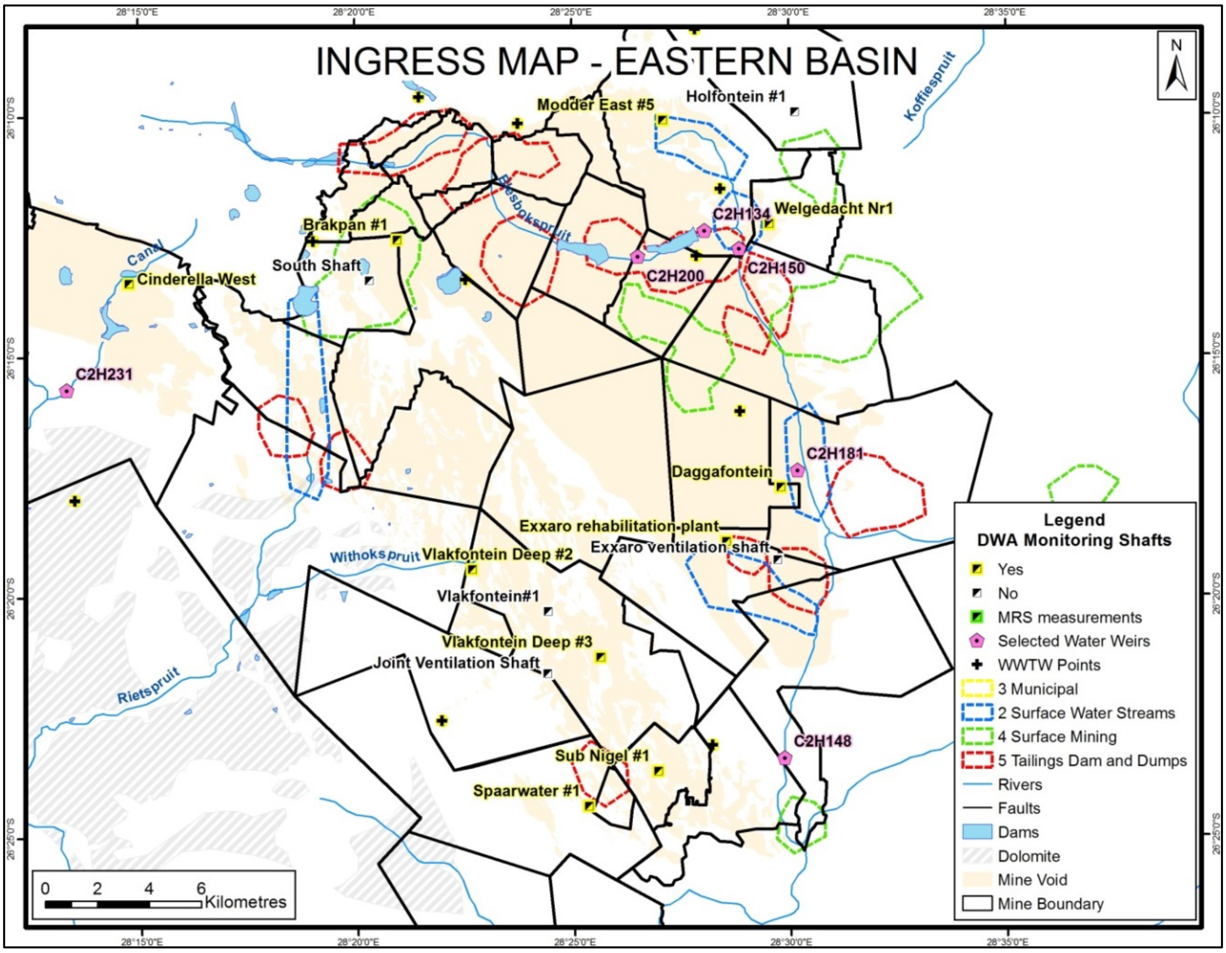


Figure 15.9: Eastern Basin: Existing flow gauging stations

The following weirs have been selected for monitoring:

- C2H200 and C2H134 are located upstream and downstream respectively of Cowles Dam, which is a major source of Ingress. By monitoring these weirs, it will be possible to determine the amount that Cowles Dam contributes to ingress; and
- The proposed pumping shaft for the Eastern Basin is Grootvlei No. 3. The weir C2H150 is positioned upstream of the Grootvlei No. 3 pumping shaft, and monitoring this weir will indicate a flow and baseline water quality prior to the effluent discharging from the treatment plants. The position of the weir is indicated in **Figure 15.9**. The weir just downstream of the proposed discharge from the STI, C2H181 is located on the Blesbokspruit in the vicinity of Grootvlei No. 3 Shaft, and the weir C2H148 is located on the Blesbokspruit near Marievale No. 5 Shaft. If Marievale No. 5 Shaft were chosen as the pumping site, both C2H181 and C2H148 weirs should be monitored for flow and water quality at monthly intervals to provide an understanding of the impact of the STI on the water quality and quantity.

16 STAKEHOLDER ENGAGEMENT AND COMMUNICATION

16.1 Background

Acid Mine Drainage (AMD) management is a complex and multifaceted challenge involving many components and requiring inputs from a wide range of stakeholders to ensure that a sustainable LTS is secured. Effective engagement and communications with stakeholders and the public is a key component of managing AMD.

While this Feasibility Study for the LTS addresses the AMD originating from the mine voids, there are several other parallel initiatives in the bigger picture of addressing the AMD challenge. These initiatives include the STI, monitoring of the underground mining basins, ingress control, work undertaken by the DWA on the Vaal Reconciliation Strategy, and others. Most of these initiatives have their own separate project focussed communication activities with stakeholders and the public. Hence, the current stakeholder engagement and communication context around AMD management related issues and projects, could be construed as fragmented, uncoordinated, leading to stakeholder confusion, mistrust, fear, media speculation and lack of confidence in Government's efforts regarding AMD management in the bigger context.

Stakeholders also do not always understand all the facts about AMD, especially the related complexities and technical issues. Frequently, in situations when there is a lack of proactive sharing of the factual information and a lack of awareness and capacity-building, there is a tendency to create or embellish information. AMD has attracted and will continue to attract high levels of media attention. The reporting is often negative (in the perceived absence of a positive angle) reinforcing a pessimistic and fearful view of the AMD problem among members of the public.

Hence, the approach in the Communication Strategy for the LTS Feasibility Study was to provide information and messages in context with the overall AMD approach. In addition to present sufficient factual information in different forums and formats (as appropriate), to facilitate stakeholder understanding and meaningful contribution to the Study.

Since the Feasibility Study was a planning study, which to a large extent was being informed by existing information, monitoring initiatives, technical input and expert advice, the key objectives of that the DWA AMD FS 2012, Study Report No. 9.1: **"Communication Strategy and Action Plan"** were to:

- Undertake focussed consultation with identified key stakeholders and stakeholder sectors/ groups to assist in identifying sustainable solutions, technical options and management scenarios;
- Engage identified key stakeholders from various relevant fields throughout the Study, to obtain their inputs and discuss the draft outcomes of various study components;

- Assist the DWA to keep the wider stakeholder group informed of progress and key outcomes, and to provide opportunities for constructive input to inform the Feasibility Study; and
- Communicate information regarding the Study to the wider stakeholder group in a manner that enhances their understanding of the AMD challenge and the efforts by DWA and other initiatives to address it, and enable them to provide constructive inputs.

This approach allowed for discussion of common concerns, and for focused discussions on, e.g. environmental and social considerations. In addition, it allowed the Study Team to engage with the wide range of key stakeholders on various levels, e.g. through technical discussions with academics or governance discussions with Provincial Government, while allowing general communication and feedback on the Study to the stakeholders not directly engaged in the technical components of the Study.

The approach has also contributed to a change in the attitudes and understanding of key stakeholders engaged in this Feasibility Study, with key stakeholders having expressed positive sentiments regarding DWA's commitments to AMD management and involving stakeholders in the process.

It is therefore important to utilise this current positive engagement and communication environment, and the lessons learned in the process for the LTS Feasibility Study, as a foundation to enhance the stakeholder engagement and awareness/ capacity-building aspects going forward into the regulatory authorisation and implementation phases of the project. In doing so, it is also essential not to lose the momentum already gained and to commence as soon as possible in the implementation phase, with stakeholder engagement and communication activities that:

- Build stakeholder awareness, understanding and capacity for meaningful participation towards acceptance of the most sustainable LTS;
- Reduce the risk of public concern, anger, misunderstandings and perceptions about the the proposed LTS;
- Correct inaccurate perceptions;
- Manage undue fears and expectations; and
- Build and strengthen trust and confidence in Government's, and especially DWA's efforts and commitments, to address and manage the AMD challenge.

Some of the issues that have been raised by the Key Stakeholders were not only important for the Study, but will also need to be kept in mind during implementation. They are documented in the report on key stakeholder engagement and communications (DWA AMD FS 2013, Study Report No. 9: **"Key Stakeholder Engagement and Communications"**). Although there is now more confidence in the LTS process, the stakeholders have warned against a possible e-Toll situation where the ground swell backlash are resistance from the general public could be severe. This could take the form of disobedience by the taxpayer, and water user resistance presenting as unwillingness to pay for water. The public need to be informed how the cost of the AMD treatment will be recovered and will need to be seen to be fair. It needs to be visible to the stakeholders that the polluter pays principle which is being applied – the general concerns and views expressed included the following:

- Public confidence in the LTS would be improved if effective public participation is provided for in future processes and information is available. The results of current quantity and quality monitoring should be made available to the public;
- Monitoring of surface and subsurface water quantity and quality should be improved so that management action may be improved, with probable substantial savings in operating costs with time;
- Rehabilitation of areas, and compensation of those who have been affected by AMD is a concern as it has yet to be addressed by Government;
- Any communication strategy by DWA will need to actively involve other departments, such as DMR, etc., and they should also actively participate in meetings, etc.; and
- The public need the comfort that an EIA or similar process will be run to provide the opportunity for the public to obtain infrastructure and raise concerns.

Information dissemination to the key stakeholders, as well as the general public, has also been undertaken through the development of the AMD Website and distribution of newsletters. Wider Public Consultation is to follow during the EIA process that is recommended to proceed soon.

A proper public relations and information sharing exercise should be done apart from the statutory consultation processes related to the EIA process.

16.2 Recommendations

Given this background and to achieve the abovementioned objectives for engagement and communication to role-players and the general public in the Implementation Phase of the LTS for AMD, the following are recommended. Note that these recommendations are in addition to the public consultation required for the regulatory authorisation process (EIA), and should run as separate programmes in parallel with the EIA consultation process.

It is recommended that DWA:

- Develops an overarching communication strategy and channel to ensure that communication activities around AMD-related issues from the various initiatives are coordinated through a single entry point within the Department, i.e. DWA Communications. This is to ensure that the messages received by the public, shows DWA and other Government Departments speaking with "one voice" about all AMD related issues. This initiative can be considered at the IGTT where the other representatives involved in AMD initiatives are represented;
- Embarks on nationwide public awareness raising and capacity-building programmes (includng media coverage and proactive information dissemination) focussed on the "bigger picture" of AMD management – its challenges, the several initiatives by

Government and others, Government's commitment, driven by the DWA towards addressing the AMD-related issues, etc.; and

- Continues to engage key stakeholder groups and sectors through existing structures such as the Study Stakeholder Committee (SSC) established for the LTS Feasibility Study, Catchment Forums, as well as through newly established structures for example, Sector-based Liaison Forums.

It will also be important and very positive if it can be achieved that the Mining sector is seen to be visible in taking proactive steps and taking responsibility for protecting the environment and the treatment of AMD.

16.3 Responsibilities

The coordinated effort to link all AMD-related stakeholder engagement, communication, and awareness/ capacity-building activities of the various AMD-related initiatives into a single source of information sharing and communication; is intended for:

- Providing a single channel of information and messages in context with the overall AMD approach;
- Presenting sufficient factual information in different forums and formats (as appropriate) to facilitate stakeholder understanding and meaningful contribution; and
- Providing sufficient opportunity for stakeholder input.

This effort should ideally be initiated and driven by the DWA (Chief Directorate: Communications) supported by technical line functions, linking to existing and future communication structures and initiatives, and should be planned and implemented in collaboration with the:

- DMR;
- DEA;
- DST; and
- Other relevant organs of state.

Note that if a PSP is appointed to undertake the public relations programme for AMD, DWA must ensure that it is not the same PSP involved in the regulatory public consultation processes for the EIA for the LTS.

17 RECOMMENDATIONS FOR INGRESS AND POLLUTION CONTROL

17.1 Introduction

The impact of surface water ingress directly into the underground workings is significant for all three basins. The ingress mainly occurs via reef outcrops, opencast mine pits and backfilled workings, tailings dams, as well as from rivers and other water bodies. It may be possible that water leaking from water and waste water distribution systems also reach the mine void to accelerate the AMD problem. The bulk of the ingress, however, cannot easily be controlled as there are many diffuse sources within the basins. Follow up studies are therefore required to establish both the practicality and cost effectiveness of controlling ingress from various sources and prioritise areas for action. CGS is completing such a study of 19 areas in the Eastern Basin. In the Central Basin, CGS has completed the design of three canals. A comprehensive ingress control and management strategy, however, is required to reduce water ingress in all three basins. In the long-term, this could potentially reduce the required pumping rates and, hence, lower pumping, treatment and maintenance costs. Sources of Ingress in each basin are described in the following section.

The capital and operating cost estimates for the LTS have shown that significant investments will be necessary to construct and operate the LTS. The OPEX over a period equals to the CAPEX every 7 to 10 years. It is therefore crucial to find ways to reduce the costs of managing AMD, whether this is by implementing technologies that can achieve the same objectives but at lower costs, or by reducing the volume of water that must be pumped and treated.

Keeping clean water clean, i.e. preventing unpolluted surface water from entering the mine voids and becoming acidic, and preventing as much ingress of any water as possible, is one of the most cost effective measures in the management of AMD.

In the DWA AMD FS 2013, Study Report No. 5.2: **"Assessment of the Water Quantity and Quality of the Witwatersrand Mine Voids Report"**, the ingress volumes, as well as the potential reduction in ingress if a range of ingress control measures are implemented, were estimated from past studies:

- Western Basin – Estimated average ingress as 23 Mℓ/d. Potential (maximum) reduction of up to 11 Mℓ/d. Assume a 5 Mℓ/d reduction is achievable;
- Central Basin – Estimated average ingress as 46 Mℓ/d. Potential (maximum) reduction of up to 20 Mℓ/d. Assume only half of this is achievable, thus a 10 Mℓ/d reduction is assumed; and
- Eastern Basin – Estimated average ingress as 80 Mℓ/d. Potential (maximum) reduction of up to 42 Mℓ/d. Assume only half of this is achievable, thus a 21 Mℓ/d reduction is assumed.

No detailed assessment as to the practicality and detailed cost implication has been made for the control of ingress, as it is outside the scope of work for this Study. It is recommended that follow-up studies be undertaken to define in more detail the ingress points and sources, as well as the extent and practicality to reduce the ingress with an estimate of associated costs if these are not part of the project being carried out by the CGS, described below.

The estimated volume of water entering the mine void in each basin and the volume which could be prevented through ingress control is summarised in **Table 17.1**.

Table 17.1: Possible Benefits of Ingress Control

Basin	Predicted Ingress (Mℓ/d) No Ingress Control		Predicted Saving (Mℓ/d)	Predicted Ingress (Mℓ/d) With Improved Ingress Control	
	Average	Range		Average	Range
Western	23	19-27	5	18	14-22
Central	46	34-84	10	36	24-74
Eastern	80	70-100	21	59	49-79

This possible reduction in ingress has been ignored in the sizing of infrastructure and in estimating long-term operating costs. However, the saving in operating costs which can be achieved by reducing the volumes of water that must be pumped and treated is estimated in **Table 17.2**.

Table 17.2: Possible Savings as a result of Ingress Control

Basin	Pumping	Treatment		Sludge Disposal	Treated Water Delivery	Combined Saving (R Million per Mℓ/d/a)	Assumed Ingress Reduction (Mℓ/d)	Total Saving (R million/a)
		HDS	RO					
Western	0.22	1.45	3.00	1.27	0.12	6.1	5	30.5
Central	0.24	1.39	3.35	0.83	0.20	6.0	10	60.0
Eastern	0.29	0.88	1.59	0.63	0.20	3.6	21	75.6
Total possible saving with assumed ingress control (R million/a)								166.1

These savings exclude the cost of ingress control measures and are intended only to give an indication of how much money can be spent on such measures. However, when the possible savings compared with the estimated capital cost of the three basins in the Central Basin of R 80 million, it seems that those measures will be cost effective.

17.2 Ingress Control

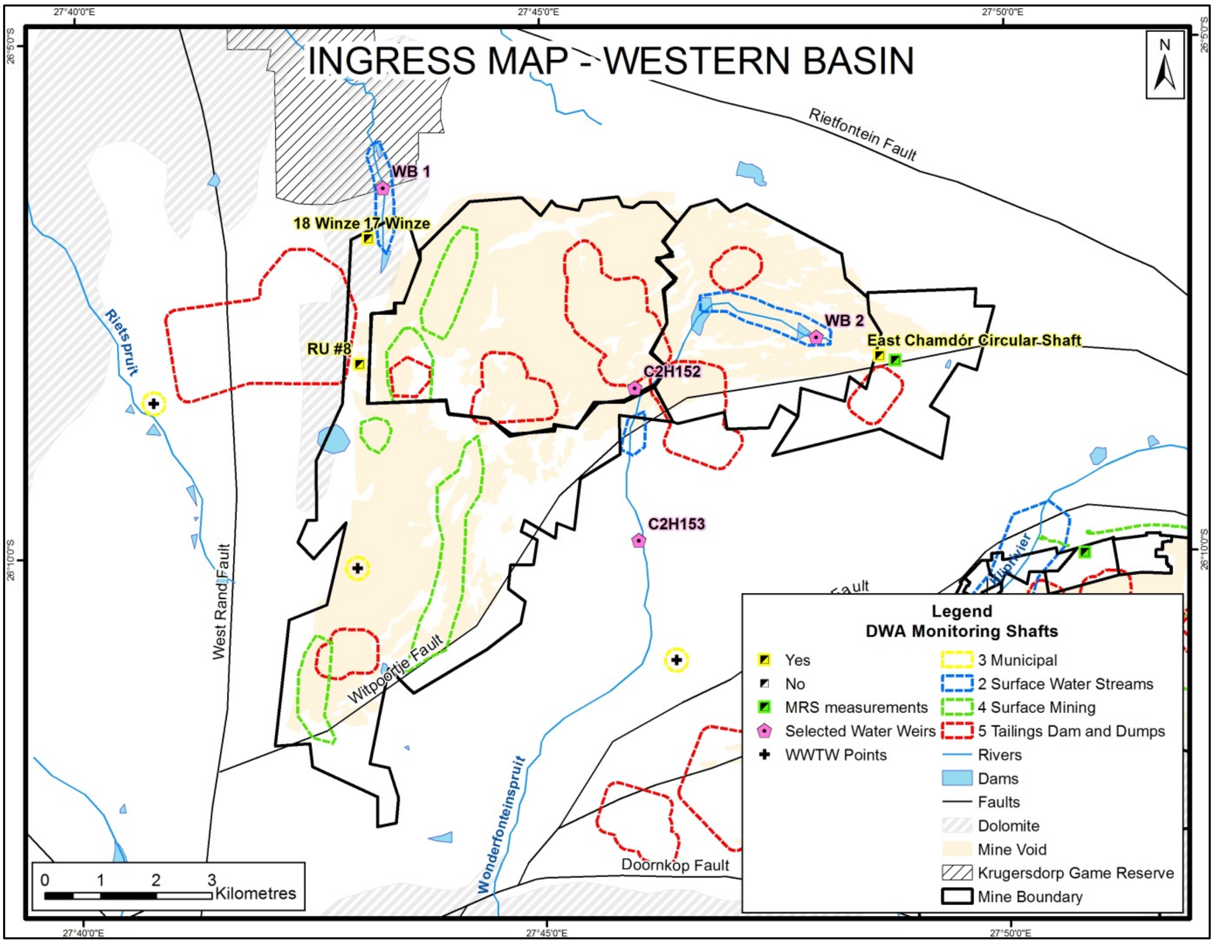
17.2.1 Western Basin

A summary of ingress sources in the Western Basin is provided in **Table 17.3** and also indicated in **Figure 17.1**.

Table 17.3: Summary of the Ingress Sources for the Western Basin

No.	Source Type	Detailed Ingress Areas
1	Undisturbed geology /Shallow aquifers	Recharge of a shallow weathered aquifer located above areas of shallow underground mining. The dolomite outlier in the Krugersdorp Game Reserve (KGR) is partially weathered to permeable wad and provides a pathway for direct recharge from precipitation into the hydraulically connected mine voids via the Black Reef workings. The Cradle of Humankind dolomite is not hydraulically connected to the mine void.
2	Surface water (dams, rivers, wetlands)	Upper portions of the Wonderfonteinspruit and the storage of water pumped from the void in Robinson Lake and the wetlands below it. Once the hydraulic gradient has been reversed towards the mine void, decant into the Tweelopies Spruit will cease but ingress from the upper reaches of the Tweelopies Spruit may be induced.
3	Municipal infrastructure (leaking mains and sewerage, stormwater run-off)	Leakage of municipal services (sewers and water reticulation) in urbanised areas overlying the mine voids. Ingress of stormwater directed into abandoned surface mining operations observed in the Mogale City Municipality.
4	Surface mine workings (open pits, shafts, inclines)	West Wits (being used for sludge disposal) and Millsite Pits are holed directly into the mine void. Ingress into the mine void via open pits along the Witpoortjie Fault in south-western area of the basin.
5	Tailings dams and mine dumps	Very poor quality seepage and stormwater from Dump 20 into adjacent Millsite Pit. Dumps 38-41 and Valley seep into mine void via dolomite wad aquifer.

Source: DWA AMD FS, 2013: Study Report No. 5.2 – Mine Voids



Source: DWA AMD FS, 2013: Study Report No. 5.2 – Mine Voids
Figure 17.1: Western Basin: Ingress sources

The following control measures for the Western Basin, as described in DWA AMD FS 2013, Study Report No. 5.2**: "Assessment of the Water Quantity and Quality of the Witwatersrand Mine Voids"**, should be considered for reducing mine void ingress:

- Rehabilitation of existing open pits and sealing shafts and initiates;
- Removal of mine dumps, currently underway;
- Rivers and other water bodies, including possible canalisation of the upper reaches of the Wonderfonteinspruit over areas of surface and shallow underground mining is possible, but should be as a low priority due to the high capital costs; and
- Municipal sources, including upgrade of stormwater drainage, water and waste water distribution systems to reduce ingress into abandoned surface workings in the Mogale City area, but this is a high cost item for minimal benefit.

17.2.2 Central Basin

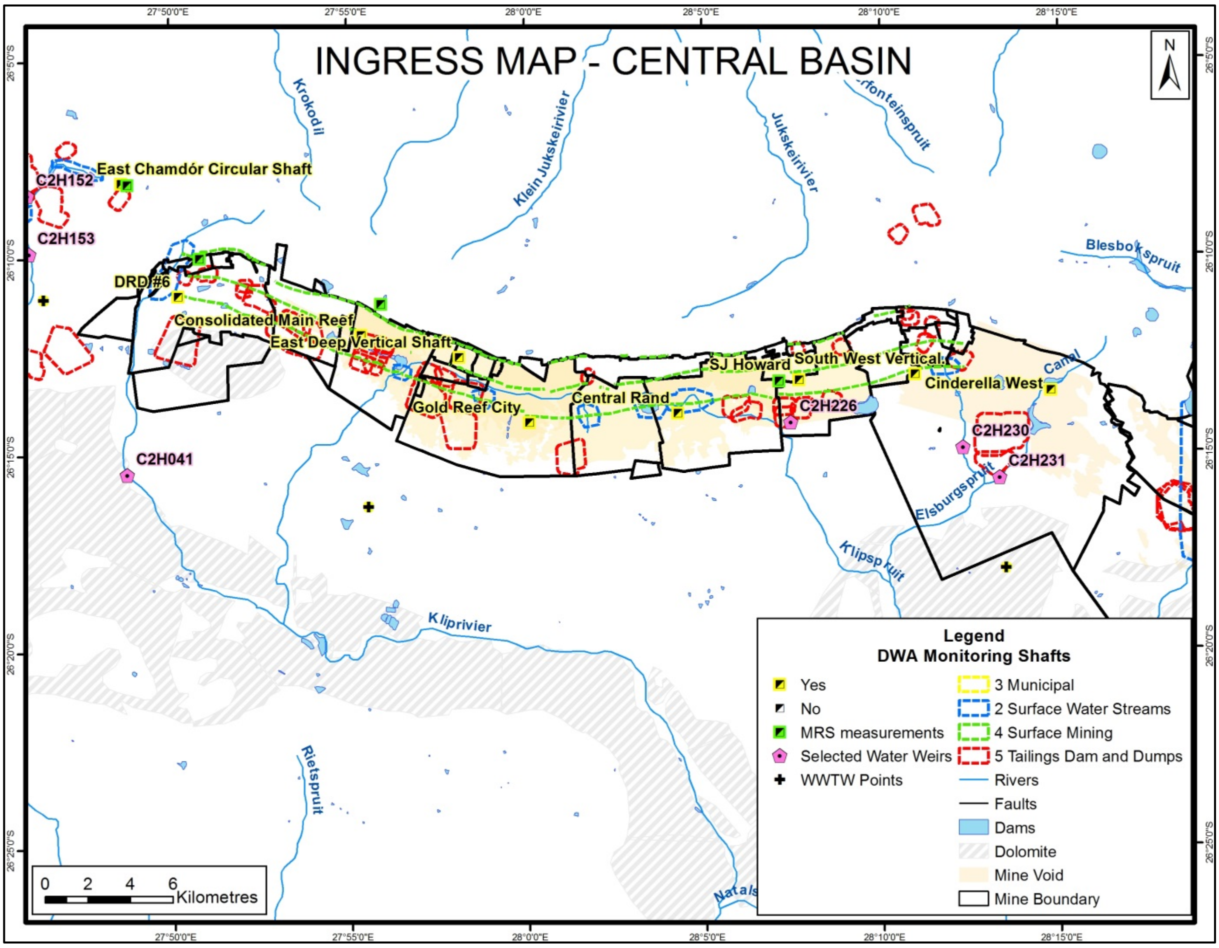
The land use in the vicinity of the basins is primarily urban development. This includes commercial, industrial and residential development. The built-up areas are concentrated to the north of the outcrop of the gold-bearing reefs. The surface excavation of the shallow reefs along their outcrop, with a strike length of approximately 15 km, resulted in topographically lower lying areas with highly disturbed land coverage, allowing a higher rate of infiltration of precipitation. It should also be noted that the runoff, due to rainfall in this basin, has a fairly low effect on the ingress volumes due to the already constant flow within the watercourses, due to leaking sewer lines and stormwater drainage systems.

A summary of ingress sources in the Central Basin is provided in **Table 17.4** and also indicated in **Figure 17.2**.

Table 17.4: Summary of the Ingress Sources in the Central Basin

No.	Ingress area	Comments
1	Undisturbed geology /Shallow aquifers	Ingress through the shallow aquifer above the mine void has been estimated as between 69% to 40% of total ingress by different reports (Winde, 2011). However, as no dolomite aquifers overlying the mine void and extensive urbanisation reduces recharge of shallow aquifers, so it was assumed this estimate to be too high.
2	Surface water (dams, rivers, wetlands)	Water discharged to the Elsburgspruit and Boksburg Canal could ingress to the mine void. Where surface streams and tributaries of the upper reaches of the Klipspruit cross undermined areas, or structures such as dykes, faults as it flows parallel to strike (E to W) over the void. Ingress from streams has been estimated to account for 26.7% to 40.4% of the total ingress by different reports (Winde, 2011).
3	Municipal infrastructure (leaking mains and sewerage, and stormwater run-off)	The Central Basin is highly urbanised (Johannesburg and Ekurhuleni Municipalities) so a larger component of water leaking from municipal services adds to the volume of water entering the mine void. In addition, irrigation of mine golf courses, vegetated slimes dams, etc., adds to sub-surface seepage.
4	Surface mine workings (open pits, shafts, inclines)	Extensive historic pits along the strike of the Central Basin that have been poorly back-filled, allows high infiltration varying from 1.2 to 12.5 Mℓ/d or 4 to 14% of total ingress into void according to different studies.
5	Tailings dams and mine dumps	Ingress of water from mine residue deposits (at least 15 identified), which were placed directly on top of disturbed reef, over shafts, or on dykes or faults connected to the void. There are reports of tailings pumped directly into the mine void resulting in an ingress of >3.5 Mℓ/d, although this practice has been discontinued (Winde, 2011). Reclamation of mine dumps results in active disposal at 3 existing slimes dams at NASREC with estimated 10 Mℓ/d seepage losses, seepage rate of 7 Mℓ/d estimated from Cooke slimes dams (from Winde, 2011). Water used to hydraulically mine the dumps is also a source of ingress, but this will reduce once the dumps have been removed.

Source: DWA AMD FS, 2013: Study Report No. 5.2 – Mine Voids



Source: DWA AMD FS, 2013: Study Report No. 5.2 – Mine Voids

Figure 17.2: Central Basin: Ingress sources

It is considered that the ingress in the Central Basin appears to be more susceptible to wet and dry seasons due to direct ingress of infiltration through the extensive shallow mine excavations along strike and the numerous surface water bodies. In order to minimise surface water ingress, if possible, the following steps should be taken:

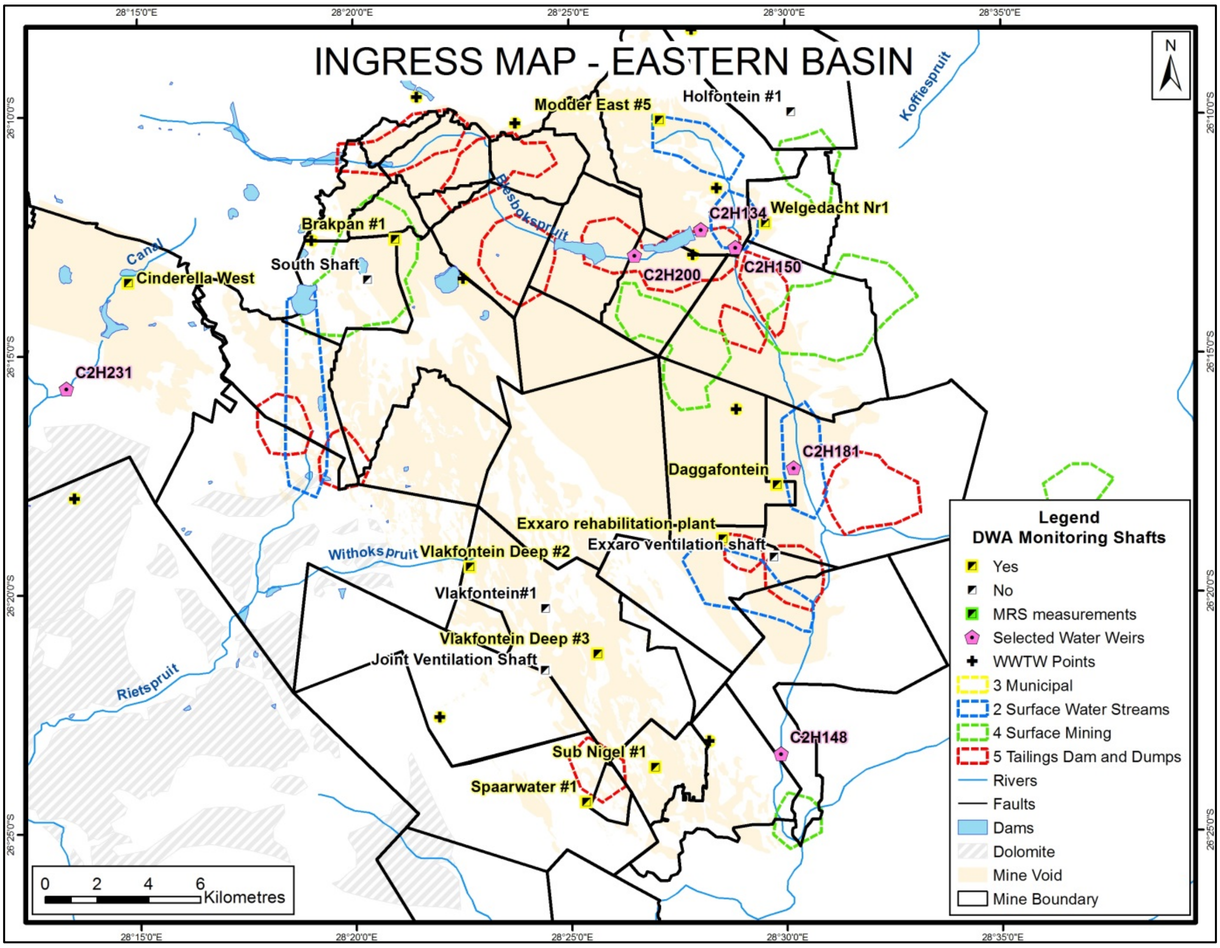
- The water bodies that cross major faults, dykes and shallow undermined areas should be canalised across these more permeable structures;
- The loss/leakage of water from the municipal water supply networks. These possible sources will need to be investigated in collaboration with the Johannesburg and Ekurhuleni Metropolitan Councils;
- As the tailings dams are re-worked, the source of water will be reduced, and ingress into the voids will decrease;
- Removal of the mine dumps as is currently underway, could reduce ingress further;
- Monitoring boreholes should be installed around tailings dumps and slimes dams in order to monitor the groundwater contamination and ingress;
- These monitoring boreholes should intercept the shallow surface aquifer, as well as the deeper aquifer;

- Water levels should be recorded; and
- Water quality should be recorded.

It should be noted that before any of the above control measures are implemented, further detailed and site specific cost-benefit studies and monitoring would need to be undertaken. This would aid in determining the net benefit of implementing the control measures in relation to initial capital expenses and a reduction in long-term operating and maintenance cost of the decanting pumps, as well as the water treatment works and waste material handling facilities.

17.2.3 Eastern Basin

Ingress sources in the Eastern Basin are indicated in **Figure 17.3**.



Source: DWA AMD FS, 2013: Study Report No. 5.2 – Mine Voids

Figure 17.3: Eastern Basin: Ingress sources

The majority of the inflows are from the dolomites through fractures in the Green Sill into the void, but there is no practical method for reducing these diffuse inflows. Sources of surface water ingress amounts to nearly 33% of the total ingress volume and open pits or shallow mine workings making up 14% of the total ingress.

In the Eastern Basin, the following options were identified and evaluated to prevent surface water ingress into the underground works (**Mafanya and Esterhuyse, 2011**):

- The options varied from lining the water sources (dams and spruits) to building of canals and diversion of culverts;
- The opening up of culverts under roads in the Blesbokspruit to prevent ponding of water and the consequent ingress to the underground mine void could start immediately. The need to manage the drainage of water through a wetland that largely originated as a result of antropgenic activities, must be balanced with the need to protect the wetland with Ramsar status;
- In the Nigel area, the possibility exists to install more culverts under the R42 road which should lessen ingress;
- There are future plans to drain Cowles Dam in order to mine the slimes, at which point flow would be diverted around Cowles Dam. This action has to be monitored in order to build up pre-engineering data to be able to determine if ingress decreases once the dam is drained;
- Interception of clean dolomitic water that flow into the mines before it becomes polluted via a well field or in-mine infrastructure; and
- Would make a source of clean water available for use and also reduce the volume of water from the basin that needs to be pumped and treated.

Site specific control measures, as recommended by **Mafanya and Esterhuyse (2011)**, are summarised in **Table 17.5** below.

Table 17.5: Site specific ingress control measures

Ingress area	Proposed Actions
West Pit	Build canal AND unblock culvert.
Cowles Dam	Mine sediments and divert flow around the dam
South Blesbokspruit	Unblock or enlarge culverts AND divert flow over certain portions – significant volume to be saved.
Leeupan	Reduce the grey water entering the pan by collecting the water and discharging the water to the sewage reticulation network. Line pan, Ekurhuleni is in an advanced stage of developing the pan as nature reserve, flow diversion will nullify purpose of nature reserve
Central Blesbokspruit	Unblock and enlarge culverts AND divert flow over certain portions – significant volume to be saved.
North Blesbokspruit (northern area)	Unblock and enlarge culverts AND divert flow over certain portions – significant volume to be saved.
North Blesbok (southern area)	Unblock and enlarge culverts
Van Rhyn (ponding)	Repair channel which will remove the dam - should reduce ponding significantly, getting rid of the unnatural dam.

Ingress area	Proposed Actions
Van Rhyn (direct runoff)	Close cracks and stabilize openings.
Largo	Close openings – foam.
Gravelotte (opencast mine, open shaft)	Shaft closing costs low enough, costs to close opencast mine too high to be feasible. Construct upstream bunds.
New Kleinfontein	Repair channel.

Source: Mafanya and Esterhuyse, 2011

17.2.4 Current Council for Geoscience Project

The DMR, through the CGS, has embarked on research, which seeks to identify ways to prevent ingress of surface water into the underground workings, manage the decant of mine-polluted water, minimise the cost of pumping and treatment of extraneous water, protect its valuable mineral resources and its people, and prevent environmental damage. The ultimate objective of the project is to arrive at management options, apportionment of pollution sources and the attendant liabilities for various contributors, and improved strategies for mine closure relating to mine water aspects.

The project titled "*A Strategic Water Management Plan (SWMP) for the Prevention of Water Ingress into Underground Workings of the Witwatersrand Mining Basins*" (Boer, et al (2004)) seeks to arrive at solutions to decrease the risk to society and the state for bearing the costs of pumping into perpetuity when mines close down and to manage and control decant of highly polluted water to surface with its attendant risks, particularly to health.

The CGS was tasked by the DMR to conduct research to address the problems described above. In particular, the research is aimed at identifying sustainable management options:

Objective 1: Prevent ingress of surface and groundwater into the underground workings;

Objective 2: Manage decant of mine-polluted water;

Objective 3: Predict and prevent harm to the environment; and Objective 4: Apportion pollution sources and liabilities.

The geographical scope of the project encompasses the following goldfields in the Witwatersrand: Evander, East Rand Basin (ERB), Central Rand Basin (CRB), West Rand Basin (WRB), Far West Rand Basin (FWRB) and the Klerksdorp, Orkney, Stilfontein, Hartbeesfontein) (KOSH) and Free State Basins.

The current work plan scope of the SWMP takes cognisance of the following recommendations contained in the AMD Report:

i. Prevent decanting by pumping;

ii. Implement ingress control measures to reduce the rate of flooding and the eventual decant / pumping volume and costs;

iii. Water quality management;

iv. Neutralization and metal removal in the short-term;

v. Removal of salt loads from river systems to be considered in the medium to long-term (direct use or desalination to potable quality);

vi. Improve monitoring and undertake research to inform better decision-making;

vii. Manage and monitor other AMD sources within the Witwatersrand, such as slimes dams;

viii. Investigate and implement an environmental levy on operating mines to help cover the costs of mining legacies;

ix. Assess and appraise the risks posed by AMD and recommend remedial measures into the future; and

x. Address future risks and the changing nature of the problem over time.

Furthermore, CGS participates in the activities coordinated by the IGTT, which reports to the IMC. This ensures alignment of these related programmes and prevents the duplication of effort by State institutions.

The actions taken by the CGS project to achieve these objectives are:

- **Canalisation of the natural watercourse from Florida Lake to Fleurhof Dam in the Central Basin:**

  The Northern section of the canal has also recently been completed and flow monitoring is in progress to assess its effectiveness.

  The Southern and Northern sections of the canal have been constructed and are handed over to the Johannesburg Roads Agency who will manage it on behalf of the City of Johannesburg.

- **Ingress prevention in other portions of the Central Basin:**

  Other areas with the potential for ingress have been identified in the Central Basin. These areas are zones where surface streams intersect with the outcrop of the reefs which were mined. In these zones, early surface operations have been identified, as well as zones of shallow undermining.

  Feasibility studies for the implementation of ingress control measures in the Central Basin, such as canals, were completed and three canals prioritised for construction:

  – A PSP was appointed for the designs of the DRD Canal (5 km), Elsburgspruit Canal (600 m) and New Canada Dam Canal (1.2 km). Tender documents are being prepared and it is expected that tenders will be advertised in April 2014 when DMR has funds available. The capital cost is estimated at R 80 million in 2013.

    An estimated 34 Mℓ/d of water is reported to ingress at different locations within the Central Basin, especially where streams traverse areas of shallow undermining, and these canals will assist in reducing these volumes.

- The construction of canals is a listed activity in terms of the NEMA (107:1998) EIA Regulations Listing Notice 1. Activities listed in terms of this list require that a Basic Assessment be completed and a report submitted to a relevant authority before construction can commence. This work is being carried out. Basic Assessment Reports will also be completed through a PSP. Meetings have been held between the CGS and the GDARD with regards to the proposed canals. IAPs, including land owners and other organs of state have already been identified.
- In some areas, existing canals which are believed to have been constructed in the past to prevent ingress, have been identified and are generally in a poor state of repair. They will be considered for rehabilitation.

- **Western Basin:**

  A number of ingress areas have been identified in the Western Basin. These have been communicated to the relevant authorities. A number of large open pits, in particular the West Wits and Millsite Pits, have been identified as significant ingress points. Support has been given to the licensing of the disposal of tailings into these pits, along with the recommendation that the closure plans for these operations need to include final shaping and capping of the tailings deposits, such that they will shed water and prevent ingress of water to the mine void. Mintails are developing a methodology for sealing the WWP.

- **Eastern Basin:**

  A study is currently underway in the Eastern Basin to apportion ingress to differing water sources and to, where possible, apportion legal responsibility for ingress control.

  In the past, the Grootvlei Mine constructed a canal between their East and West Pits on the advice of the CGS and the DMR. This was reported to have locally reduced ingress. The source apportionment study in the Eastern Basin aimed to identify water sources which will allow the optimisation of ingress prevention in this basin.

  Ranking of major surface water ingress areas along the Blesbokspruit within the ERB for prioritisation of implementation and further actions. Having completed a preliminary assessment of major surface water ingress areas within the Blesbokspruit catchment of the ERB, a decision was made to embark upon an exercise to establish criteria and ranking of the sites visited in order to arrive at a prioritisation for implementation of ingress reduction interventions.

  A Multi-Criteria Decision Analysis (MCDA) approach was used in order to achieve the ranking, with the choice of the Analytical Hierarchy Process (AHP) to establish preference and to arrive, using a numerical process, at a ranked and prioritised list of the set of major surface water ingress areas of the Eastern Basin. Fourteen (14) major surface water ingress areas in the Eastern Basin were ranked according to implementation sequence. An obvious problem exists regarding the highest ranked major surface water ingress site, the southern Blesbokspruit. This site contains the significant RAMSAR-listed wetland of the Marievale Bird Sanctuary. Obtaining the necessary environmental authorisations for the implementation of ingress reduction measures will present a challenge; as such measures will inevitably affect the Marievale Bird Sanctuary and the RAMSAR Blesbokspruit wetland.

Furthermore, the two sites that have been identified for canal construction (Gravelotte and Geduld) would have to have geotechnical assessments done in order to establish the precise path lengths and underlying materials and structures for the canals and their preliminary designs.

Where major surface water areas have been identified for *in situ* bottom sealing, research and pilot / laboratory tests would have to be carried out to obtain the best *in situ* sealing materials that are available and to establish their submerged behaviour and bottom sediment solidification / stabilisation characteristics.

Certain major surface water ingress areas of the Eastern Basin are dams that are thought to be unlined on their bottom surfaces with consequent elevated levels of daily ingress to the sub-surface and into the underground mines. These include Cowles Dam and Geduld Dam. Studies will have to be undertaken to confirm that the dams are, in fact, unlined on their bottom surfaces and that this causes increased rates of infiltration and ingress of the surface water into the sub-surface and underground mine voids

- **Other areas:**

  All other areas are currently under investigation. In particular, the generation of conceptual groundwater flow models should assist in the identification of ingress points which may be addressed via engineering projects.

  The model area covers 3D mine surface and sub-surface mine modelling of, Rand Lease and Consolidated Main Reef mines constituting the western part of the Central Basin. All underground mine infrastructure (shafts, holings, tunnels, stopes, raises, etc.), reef geometry and orientation, stratigraphy, geological structures (dykes, faults, etc.) are accurately mapped with a global coordinate system. Surface modelling models all surface mine workings, topography with development and drainage system.

  The work needs to continue, covering the whole of the Central and Eastern Basins. The CGS is busy with procurement of the services of a PSP.

- **Predict and prevent harm to the environment:**

  Prediction of harm to the environment is closely linked to the monitoring of the water levels, qualities and flows within the different basins. This is currently being done in co-operation with the HMC, which reports to the IGTT.

  On a more proactive level, the SWMP includes a component to look at the potential application of passive treatment technologies in the different areas of the Witwatersrand. This includes both areas where water seeps from the mine void to the surface and subsurface environments, and areas of seepage from mine residues, which present a significant diffuse source of pollution to surface- and groundwater in the mining areas. A component of the project is also looking at the characterisation of the different mine residue materials and deposits.

Previous work done on behalf of the Cradle of Humankind World Heritage Site Management Authority suggested that while the dolomitic aquifers impacted on by mine water have significant capacity to neutralise acidic water, this did not present a sustainable solution to the recharge of these aquifers with mine water. This research is continuing to provide more specific and detailed results.

- **Develop a mine water management strategy:**

  Since the formation of the IMC in 2010 and the resulting actions, a water management strategy has been unfolding, at least for emergency and short-term actions. The focus of the SWMP is largely on the prevention of problems, as far as this is feasible. The recommendation that ingress should be prevented wherever possible is in line with the IMC's recommendations, as well as the DWA Best Practice Guidelines for Mine Water Management. This will provide an input into the development and implementation of long-term strategies in general, but specifically in support of a long-term approach in the three basins in question.

17.3 GDARD Study

The GDARD embarked on an initiative to enable the reclamation of mine residue areas for beneficial use. Reclamation is expected to have a significant positive effect on the AMD pollution from mine dumps. Also, considering that a significant number of informal settlements are happening in close proximity to mine dumps, the social impact of reclamation, and or rehabilitation of such land, will be important.

Amongst others, the GDARD embarked on a program of creating awareness, and investigation of ways and means of reclaiming such land. The latest feedback was that the Department needs to review the expected outcomes and will in future endeavour to ask for proposals for redefined tasks.

The coordination of this initiative and specifically the communication actions, with that of the future AMD implementation actions will be important.

The communities living around the Mine Residue Area (MRA) and/or using polluted surface- or groundwater are most affected. There is a need to build awareness in the affected communities, involve them in finding productive solutions and capacitate them in implementing site specific solutions.

The main aim of the event was to present the AMD status, as well as national and provincial authority initiatives to address AMD/MRA and to ensure the community understands the impact of mining pollution. This event also fostered understanding of the issues of civil society in terms of the impact of AMD and MRA.

A consultation process was conducted, including a presentation of the intended event to both Randfontein and Mogale Municipalities (such meetings include Wards Councillors) and Members of Executive Committee (MEC) and Ministerial Committee (MMC) meeting (all MMCs responsible for the environment were present). The relevant mining companies (Mintails and Gold One) were consulted and invited to be part of the planning team. These mining companies were also given an opportunity to put together a joint presentation on the treatment plants. They also supported MEC site visits to see treatment facilities for both mines which were also attended by MMCs, Councillors and members of communities. Local municipalities were invited to be part of the planning team and Mogale City was also given an opportunity to give presentation on the impact of AMD on the game reserve adjacent to the decanting point. The event was well attended (more than 500 people) and carried positive messages on observed improvement of water quality and river health of Tweelopies Spruit (viewed from the venue) and current and planned Government interventions.

The event was mainly intended for local communities and a few hundreds of community representatives, particularly Ward Councillors and Ward Committee members, have attended. Affected informal settlements, such as Tudor Shaft, were included. In addition to strong representation from Local Government (Mogale City, Randfontein and West Rand District), the representatives from the Gauteng Department of Local Government and Housing and Department of Infrastructure Development also attended. The National Nuclear Regulator (NNR) and a number of National Departments (DWA and DST) sent representatives, while the DMR sent an apology.

The stakeholders raised concerns with regard to drinking water quality, animal life and dust from mining dumps. However, the stakeholders also gave complements to the organisers of the event, their Ward Councillors who told and arranged them to attend the event and lastly, Government interventions to address the AMD problem.

18 REHABILITATION OF RIVERS

18.1 Background

The rehabilitation of rivers affected by AMD is one of the supplementary activities required for effective management of AMD. It takes the form of source controls and various mitigation measures. Source controls will be addressed through the combination of the STI and LTS, as well as operating mines who must manage ingress on the properties under their control.

The focus of this section is the reparation of the effects of past uncontrolled AMD decant and the effects of saline discharges by the STI.

Rehabilitation of the Tweelopies Spruit in the in the Western Basin is required due to the following:

- Decanting and discharge of a mixture of partially treated and untreated AMD into the Tweelopies Spruit from 2002 until 2012 (10 years of AMD flow); and
- The application of lime to neutralise the acidity of the water which caused the precipitation of Iron (III) hydroxide and other metal precipitates commonly know as “yellow boy” in the Tweelopies Spruit, causing an uninhabitable crust to form.

This has resulted in:

- Habitat destruction and alteration of the physical system;
- Extermination of essential elements of the habitat which is required for continued biological function (e.g. O_2 depletion); and
- Destruction of macroscopic life through the addition of toxic elements.

It is only recently with the implementation of the immediate measures (source control) that life has started to return to this system. In addition to the water quality impacts, however increased volumes associated with discharge have affected the systems in the three basins, especially with the Tweelopies Spruit which was under natural conditions a non-perennial system.

AMD decant took place in the Central and Eastern Basins, but the effects have been ameliorated through the requirement to pump and treat (Grootvlei). Neutralised AMD was discharged by the mines in both basins. This ceased at varying times in the past and subsequent flows have flushed the systems as far as is probably practical. Neutralised AMD will again be discharged in January 2014 (Central Basin) and early 2015 (Eastern Basin). The water quality should be monitored and the environmental impacts assessed. However, no specific rehabilitation is proposed for these basins at this stage.

18.2 Principles

This discussion assumes that the remediation of prior impacts caused by AMD will only be done after the implementation of the LTS (the LTS can therefore be seen to be part of the rehabilitation), when the water quality, amount and velocity of runoff in the river are set. Rehabilitation interventions to the current state are not advisable, as the state of the river system will change, based on the LTS.

Rehabilitation is dependent on the source of re-colonising organisms and therefore will be dependent on the health of downstream systems.

It should be noted that after the implementation of the LTS and even after any rehabilitation is done in the Tweelopies Spruit, other sources of pollution in the catchment, not specifically related to underground AMD, will continue to have an effect. These include non-point sources such as old mine residue deposits as well as point sources such as the discharge of municipal effluent.

Therefore, rehabilitation efforts must be well motivated, and specifically focused towards the effects of AMD and formation of "yellowboy" in the Tweelopies Spruit.

18.3 Approach

In the case of the Tweelopies Spruit, the following approaches are proposed:

- **Step 1**: Dedicated ecological baseline assessment of the system, to include a full range of aquatic, water quality, hydrology riparian and terrestrial habitats associated with the system, now that the STI is in place. This should be carried out at least once in summer and once in winter. It should be carried out by a multi-disciplinary team of experts, and include at least:
  - Present Ecological State (PES) assessment of the system, which include the full range of drivers and responses
  - Assessment of the remaining pollution sources, such as old tailings or waste rock dumps, as well as dysfunctional sewage WWTWs and their contributions to / effects on the ecological integrity of the Tweelopies Spruit.
  - Engaging stakeholders who are riparian to the river;
  - Assessment of the impacted area (i.e. how far downstream are the effects visible);
  - Assessment of the impacts caused and likelihood of and time frame for natural rehabilitation to occur; and
  - Assessment of the fate of the yellow boy modules, which have been generated from the crust which has formed since neutralisation.
- **Step 2**: Recommend proven rehabilitation options with related costs, and proposed phasing. The recommendations should at least cover:
  - Removal of the precipitation layer of a river bed and banks;
  - Bank stability and resilience against high flow or flood events;
  - Riparian vegetation rehabilitation;
  - Cost benefit analysis of rehabilitation actions proposed.

- **Step 3**: Obtaining environmental approvals required to effect the work (as working in the floodline is an activity listed in the NWA (36:1998) and NEMA (107:1998). Section 21 (c) and (i) of the NWA (36:1998) should be considered in terms of its applicability.
- **Step 4**: Procurement of a rehabilitation contractor to conduct the necessary work.
- **Step 5**: Monitoring plan to assess the effectiveness of the operations. It will be important to select suitable indicators of rehabilitation for monitoring and may include for instance monitring trens in the diatomic, macro-invertebrate, water quality and fish, in order to compare with the baseline monitoring it os recommended that the results include but are not limited to interpretation in terms of chages in the PES of the system. In this regard there may be opportunities to align with existing monitoring programmes. Monitoring and reporting on the effectiveness of rehabilitation includes communication with stakeholder and the public.

18.4 Funding

Rehabilitation should be funded initially by government but may be covered as part of the process detailed in DWA AMD FS 2013, Report 7: **“Institutional Procurement and Financing Options”** (i.e. the application of the polluter pays principle). The cost of rehabilitation should be considered as part of the LTS and the possibility of cost recovery from the mines should be included in the negotiations on cost recovery for the LTS in the Western Basin.

19 FURTHER INVESTIGATIONS

19.1 Introduction

This Feasibility Study has collected and analysed the available information on the management of AMD and completed the Prefeasibility and Feasibility level investigations and design. A Reference Project for each basin, with limited risk and which could manage AMD in the long-term, has been defined and costed. It has also recommended a medium-term solution, based on the Reference Projects, to be implemented as soon as possible in each basin and identified a number of areas where further investigations are required to assess the potential for cost effective solutions or to provide contingency plans in case there are significant changes in the nature of the AMD challenge. For example, a contingency plan is required in case there is a significant underground collapse leading to reduced or loss of connectivity between some compartments.

The objectives of the proposed future investigations are thus to identify or improve the current knowledge of newer technologies and approaches to managing AMD or to prepare for significant changes in the mine void or the water quality or ingress. The investigations should also take full account of all the new information which will become available during the construction and operation of both the STI and the LTS.

19.2 Assessment of Treatment Technologies

The cost of treatment of AMD and management or disposal of the residues is one of the most expensive elements of managing AMD, accounting for more than 50% of the operating costs. Monitoring and evaluating the performance of the STI and LTS, with particular reference to the treatment processes is very important if the cost of managing AMD is to be reduced, based on the results of the lessons being learnt. The cost, quality of feed water, quality of water produced and characteristics of the residues are key variables to be assessed. Operational problems must also be well documented and considered. The required analysis could be carried out by the Implementer or be combined with the evaluation of PTPs in the Western Basin.

The use of the Western Basin to provide an opportunity for as yet unproven technologies to be tested at large scale, PTPs is an important step and will provide valuable information. DWA should oversee the work if the WRC, DST and other parties responsible for the installation and operation of the commissioning of PTPs, and ensure that all the results are carefully analysed to guide future management of AMD. In particular, the suitability of the technologies for full scale implementation, after the Pilot Testing Phase, their cost effectiveness and associated infrastructure requirements should be studied, in relation to the requirement of all three basins.

This overarching assessment cannot be part of the contract requirement for each Pilot Plant contract but should be undertaken by WRC. The results of the Pilot Plant studies should be compared with the results of the evaluation of the STI and LTS described above. The full assessment and reporting should preferably form part of the study described in Section 11.

19.3 Feasibility of Tunnels in the Western Basin

The possibility of gravity or primarily gravity abstraction in the Western and Central Basins were assessed in the Prefeasibility Phase and are described in that report (DWA AMD FS 2013, Study Report No. 5: **"Technical Prefeasibility Report"**). With the proposed TOL of 1 500 m amsl (146 mbs) to protect the ECL, the Central Basin ECL required AMD to be pumped into a tunnel and this option was not economic compared with the recommended option to pump at SWV. In addition, it is not appropriate at present since the SECL to protect the planned mining is between 250 and 400 m below surface.

In the Western Basin, a gravity tunnel to maintain the proposed (higher level) ECL of 1 585 m amsl was feasible but not economic under present day conditions. However, it is possible that circumstances may change in future and at least a new screening and Prefeasibility of the tunnel options should be carried out in time for that option to be considered for implementation in the next phase.

The option of dewatering the Western Basin by gravity through a tunnel was shown in the Prefeasibility Study to have a number of advantages, but these will depend on:

- the treatment technology selected which will depend on the success of the proposed PTPs; and
- the location of the end user of the treated water. Discharging the treated water to the river would make the tunnel particularly favourable.

Should these factors prove favourable, then a Feasibility Study of the tunnel should be undertaken by engineers experienced in tunnel design, and should include detailed topographic and geotechnical studies. Whether or not the tunnel needs to be lined, has a major effect on costs and must receive particular attention.

REFERENCES

Beukes, 1987. Report on the rewatering of the dolomites also contributes to Karstification – new sinkholes formed when water table returned to its original pre-mining level.

Bosch, 2008. Report on Development a model of the geology.

Botha & Mouton, (date unknown). Report on Results of Gravimetric Surveys.

Brink, 1981. Report on Results of Gravimetric Surveys.

Council for Geoscience by the Department of Mineral Resources. A Strategic Water Management Plan (SWMP) for the Prevention of Water Ingress into Underground Workings of the Witwatersrand Mining Basins.

Council for Geoscience by the Department of Mineral Resources. Regional Mine Closure Strategy.

DWA AMD FS 2013, Study Report No. 3 – Department of Water Affairs (DWA), 2012: Feasibility Study for a Long-Term Solution to address the Acid Mine Drainage Associated with the East, Central and West Rand Underground Mining Basins. Study Report No. 3: Legal Considerations for Apportionment of Liabilities– DWA Report No.: P RSA 000/00/16312

DWA AMD FS 2013, Study Report No. 4 – Department of Water Affairs (DWA), 2012: Feasibility Study for a Long-Term Solution to address the Acid Mine Drainage Associated with the East, Central and West Rand Underground Mining Basins. Study Report No. 4: Alternative Approaches for Apportioning Liabilities– DWA Report No.: P RSA 000/00/12412

DWA AMD FS 2013, Study Report No. 5 – Department of Water Affairs (DWA), 2012: Feasibility Study for a Long-Term Solution to address the Acid Mine Drainage Associated with the East, Central and West Rand Underground Mining Basins. Study Report No. 5: Technical Prefeasibility Report – DWA Report No.: P RSA 000/00/16512

DWA AMD FS 2013, Study Report No. 5.2 – Department of Water Affairs (DWA), 2012: Feasibility Study for a Long-Term Solution to address the Acid Mine Drainage Associated with the East, Central and West Rand Underground Mining Basins. Study Report No. 5.2: Assessment of the Water Quantity and Quality of the Witwatersrand Mine Voids – DWA Report No.: P RSA 000/00/16512/2

DWA AMD FS 2013, Study Report No. 6 – Department of Water Affairs (DWA), 2012: Feasibility Study for a Long-Term Solution to address the Acid Mine Drainage Associated with the East, Central and West Rand Underground Mining Basins. Study Report No. 6: Concept Design – DWA Report No.: P RSA 000/00/16612

DWA AMD FS 2013, Study Report No. 7 – Department of Water Affairs (DWA), 2012: Feasibility Study for a Long-Term Solution to address the Acid Mine Drainage Associated with the East, Central and West Rand Underground Mining Basins. Study Report No. 7: Institutional, Procurement and Financing Options – DWA Report No.: P RSA 000/00/16712

DWA AMD FS 2013, Study Report No. 9 – Department of Water Affairs (DWA), 2012: Feasibility Study for a Long-Term Solution to address the Acid Mine Drainage Associated with the East, Central and West Rand Underground Mining Basins. Study Report No. 9: Key Stakeholder Engagement and Communications – DWA Report No.: P RSA 000/00/16912

DWA AMD FS 2012, Study Report No. 9.1 – Department of Water Affairs (DWA), 2012: Feasibility Study for a Long-Term Solution to address the Acid Mine Drainage Associated with the East, Central and West Rand Underground Mining Basins. Study Report No. 9.1: Communication Strategy and Action Plan – DWA Report No.: P RSA 000/00/16912/1

DWA AMD FS 2013, Study Report No. 10 – Department of Water Affairs (DWA), 2012: Feasibility Study for a Long-Term Solution to address the Acid Mine Drainage Associated with the East, Central and West Rand Underground Mining Basins. Study Report No. 10: Feasibility Report – DWA Report No.: P RSA 000/00/17012

Department of Public Works – Guidelines for Consultants, August 2003. Further pre-cautionary measures and details – Appropriate Developments of Infrastructure in Dolomite.

Dreybrodt, 1996. Report on Large scale pumping of water y the mines caused a drop in the water table.

Dreybrodt, 1996. Report on the rewatering of the dolomites also contributes to Karstification – new sinkholes formed when water table returned to its original pre-mining level.

Enslin et al, 1996. Report on Large scale pumping of water y the mines caused a drop in the water table.

Enslin et al, 1976. Report on the rewatering of the dolomites also contributes to Karstification – new sinkholes formed when water table returned to its original pre-mining level.

Enslin & Smit, 1955. Report on Results of Gravimetric Surveys.

Enslin & Smit, 1955. Resistivity Surveys.

Enslin & Smit, 1955. Gravimetric Surveys.

Formamet, 1981. Seismic Surveying.

Kleywegt & Pike, 1982. Report on Large scale pumping of water by the mines caused a drop in the water table.

Kleywegt (date unknown). Report on rotary percussion drilling.

Kleywegt, (date unknown). Report on Results of Gravimetric Surveys.

Mafanya & Esterhuyse, 2011. Report on Site specific control measures.

Roux, 1981. Gravimetric survey.

TCTA, 2011. Due Diligence Report – Neutralisation of AMD and Proposals outlined for each basin regarding AMD abstraction, water treatment, treated water discharge and sludge disposal.

Trollip, 2006. Report on Results of Gravimetric Surveys.

Swart et al, 2003. Report on Large scale pumping of water y the mines caused a drop in the water table.

Swart et al, 2003. Report on the rewatering of the dolomites also contributes to Karstification – new sinkholes formed when water table returned to its original pre-mining level.

Van Schoor, 2002. Report on - Ground Penetrating Radar (GPR) is a method for surveying near-surface conditions.

Vela VKE and Council for Geoscience, December 2009. An Engineering Service Agreement was entered into between Vela VKE and CGS to provide professional services specifically for the canalisation of natural watercourse between Florida Lake and Fleurhof Dam.

Winde, 2011.

Zisman, 2001. Report on - Ground Penetrating Radar (GPR) is a method for surveying near-surface conditions.

Zisman, 2001. Resistivity surveys.

Appendix A
Concept Note on Pilot and Demonstration Scale Mine Water Treatment Scheme for the Witwatersrand Basins: WRC 02/05/2013

Water Research Commission | Department of Science and Technology | Department of Water Affairs | Aurecon

Pilot and Demonstration Scale Mine Water Treatment Scheme for the Witwatersrand Basins

Concept Note

Core Concept

The Water Research Commission (WRC), Department of Science and Technology (DST) and the Department of Water Affairs supported by Aurecon wish to jointly develop and implement a Pilot and Demonstration Scheme (PDS) to test at pilot and demonstration scale new methods of mine water treatment, initially for the Witwatersrand Basins, but expanding later to include other areas of the country.

This is an inter-institutional initiative to contribute to addressing South Africa's dual crises of insufficient water knowledge in key water domains and a critical lack of market-ready mine water treatment technology.

The aim is to select and test novel treatment methods which have not yet been proven at large scale, which omission precludes their uptake into mainstream engineering practice. This will directly contribute to solutions for South Africa's pressing needs in critical areas that require water technologies, innovations and medium to long term solutions. This intervention will also provide an academic-water business partnership within each project and could also provide commercial solutions that will be marketable elsewhere in the world.

Background

Through a series of engagements with stakeholders in the South African mine water treatment and management community, the Department of Water Affairs supported by Aurecon, the Department of Science and Technology (DST) and Water Research Commission (WRC), have identified that there is gap in the sector specifically relating to the full scale application of newly developed treatment technologies. The gap exists between water research and laboratory scale piloting of technologies and the end point where these technologies are taken up by the market. This results in South African research being bought by foreign companies rather than being used to solve the local problems it was designed for. It also creates a situation where, at times, the sector is forced to import market-ready solutions from outside the country because of this innovation gap in our own market. As such, the issue of water technology scale-up and demonstration was identified as a national priority.

In a recent DST - WRC workshop on the topic of the innovation chasm, the stakeholder group was asked to list challenges that hinder South Africa's capacity to take up new technologies. Some of these are listed below:

- Poor coordination between existing organisations;
- Risk aversion in the sector regarding uptake of new methods and tools (lack of commitment, red tape, regulatory environment);

- Users of technology are not close enough to research;
- Insufficient focus on pilot scale;
- Researchers cannot turn their research into products and commercialise them;
- There is a focus on academic outputs, rather than technical ones. There is a lack of academic incentives for technology demonstration;
- No enabling body to ‘bridge the innovation gap’;
- The current education system does not encourage entrepreneurship;
- There are no programmes to give entrepreneurs incentives to invest in product prototyping and commercialisation;
- Lack of money on pilot scale level - no research institute has these funds - user organisation needs to put capital into the pilots.

(The situation is not unique to mine water but relates to all aspects of water-related innovation, hence the DST and the WRC already have a partnership in place in terms of this wider context.)

Aim

The aim of the PDS is to provide a dedicated programme of support that unites researchers and the end users of research (both private sector and in Government), to provide properly-run, convincing trials at pilot “industrial” scale for mine water treatment methods which are currently considered to be embryonic or unproven.

The outcomes of the PDS will be manyfold: firstly, pilot and demonstration plants will be open for viewing, so as to provide the sector with demonstrable new technology for application. Secondly, human capacity development in priority areas, such as chemical engineering, biotechnology, and wastewater treatment. Thirdly, South Africa’s water and mining sectors will gain international competitiveness through being at the forefront of science and engineering to solve the global mine water crisis.

Programme Description

The PDS will provide for selected technologies to be scaled-up at suitable sites for full testing to be performed over a suitable time frame (between 12 and 48 months is anticipated). The first technologies to be piloted will be those which were recommended by the Team of Experts in their 2010 report, but which have not yet been operated at greater than laboratory scale in South Africa and which have therefore been rejected as suitable for immediate implementation.

The Pilot Scheme will create a pipeline of new ammunition in our arsenal of mine water treatment methods to feed into the wastewater and water sector.

Programme Governance

With this context in place the DST / WRC / DWA (Aurecon) group discussed a number of issues. It was agreed that the basic context and principle was good but issues, need to be maintained and clarified, such as:

- Emphasis must be placed on the trials being neutral and transparent;
- The need to be cautious about overlapping the pilot scheme goal and mandate with the goals and mandates of existing institutions;
- The need to ensure that this scheme has credibility with the private and industrial sector;
- The need to take an inventory of what we have in the water sector in terms of research and technological solutions;

- The need to clarify or define what we mean when talking about mine water treatment and novel technologies.

The WRC will apply strong quality assurance measures to the scheme projects individually, and to the programme overall, to prevent inappropriate rejection or recommendation of treatment methods.

The programme and projects will be supported by the following groups and people:

- A Pilot Scheme Scientific Advisory Board: a group of people from research sectors and the potential users and regulators of the research products will be selected for their knowledge of the research landscape of the mine water sector; their responsibility is to guide the spread of projects within the scheme and to have oversight of the progress of the trials. The Scientific Advisory Board will meet annually.
- A small, focussed Reference Group which is tailor made for each individual pilot or demonstration plant within the scheme. The role of the Reference Group is to provide support and advice to the Project Leader, to peer-review the work as it progresses and to review the final report prior to publication. Each Reference Group will be specific to the particular project, and will be chaired by:
- A Research Manager, selected for his/her abilities in mentorship within the exact field of research into which the project falls. The Research Manager will act as a point person, coach and source of formative assessment for every progress and final report submitted as well as chairing the Reference Group and feeding information regarding project progress to the Scientific Advisory Board.
- A Pilot Scheme Co-ordinator, who will liaise with the Project Leaders regarding submission of progress and final reports, deal with scheduling and document management for project meetings and convene and distribute documents to the Reference Groups and the Scientific Advisory Board.

Outcomes of the Pilot Scheme

The outcomes of the PDS can be summarised by asking who will benefit, and how:

Who will benefit from the PDS?	How will they benefit?
Stakeholders who have a liability for mine water treatment	Greater efficiency and better quality end products from taking up a new technology
Natural environment	Better protection from the impacts of uncontrolled mine water decant due to the adoption of new technologies. More cost effective treatment of MINE WATER will result in more MINE WATER being treated and less being released in an uncontrolled manner.
Industrial water users	More water available for industrial use, at the required quality and lower cost
Drinking water treatment and supply	Greater efficiency due to better influent because of improved waste water treatment works and greater assurance of supply
General public	Better health due to treated water quality of MINE WATER being achieved at a lower cost due to the adoption of new technologies
Researchers	Greater impact and application of their research
Water sector	More employable young water professionals because of gaining practical demonstration training skills.
Students and learners	Demonstration training and jobs, and more satisfying careers will be fostered which makes young people more likely to stay in the sector

Appendix B Environmental Authorisation for Immediate and Short-Term Interventions: DEA 07/01/2013

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

Private Bag X 447· PRETORIA · 0001· Fedsure Building · 315 Pretorius Street · PRETORIA
Tel (+ 27 12) 310 3911 · Fax (+ 2712) 322 2682

NEAS Reference: DEA/EIA/0000498/2011
DEA Reference: 12/12/20/2403
Enquiries: Masina Litsoane
Telephone: 012-395-1778 **Fax:** 012-320-7539 **E-mail:** MLitsoane@environment.gov.za

Mr. Bashan Govender
Deparment of Water Affairs
Private Bag X995
PRETORIA
0001

Fax no: 012-392-1359

PER FACSIMILE / MAIL

Dear Mr Bashan

APPLICATION FOR ENVIRONMENTAL AUTHORISATION IN TERMS OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998: GN R.543: IMMEDIATE AND SHORT TERM INTERVENTIONS FOR THE TREATMENT OF ACID MINE DRAINAGE IN THE WESTERN, CENTRAL AND EASTERN BASINSOF THE WITWATERSRAND GOLD FIELDS, GAUTENG PROVINCE

With reference to the above application, please be advised that the Department has decided to grant exemption and authorisation. The environmental authorisation (EA) and reasons for the decision are attached herewith.

In terms of regulation 10(2) of the Environmental Impact Assessment Regulations, 2010 (the Regulations), you are instructed to notify all registered interested and affected parties, in writing and within 12 (twelve) days of the date of the EA, of the Department's decision in respect of your application as well as the provisions regarding the submission of appeals that are contained in the Regulations.

Your attention is drawn to Chapter 7 of the Regulations, which prescribes the appeal procedure to be followed. This procedure is summarised in the attached document. Kindly include a copy of this document with the letter of notification to interested and affected parties.

Should the applicant or any other party wish to appeal any aspect of the decision a notice of intention to appeal must be lodged by all prospective appellants with the Minister, within 20 days of the date of the EA, by means of one of the following methods:

By facsimile:	012 320 7561;
By post:	Private Bag X447, Pretoria, 0001; or
By hand:	2nd Floor, Fedsure Building, North Tower, Cnr. Lilian Ngoyi (Van der Walt) and Pretorius Streets, Pretoria.

If the applicant wishes to lodge an appeal, it must also serve a copy of the notice of intention to appeal on all registered interested and affected parties as well as a notice indicating where, and for what period, the appeal submission will be available for inspection, should you intend to submit an appeal.

Please include the Department *(Attention: Director: Integrated Environmental Authorisations)* in the list of interested and affected parties, notified through your notification letter to interested and affected parties, for record purposes.

Appeals must be submitted in writing to:

Mr T Zwane, Senior Legal Administration Officer (Appeals), of this Department at the above mentioned addresses or fax number. Mr Zwane can also be contacted at:

Tel: 012-310-3929
Email: AppealsDirectorate@environment.gov.za

Please note that the Minister may, on receipt of appeals against the authorisation or conditions thereof suspend the authorisation pending the outcome of the appeals procedure.

Yours sincerely

Mr Mark Gordon
Chief Director: Integrated Environmental Authorisations
Department of Environmental Affairs
Date: 07/01/2013

CC:	Mr S Horak	Digby Wells	Tel: 011-789-9495	Fax: 011-789-9498
	Mr H Nkosi	Ekurhuleni Metropolitan Municipality	Tel: 011-999-3316	Fax: 086-506-8177
	Ms L Molefe	City of Johannesburg	Tel: 011-587-4238	Fax: 011-587-4228
	Mr M Mokoena	Mogale City Local Municipality	Tel: 011-951-2101	Fax: 011-660-1507
	Mr T Zwane	Appeals Authority (DEA)	Tel: 012-310-3929	Fax: 012-320-7561
	Mr S Malaza	Compliance Monitoring (DEA)	Tel: 012-310-3397	Fax: 012-320-5744

APPEALS PROCEDURE IN TERMS OF CHAPTER 7 OF THE NEMA EIA REGULATIONS, 2010 (THE REGULATIONS) AS PER GN R. 543 OF 2010 TO BE FOLLOWED BY THE APPLICANT AND INTERESTED AND AFFECTED PARTIES UPON RECEIPT OF NOTIFICATION OF AN ENVIRONMENTAL AUTHORISATION (EA)

APPLICANT	INTERESTED AND AFFECTED PARTIES (IAPs)
1. Receive EA from the relevant Competent Authority (the Department of Environmental Affairs [DEA]).	1. Receive EA from Applicant/Consultant.
2. Within 12 days of date of the EA notify all IAPs of the EA and draw their attention to their right to appeal against the EA in terms of Chapter 7 of the Regulations.	2. N/A.
3. If you want to appeal against the EA, submit a notice of intention to appeal within 20 days of the date of the EA with the Minister of Water and Environmental Affairs (the Minister).	3. If you want to appeal against the EA, submit a notice of intention to appeal within 20 days of the date of the EA. with the Minister of Water and Environmental Affairs (the Minister).
4. After having submitted your notice of intention to appeal to the Minister, provide each registered IAP with a copy of the notice of intention to appeal within 10 days of lodging the notice.	4. After having submitted your notice of intention to appeal to the Minister, provide the applicant with a copy of the notice of intention to appeal within 10 days of lodging the notice.
5. The Applicant must also serve on each IAP: • a notice indicating where and for what period the appeal submission will be available for inspection.	5. Appellant must also serve on the Applicant within 10 days of lodging the notice, • a notice indicating where and for what period the appeal submission will be available for inspection by the applicant.
6. The appeal must be submitted in writing to the Minister within 30 days after the lapsing of the period of 20 days provided for the lodging of the notice of intention to appeal.	6. The appeal must be submitted to the Minister within 30 days after the lapsing of the period of 20 days provided for the lodging of the notice of intention to appeal.
7. Any IAP who received a notice of intention to appeal may submit a responding statement to that appeal to the Minister within 30 days from the date that the appeal submission was lodged with the Minister.	7. An Applicant who received notice of intention to may submit a responding statement to the appeal to the Minister within 30 days from the date that the appeal submission was lodged with the Minister.

NOTES:

1. **An appeal against a decision must be lodged with:-**
   a) the Minister of Water and Environmental Affairs if the decision was issued by the Director- General of the Department of Environmental Affairs (or another official) acting in his/ her capacity as the delegated Competent Authority;
   b) the Minister of Justice and Constitutional Development if the applicant is the Department of Water Affairs and the decision was issued by the Director- General of the Department of Environmental Affairs (or another official) acting in his/ her capacity as the delegated Competent Authority;

2. **An appeal lodged with:-**
   a) the Minister of Water and Environmental Affairs must be submitted to the Department of Environmental Affairs;
   b) the Minister of Justice and Constitutional Development must be submitted to the Department of Environmental Affairs;

3. **An appeal must be:-**
   a) submitted in writing;
   b) accompanied by:
   - a statement setting out the grounds of appeal;
   - supporting documentation which is referred to in the appeal; and
   - a statement that the appellant has complied with regulation 62 (2) or (3) together with copies of the notices referred to in regulation 62.

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

Integrated Environmental Authorisation Issued in terms of

The National Environmental Management Act, 1998 and the Environmental Impact Assessment Regulations 2010

and

The National Environmental Management: Waste Act, 2008 and Government Notice 718 of 2009

Immediate and short term interventions for treatment of acid mine drainage in the Western, Central and Eastern Basins of the Witwatersrand Gold Fields, Gauteng Province

West Rand District Municipality, Ekurhuleni and City of Johannesburg Metropolitan Municipalities

Authorisation register number:	*12/12/20/2403*
Last amended:	*First Issue*
Holder of integrated authorisation:	*Department of Water Affairs*
Location of activities:	*GAUTENG PROVINCE:* ***Western Basin*** *– Krugersdorp, Witpoortjie and Randfontein* ***Central Basin*** *– From Durban Roodepoort Deep to East Rand Proprietary Mines* ***Eastern Basin*** *– Boksburg, Brakpan, Springs and Nigel within Ekurhuleni Metropolitan Municipality, Randfontein and Mogale City Local Municipalities.*

This authorisation does not negate the holder of the authorisation's responsibility to comply with any other statutory requirements that may be applicable to the undertaking of the activity.

DECISION

The Department is satisfied, on the basis of information available to it and subject to compliance with the conditions of this integrated environmental authorisation ("the environmental authorisation") that the applicant should be authorised to undertake the NEMA EIA and NEMWA listed activities specified below.

Details regarding the basis on which the Department reached this decision are set out in Annexure "I" to this environmental authorisation.

NEMA EIA AND NEMWA ACTIVITIES AUTHORISED

By virtue of the powers conferred on it by NEMA, the NEMA EIA Regulations, 2010, NEMWA and Government Notice 718 of 3 July 2009 the Department hereby authorises –

DEPARTMENT OF WATER AFFAIRS

with the following contact details –
Mr. Bashan Govender
Deparment of Water Affairs
Private Bag X995
PRETORIA
0001

Tel:	(012) 392-1306
Fax:	(012) 392-1359
Cell:	(082) 807-3522
E-mail:	govenderb@dwa.gov.za

to undertake all activities required for the commission of the works as described in the scoping report dated November 2012 at:

Alternative S1	Latitude	Longitude
Western Basin Site	26°8'23.074"S	27°42'13.018"E
Central Basin Site	26°13'3.277"S	28°10'56.877"E
Eastern Basin Site	26°15'5.173"S	28°29'19.461"E

Basin	Farm Name	Portion Number
AMD Abstraction		
Western	Uitvalfontein 244 IQ	Remainder
Central	Driefontein 87 IR	Remainder of portion 1
Eastern	Grootvally Small Holdings	Holdings 100 - 106
Treatment Plants		
Western	Randfontein 247 IQ	Portion 1 R/E
Central	Driefontein 87 IR	Remainder of portion 1
Eastern	Grootvally Small Holdings	Holdings 100 - 106
Discharge Points		
Western	Waterval 174 IQ	Remaining Extent
Central	Driefontein 682 IR	Remainder
Eastern	Grootvally Small Holdings	Holdings 100 - 106

- for the implementation of emergency works aimed at mitigating acid mine drainage in the Witwatersrand Gold Fields, within Mogale City and Randfontein Local Municipalities; City of Johannesburg and Ekurhuleni Metropolitan Municipalities hereafter referred to as "the property".

The interventions proposed will include of the following activities:

Immediate term interventions – Western Basin

Immediate AMD mitigation measures can be implemented practically in the Western Basin based on the following:

- Upgrading and retrofitting of the existing Rand Uranium Treatment Plant as the best opportunity in terms of treatment capacity and ease of implementation.

- Bringing the Rand Uranium Treatment Plant's additional treatment trains back into operation, after appropriate mechanical and electrical equipment has been installed.
- The potential AMD treatment capacity, including the existing single operational treatment train is estimated to be 26-32 Mℓ per day.

Short term interventions

Western Basin

The site of the proposed Western Basin AMD water treatment plant for the short term intervention is near to the existing Rand Uranium treatment plant. Short term intervention activities planned for the Western Basin will include:

- Abstraction of AMD via pumps in Shaft No. 8 at a depth to achieve the ECL of 1550 mamsl;
- The lowering of the current water table in the old mine workings to 165 m below surface by pumping an average of 53 Ml/day (peak of 60 Ml/day) from Shaft No. 8;
- Construction and operation of a new HDS treatment plant on the Randfontein Estates site;
- Construction of a treated water pipeline to a suitable discharge point on the Tweelopiespruit within the Krugersdorp Game Reserve; and
- Construction of waste sludge disposal pumps and pipeline to the West Wits Pit for the disposal of the sludge from the treatment process.

Central Basin

The proposed Central Basin AMD treatment plant is to be situated on the western portion of the ERPM South West Vertical (SWV) Shaft area. Activities will include:

- Abstraction of AMD via pumps in the SWV Shaft to keep the water from rising above the ECL at 150 m below the ERPM Cinderella East Shaft collar level (1 617 m) or 1467 mamsl;
- Pumping and treating an average of 72 Ml/day (peak of 84 Ml/day);
- Construction of a new HDS plant adjacent to the SWV shaft;
- Construction of a waste sludge pipeline to the Crown Knights Gold processing plant;
- Construction of a treated water pipeline to a suitable discharge point on the Elsburgspruit; and
- Investigation and planning for a possible future waste sludge pipeline to the ERGO Brakpan Tailings Storage Facility (TSF).

Eastern Basin

The proposed Eastern Basin AMD water treatment plant will be situated at the Grootvlei Mine Shaft No. 3. Activities will include:

- Abstraction of AMD via installed pumps in Grootvlei No. 3 shaft at a pump depth to achieve the ECL level of 1280 mamsl;
- Pumping and treating at an average of 106 Ml/day and a peak of 110 Ml/day;
- Construction of a new HDS treatment plant adjacent to the Grootvlei No. 3 shaft;
- Investigation and planning for the possible construction of a waste sludge pipeline to the Daggafontein, Brakpan and/or Grootvlei TSFs; and
- Construction of a treated water pipeline to a suitable discharge point on the Blesbokspruit

EXEMPTIONS

Further, the Department hereby exempts -

The Department of Water Affairs from the requirements of the Environmental Impact Assessment Regulations 2010 in terms of sub-regulations (50), (51) and (52), for the development of the immediate and short term interventions for the treatment of acid mine drainage in the western, central and eastern basins as identified in the application for exemption dated 27 November 2012 – and authorises the Department of Water Affairs to undertake all activities required for the undertaking of the works as described in the scoping report dated November 2012 on the footprint as identified above.

SCOPE OF AUTHORISATION

1. Authorisation is granted for the implementation of emergency works aimed at mitigating acid mine drainage in the Witwatersrand Gold Fields. The immediate and short term interventions for the treatment of acid mine drainage are hereby approved.
2. The Department shall by written notice to the holder of an environmental authorisation and exemption suspend with immediate effect an environmental authorisation if suspension of the authorisation is necessary to prevent harm or further harm to the environment.
3. The activities must commence within a period of three (3) years from the date of issue. If commencement of the activity does not occur within that period, the environmental authorisation and exemption lapse and a new application for an environmental authorisation must be made for the activities to be undertaken. Commencement with one activity in terms of this decision constitutes commencement of all authorised activities.
4. The holder of the environmental authorisation and exemption shall be responsible for ensuring compliance with the conditions contained in this decision. This includes any person acting on the holder's behalf, including but not limited to, an agent, servant, contractor, sub-contractor, employee, consultant or person rendering a service to the holder of the decision.
5. Any changes to, or deviations from, the project description set out in this authorisation must follow the amendment processes as prescribed in Chapter 4 (Parts 1-3) of the NEMA EIA Regulations, 2010 and be approved, in writing, by the Department before such changes or deviations may be effected. In assessing whether to grant such approval or not, the Department may request such information as it deems necessary to evaluate the significance and impacts of such changes or deviations and it may be necessary for the holder of the authorisation to apply for further authorisation in terms of the regulations.

Management of the activity

6. The construction Environmental Management Programme (EMPr) integrated as part of the Application for EA is hereby approved. This EMPr must be implemented and adhered to.

6.1. The approved EMPr must be implemented and strictly enforced during all construction phases of the project. It shall be seen as a dynamic document and shall be included in all contract documentation for all phases of the development when approved.

7. Changes to the EMPr which are environmentally defendable, shall be submitted to this Department for acceptance before such changes may be effected.
8. The Department reserves the right to request amendments to the EMPr should any impacts that were not anticipated be discovered.

Environmental control officer

9. The holder of this decision must appoint an independent Environmental Control Officer (ECO) with experience or expertise in the field for the construction phase of the development. The ECO will have the responsibility to ensure that the conditions referred to in this decision are implemented and to ensure compliance with the provisions of the EMPr.
10. The ECO must be appointed before commencement of any authorised activity.
11. Once appointed, the name and contact details of the ECO must be submitted to the Director: Compliance Monitoring of the Department.
12. The ECO must remain employed until all rehabilitation measures, as required for implementation due to construction damage, are completed and the site is ready for operation.

12.1. The ECO must:

12.2. Keep record of all activities on site, problems identified, transgressions noted and a schedule of tasks undertaken by the ECO.

12.3. Keep and maintain a detailed incident (including spillage of bitumen, fuels, chemicals, or any other material) and complaint register on site indicating how these issues were addressed, what rehabilitation measures were taken and what preventative measures were implemented to avoid re-occurrence of incidents/complaints.

12.4. Keep and maintain a daily site diary.

12.5. Keep copies of all reports submitted to the Department.

12.6. Keep and maintain a schedule of current site activities including the monitoring of such activities.

12.7. Obtain and keep record of all documentation, permits, licences and authorisations such as waste disposal certificates, hazardous waste landfill site licences etc. required by this facility.

12.8. Compile a monthly monitoring report.

Waste management control officer

13. The applicant must designate a Waste Management Control Officer (WMCO), who will monitor and ensure compliance and correct implementation of all conditions and provisions as stipulated in the environmental authorisation and approved EMP related to the authorised activities.
14. The WMCO must report any non-compliance with any environmental authorisation conditions or requirements or provisions of NEMWA to the Department through the means reasonably available.
15. The duties and responsibility of the WMCO should not be seen as exempting the holder of the environmental authorisation from the legal obligations in terms of the NEMWA.

Recording and reporting to the department

16. The holder of this authorisation must keep all records relating to monitoring and auditing on site and make it available for inspection to any relevant and competent authority in respect of this development.
17. All records and/or reports required or resulting from activities relating to this environmental authorisation must:

17.1. be legible;

17.2. be submitted as required and must form part of the external audit report;

17.3. if amended, the record and/or report must be amended in such a way that the original and any subsequent amendments remain legible and are easily retrievable; and

17.4. be retained in accordance with documented procedures which are approved by the Department.

18. All documentation e.g. audit/monitoring/compliance reports and notifications, required to be submitted to the Department in terms of this authorisation, must be submitted to the Director: Compliance Monitoring at the Department.
19. The holder of the environmental authorisation must keep records and update all the information referred to in Annexure II and submit this information to the Department on an annual basis.

Environmental audit report for construction

20. The holder of the authorisation must submit an environmental audit report to the Department within 30 days of completion of the construction phase (i.e. within 30 days of site handover) and within 30 days of completion of rehabilitation activities.

21. The environmental audit report must:

21.1. Be compiled by an independent environmental auditor;

21.2. Indicate the date of the audit, the name of the auditor and the outcome of the audit;

21.3. Evaluate compliance with the requirements of the approved EMP and this environmental authorisation;

21.4. Include measures to be implemented to attend to any non-compliances or degradation noted;

21.5. Include copies of any approvals granted by other authorities relevant to the development for the reporting period;

21.6. Highlight any outstanding environmental issues that must be addressed, along with recommendations for ensuring these issues are appropriately addressed;

21.7. Include a copy of this authorisation and the approved EMP

21.8. Include all documentation such as waste disposal certificates, hazardous waste landfill site licences etc. pertaining to this authorisation; and

21.9. Include evidence of adherence to the conditions of this authorisation and the EMP where relevant such as training records and attendance records.

Commencement of activities

22. An appeal under section 43 of the National Environmental Management Act (NEMA), Act 107 of 1998 (as amended), does not suspend an environmental authorisation or exemption, or any provisions or conditions attached thereto, or any directive, unless the Minister, MEC or delegated organ of state directs otherwise.

23. Should you be notified by the Minister of a suspension of the authorisation pending appeal procedures, you may not commence with the activity until such time that the Minister allows you to commence with such an activity in writing.

Notification to authorities

24. Prior written notice must be given to the Department that the activity will commence. Commencement for the purposes of this condition includes site preparation. The notice must include a date on which it is anticipated that the activity will commence.

Operation of the activity

25. Prior written notice must be given to the Department that the activity operational phase will commence.
26. The holder of this authorisation must compile an operational EMPr for the operational phase of the activity and submit to the Department for written approval prior to commencement of operations or alternatively, if the holder has an existing operational environmental management system, it must be amended to include the operation of the authorised activity.

Site closure and decommissioning

27. Should the activity ever cease or become redundant, the applicant shall undertake the required actions as prescribed by legislation at the time and comply with all relevant legal requirements administered by any relevant and competent authority at that time.

Leasing and alienation of the site

28. Should the holder of the environmental authorisation want to alienate or lease the site, he/she shall notify the Department in writing of such an intention at least 120 days prior to the said transaction. Should the approval be granted, the subsequent holder of the environmental authorisation shall remain liable to compliance with all authorisation conditions.

Transfer of environmental authorisation

29. Should the holder of the environmental authorisation transfer holdership of this environmental authorisation due to a change of ownership [as provided for in terms of S24E(c) of NEMA], he/she must apply in terms of Section 52 of NEMWA.
30. Should the transfer of holder ship of this environmental authorisation mentioned above be for any reason other than the change of ownership in the property, the holder of this environmental authorisation must inform the Department of any change in ownership in the property and must request an amendment to this environmental authorisation to reflect such change in ownership.
31. Any subsequent holder of an environmental authorisation shall be bound by conditions of this environmental authorisation.

Investigations

32. If, in the opinion of the Department, pollution, nuisances or health risks may be or are occurring on the site, the holder of the environmental authorisation must initiate an investigation into the cause of the problem or suspected problem, including such investigations as identified by the Department related to the risks posed. Should the investigation carried out reveal any unacceptable levels of pollution, the holder of the environmental authorisation must submit mitigation measures to the satisfaction of the relevant Department.

Specific conditions

Site Security and Access Control

33. The holder of the environmental authorisation must ensure effective access control to the construction sites to prevent unauthorised entry. Weather-proof, durable and legible signs in at least three official languages applicable in the area must be displayed at each entrance to the site. The signs must indicate the risks involved in entering the site, must include the person responsible for the operation of the site.

Permissible waste

34. Any portion of the site which has been constructed or developed in accordance with this environmental authorisation may be used for the storage of sludge before treated and disposed.
35. The classification, acceptance and disposal criteria as listed in the latest edition of the document "Minimum Requirements for Handling, Classification and Disposal of Hazardous Waste, Waste Management Series, Department of Water Affairs and Forestry or by the Department in future, (hereinafter referred to as the "Minimum Requirements Series"), must be conformed to.

Construction and commissioning of activities

36. The site construction (existing and new) must be approved by a registered professional engineer and compliant with recognised civil engineering standards and adequately lined to protect surface and ground water resources.

37. The storage site must have a firm, impermeable, and chemical resistant floors and a roof to prevent direct sunlight and rain water from getting in contact with the sludge.
38. The holder of the environmental authorisation must construct and maintain on a continuous basis a drainage and containment system capable of collecting and storing all runoff water arising from the site, which could be expected as a result of the of the 1 in 100 years flood over a period of 24 hours to prevent such runoff water from coming into contact with waste. The system must under the said rainfall event, maintain a freeboard of half a metre.
39. The site plan must only be changed under the supervision of a registered professional engineer.

Environmental auditing and reporting

40. Internal Audits

40.1. Internal audits must be conducted annually by the holder of the environmental authorisation in order to audit compliance with conditions related to the treatment works of this environmental authorisation and the approved EMPr, and on each audit occasion an official report must be compiled by the relevant auditor to report the findings of the audits, which must be made available to the external auditor specified in condition below.

41. External Audits

41.1. The holder of the environmental authorisation and approved EMPr must appoint an independent external auditor to audit the treatment works biannually subject to the environmental authorisation and this auditor must compile an audit report documenting the findings of the audit, which must be submitted by the holder of the environmental authorisation.

41.2. The audit report must-

(i) Indicate compliance to requirements related to the treatment works as included in the approved operational EMPr for the treatment works;

(ii) Specifically state whether conditions related to the treatment works of this environmental authorisation are adhered to;

(iii) Include an interpretation of all available data and test results regarding the operation of the site and all its impacts on the environment;

(iv) Specify target dates for the implementation of the recommendations by the holder of the environmental authorisation to achieve compliance;

(v) Contain recommendations regarding non-compliance or potential non-compliance and must specify target dates for the implementation of the recommendations by the holder of the environmental authorisation and whether corrective action taken for the previous audit non conformities was adequate;

(vi) Show results graphically and conduct trend analysis; and

(vii) Include the information required in Annexure II.

41.3. The holder of the environmental authorisation must carry out all tests required in terms of this environmental authorisation in accordance with published laboratory analysis methods or those prescribed by and obtainable from the South African Bureau of Standards (SABS), referred to in the Standards Act, 2008 (Act 08 of 2008).

41.4. Each external audit report referred to in *External Audits* above must be submitted to the Department within 30 days from the date on which the external auditor finalised the audit.

Reporting

42. The holder of the environmental authorisation must, within 14 days inform the Department from the occurrence or detection of any incident referred to hereunder, within 14 days period of time specified by the Department submit an action plan, which must –

42.1. Correct the impact resulting from the incident;

42.2. Prevent the incident from causing any further impact; and

42.3. Prevent a recurrence of a similar incident to the satisfaction of the Department.

43. In the event that measures have not been implemented within 21 days of the incident, or within the time period identified by the Department, or the measures which have been implemented are inadequate, the Department may implement the necessary measures at the cost and risk of the holder of the environmental authorisation.

44. The holder of the environmental authorisation must keep an incident report and complaints register, which must be made available to the external auditor, representatives of this Department and Department of Water Affairs for the purpose of audit.

45. The Department must be notified as soon as the holder of this environmental authorisation becomes aware of the following incidents:

45.1. Any malfunction, breakdown or failure of equipment or techniques, accident or fugitive emission which has caused , is causing or may cause significant pollution;

45.2. The breach of this environmental authorisation; and

45.3. Any significant adverse environmental and health effects.

General operation and impact management of waste management activities

46. Waste, which is not sewage from the authorised development, must be dealt with according to relevant legislation or the Department's policies and practices.
47. The holder of environmental authorisation must prevent spillages. Where the spillages occur, the holder of authorisation must ensure the effective and safe cleaning of such spillages.
48. The treatment of effluent must not impact on a water resource or on any other person's water use, property or land and must not be detrimental to the health of the public in the vicinity of the activity.
49. The holder of environmental authorisation must prevent the occurrence of nuisance conditions or health hazards.
50. The pipelines used for the conveyance of effluent must be painted in a conspicuous colour or manufactured of a coloured material distinctly different from the colour of the pipes in which drinking water is flowing to avoid the possibility of any cross-connection of the different pipelines.
51. The holder of environmental authorisation must ensure that all personnel who work with hazardous waste are trained to deal with these potential hazardous situations so as to minimise the risks involved. Records of training and verification of competence must be kept by the Authorisation Holder.
52. The holder of authorisation must ensure that the effluent treatment operates within its design parameters at all times.
53. The holder of environmental authorisation must ensure that non biodegradable solids and the sludge are disposed of at a Waste Management Facility licensed to accept such wastes.
54. The holder of environmental authorisation must take all reasonable steps to ensure that the integrity of the waterproof base and infrastructure used for the treatment of acid mine water are routinely monitored and corrective action must be taken before containment integrity is breached.
55. No effluent must be discharged into any storm water drain or furrow, whether by commission or by omission.

Water quality monitoring

56. Surface water monitoring shall be performed in all storm water drains on and adjacent to the Site at locations selected in conjunction with the Department of Water Affairs and at such a frequency as determined by the responsible authority.
57. A proper macro element groundwater quality monitoring program must be implemented as soon as possible to establish baseline prior to the installation of the new treatment facilities.
58. A water quality monitoring program should be developed by a suitably qualified (SACNASP registered) person to allow for groundwater and surface water contamination monitoring.

59. Shallow monitoring wells must be installed around the treatment facilities.

60. Reasonable steps must be taken to ensure that the integrity of the waterproof base and infrastructure are routinely monitored and corrective action is taken before containment integrity is breached.

Date of environmental authorisation: 07/01/2013

Mr Mark Gordon
Chief Director: Integrated Environmental Authorisations
Department of Environmental Affairs

Annexure I: Reasons for Decision

1. Key factors considered in making the decision

All In reaching its decision, the Department took, *inter alia,* the following into consideration -

a) The information contained in the FSR dated November 2012;
b) Motivation Report in support of application for exemption dated November 2012;
c) The mitigation measures included in the construction EMPr dated November 2012;
d) The information contained in the Public Participation Process Report dated November 2012;
e) The comments from interested and affected parties as included in the FSR dated November 2012; and in the Public Participation Process Report dated November 2012;
f) The findings of the site inspection conducted on 02 November 2011; and
g) The objectives and requirements of relevant legislation, policies and guidelines, including section 2 of the National Environmental Management Act, 1998 (Act No. 107 of 1998).

2. Findings

After consideration of the information and factors listed above the Department reached the following conclusions:

a) The IMC Report indicated that these interventions are urgently required as the prevention of AMD decant in the basins is considered to be of national importance.
b) The impacts on the environment of the activity have been considered and are regarded as being mitigatable. The consequences to the surrounding environment should the activity not go ahead is however the major area of concern.
c) Allowing untreated mine water to enter into the environment in an uncontrolled manner is more likely to be detrimental to the environment than pre-treating the water and releasing it in a controlled manner.
d) The procedure followed for impact assessment is adequate for the decision-making process.
e) The proposed mitigation of impacts identified and assessed adequately curtails the identified impacts.

f) A sufficient public participation process was undertaken and the applicant has satisfied the minimum requirements as prescribed in the EIA regulations, 2010, for public involvement.

In view of the above, the Department is satisfied that, subject to compliance with the conditions contained in the environmental authorisation, the activities will not conflict with the general objectives of integrated environmental management laid down in Chapter 5 of the National Environmental Management Act, 1998 and that any potentially detrimental environmental impacts resulting from the activity can be mitigated to acceptable levels. The application is accordingly granted.

ANNEXURE II

INFORMATION WHICH SHALL BE SUBMITTED ON AN BI-ANNUAL BASIS IN ACCORDANCE WITH THE "RECORDING AND REPORTING TO THE DEPARTMENT" ABOVE

* = *Indicate with an X. Please print legibly.*

NAME OF SITE: ________________________________ DATE OF REPORT: _______(y/m/d)

1. Registered owner(s) of property on which the treatment facility is situated:

Name	Telephone	
Postal Address	Fax	
	Postal Code	

2. Operator in control of the treatment facility:

Name	Telephone	
Identity number	Tel. After hours	
Educational Qualifications		
Other Relevant competencies:		

3. Indicate the type of waste and approximate quantities of effluent treated during the six months:

Type of waste (Specify)	Quantity (m³ annum⁻¹)
TOTAL	

4. Indicate the type of waste and approximate quantities of sludge reused, recycled, or disposed of during the six months:

Type of waste	Quantity (m^3 $annum^{-1}$)	reused, treated or disposed
TOTAL		

I, the undersigned, declare that the information stated above is to my knowledge a true reflection of the status at the ____________________ effluent treatment facility.

Signature: ____________________________

Name: ____________________________

Capacity: ______________________________

Place: ___________________ Date_______________

This form may be obtained electronically from the Department.

Appendix C
Request for Information: DWA 21/12/2012

water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

Home	Study Objectives	Study Area	Study Approach & Progress	Communication	Documents	Gallery	Links & FAQ's	Contacts

Announcements

Request for Information: Long-Term Solutions for the management of AMD

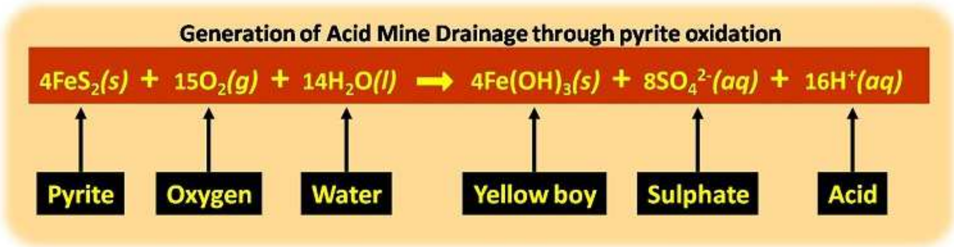
Acknowledgements for Contributions

ACID MINE DRAINAGE: LONG TERM SOLUTION FEASIBILITY STUDY

FEASIBILITY STUDY FOR A LONG-TERM SOLUTION TO ADDRESS THE ACID MINE DRAINAGE ASSOCIATED WITH THE EAST, CENTRAL AND WEST RAND UNDERGROUND MINING BASINS

THE NATURE OF ACID MINE DRAINAGE

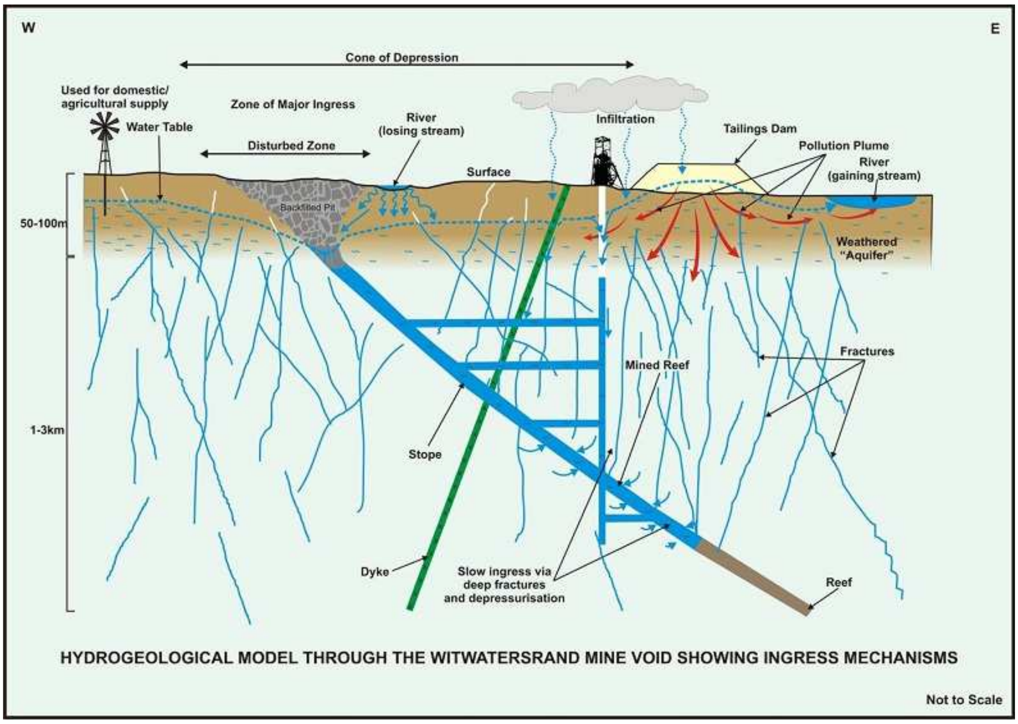
Acid Mine Drainage (AMD) is generated when sulphide bearing minerals, often in the form of pyrite (which is iron-sulphide or FeS2 found inter alia in reefs mined for gold), are exposed to oxygen and water. This process, termed pyrite oxidation, is characterised by the generation of sulphuric acid and dissolved iron, as illustrated with a typical chemical reaction depicted below.



Apart from iron, the associated decreasing pH is also conducive to the mobilisation of various other metals, such as copper, lead, aluminium, manganese and uranium. Although the AMD generating reactions also occur in abiotic environments, colonies of microorganisms, such as certain acidophiles (bacteria thriving under acidic conditions), greatly accelerate the decomposition of metal ions. When the pH of AMD is raised, either through contact with fresh water or with neutralising minerals, metals, such as the previously soluble iron(III) ions precipitate as iron(III) hydroxide – a yellow-orange solid colloquially known as "yellow boy".

MINING'S "WATER" LEGACY

In the Witwatersrand area, in the Province of Gauteng, mining has taken place in the three underground mining basins of the East, Central and West Rand since the discovery of gold in 1886. It was the driving force of the economic growth and development of what is Gauteng today and it was the backbone of the economy of South Africa for many years. During this time the more than 120 mines would have been required to pump out the water that had entered the mines in order to allow for safe mining conditions. As the mines were worked out and were abandoned, dewatering of the mine voids became the responsibility of fewer and fewer mines, and the voids (tunnels, drives and shafts) started filling with water. The mechanism through which this occurs is illustrated conceptually below:



AMD, generated through the ingress of water into the mine voids, is generally characterised by one or more of the following: low pH, high salt content (mostly made up of sulphates), and high levels of metals – particularly iron (giving it the red-orange colour). In cases where uranium is present, radiological risks may also be present.

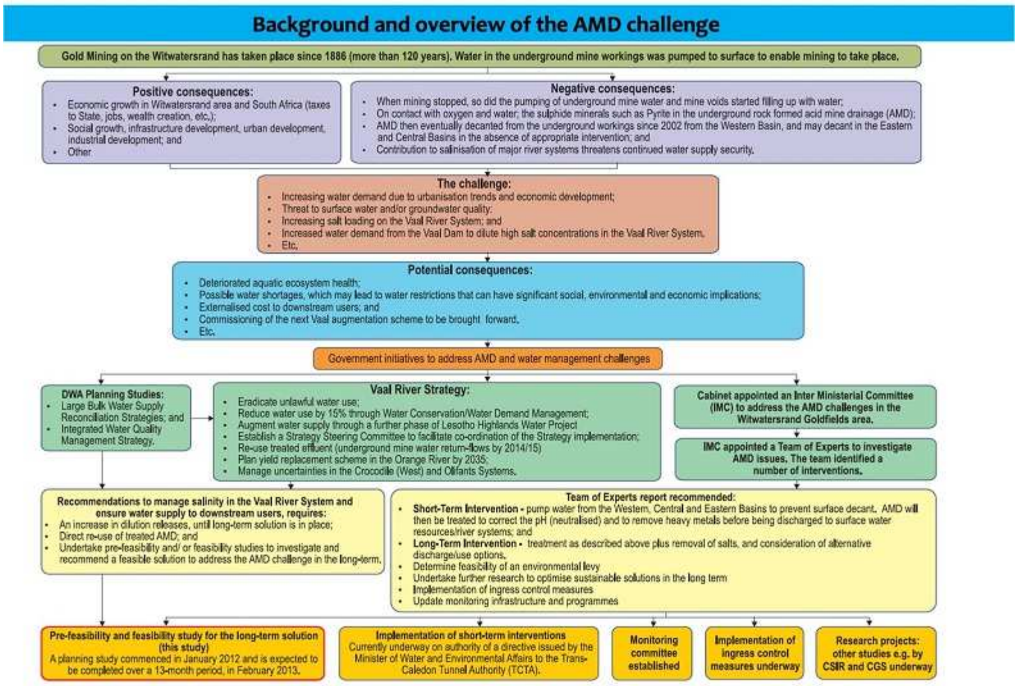
As the water levels in the mine voids rise, the risk of possible seismic activity (i.e. tremors) increases, AMD can contaminate shallow aquifers, and if the underground mine water reaches the near-surface environment, geotechnical impacts (i.e. such as sinkhole formation) may potentially be caused. The uncontrolled rising of the underground mine water levels may also cause negative socio economic consequences, such as the potential flooding of the Gold Reef City underground museum and the possible sterilisation of remaining gold reserves. Once the AMD reaches the surface and starts to decant, as was the case since 2002 until recently in the Western Basin, it flows down to wetlands, streams and rivers, and mortality of aquatic biota may occur. Since our rivers are inter alia used as a water source for the supply of water for agriculture, recreation and drinking purposes, AMD potentially affects the fitness for use of such water. AMD can also have a cost implication further downstream due to elevated salt levels that may be caused.

MINING AND WATER SECURITY IN THE VAAL RIVER WATER SUPPLY AREA

If the salt loading on the Vaal River System associated with the discharges of AMD from mines and sewage effluent are not eliminated or suitably reduced, excessive dilution-releases from the Vaal Dam will be required to achieve the required Resource Water Quality Objectives in the Vaal Barrage and downstream river. This will result in unusable surpluses developing in the Lower Vaal River, potentially externalising the cost of pollution to the Lower Orange River. Should the AMD issue, and specifically the increasing salt loading caused in the Vaal River System, not be addressed appropriately by 2014/15, the acceptable levels of assurance of water supply may be threatened. Although being dependent on the rain and runoff experienced in a moving 2 year period, this means that there will be an increasing risk of water restrictions that may have to be imposed on Vaal River water users. Vaal Position Paper.

ADDRESSING AMD

In order to address the AMD threats responsibly, DWA, together with a number of other departments such as DMR have initiated a number of interventions and studies (included in the diagram below). Each of these initiatives is aimed at solving a particular part of the problem.



The Inter-Ministerial Committee (IMC) on AMD, comprising of the Ministers of Mineral Resources, Water and Environmental Affairs, Science and Technology and the Minister in the Presidency: National Planning Commission directed that a Team of Experts investigate solutions to the AMD related challenges associated with various Gauteng gold mines. Following this, Cabinet on 9 February 2011 approved the IMC report and the Department of Water Affairs (DWA) has subsequently taken the following steps to address the problem

- On 6 April 2011, the Trans-Caledon Tunnel Authority (TCTA) was instructed to undertake emergency works to protect the respective Environmental Critical Levels (ECLs) in the Eastern and Central Basins and to lower the underground mine water levels in the Western Basin; and to neutralise and remove the heavy metals from the pumped underground mine water prior to it being released to surface water resources;
- A Hydrological Monitoring Committee (HMC) was established under the chairmanship of DWA to monitor the re-watering and quality of water, in respect of the East, Central and West Rand. The Council for Geoscience (CGS), the Department of Mineral Resources (DMR) and the Council for Scientific and Industrial Research (CSIR) are also involved; and
- A feasibility study to address underground mine water induced salt loading of major river systems in the long-term was initiated on 1 February 2012.

FINDING LONG-TERM SOLUTIONS

In addition to the Short Term Interventions and Ingress Control Interventions a "Feasibility Study for a long term solution to address the AMD associated with the East, Central and West Rand underground mining basins" is currently underway. This Feasibility Study comprises of three phases, i.e. the Initiation Phase, the Pre-Feasibility Phase, where the options for the long-term pumping, treatment, use and management of AMD are screened and a Feasibility Phase, where the most feasible option is investigated further for each of the underground mining basins. Detail on the scope of the Feasibility Study can be obtained at Inception Report and a list of the study deliverables and their progress can be obtained at study progress

water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

REQUEST FOR INFORMATION

Invitation to those interested in proposing long-term solutions for the management of Acid Mine Drainage in the Witwatersrand

Purpose of this Request

Considering the complexity of managing Acid Mine Drainage (AMD) in the East, Central and West Rand underground mining basins in the Gauteng province, the Department of Water Affairs (DWA) wishes to seek from the open market innovative solutions for the long-term management of AMD originating from the Witwatersrand underground mine voids. Information received with regard to the solutions will be captured for consideration in the on-going Feasibility Study.

Parties interested in providing information could be any individual or service provider or group of service providers that can offer any of the services required for the management of AMD. This would include institutional matters, financial matters, technology as well as the operation and maintenance of the pump stations, treatment plants and waste management.

Background

In January 2012, The Department of Water Affairs initiated a **"Feasibility Study for a long-term solution to address the AMD associated with the East, Central and West Rand underground mining basins"**. This study is currently in the process of concluding its pre-feasibility (options screening) phase. More information on this study can be found on the DWA AMD Website at: http://www.dwa.gov.za/Projects/AMDFSLTS/

A feasible long-term solution for the management of AMD will not only involve the sustainable protection of water resources and the environment from pollution, but the salts that are contributed by AMD to the river systems must also be removed in order to meet downstream user requirements and ensure security of supply. The management and safe disposal of by-products from the treatment of AMD will be as important as the quality of water being discharged to the environment or supplied to users.

Type of Information Requested

Interested parties and service providers are invited to provide concise information on their proposed solutions, or services for the following, for which we will undertake to enter into a commitment in terms of a Declaration on Protection of Information:

- A complete long-term solution for managing AMD, including use or disposal of waste;
- Details of treatment options or technologies which can form part of a solution;
- Design, construction, operation and maintenance of infrastructure for treatment and distribution of water and/or management of waste;
- Use of waste products; and
- Financing.

Guidelines for Provision of Information

Interested parties and service providers are invited to provide concise information on their proposed solutions, or services. Proposed solutions should be able to manage or treat the full flow of AMD expected from a basin, although proposals that can work in modules of 10 Mega litres per day will also be considered.

Currently it is expected that the following approximate volumes of AMD will be extracted from the underground mine workings:

Western Basin between 20 – 27 Mℓ/day, Average 23 Mℓ/day

Central Basin between 30 – 90 Mℓ/day, Average 46 Mℓ/day

Eastern Basin between 70 – 100 Mℓ/day, Average 80 Mℓ/day

AMD would normally be subjected to the following processes before it is fit for release to the environment or is utilised in potable or industrial systems:

- Neutralisation of the acids;
- Removal of metals and Nucleoids;
- Removal / reduction of sulphates and other salts; and/ or
- Removal of specific chemicals.

Water quality characteristics of AMD, before first stage neutralisation and the characteristics after first stage neutralisation are given in the Guideline for the Provision of Information (see link below).

Those parties offering technological and treatment solutions should either own or be the license holder for the technology in South Africa. Suggestions for innovative and sustainable solutions that can be considered in the long-term solution are welcome, including solutions involving passive treatment of AMD.

Further details on the information to be provided are also given in the Guideline for the Provision of Information, which must be consulted before the submission of information.

Process for the Provision of Information

Parties that are interested in providing information are requested to:

1. Download and read the Guideline for the Provision of Information
2. Complete the online Registration Form
3. Email a copy of the saved Registration form and the information on your solution (the type of information the DWA would require and the email address is provided in the guideline).

The completed registration form together with the information you wish to provide should be submitted before **31 January 2013**.

Terms and Conditions

This RfI will inform the Feasibility Study and the anticipated procurement of a long-term solution for managing AMD associated with the mine voids in the Witwatersrand and is thus an important first step in the process.

Interested parties who submit proposed solutions will be captured on a RfI database that will be used to inform those on the database if and when procurement documents are issued to procure the provision of a suitable long-term solution to address AMD.

Parties interested in submitting information must note that although the outcome of the RfI may inform future procurement processes, the submission of information or registration of your interest does not constitute a commitment, implied or otherwise, that DWA will take procurement action in this matter or be responsible for any cost incurred in furnishing this information, nor does it place anybody as a potential vendor on the DWA vendor list or Environmental Impact Assessment (EIA) Interested and Affected Parties (I&AP) list.

water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

Home	Study Objectives	Study Area	Study Approach and Progress	Communication	Documents	Links	Gallery	FAQ's	Contacts

REQUEST FOR INFORMATION

Invitation to those interested in proposing solutions for the long term management of Acid Mine Drainage in the Witwatersrand

Company Name:*

Contact Person:*

E-mail Address:*

Telephone Number: +

Mobile Number:* +

Fax Number: +

Physical Address:*

Postal Address:

I would like to register interest in providing the following services for the long-term management of AMD in the Witwatersrand:*

- ☐ Funding
- ☐ Treatment Technology(ies)
- ☐ Waste Management
- ☐ Designing and Constructing Infrastructure
- ☐ Operating and Maintaining Infrastructure
- ☐ Other

If you have selected "Other" Please stipulate the type of service you would be able to provide:*

If you have selected the provision of a treatment technology, please stipulate if it is a technology for treating:*

- ☐ Acid Mine Drainage (Water)
- ☐ Acid Mine Drainage (Sludge)

I have read the guidelines for the provision of information and I am interested in providing further information on the items selected above.

Please indicate:* ☐ Yes ☐ No

If you have selected yes, please send a copy of this form, together with the relevant information (as per the guidelines for the provision of Information) to AMDRFI@dwa.gov.za

Submit and Save

water affairs

Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

GUIDELINES

Guidelines, Background and Data for those Interested in Providing Services or Proposing Long-term Solutions for the Management of Acid Mine Drainage associated with the East, Central and West Rand underground mining basins

Purpose of the Guideline.

This document serves as a guideline for the submission of information regarding innovative long-term solutions for the sustainable management of AMD associated with the East, Central and West Rand underground mining basins. It contains both technical information enabling those interested to submit their ideas and it provides the details on how to submit the information.

Background.

The Department of Water Affairs is currently undertaking a ***"Feasibility Study for a long-term solution to address the AMD associated with the East, Central and West Rand underground mining basins"***.

The main goal of the AMD Long-Term Solution Feasibility Study is to-

Investigate and recommend a feasible long-term solution to the AMD problems emerging in the Central, East and West Rand underground mining basins.

A feasible solution will be one that is technically sound, environmentally sustainable, economically viable, institutionally feasible & legally acceptable.

This study will be used to inform the criteria to be used for the evaluation of possible service provider(s) for the long-term solution to AMD for which interested parties may register their interest. Parties who register their interest will be advised if and when procurement documents are issued to procure a suitable long-term solution to address AMD.

As part of the feasibility study the Department needs to obtain information on the different types of treatment technologies that are available and the associated costs. It also needs to obtain information on the possible institutional and financial solutions.

This information gathering is to inform the Feasibility Study, and is thus not a part of any procurement or pre-qualification process and no comments as to the suitability or otherwise of the processes presented will be communicated to any outside party by the Study Team. The information will be used solely for the purpose of testing the market and informing the feasibility study.

Guidelines for the Provision of Information on Treatment Technologies.

AMD treatment will be required to:

- Neutralize acids
- Remove metals
- Remove sulphates and other salts
- Remove specific chemicals (such as cyanide)

The sustainable management of the treatment by-products is also an important component of the long term solution and is seen as an integral part of any proposed solution.

The quantities to be treated by the process are:

Western Basin between 20 – 27 Mℓ/day, Average 23 Mℓ/day
Central Basin between 30 – 90 Mℓ/day, Average 46 Mℓ/day
Eastern Basin between 70 – 100 Mℓ/day, Average 80 Mℓ/day

It is expected that proposed technologies should either be able to treat the raw water, with the qualities reflected in the tables below, or the water coming from the first stage treatment (Neutralisation), also described below. The treatment technology proposed should be able to treat the wide range of water quality values as reflected in the statistical water quality data sets. The process design should be able to treat the 90th percentile values as the worst case. The operational impacts of treatment and volumes of waste should however rather be representative of the 50th to the 75th percentile of the data set. It is expected that the quality of the water will vary with time, once pumping commences.

The information that is currently available on the quality of the AMD as it comes out of the mining void is as follows:

Western Basin								
Parameter	**Unit**	**Percentile**						
		5th	10th	50th	60th	75th	90th	95th
pH	@ 25°C	3.5	3.9	5.4	5.5	5.6	5.9	6.0
Conductivity	mS/m @ 25°C	320	334	385	392	415	434	442
TDS^	mg/ℓ	3 549	4 031	4 628	4 743	4 890	5 208	5 434
Iron	mg/ℓ	358	439	662	703	772	890	954
Sulphate	mg/ℓ	2 366	2 687	3 085	3 162	3 260	3 472	3 623
Sodium	mg/ℓ	65	86	110	118	132	175	227
Calcium	mg/ℓ	424	470	549	558	584	633	703
Manganese	mg/ℓ	31	38	56	63	70	81	89
Acidity	mg/ℓ	794	864	1 039	1 062	1 174	1 406	1 520
^Estimated	n = 148 for all parameters	Data accumulated between January 2011 and March 2012						

Central Basin								
Parameter	Unit	Percentile						
		5th	10th	50th	60th	75th	90th	95th
T	°C	21.7	22.0	22.9	23.2	25.3	26.3	26.8
pH		2.4	2.5	3.0	3.7	4.2	4.3	4.4
EC	mS/m	371	371	397	405	412	450	465
TDS^	mg/ℓ	3 644	3 896	4 247	4 319	4 429	4 561	4 592
Tot Alk	mg/ℓ CaCO3	2.5	2.5	2.5	2.5	8.9	28.9	34.0
Na	mg/ℓ	108	110	122	134	169	170	171
Mg	mg/ℓ	118	159	172	177	201	249	258
Al	mg/ℓ	10	21	122	129	133	184	193
K	mg/ℓ	3	3	5	5	7	12	13
Ca	mg/ℓ	241	243	279	351	403	459	563
Fe	mg/ℓ	1	2	40	41	48	94	108
Mn	mg/ℓ	13	24	47	47	49	50	50
F	mg/ℓ	0	0	1	2	2	4	4
Cl	mg/ℓ	84	87	137	138	141	144	146
NO3	mg/ℓ	10	12	23	26	29	33	34
PO4	mg/ℓ	0	0	0	0	0	11	15
SO4	mg/ℓ	2 429	2 597	2 831	2 879	2 953	3 041	3 062
Li	µg/ℓ	274	290	372	-	428	450	495
Be	µg/ℓ	2	4	20	21	23	24	25
B	µg/ℓ	214	245	280	300	318	361	712
V	µg/ℓ	1	1	1	1	4	9	12
Cr	µg/ℓ	5	5	87	100	129	130	148
Co	µg/ℓ	601	1 200	4 684	4 923	5 205	5 637	5 760
Ni	µg/ℓ	1 268	2 600	10 589	11 122	11 669	12 633	12 850
Cu	µg/ℓ	28	40	328	332	371	375	376
Zn	µg/ℓ	1 046	1 991	9 122	9 195	9 625	11 174	11 736
Ga	µg/ℓ	3	3	3	3	19	79	88
As	µg/ℓ	1	1	31	33	39	55	115
Se	µg/ℓ	6	10	40	42	45	46	47
Rb	µg/ℓ	15	15	19	19	25	38	42
Sr	µg/ℓ	443	493	634	638	661	693	697
Mo	µg/ℓ	3	3	3	3	3	3	3
Ag	µg/ℓ	1	1	1	1	15	15	15
Cd	µg/ℓ	1	1	11	11	12	12	15
Te	µg/ℓ	1	1	1	1	1	1	1
Ba	µg/ℓ	5	5	11	18	442	2 053	2 213
Tl	µg/ℓ	1	1	1	1	1	1	1
Pb	µg/ℓ	5	7	28	35	80	132	276
Bi	µg/ℓ	1	1	1	1	1	1	2
U	µg/ℓ	56	123	606	645	657	682	695
Number of samples = 12		^ Estimated		Numbers rounded				

Eastern Basin									
Parameter	Unit	n	Percentile						
			5th	10th	50th	60th	75th	90th	95th
T	°C	138	18.9	20.0	26.5	27.0	28.0	28.0	29.0
pH		101	5.9	6.1	6.5	6.5	6.6	6.9	7.1
EC	mS/m	144	98	161	280	292	312	349	360
TDS^	mg/ℓ	138	484	781	2 292	2 468	2 840	3 196	3 358
Alkalinity	mg/ℓ CaCO3	61	12	32	168	187	232	327	560
Total Hardness	mg/ℓ	23	1 481	1 500	1 655	1 692	1 700	1 749	1 759
Salinity	mg/ℓ	38	0	0	1	1	1	2	2
Na	mg/ℓ	139	58	70	208	223	238	252	264
Mg	mg/ℓ	51	0	0	54	62	119	163	166
Al	mg/ℓ	79	0	0	0	0	0	1	2
K	mg/ℓ	38	3	3	4	5	5	6	6
Ca	mg/ℓ	61	0	0	77	129	379	407	421
Fe	mg/ℓ	139	0	0	74	88	126	209	227
Mn	mg/ℓ	139	0	0	3	3	4	5	6
Cl	mg/ℓ	139	66	75	157	170	184	205	254
NO2	mg/ℓ	38	0	0	0	0	0	0	0
Br	mg/ℓ	38	0	0	0	0	0	0	0
NO3	mg/ℓ	38	0	0	8	11	15	20	31
PO4	mg/ℓ	38	0	0	7	8	10	13	19
SO4	mg/ℓ	139	240	364	1 148	1 273	1 610	1 917	2 289
Li	µg/ℓ	38	4	6	17	23	39	95	147
B	µg/ℓ	38	64	71	98	106	125	523	1 170
Ni	µg/ℓ	61	0	0	302	350	515	1 318	2 553
Co	µg/ℓ	38	0	0	45	61	96	446	748
Cu	µg/ℓ	38	0	0	0	0	9	73	499
Zn	µg/ℓ	38	520	525	586	647	1 021	3 131	4 416
Ga	µg/ℓ	38	0	0	0	0	0	23	43
As	µg/ℓ	38	0	0	0	0	10	46	112
Se	µg/ℓ	38	0	0	8	14	29	56	94
Rb	µg/ℓ	38	5	7	11	14	20	29	33
Sr	µg/ℓ	38	126	179	336	461	616	1 100	1 433
Ag	µg/ℓ	38	0	0	0	0	0	0	1
Cd	µg/ℓ	38	0	2	3	3	3	9	18
Ba	µg/ℓ	38	93	95	104	106	108	320	1 146
Pb	µg/ℓ	38	14	15	16	17	18	41	83
U	µg/ℓ	38	1	2	10	21	92	357	470
COD	mg/ℓ	67	11	12	32	38	53	166	180
DO	mg/ℓ	100	1.3	1.8	2.4	2.5	2.6	3.1	3.4
Data rounded									

The quality of the treated underground mine water, after first stage neutralization in the short-term treatment process (currently being implemented by the TCTA), which can be used as the feed water for the long-term (second stage) treatment works is expected to be as follows:

Water Quality Parameter	Units	Quality
pH		6 – 9
Iron (Fe)	mg/ℓ	<1
Manganese (Mn)	mg/ℓ	<3
Aluminium (Al)	mg/ℓ	<1
Uranium	µg/ℓ	<50
Sulphate	mg/ℓ	<2500

The quality of the water, after second stage treatment in the works envisaged in the Long-Term Solution, should meet either or both of the following specifications:

Water Quality Parameter	Units	Potable SANS 241-1:2011	Environmental release
Flow	Mℓ/d	25	25
Total Dissolved solids	mg/ℓ	<1 200	<650
Conductivity	mS/m	<170	<100
Calcium (Ca) (SANS 241:2006)	mg/ℓ	(<150)	
Magnesium (Mg) (SANS 241:2006)	mg/ℓ	(<70)	
Sodium (Na)	mg/ℓ	<200	<80
Sulphate (SO_4)	mg/ℓ	<250	<350
Chloride (Cl)	mg/ℓ	<300	<75
pH		>5 to 9,7	6,4 – 8,5
Iron (Fe)	mg/ℓ	0,3	<1,0
Aluminium (Al)	mg/ℓ	<0,3	
Manganese (Mn)	mg/ℓ	<0,1	<2,0
Uranium (U)	mg/ℓ	<0,015	

How to submit information on Treatment Technologies

If you wish to provide information on a treatment technology , please complete the technology data sheet at the end of this document and submit supplementary information which provides:

- A description of the process in adequate detail to enable the study team to understand the principals involved in the technology. Provide a description of maximum 3 pages plus 3 pages of diagrams and drawings;
- Projected Capital Expenditure (CAPEX) for a 30 Mℓ/d facility;
- Annual Operational Expenditure of the process (OPEX) for a 30 Mℓ/d facility –(indicate order of magnitude if actual figures are not available);
- Chemical, energy and labour requirements of the process;
- Waste products produced (quality and quantity), disposal required or re-use potential; and
- Quality of the treated water produced by the process. Options under consideration include:
    - to produce potable water,
    - to produce secondary quality water for industrial and agricultural use,
    - to produce water of a quality fit for environmental discharge.

Options involving the passive treatment of AMD are also welcome.

Guidelines for the Provision of Information for the Construction, Operation, Maintenance and/or funding of AMD Treatment Facilities

If you are interested in providing information on the operation and maintenance services of a treatment facility and/or in funding the AMD solution:

- Register such interest in the registration form and describe how your organisation would be involved/why your organisation would be suitable for the construction, operation, maintenance and/or funding of such facilities.

Process for the Provision of Information.

The information requested above, which should ideally not be in excess of 3MB, should be emailed, together with a copy of the completed registration form to AMDRFI@dwa.gov.za before **31 January 2013.**

This will enable the information to be considered in the Feasibility Study for a long-term solution to address the AMD associated with the East, Central and West Rand underground mining basins**.** Any information submitted after the 31st January 2013 will be still be captured on the RfI database but may not be considered in the Feasibility Study,

**Submission of information or registration of your interest does not form part of any procurement or Environmental Impact Assessment (EIA) processes, nor does it place anybody as a potential Vendor on the DWA Vendor List. Any response or non-response to this invitation will have no bearing on any future procurement process. The issuing of this invitation is not and should not be construed as a commitment by DWA to issue any procurement documentation.*

TECHNOLOGY DATA SHEET

Company name: ______________________________

Contact person: ______________________________

It will be useful if you provide the following additional information on your technology either in the form below or in your suplementary information.

Classification of Main Process *(tick the appropriate box for man process)*

Reverse Osmosis: [ ]

Ion Exchange: [ ]

Chemical Precipitation: [ ]

Biological Process: [ ]

Passive Treatment: [ ]

Other:
- Describe ______________________________

____

Status of Development *(tick appropriate box and provide information)*

Laboratory Scale: [ ]

Small Scale Pilot Plants: Capacity [ ]
Location (Town + Country) ______________________________
[Description + indication if site can be visited]: ______________________________
____
Client Reference: ______________________________
In operation since: ______________________________

Large Scale Pilot Plant 1: Capacity [ ]
Location (Town + Country) ______________________________
[Description + indication if site can be visited]: ______________________________
____
Client Reference: ______________________________
In operation since: ______________________________

Large Scale Pilot Plant 2: Capacity [ ]
Location (Town + Country) ______________________________
[Description + indication if site can be visited]: ______________________________
____
Client Reference: ______________________________
In operation since: ______________________________

In use for Production: Capacity [ ]
Location (Town + Country) ______________________________
[Description + indication if site can be visited]: ______________________________
____
Client Reference: ______________________________
In operation since: ______________________________

Short Description of Process - *to enable understanding of the chemistry, viability and sustainability to be added as separate document*

current works.
Quality of Water (treated)

	Raw		Treated	
pH	________	mg/ℓ	________	mg/ℓ
SO_4	________	mg/ℓ	________	mg/ℓ
Ca	________	mg/ℓ	________	mg/ℓ
Mg	________	mg/ℓ	________	mg/ℓ
Fe	________	mg/ℓ	________	mg/ℓ
Mn	________	mg/ℓ	________	mg/ℓ
U	________	mg/ℓ	________	mg/ℓ
Alkalinity	________	mg/ℓ	________	mg/ℓ
TDS	________	mg/ℓ	________	mg/ℓ
EC	________	mS/m	________	mS/m
Na	________	mg/ℓ	________	mg/ℓ
Cl	________	mg/ℓ	________	mg/ℓ
F	________	mg/ℓ	________	mg/ℓ

Type of Waste (by products) Produced *(list of main waste products + possible re-use)*

Indicate special requirements (for e.g. extensive land, hazardous waste dumps, irrigable soil, wetland, etc.

Description	Volume	Mass	Dry	Wet	Re-usable
____________	________ m^3/d	________ kg/d	☐	☐	☐
____________	________ m^3/d	________ kg/d	☐	☐	☐
____________	________ m^3/d	________ kg/d	☐	☐	☐
____________	________ m^3/d	________ kg/d	☐	☐	☐
____________	________ m^3/d	________ kg/d	☐	☐	☐

Main Chemical Usage

List of hazardous or main Chemicals required:

Energy Consumption

Energy: ________ kWh/kℓ treated

________ kJ/kℓ treated

Operation cost

Staff/Labour required for operation *[Indication of staff cost and short description of special staff + qualifications required]*:

Passive Treatment

Indicate special requirements such as land, irrigation systems, wetland area, etc.:

Indicate quality of effluent:

Indicate possible environmental impacts (ground water sources, soils, etc.):

Indicate where such pilot / operational systems can be visited:

REQUEST FOR INFORMATION: INVITATION TO THOSE INTERESTED IN PROPOSING A LONG-TERM SOLUTION FOR THE MANAGEMENTOF ACID MINE DRAINAGE (AMD) IN THE WITWATERSRAND

Managing AMD from the deep gold mines in the Witwatersrand has been a major environmental challenge for many years.

In January 2012, the Department of Water Affairs (DWA) initiated a “Feasibility Study for a long-term solution to address the AMD associated with the East, Central and West Rand underground mining basins”. The objective of the Feasibility Study is to investigate and recommend the most feasible long-term solution to the AMD situation in the study area, in order to ensure long-term water supply security and continuous fitness for use of Vaal River water and of water in associated catchments.

A feasible long-term solution for the management of AMD will not only involve sustainable protection of water resources and the environment from pollution, but salts that are contributed by AMD to the river systems must also be removed in order to meet downstream user requirements and ensure security of supply.The management and safe disposal of by-products from the treatment of AMD will be as important as the quality of water being discharged to the environment or supplied to users.

Further information on this study can be found on the DWA AMD Website: http://www.dwa.gov.za/Projects/AMDFSLTS

Considering the complexity of managing AMD in the East, Central and West Rand underground mining basins in the Gauteng province, the DWA wishes to seek, from the open market, innovative long-term solutions for the management of AMD originating from the Witwatersrand underground mine voids. Information received with regard to the solutions will be captured for consideration in the on-going Feasibility Study.

Interested parties and service providers are invited to provide concise information on their proposed solutions, or services for the following, for which we will undertake to enter into a commitment in terms of a Declaration on Protection of Information:

- A complete long-term solution for managing AMD, including use or disposal of waste;
- Details of treatment options or technologies which can form part of a solution;
- Design, construction, operation and maintenance of infrastructure for treatment and distribution of water and/or management of waste;
- Use of waste products; and
- Financing;

Parties interested in providing information could be any individual or service provider or group of service providers that can offer any of the services required for the management of AMD. The proposed solution should be able to manage or treat the full flow of AMD expected from the basins, although proposals that can work in modules of 10 Mega litres per day will also be of interest.

More details on the information to be provided are given in a Guideline for the Provision of Information, which is available on the DWA website (www.dwa.gov.za) and which must be consulted before submission of any information. An online registration form is also available which must be completed prior to submitting information. Interested parties are requested to submit the completed registration form together with the information before 31 January 2013.

Interested parties who submit proposed solutions will be captured on an RfI database that will be used to inform those on the database if and when procurement documents are issued to procure the provision of a suitable long-term solution to address AMD.

This RfI will inform the Feasibility Study and the anticipated procurement of a long Term Solution for managing Acid Mine Drainage and is thus an important first step in the process.

water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

Although the outcome of the RfI may inform future procurement processes, the submission of information or registration of your interest does not constitute a commitment, implied or otherwise, that DWA will take procurement action in this matter or be responsible for any cost incurred in furnishing this information, nor does it place anybody as a potential vendor on the DWA vendor list or EIA I&AP list. To register interest or submit documents, please visit: www.dwa.gov.za

Appendix D
Project Risks

ACID MINE DRAINAGE
Risk Matrix
11-Oct-13

Effect			
High	Medium	High	High
Moderate	Low	Medium	High
Low	Low	Low	Medium
	Unlikely	Possible	Likely
		Probability	

No.	Category	Risk	Description	Mitigation Strategy	Probability	Effect	Impact of Risk	Comments
1	**Planning Risks**	Site ownership risk	The possibility that there are delays in achieving 'site clearance' in favour of the Institution and therefore access to the site cannot be granted. Other challenges to the legal title of the project site may include the following: (i) Third party prior ownership claim to Project Site. (ii) Period of registering land claims re-opened. (iii) Land claims register not accurate. Although the risk is pre-financial close, a Contracting Party could delay Financial Close and construction commencement post commercial close.	Early commencement of Land and Land Rights Options Process (LLROP) Good Due Diligence	Possible	High	High	
2		Planning consent risk - Local Authority Approvals	The possibility that the required permits, licenses, consents to commence the project are not forthcoming and thus delay the project. These include, town planning and traffic management.	IA to obtain LA approval of all proposed sites. Obligate the Private Party to obtain the necessary approvals and consents to comply with town planning regulations through the availability payment mechanism. The DBOM or DBOMF (PPP) agreement requires the Private Party to provide a work programme indicating what permits are required and by when. This will require the Private Party to perform the necessary due diligence to identify the requirements and progress consents, and ensure effective management of the planning process and sufficient allocation of time in the project process to complete the necessary processes.	Unlikely	Low	Low	
3		Planning consent risk - Water Approvals	The possibility that the required permits, licenses, consents to commence the project are not forthcoming and thus delay the project. These include water licence and re-zoning approvals.	DWA will facilitiate the required licences	Unlikely	Moderate	Low	
4		Heritage risk	The possibility that Gauteng Heritage Resources Agency (GHRA) consent required for the removal or alteration of identified heritage buildings will be delayed or cannot be obtained, which may delay the project and cause additional costs. This may be due to the presence of structures and articles protected under the Heritage Act other than fossils, antiquities, unmarked graves and other than those structures identified prior to or during RFP, requiring compliance with the Heritage Act.	Due Diligence has not identified any heritage buildings.	Unlikely	Low	Low	
5		Affordability risk	The possibility that expenditure on the project cannot be accommodated within the current levels of government expenditure and revenue (as captured in the current budget and medium-term forecasts); and/or that the Institution may not be able to make future payments without exceeding expected future allocated budgets.	Maintain project governance structures and forums throughout the procurement process to provide project direction and ensure that approvals – with regards to the requirement and affordability – are in place at the required points in the competitive dialogue process. NT will support the project through the annual budget.	Likely	High	High	
6	**Short term intervention (STI) risks**	STI completion risk	The possibility that the STI infrastructure is not on time, and TOL is breached.	Monitor STI programme and ensure approvals are timeous.	Possible	High	High	
7		STI design risk	The possibility that the STI design does not meet specified outputs.	Design Review.	Possible	Moderate	Medium	
8		STI process risk	The possibility that the tendered STI process does not meet the design specifications at the tender stage.	Diligent tender technical evaluation.	Possible	Moderate	Medium	
9		STI life cycle risk	The possibility that the STI infrastructure assets do not meet the output specifications for whole project life.	Appropriate specifications. Close superintendance of construction. Good maintenance.	Unlikely	Low	Low	
10		STI latent defects risks	The possibility of loss or damage arising from latent defects in the STI facilities.	Appropriate due diligence before procurement of LTS.	Possible	Moderate	Medium	Note that this is a short term solution. Risks are determined for that short period unless it is stated.
11		STI operating cost risk	The possibility that the STI operations are more expensive than expected.	Pumping and plant operation (electricity and chemicals)..	Possible	Moderate	Medium	Exclude Annual maintenance and Lifcycle Costs
12		STI not used	STI that is not used then stored on surface and mothballed.	Only applies to PPP option	Unlikely	Low	Low	
13	**Underground mine water hydrogeology**	Water quality change risk	The possibility that the raw water quality or quantity changes over time outside accepted tolerance level.	Accurate understanding of the void condition and the impacting conditions. Robust process design.	Possible	Moderate	Medium	
14		Water quantity change risk	The possibility that the water quantity produced is different to the planned	Robust abstraction and process design	Possible	Moderate	Medium	
15		Shaft Collapse Risk	The possibility that the abstraction shaft collapses	Good due diligence. An alternative plan for abstraction that isready and in place, especially in the Central Basin	Possible	High	High	
16		Connectivity Risk	The possibility that the shaft or shafts connecting the void to the abstraction shaft collapses	Good due diligence. An alternative plan for abstraction that isready and in place	Possible	High	High	
17	**Construction Works Risks**	Construction cost overrun risk (construction works)	The possibility that during the design and construction phase, the actual project costs will exceed projected project costs.	Fixed price construction contracts. Contingency provisions. Standby debt facilities/additional equity commitments; provided that these commitments are made upfront and anticipated in the base case financial model. Detailed drawings / experienced QS / risk contingency.	Possible	Moderate	Medium	
18		Technology supply cost overrun risk	The possibility that there will be a price/technology change from contract close to commissioning and that during construction the actual equipment costs will exceed projected costs.	Provide clear output specifications of the equipment requirement. Obligate Private Party to provide a fixed maximum cost, excl. exchange rate risk. To ensure bidders provide the most cost effective and value for money solution, propose a review process closer to the commissioning date,	Possible	Moderate	Medium	
19		Control equipment cost overrun risk	The possibility that there will be a price/technology change from contract close to commissioning and that during construction the actual IT costs will exceed projected costs.	Provide clear output specifications of the IT Equipment requirement. Obligate Private Party to provide a fixed maximum cost, excl. exchange rate risk. To ensure bidders provide the most cost effective and value for money solution, propose a review process closer to the commissioning date,	Possible	Moderate	Medium	
20		Output specifications change risk	The possibility that the output specifications are changed during the design process. (Institution changes specifications throughout design and construction phase impacting costs / time)	Detailed scope/project definition and output specifications development early in the project.	Possible	Moderate	Medium	
21		Utilities unavailable / delayed during construction risk	The possibility that utility services (water, electricity) required for the construction are delayed (caused by distribution capacity shortage or relocation of services) (Cost to increase capacity of utilities)	Assessment of current site provision and accurate estimation of new facility requirements during the design process. Robust Output Specification.	Possible	Low	Low	
22		Design risk	The possibility that the facility design (including layout) may not achieve the required output specifications and/or the design fails, including: • Design / layout failure (including process plant, pumps and pipeline)	Provide clear output specifications. Design warranty. Patent and latent defect liability. Consultation with and review by Institution. Independent Expert appointment to resolve disputes on expedited basis. Experts to take cognisance of the layout. Proper Safety & Health plan.	Likely	Moderate	High	
23		Design not delivered on time	Design not finalized or delivered on time.	Strong project management. Design warranty	Possible	Moderate	Medium	
		Inflexible Design	The risk that the design is such that limited or costly changes must be made to accommodate future changes in use.	Design flexibility requirements to be included in Specifications;	Possible	Moderate	Medium	
		Engineering design risks	The risk that engineering specifications are not appropriate (e.g. slabs, concrete strength, utilities requirements including standby facilities).	Correct Professional teams, PI cover	Possible	Low	Low	
24		Design approval risk	Institution does not review and approve design timeously	Fully Mandated Contract Management Team from Institution.	Likely	High	High	
25		Construction completion risk	The possibility that the completion of the works required for a project may be (i) delayed so that the delivery of the services cannot commence at the scheduled service commencement date, or (ii) delayed, unless greater expenditure is incurred to keep to	Special insurance (project delay insurance). Appointment of an independent certifier to certify the completion of the works. Liquidated damages, construction bonds and other appropriate security from the Private Party to achieve	Possible	Moderate	Medium	

No.	Category	Risk	Description	Mitigation Strategy	Probability	Effect	Impact of Risk	Comments
			completion date.	completion.				
26		Construction subcontractor risk	The possibility that the construction contractor (D&C: IT, ME, FM, other service, etc.) under-performs, defaults or becomes insolvent.	Subcontractors must have expertise, experience and contractual responsibility for their performance obligations. Replacement of subcontractors to be pre-approved by the Institution. Due diligence by the Institution must include review of first-tier Subcontractors. (Performance guarantees);	Unlikely	Low	Low	
27		Geotechnical risk	The possibility that the site conditions (soil, conditions, geological, hydrogeological, geotechncial etc.) are unsuitable to construct, and impacts on time or costs.	Conduct Geotechnical survey on land identified to establish any problematic site conditions. Geotechnical due diligence to be done by Private Party. Timing of Bidder's Due Diligence to be considered.	Possible	Moderate	Medium	
28		Latent defects risks on new works	The possibility of loss or damage arising from latent defects in the new facility, and which results in unplanned and/or increased maintenance and/or repair costs.	Private Party to allocate risk appropriately between D&C and operations (D&C warranties; FM oversight of construction; Independent Certifier)	Unlikely	Moderate	Low	
29		Failure to construct to the design risk	The possibility of the construction not conforming to the approved design in the initial bid or contract.	Independent Engineer should pick up non-conformance.	Unlikely	Moderate	Low	
30		Public liability risk	The possibility that the Private Party's actions (or lack of action) cause injury and/or loss to people and property during *construction.*	Effective security policy and security strategy to be put in place by the Private Party; insurance; construction protocol, health and safety, physical security (Design of facility. Operating procedures of the PP Insurance)	Unlikely	Moderate	Low	
31		Pre-Financial Close environmental contamination risk	The possibility that contamination on the current site may prevent further developments on site. This relates to contamination and other environmental issues existing prior to handing over Project Site to Private Party; irrespective of whether identified or not.	Assessment of current site through geotechnical surveys. (Due diligence by Department and Private Party. Private Party not to rely on Department's due diligence.)	Unlikely	Moderate	Low	
32		Construction environment damage risk	The possibility of liability for environmental damage and/or contamination of hazardous substances arising from construction activities by the Private Party or third party during the project term, after the Project Site handover.	Independent surveys of the project site commissioned by the Private Party at its cost. (Reputable D&C Subcontractor, indemnity from Private Party)	Unlikely	Moderate	Low	
33		Operational environment damage risk	The possibility of liability for environmental damage and/or contamination of hazardous substances arising from operating activities by the Private Party or third party during the project term.	Independent surveys of the project site commissioned by the Institution at its cost.	Possible	Moderate	Medium	
34	**Environmental Risks**	Environmental risk	The possibility of liability for losses caused by environmental damage and/or contamination arising (i) from construction or operating activities (see operating risk) during the project term, or (ii) from pre-transfer activities whether undertaken by the Institution or a third party. (Cost & regulatory risks)	Through due diligence by the bidders of the Project Site conditions. Independent surveys of the Project Site commissioned by the Institution at its cost. Institution indemnity for latent pre-transfer environmental contamination as a specific project deliverable.	Possible	Moderate	Medium	
35		Waste environmental compliance risk	The possibility that the Private Party does not comply with waste regulations and contaminates the environment, or the costs of complying with environmental requirements for waste results in higher than planned costs.	Detail and put in place appropriate waste removal processes in order to prevent any contamination. (Write into Service Level Agreement (SLA))	Possible	Moderate	Medium	
36		EIA authorisation risk	The possibility that EIA consent required will be delayed or cannot be obtained or, if obtained, can only be implemented at a greater cost than originally projected. The public sector can undertake the EIA before reaching preferred bidder status with a specific design of a building. However, there is a possibility that the design may differ from the solution provided by the preferred bidder. Alternatively, the EIA can be undertaken on appointment of a Preferred Bidder when the designs and elevations are fixed; however the risk is that it is a slightly longer process and extends beyond financial close. A delay to financial close would result in an escalation in the contract price and prolonged foreign exchange rate exposure for government.	Government to engage with the relevant authority at the Feasibility Study phase to determine whether an EIA is required as it is an existing site, and identify the appropriate level of EIA required. After Preferred Bidder status, task the Private Party with undertaking the necessary procedures to obtain EIA consent.	Possible	Moderate	Medium	
37		Protests by Community	The possibility that the community organises protests against the development and /or the method of contracting. Result contractor may be prevented from accessing site.	Ensure excellent public communications, engagement with stakeholder groups in particular the local community and labour unions.	Possible	Moderate	Medium	
38		Cost overrun risk	The possibility that the design is inappropriate and cause cost overruns in operation services for the duration of the project (eg, electricity, membranes, chemical, staffing)	Appropriate design by Private Party. (Design flexibility). Design review & bid evaluation during procurement process. Design of building to be conducted by appropriately qualified experts.)	Possible	Moderate	Medium	
39		Infrastructure maintenance risk	The possibility that the cost of maintaining the project facility in the required condition may vary from the projected maintenance costs. i.e. Future life cycle / replacement costs higher than planned.	Private Party is to develop robust lifecycle model for the full concession period. Life Cycle expert to be consulted to evaluate Private Party proposal. (Inputs into Design; oversight of construction, experienced Facility Management (FM) provider)	Possible	Moderate	Medium	
40		Infrastructure abuse/misuse risk	The possibility that the cost of the maintaining the project facility in the required condition may vary from the projected maintenance costs as a result of abuse/overuse/misuse.	Effective facilities management strategy to be developed to enable the Private Party to monitor usage of infrastructure. Training and certification of staff.	Possible	Low	Low	
41		Poor maintenance risk	The possibility that infrastructure maintenance is not carried out and/or life-cycle programme is not sufficient and more regular maintenance is required.	Private Party to ensure appropriate maintenance is carried out so as to meet output specifications. Private Party to ensure adequate refresh programme. Good superintendance by IA.	Unlikely	Moderate	Low	
42		Water treatment risk	The possibility that the water quality produced is poorer due to poor operation.	Good operations terms and strong superintendance.	Unlikely	Low	Low	
43		Waste management risk	The possibility that the volume of residues are different to the planned	Flexicle designs with incremental construction of SSF.	Possible	Low	Low	
44		Loss/Theft/Vandalism risk (plant and equipment)	The possibility that the cost of maintaining the project facility, IT and equipment in the required condition may vary from the projected maintenance costs as a result of loss/theft/vandalism.	Effective facilities management strategy to be developed to enable the Private Party to monitor usage of infrastructure. Appropriate monitoring and management of IT and equipment. Authorised User control.	Likely	Moderate	High	
45		Loss/Theft/Vandalism risk (pipelines and control equipment)	The possibility that the cost of maintaining the project facility, pipelines and control equipment in the required condition may vary from the projected maintenance costs as a result of loss/theft/vandalism.	Effective facilities management strategy to be developed to enable the Private Party to monitor usage of infrastructure. Appropriate monitoring and management of equipment. Authorised User control.	Possible	Moderate	Medium	
46		IT disaster recovery risks	The possibility that there is inadequate IT disaster recovery system in place leading to additional costs and data loss.	Provision of an up-to-date disaster recovery system that will enable recovery of information during any scale of disaster. Ensure backups, and external storage at a disaster recovery site.	Possible	Moderate	Medium	
47		Chemicals and consumables resource risk	The possibility of a shortage in the supply of chemicals and consumables required for the operation of the project, including deficiencies in the quality of available supplies.	Detailed evaluation of current usage figures and anticipated future usage to ensure appropriate future proofing.	Unlikely	Low	Low	
48		Technology availability risk	The possibility that the equipment and systems do not meet the output specifications of the Institution, including: • delays in commissioning • training and procedure • availability during operations period and	Ensure a robust programme is developed in order to allow for technology systems to be available when required by the Institution	Unlikely	Low	Low	
49	**Operations Risks**	Water demand quantity change risk	The possibility that the demand for the treated water generated by a project may be less than projected, whether for example because the need for the Services ceases or decreases. In relation to a Unitary Payment funded project, the Unitary Payment must be paid based on availability, not actual usage by the institution. In relation to a user-charge funded project, the risk is allocated to the Private Party. Appropriate off-take/end-user agreement with Rand Water.		Unlikely	Low	Low	
50		Specification change risk	The possibility that the Institution changes scope or output specification during operations.	Detailed scope/project definition and output specifications development early in the project.	Unlikely	Low	Low	
51		Operations subcontractor risk	The possibility that the operations subcontractor (first-tier and below i.e. D&C: IT, ME, FM, other service, etc.) underperforms or defaults resulting in higher costs and/or delays.	Subcontractors must have expertise, experience and contractual responsibility for their performance obligations. Replacement of subcontractors to be pre-approved by the Institution. Due diligence by the Institution must include review of first-tier subcontractors. (Performance guarantees;	Possible	Low	Low	
52		Industrial action risks	The possibility that Project staff embark on industrial action causing reduced availability of the facility and additional costs and time delays.	Comprehensively developed communication plan to enable clear and direct communication between all stakeholders of the project	Possible	Low	Low	
53		Project commissioning risk	The possibility that inappropriate or unsatisfactory project asset commissioning results in a delay to service commencement, i.e. the integration of commissioning of building, equipment, IT, and FM services costs more or takes longer. This also includes safety approvals e.g. fire.	Ensure Private Party develops robust commissioning strategy (Phased cold and hot commissioning; Co-ordination / integration agreement between contractor, ME supplier, IT supplier, FM service provider)	Likely	Moderate	High	
54		Existing equipment contract risk (incl in STI)	The possibility that termination of current equipment supplier and maintenance contracts cause additional costs.	Legal team to review current contract status.	Unlikely	Low	Low	
55		Utilities risk	The possibility that the consumption of utility services (water, electricity) is higher/lower than benchmarks/projections; and there is a cost to increase the capacity of utilities.	Private Party to ensure consumption is efficient. (Robust Output Specification)	Possible	Low	Low	
56		Electricity outages risk	The possibility of disruption to electricity supplies during operations, which are crucial to the running of essential services.	Provide sufficient Emergency back-up facilities on site to cover for any disruption in utility services per output specifications. (UPS/Generators) Risk is that backup generators do not work.	Likely	Moderate	High	
57		Health and safety risk	The possibility that the facility needs to be quarantined for health and safety requirements and that safety legislation is not complied with (Incl OHS Act).	Detailed description of the requirements to be developed through consultation with the appropriate specialists. Implementation of appropriate infection control systems by the Private Party. (Penalty regime, insurance, etc.)	Possible	Moderate	Medium	
58		Public liability risk	The possibility that a party causes damage to a person or property	Ensure an appropriate level of Public liability is provided by the Private Party and sufficient safety processes and procedures are in place (Insurance, employment of skilled people)	Possible	Low	Low	
59		Training / procedures risks	The possibility that the IT and Equipment technology is inappropriately used due to insufficient training and procedures, during commissioning and/or operations.	Ensure that the Private Party has developed robust training and procedure strategy for all staff. Certification of users through provision of training and manuals.	Possible	Low	Low	

No.	Category	Risk	Description	Mitigation Strategy	Probability	Effect	Impact of Risk	Comments
60		Inappropriate Equipment user requirements risk	The possibility that the equipment technology user requirements are not appropriate or well-defined enough to deliver the required output specifications.	Detailed, specific and realistic requirements to be drawn up by the Institution as part of the output specification. Involvement of an IT and equipment specialist during this process will be important.	Possible	Low	Low	
61		Inappropriate technology refresh cycle risk	The possibility that technology refresh cycles are too short. The risk that new technology or new discoveries and applications make the Facility, equipment obsolete or needs to be replaced at higher cost or earlier timing than planned.	Sufficient assessment of the technology systems to identify potentially obsolete components and to assess the correct refresh cycles. (Replacement cycles; replacement reserve account / Final condition survey; performance bond)	Possible	Moderate	Medium	
62	**Legal Risks**	Corrupt gifts and payments, if identified, post financial close risk	The possibility that the Contractor offers, gives or agrees to give any gift or consideration of any kind as an inducement or reward to the Institution in connection with the procurement of the Contract and the ongoing contractual relationship.		Unlikely	High	Medium	if not remediable, termination with prejudice to equity
63		Force majeure risks	The possibility of the occurrence of certain unexpected events that are beyond the control of the Parties (whether natural or "man-made"), which may affect the construction or operation of the project.	Define "force majeure" narrowly to exclude risks that can be insured against and that are dealt with more adequately by other mechanisms such as Compensation Events, Relief Events. Termination for Force Majeure. The risk allocation is shared if not insurable. The Institution may pay limited compensation on termination.	Likely	Moderate	High	
64		Project not afforbale to Market. Cost of water too high.	The possibility that the cost of the treated water is above the affordability of the recipients.	Tariff offset through National Government support	Likely	Moderate	High	
65		Unforeseeable conduct risk	The possibility of unforeseeable conduct by the Institution or by any of the government authorities that materially and adversely affects the expected return on equity, debt service or otherwise results in increased costs to the Private Party.	Limit risk to unforeseeable conduct for which there is no other relief in the Contract and to expropriating actions. Distinguish between general and discriminatory unforeseeable conduct. In relation to discriminatory unforeseeable conduct, special compensation.	Unlikely	High	Medium	
66		Expropriation risk	The possibility of expropriation, nationalisation or privatisation (collectively, "expropriating actions") of the assets of the Private Party. This risk overlaps with some financial risks (e.g. tax rate change risk).		Unlikely	High	Medium	
67	**Financial and economic risks**	Construction inflation rate risk	The possibility that fluctuating inflation rates may impact overall cost of the project.	A base rate could be agreed between parties. Any benefit from lower inflation rate may be distributed between both parties. The same will apply if the inflation rate should increase above anticipated rates	Unlikely	Low	Low	
68		Foreign exchange rate risk	The possibility that exchange rate fluctuations will impact on the envisaged costs of imported inputs required for the construction of operations phase of the project.	Hedging instruments (e.g. swaps). Agreement on fixed exchange rate at which equipment and materials will be purchased. Any fluctuations in price may need to be split between Institution and Private Party. Currency hedges	Likely	Moderate	High	
69		Utilities inflation risk	The possibility that utilities' (electricity, water, sewerage) prices are higher than the CPI linked unitary payment adjustments.	Energy management systems. Leak management. Index-linked adjustment to unitary payments and sharing of above/below CPI increases. The Private Party bears the risk up to an agreed index; increases in excess of agreed index are shared between the Private Party and the Institution.	Likely	Moderate	High	
70		Funding Risk	Project not attractive to Private Sector Funders	Package the project so that the risk alloctaion is clear, reasonable and that the project is bankable	Possible	High	High	
71		Revenue Risk	Recipient (Rand Water) reluctant to take off the treated water. Revenue is negatively impacted. Recipient does not have their infrastructure ready to accept treated water.	Early engagement and political intervention with the potential recipients. Early engagement with Rand Water to finalise agreement.	Possible	High	High	
72		Affordability Risk	Market costs higher than feasibility costs	Conservative and comprehensive costings used in the feasibility	Possible	Moderate	Medium	
73		Interest rate risk	The possibility that real interest rates are higher than planned, resulting in increased debt services costs and reduced equity. This affects the availability and cost of funds.	Hedging instruments (e.g. swaps). Fixed rate loans. Interest rate hedging agreements	Likely	Moderate	High	
74		Operating Life Inflation risk	The possibility that the actual inflation rate will exceed the projected inflation rate, which results in increased costs. This risk is more apparent during the operations phase of the project.	Management of costs. Risk shared through index-linked adjustment to unitary payments or user charges. The Institution bears the risk up to an agreed index; increases in excess of agreed index are borne by the Private Party.	Likely	Moderate	High	
75		Tax rate change risk	The possibility that changes in applicable tax rates or new taxes may decrease the anticipated return on equity. (VAT is government risk and is excluded; other taxes (IT, duties, etc.) are generally Private Party risk)	If change arises from discriminatory unforeseeable conduct, then special compensation, unless it was known that the tax rate would change.	Unlikely	Moderate	Low	
76		Insurance inflation risk	The possibility that insurance premiums are higher or lower than the CPI linked unitary payment adjustments.	Index-linked adjustment to unitary payments and sharing of above/below CPI increases. The Private Party bears the risk up to an agreed index; increases in excess of agreed index are shared between the Private Party and the Institution.	Unlikely	Low	Low	
77		Insolvency and outside creditor risk	The possibility of the insolvency of the Private Party in a DBOM or DBOMF (PPP)	Finance to step in. Use DBOM contract.	Unlikely	High	Medium	
78		Residual value risk	The risk that the Project Assets at termination or expiry of the DBOM or DBOMF (PPP) Agreement will not be in the prescribed condition for hand back to the Institution.	Include license; regular inspectiOns and design for 50 year life specifications.	Unlikely	High	Medium	
79		Uninsurable risk	The possibility (i) that any risks that are insurable as at the signature date pursuant to the agreed project insurances later become uninsurable or (ii) of substantial increases in the rates at which insurance premiums are calculated. With regards to (i), if the Private Party caused the uninsurability or, even if it did not, but the Private Party cannot show that similar businesses would stop operating without the insurance in question, then the Private Party bears the risk.	In the case of (i), at the option of the Institution, self-insurance by the Institution or, if the uninsurable event occurs, then termination of the DBOM or DBOMF (PPP) Agreement as if for force majeure with compensation to the Private Party. Reserves	Unlikely	Moderate	Low	
80	**BEE Risks**	Level of B-BBEE target risk	The possibility of one or more of the 7 elements of B-BBEE requirements being too aggressive resulting in Bidders being unable to meet the requirements. Consequently, the realisation of the affected elements will be lower than expected.	There are no minimum thresholds for the B-BBEE elements. Therefore the targets should not be instrumental in potential bidders deciding on whether or not to submit bids.	Possible	Low	Low	
81		Evaluation of B-BBEE proposal risk	The Regulation permits the Institution to only evaluate existing entities which may result in the Institution not obtaining its objectives.	Application for an exemption to enable the Institution to take into account the Bidders' future commitment in the evaluation process.	Possible	Low	Low	
82		Failure by the private party to achieve the contracted objectives risk	The possibility of the Private Party not being able to meet the obligations committed to in the DBOM or DBOMF (PPP) Agreement.	There will be monitoring and reporting mechanisms in place. There will also be a penalty regime in place which could lead to termination.	Possible	Moderate	Medium	

Appendix E
SASOL as potential user of treated AMD 16/05/2013

sasol

reaching new frontiers

Sasol as potential user of treated Acid Mine Drainage

Summary discussion document

16 May 2013

1 Introduction

Sasol has expressed interest in the potential use of treated Acid Mine Drainage (AMD) from the Gauteng basins and has been engaging with the Department of Water Affairs (DWA) and the appointed DWA Consultant team for the AMD Long-Term Feasibility Study in this regard.

The objective of the engagement is to establish the technical and financial feasibility of the opportunity to supply treated AMD to the Sasol operating facilities in Sasolburg and/or Secunda. The treated AMD would replace raw water supply from the Vaal River system and would be utilised for industrial purposes (i.e. mainly steam production and cooling).

This discussion document provides a summary of Sasol's position on various aspects of the opportunity to use treated AMD for industrial purposes at Sasol's operating facilities and is intended to provide an input into the AMD Long-Term Feasibility Study report as well as subsequent discussions.

2 Locations for use

The two locations considered for use of treated AMD are as follows:

a. Sasol Infrachem, Sasolburg
The Sasol Infrachem complex consists of a number of chemical manufacturing and refining operations and is located in Sasolburg, approximately 60km south of Gold Reef City, Johannesburg (Central AMD basin).

b. Sasol Synfuels, Secunda
The Sasol Synfuels complex consists of fuels and chemical manufacturing operations and is located in Secunda, approximately 80km east of Springs on the East Rand (Eastern AMD basin).

3 Volumes of treated AMD required

The volumes of treated AMD that could be utilised at the two Sasol facilities respectively are as follows:

a. Sasol Infrachem, Sasolburg

The Sasol Infrachem facility use approximately 60 Ml/d of raw water from the Vaal River and could therefore potentially utilise the estimated **50 Ml/d** of treated AMD projected from the Central Basin.

b. Sasol Synfuels, Secunda

The Sasol Synfuels facility use approximately 230 Ml/d of raw water from the Vaal River system (VRESAP pipeline and/or Grootdraai Dam) as well as 25 Ml/d of treated water from the Rand Water supply system (255 Ml/d in total) and could therefore potentially utilise the estimated **90 Ml/d** of treated AMD projected from the Eastern Basin.

4 Quality of treated AMD required

The treated AMD would be utilised to replace existing raw water supplied from the Vaal River system and would be treated further to demineralised "boiler feed" water quality for steam production as well as cooling water make-up water. The major water quality parameters of concern to the Sasol processes would be Total Dissolved Salts (TDS), Total Suspended Solids (TSS) and Total Organic Carbon (TOC).

The departure point for Sasol is that the treated AMD would have to be of **equal or better quality than existing Vaal River raw water** (in terms of TDS) to be considered as a feasible alternative. Water of poorer quality (higher TDS) would not be beneficial and could not be utilised in the Sasol processes without further exacerbating the existing salt handling costs at the respective sites. Water of better quality than existing Vaal River raw water (TDS, TSS and TOC) would have additional benefits in terms of reduced water treatment and salt handling costs.

The notion that treated AMD for "industrial use"" could be of poorer quality than water required for potable use is not correct in the case of supply of treated AMD to Sasol.

For the purpose of the AMD Long-Term Feasibility Study it is assumed that some configuration of Reverse Osmosis (RO) membrane process would be used to desalinate the AMD, producing treated water of very low TSS and TOC content (<1 mg/l each) and varying concentrations of TDS, depending on the treatment process configuration. Two possible qualities of treated AMD have been assumed for potential supply to Sasol:

a. Potable equivalent quality ("base case")

Water quality roughly equivalent to Rand Water (Vaal River) potable supply:

TSS <1 mg/l (as a result of RO process)
TOC <1 mg/l (as a result of RO process)
TDS approximately **150 mg/l**

b. High quality ("value added case")

Water with substantially lower TDS concentration than existing Rand Water (Vaal River) potable or raw water supply:

TSS <1 mg/l (as a result of RO process)
TOC <1 mg/l (as a result of RO process)
TDS approximately **40 mg/l**

5 Supply period

The expected lifetime of the Sasol Infrachem (Sasolburg) and Sasol Synfuels (Secunda) facilities are estimated to be at least until 2030, with studies on-going to extend the lifetime of both these facilities.

Should it be found to be feasible, an estimated supply period of treated AMD of **at least 15 years** (2015 – 2030) can be assumed for Sasol Infrachem (Sasolburg) and Sasol Synfuels (Secunda), with further extension of supply periods being possible.

6 Impact on VRESAP pipeline

The Vaal River Eastern Sub-system Augmentation Project (VRESAP) pipeline has been in operation since 2008 and is supplying water from the Vaal Dam to Sasol Synfuels in Secunda and the Eskom power stations in the Mpumalanga Highveld area. Sasol has a share of approximately 40% of the pipeline and is repaying their part of the loans to the TCTA through an additional tariff levied on the total raw water supplied from the Vaal River system (via the VRESAP pipeline or the Grootdraai Dam). The VRESAP tariff is linked to off-take volumes, with the tariffs increasing with decreasing off-take volumes in order to service the loans in the agreed 20-year repayment period (2008 – 2028) on a "take-or-pay" principle.

The existing supply of approximately 230 Ml/d to Sasol Synfuels from the Vaal River system will decrease by approximately 90 Ml/d, should treated AMD be replacing a portion of the raw water requirements of Sasol Synfuels. This will result in an increase in the VRESAP tariff in order to repay Sasol's share of the VRESAP pipeline by 2028. The financial impact on Sasol should be neutral, but the increased VRESAP tariff will have to be taken into account in the determination of a feasible tariff for treated AMD.

The supply of treated AMD to Sasol Synfuels will result in redundant capacity of 90 Ml/d on the VRESAP pipeline which will become available to new users along the pipeline route.

7 Tariff and financial feasibility considerations

As with the base case water quality, the departure point for Sasol is that treated AMD should be supplied at **equal or lower cost, compared to existing raw water supply**, for it to be a financially feasible alternative for Sasol to consider. The comparative cost of treated AMD should include the capital and operating cost of new pipelines required to transport the AMD from the treatment plant/s to the final point of consumption (i.e. total "landed cost").

Calculation of final feasible tariffs for treated AMD is still subject to detailed financial and economic modeling and is beyond the scope of this discussion document.

8 Conclusion

The justification for Sasol to consider the supply of treated AMD as an alternative water source is mainly that it will reduce Sasol's dependency on the stressed Vaal River system, thereby increasing security of supply. The supply of treated AMD has a higher risk than conventional raw water supply as a result of the complicated AMD treatment technologies involved. This additional risk will have to be weighed against the potential cost, water quality and water security benefits.

Sasol is aware that the total cost for the treatment of AMD (capital, operating and brine handling) will exceed the maximum tariff that could feasibly be recovered from any end-user (be that potable or industrial use). The balance of the treatment cost of AMD will have to be provided from an alternative funding source, still to be determined by Government (e.g. National Treasury, a levy on all Vaal system users, recovery from mining sector or a combination of such measures).

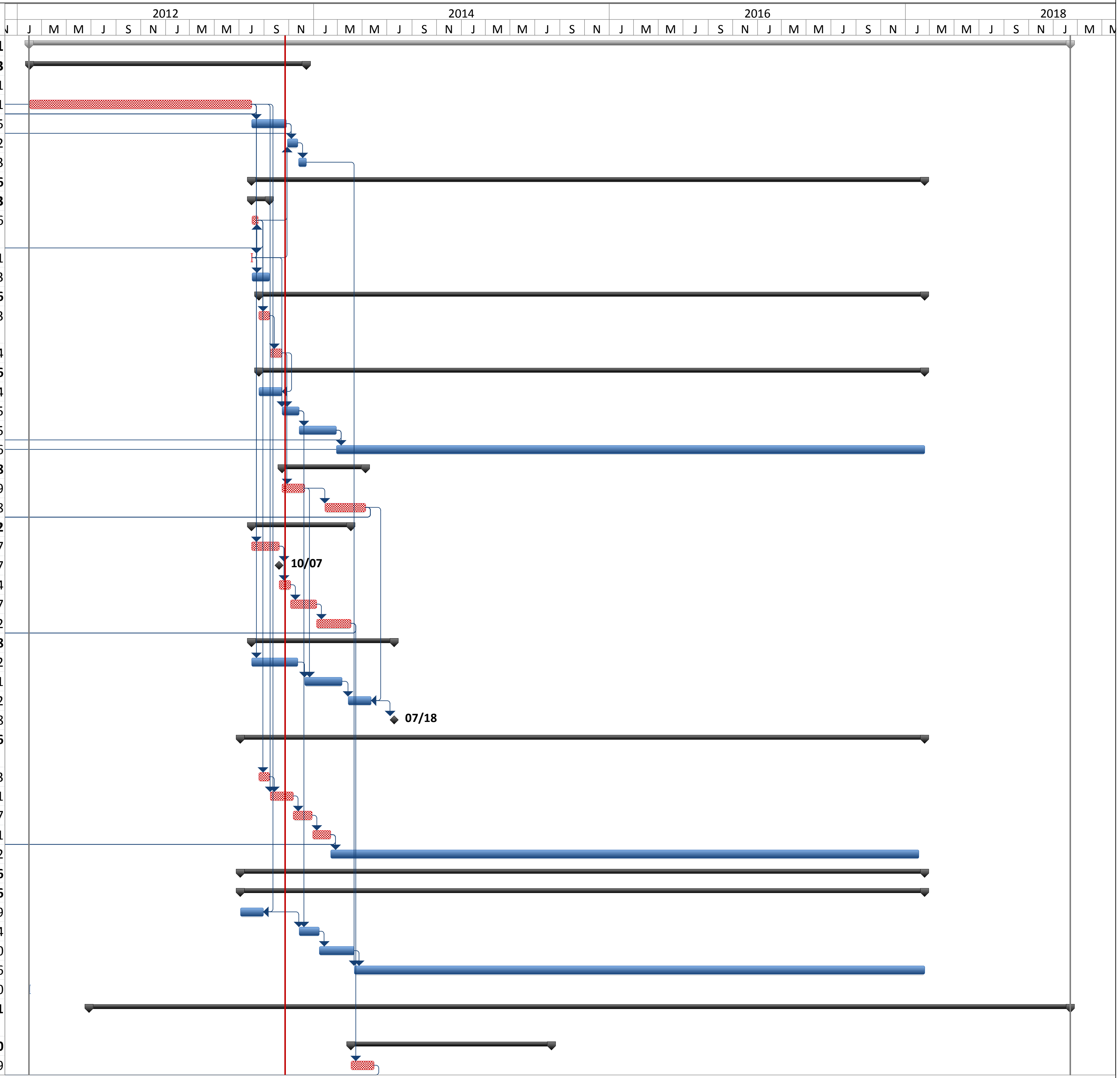
In our view, the supply of treated AMD to Sasol facilities in Sasolburg and/or Secunda will provide DWA with a **reliable, long-term user** which is **financially sound** and from which a substantial portion **of the total treatment cost of AMD could consistently be recovered**. A long-term supply agreement with Sasol could support the funding of a substantial portion of the capital requirements of AMD treatment facilities and will reduce the burden on funding from alternative sources and alternative funding models.

We remain available for further discussions on the technical and financial feasibility of the opportunity of supply of treated AMD to Sasol facilities.

Appendix F Implementation Programme

AMD FEASIBILITY STUDY
IMPLEMENTATION PLAN

ID	Task Name	Duration	Start	Finish
0	**AMD Implementation Plan**	**1764 days?**	**2012/01/30**	**2019/02/11**
1	**FEASIBILITY STUDY**	**472 days**	**2012/01/31**	**2013/12/13**
2	Project Start	0 days	2012/01/31	2012/01/31
3	Feasibility Study	377 days	2012/01/31	2013/07/31
4	DWA Approval	60 days	2013/08/01	2013/10/25
5	DWA Submit FS to National Treasury (NT)	20 days	2013/10/28	2013/11/22
6	NT Approval (TA1)	15 days	2013/11/25	2013/12/13
7	**DWA IMPLEMENTATION RESPONSIBILITIES**	**1141 days**	**2013/08/01**	**2018/02/16**
8	**Confirm Principals**	**31 days**	**2013/08/01**	**2013/09/13**
9	Confirm Institutional Structure and Responsibilities	10 days	2013/08/02	2013/08/16
10	Confirm\ of contract (DBOM or DBOMF)	1 day	2013/08/01	2013/08/01
11	Agree funding and cost recovery plan with NT	30 days	2013/08/02	2013/09/13
12	**Establish DWA Special Project Unit**	**1130 days**	**2013/08/19**	**2018/02/16**
13	Draft terms of reference for Special Project Unit	20 days	2013/08/19	2013/09/13
14	Appoint Unit Head	20 days	2013/09/16	2013/10/14
15	**Procure PSP for support**	**1130 days**	**2013/08/19**	**2018/02/16**
16	Scope of Work & RfP	40 days	2013/08/19	2013/10/14
17	Bid Period	30 days	2013/10/15	2013/11/25
18	Adjudication & Award	60 days	2013/11/26	2014/02/25
19	Contract Period	1000 days	2014/02/26	2018/02/16
20	**Establish off-take Agreements with Users**	**140 days**	**2013/10/15**	**2014/05/08**
21	Agree MOU with Rand Water	40 days	2013/10/15	2013/12/09
22	Agree tariffs with Rand Water	70 days	2014/01/29	2014/05/08
23	**IMPLEMENT EIA for LTS**	**166 days**	**2013/08/01**	**2014/04/02**
24	Prepare Directive to TCTA	46 days	2013/08/01	2013/10/07
25	Issue Directive	0 days	2013/10/07	2013/10/07
26	Scope of work & RfP	20 days	2013/10/08	2013/11/04
27	Bid Period	40 days	2013/11/05	2014/01/07
28	Adjudication & Award	60 days	2014/01/08	2014/04/02
29	**IMPLEMENT VAAL RIVER TARIFF**	**241 days**	**2013/08/01**	**2014/07/18**
30	Agree Principles	80 days	2013/08/01	2013/11/22
31	Hold forum meetings	60 days	2013/12/10	2014/03/11
32	Issue formal notifications	40 days	2014/03/27	2014/05/22
33	Start collection	0 days	2014/07/18	2014/07/18
34	**PUBLIC ENTITY AS IMPLEMENTING AGENT OR CONTRACT MANAGERS**	**1161 days**	**2013/07/04**	**2018/02/16**
35	DWA Issues directive	20 days	2013/08/19	2013/09/13
36	Scope of Work & RfP for TA	40 days	2013/09/16	2013/11/11
37	Bid Period	30 days	2013/11/12	2013/12/27
38	Adjudication & Award	30 days	2013/12/30	2014/02/11
39	TA Contract Period	1000 days	2014/02/12	2018/02/02
40	**ALTERNATIVE DWA Implements**	**1161 days**	**2013/07/04**	**2018/02/16**
41	**Procure PSP as TA**	**1161 days**	**2013/07/04**	**2018/02/16**
42	Scope of Work & RfP for TA	40 days	2013/07/04	2013/08/29
43	Bid Period	30 days	2013/11/26	2014/01/14
44	Adjudication and Award	60 days	2014/01/15	2014/04/10
45	TA Contract Period	970 days	2014/04/11	2018/02/16
46	**WESTERN BASIN**	**1 day?**	**2012/01/30**	**2012/01/30**
47	**EIA for pilot plants and Ancillary Facilities (Western Basin)**	**1663 days**	**2012/06/26**	**2019/02/11**
48	**EIA Contract Period**	**340 days**	**2014/04/03**	**2015/08/10**
49	Registration of Project	40 days	2014/04/03	2014/05/29

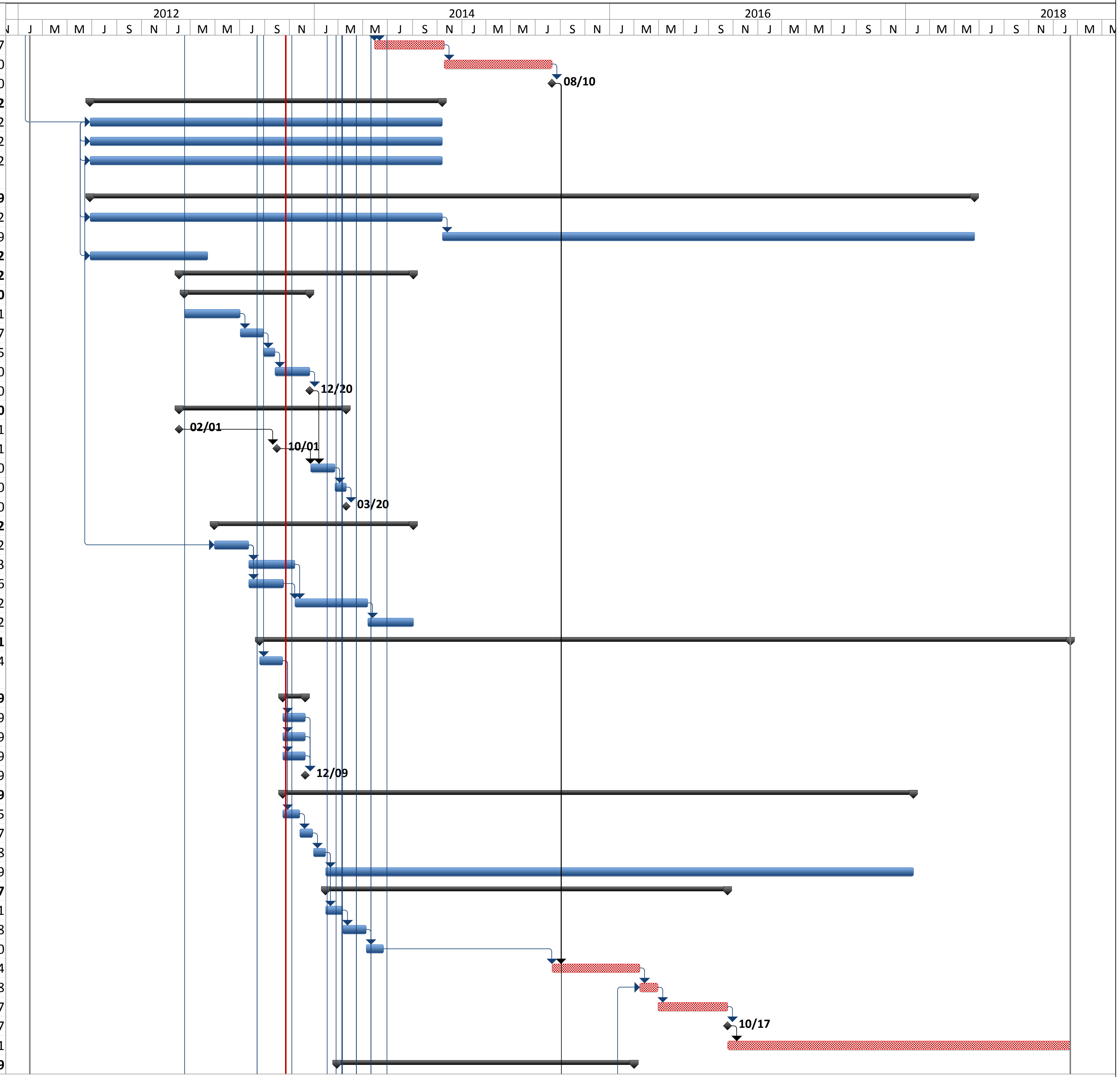


Project: AMD Implementation Plan
Edition 1
Date: 31 July 2013

Task | Milestone | Summary | Project Summary | Progress | Critical Task

AMD FEASIBILITY STUDY
IMPLEMENTATION PLAN

ID	Task Name	Duration	Start	Finish
50	Scoping phase of EIA	120 days	2014/05/30	2014/11/17
51	Impact Assessment phase of EIA	180 days	2014/11/18	2015/08/10
52	EIA Authorisations (assuming no appeals)	0 days	2015/08/10	2015/08/10
53	**Immediate Works**	**600 days**	**2012/06/26**	**2014/11/12**
54	Gold one Neutralisation (24 Ml/d)	600 days	2012/06/26	2014/11/12
55	Pump @ Shaft 8 (24 Ml/d)	600 days	2012/06/26	2014/11/12
56	Surface Discharge/ Pump at 17 Winze (Approx. 13 Ml/d)	600 days	2012/06/26	2014/11/12
57	**Discharges to Westwits pits**	**1500 days**	**2012/06/26**	**2018/06/19**
58	Westwits Pit Beaches	600 days	2012/06/26	2014/11/12
59	Westwits Pit Full	900 days	2014/11/13	2018/06/19
60	**Add clarifier @ Gold 1 if required**	**200 days**	**2012/06/26**	**2013/04/12**
61	**Shaft 8 LT pumping capacity 40Ml/d**	**399 days**	**2013/02/01**	**2014/09/02**
62	**Civil Contract**	**215 days**	**2013/02/14**	**2013/12/20**
63	Complete Civil Tender Documents	95 days	2013/02/14	2013/07/01
64	Tender Period	40 days	2013/07/02	2013/08/27
65	Adjudication and Award	20 days	2013/08/28	2013/09/25
66	Construction	60 days	2013/09/26	2013/12/20
67	Civil Contract - Ready for Operation (RfO)	0 days	2013/12/20	2013/12/20
68	**Ritz Pumps**	**284 days**	**2013/02/01**	**2014/03/20**
69	Pumps ordered	0 days	2013/02/01	2013/02/01
70	Delivery	0 days	2013/10/01	2013/10/01
71	Installation	40 days	2013/12/23	2014/02/20
72	Commission	20 days	2014/02/21	2014/03/20
73	RfO	0 days	2014/03/20	2014/03/20
74	**Mogale Gold/Mintails TWT Process**	**340 days**	**2013/04/29**	**2014/09/02**
75	Establish Process	60 days	2013/04/29	2013/07/22
76	Obtain licenses	80 days	2013/07/23	2013/11/13
77	Negotiate Agreement	60 days	2013/07/23	2013/10/16
78	Increase dewatering capacity to 20Ml/d	120 days	2013/11/14	2014/05/12
79	Increase dewatering capacity to 38Ml/d	80 days	2014/05/13	2014/09/02
80	**Pilot Plants**	**1375 days**	**2013/08/19**	**2019/02/11**
81	Determine Institutional Arrangements with WRC and DST	40 days	2013/08/19	2013/10/14
82	**Procure funding**	**40 days**	**2013/10/15**	**2013/12/09**
83	DWA	40 days	2013/10/15	2013/12/09
84	DST	40 days	2013/10/15	2013/12/09
85	Private Sector	40 days	2013/10/15	2013/12/09
86	Funding in Place	0 days	2013/12/09	2013/12/09
87	**Procure PSP support to WRC**	**1070 days**	**2013/10/15**	**2018/01/19**
88	Scope of Work & RfP	30 days	2013/10/15	2013/11/25
89	Bid Period	20 days	2013/11/26	2013/12/27
90	Adjudication & Award	20 days	2013/12/30	2014/01/28
91	Contract Period	1000 days	2014/01/29	2018/01/19
92	**Procure Pilot Plants (WRC)**	**685 days**	**2014/01/29**	**2016/10/17**
93	Prepare Tender Docs	30 days	2014/01/29	2014/03/11
94	Tender for Pilot Plants	40 days	2014/03/12	2014/05/08
95	Adjudicate & Award	30 days	2014/05/09	2014/06/20
96	Construction	150 days	2015/08/11	2016/03/14
97	Commisioning	30 days	2016/03/15	2016/04/28
98	Trial Operation	120 days	2016/04/29	2016/10/17
99	RfO	0 days	2016/10/17	2016/10/17
100	**Delivery of water to users**	**580 days**	**2016/10/18**	**2019/02/11**
101	**Ancillary Facilities for Pilot Plants**	**505 days**	**2014/02/26**	**2016/02/29**

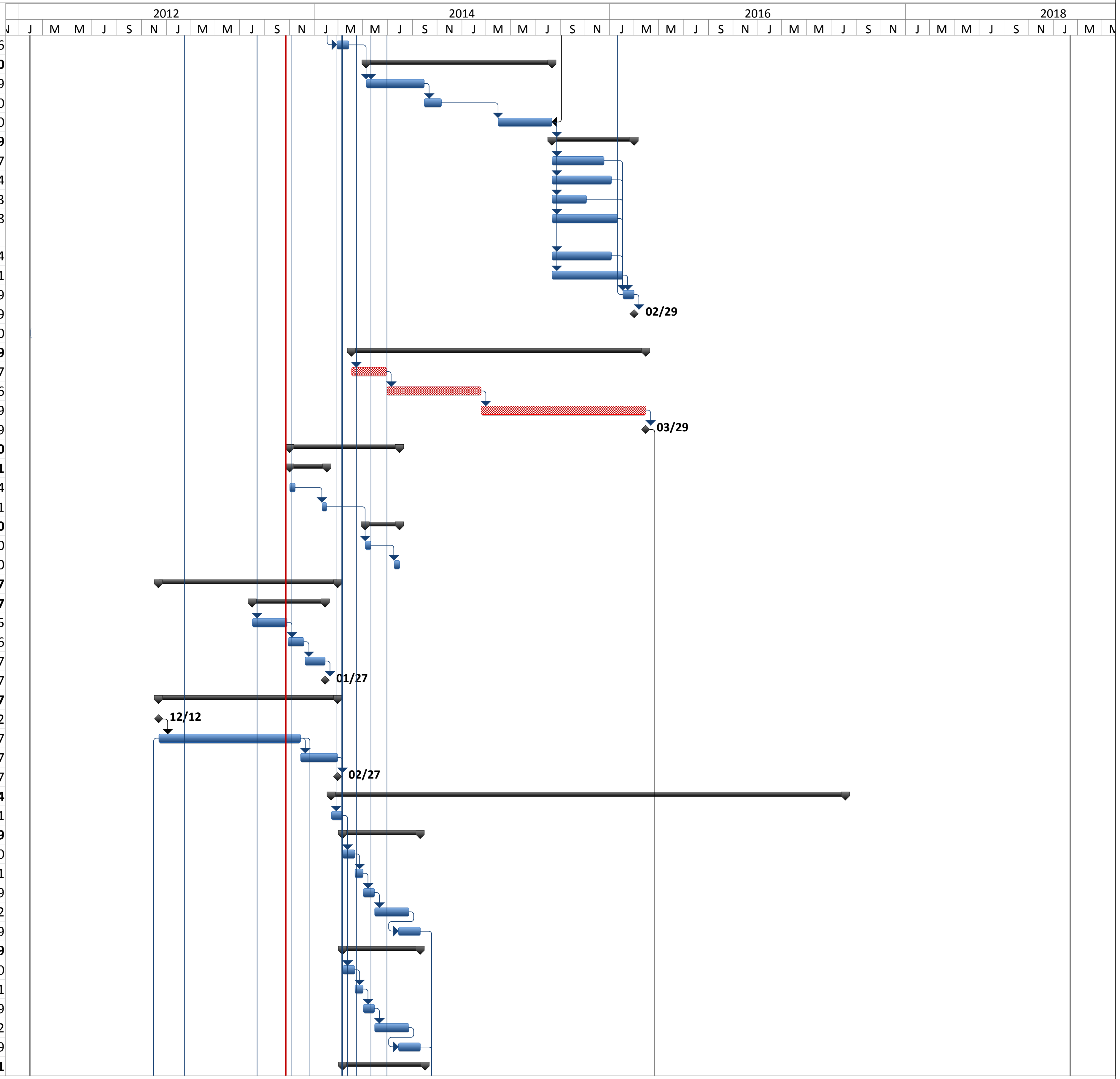


Project: AMD Implementation Plan
Edition 1
Date: 31 July 2013

Task | Milestone | Summary | Project Summary | Progress | Critical Task

AMD FEASIBILITY STUDY
IMPLEMENTATION PLAN

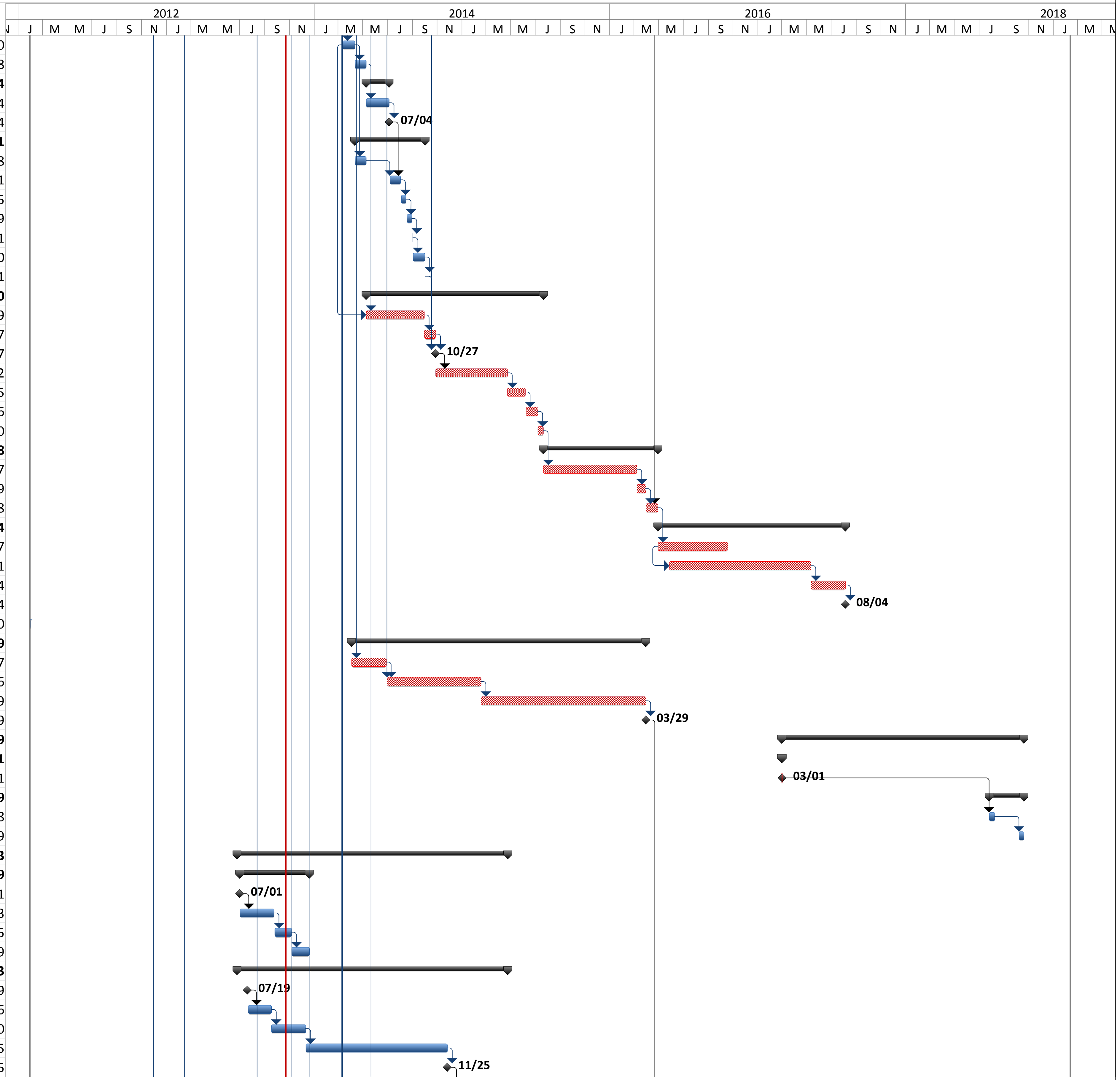
ID	Task Name	Duration	Start	Finish
102	**Mobilise DWA PSP**	20 days	2014/02/26	2014/03/26
103	**Procure Contractor**	**315 days**	**2014/05/09**	**2015/08/10**
104	Prepare Tender Docs	100 days	2014/05/09	2014/09/29
105	Tender Period	30 days	2014/09/30	2014/11/10
106	Adjudicate & Award	90 days	2015/03/31	2015/08/10
107	**Construct Ancillary Works**	**140 days**	**2015/08/11**	**2016/02/29**
108	Balancing Storage for neutralised AMD	90 days	2015/08/11	2015/12/17
109	Balancing Storage for treated Water	100 days	2015/08/11	2016/01/04
110	Sludge pipeline to WWP	60 days	2015/08/11	2015/11/03
111	Construct discharge pipeline for treated water	110 days	2015/08/11	2016/01/18
112	Construct Brine Disposal Facility	100 days	2015/08/11	2016/01/04
113	Construct Sludge Storage Facility	120 days	2015/08/11	2016/02/01
114	Commissioning	20 days	2016/02/02	2016/02/29
115	**RfO**	0 days	2016/02/29	2016/02/29
116	**CENTRAL BASIN**	1 day?	2012/01/30	2012/01/30
117	**EIA for LTS (Central Basin)**	**500 days**	**2014/04/03**	**2016/03/29**
118	Registration of Project	60 days	2014/04/03	2014/06/27
119	Scoping phase of EIA	160 days	2014/06/30	2015/02/16
120	Impact Assessment phase of EIA	280 days	2015/02/17	2016/03/29
121	EIA Authorisations (assuming no appeals)	0 days	2016/03/29	2016/03/29
122	**Critical Water Levels**	**185 days**	**2013/11/01**	**2014/07/30**
123	**SECL-GRCTF**	**60 days**	**2013/11/01**	**2014/01/31**
124	TOL (1454M)	10 days	2013/11/01	2013/11/14
125	SECL (1474M)	10 days	2014/01/20	2014/01/31
126	**ECL**	**60 days**	**2014/05/07**	**2014/07/30**
127	TOL(1500M)	10 days	2014/05/07	2014/05/20
128	ECL(1520M)	10 days	2014/07/17	2014/07/30
129	**Short Term Interventions**	**301 days**	**2012/12/12**	**2014/02/27**
130	**Ritz Pumps**	**120 days**	**2013/08/01**	**2014/01/27**
131	Delivery	60 days	2013/08/01	2013/10/25
132	Installation	30 days	2013/10/28	2013/12/06
133	Commission	30 days	2013/12/09	2014/01/27
134	RfO	0 days	2014/01/27	2014/01/27
135	**HDS Construction**	**301 days**	**2012/12/12**	**2014/02/27**
136	Tender approval	1 day	2012/12/12	2012/12/12
137	Construction	240 days	2012/12/13	2013/11/27
138	Commissioning	60 days	2013/11/28	2014/02/27
139	RfO	0 days	2014/02/27	2014/02/27
140	**Long term solution (SOE)**	**875 days**	**2014/02/12**	**2017/08/04**
141	**Mobilisation of PSP as TA**	20 days	2014/02/12	2014/03/11
142	**Geotechnical Investigation**	**135 days**	**2014/03/12**	**2014/09/19**
143	Prepare Tender Documents	20 days	2014/03/12	2014/04/10
144	Bid period	15 days	2014/04/11	2014/05/01
145	Adjudicate and award	20 days	2014/05/02	2014/05/29
146	Investigations and laboratory Testing	60 days	2014/05/30	2014/08/22
147	Reporting	40 days	2014/07/28	2014/09/19
148	**Topographical Surveys**	**135 days**	**2014/03/12**	**2014/09/19**
149	Prepare Tender Documents	20 days	2014/03/12	2014/04/10
150	Bid period	15 days	2014/04/11	2014/05/01
151	Adjudicate and award	20 days	2014/05/02	2014/05/29
152	Survey work	60 days	2014/05/30	2014/08/22
153	Mapping and Reporting	40 days	2014/07/28	2014/09/19
154	**Request for Qualification**	**142 days**	**2014/03/12**	**2014/10/01**



Project: AMD Implementation Plan
Edition 1
Date: 31 July 2013

Task | Milestone | Summary | Project Summary | Progress | Critical Task

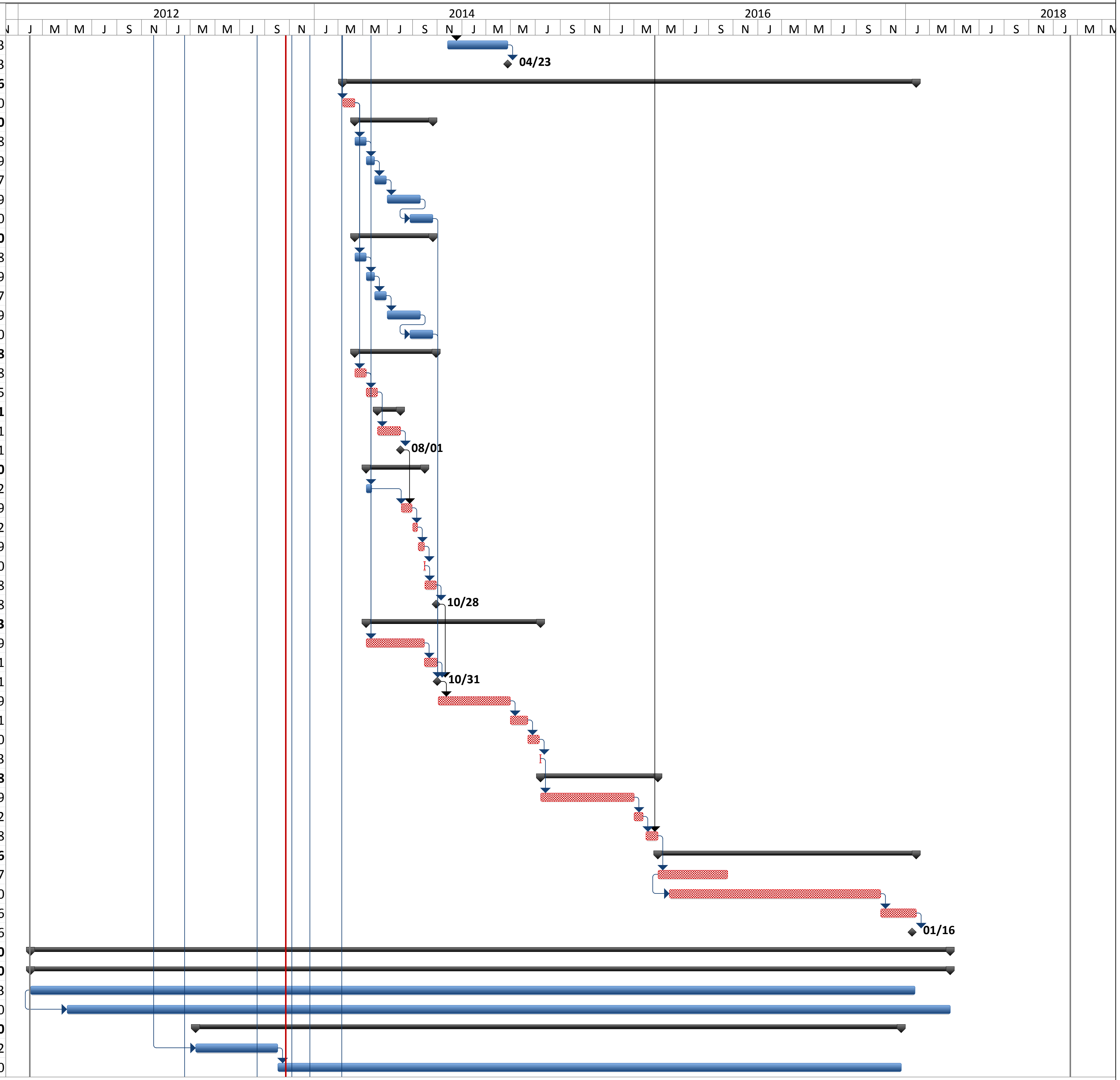
ID	Task Name	Duration	Start	Finish
155	Drafting TfQ	20 days	2014/03/12	2014/04/10
156	Document approval (TA II(a) (RfQ)	20 days	2014/04/11	2014/05/08
157	**RFQ Exposure Period**	**40 days**	**2014/05/09**	**2014/07/04**
158	Issuing and response period	40 days	2014/05/09	2014/07/04
159	Receipt	0 days	2014/07/04	2014/07/04
160	**RFQ Evaluation**	**122 days**	**2014/04/11**	**2014/10/01**
161	Agree Evaluation Criteria	20 days	2014/04/11	2014/05/08
162	Evaluation process	20 days	2014/07/07	2014/08/01
163	Technical assessment	10 days	2014/08/04	2014/08/15
164	Evaluation Committee	10 days	2014/08/18	2014/08/29
165	Pre-qualified shortlist	1 day	2014/09/01	2014/09/01
166	RFQ Approvals	20 days	2014/09/02	2014/09/30
167	Shortlist Issued	1 day	2014/10/01	2014/10/01
168	**Request for Proposal**	**300 days**	**2014/05/09**	**2015/07/20**
169	RFP Preparations	100 days	2014/05/09	2014/09/29
170	RfP Approval	20 days	2014/09/30	2014/10/27
171	RFP Issue	0 days	2014/10/27	2014/10/27
172	RFP Competitive Period	120 days	2014/10/28	2015/04/22
173	Evaluation	30 days	2015/04/23	2015/06/05
174	Approvals	20 days	2015/06/08	2015/07/06
175	Preferred Bidder	10 days	2015/07/07	2015/07/20
176	**Contract Preparation**	**195 days**	**2015/07/21**	**2016/04/28**
177	Negotiations	160 days	2015/07/21	2016/03/07
178	Report and Approval (TA III)	15 days	2016/03/08	2016/03/29
179	Financial Close	20 days	2016/03/30	2016/04/28
180	**Implementation**	**320 days**	**2016/04/29**	**2017/08/04**
181	Detail Design	120 days	2016/04/29	2016/10/17
182	Construction	240 days	2016/05/27	2017/05/11
183	Commissioning	60 days	2017/05/12	2017/08/04
184	**RfO**	0 days	2017/08/04	2017/08/04
185	**EASTERN BASIN**	1 day?	2012/01/30	2012/01/30
186	**EIA for LTS (Eastern Basin)**	**500 days**	**2014/04/03**	**2016/03/29**
187	Registration of Project	60 days	2014/04/03	2014/06/27
188	Scoping phase of EIA	160 days	2014/06/30	2015/02/16
189	Impact Assessment phase of EIA	280 days	2015/02/17	2016/03/29
190	EIA Authorisations (assuming no appeals)	0 days	2016/03/29	2016/03/29
191	**Critical water levels**	**411 days**	**2017/03/01**	**2018/10/19**
192	**Conservative ECL**	**1 day**	**2017/03/01**	**2017/03/01**
193	ECL + TOL (1280M)	1 day	2017/03/01	2017/03/01
194	**Higher ECL**	**60 days**	**2018/07/26**	**2018/10/19**
195	TOL (1450M)	10 days	2018/07/26	2018/08/08
196	ECL (1470M)	10 days	2018/10/08	2018/10/19
197	**Short Term Interventions**	**460 days**	**2013/06/24**	**2015/04/23**
198	**Ritz Pumps**	**120 days**	**2013/07/01**	**2013/12/19**
199	Order Pumps	0 days	2013/07/01	2013/07/01
200	Delivery	60 days	2013/07/01	2013/09/23
201	RfC	30 days	2013/09/25	2013/11/05
202	RfO	30 days	2013/11/06	2013/12/19
203	**HDS Construction**	**460 days**	**2013/06/24**	**2015/04/23**
204	Tender advertised	20 days	2013/06/24	2013/07/19
205	Tender period	40 days	2013/07/22	2013/09/16
206	Adjudicate & Award	60 days	2013/09/17	2013/12/10
207	Construction	240 days	2013/12/11	2014/11/25
208	RfC	0 days	2014/11/25	2014/11/25



Project: AMD Implementation Plan Edition 1 Date: 31 July 2013	Task		Milestone	◆	Summary		Project Summary		Progress		Critical Task	

AMD FEASIBILITY STUDY
IMPLEMENTATION PLAN

ID	Task Name	Duration	Start	Finish
209	Commissioning and Trial Operation	100 days	2014/11/26	2015/04/23
210	RfO	0 days	2015/04/23	2015/04/23
211	**Long term solution**	**975 days**	**2014/03/12**	**2018/01/26**
212	**Mobilise PSP as TA**	20 days	2014/03/12	2014/04/10
213	**Geotechnical Investigation**	**135 days**	**2014/04/11**	**2014/10/20**
214	Prepare Tender Documents	20 days	2014/04/11	2014/05/08
215	Bid period	15 days	2014/05/09	2014/05/29
216	Adjudicate and award	20 days	2014/05/30	2014/06/27
217	Investigations and laboratory Testing	60 days	2014/06/30	2014/09/19
218	Reporting	40 days	2014/08/25	2014/10/20
219	**Topographical Surveys**	**135 days**	**2014/04/11**	**2014/10/20**
220	Prepare Tender Documents	20 days	2014/04/11	2014/05/08
221	Bid period	15 days	2014/05/09	2014/05/29
222	Adjudicate and award	20 days	2014/05/30	2014/06/27
223	Survey work	60 days	2014/06/30	2014/09/19
224	Mapping and Reporting	40 days	2014/08/25	2014/10/20
225	**Request For Qualifications**	**141 days**	**2014/04/11**	**2014/10/28**
226	Drafting RfQ	20 days	2014/04/11	2014/05/08
227	Document approval (TA II(a) (RfQ)	20 days	2014/05/09	2014/06/05
228	**RFQ Exposure Period**	**40 days**	**2014/06/06**	**2014/08/01**
229	Issuing and Response Period	40 days	2014/06/06	2014/08/01
230	Receipt	0 days	2014/08/01	2014/08/01
231	**RFQ Evaluation**	**101 days**	**2014/05/09**	**2014/09/30**
232	Agree Evaluation Criteria	10 days	2014/05/09	2014/05/22
233	Evaluation Process	20 days	2014/08/04	2014/08/29
234	Technical assessment	10 days	2014/09/01	2014/09/12
235	Evaluation Committee	10 days	2014/09/15	2014/09/29
236	Pre-qualified shortlist	1 day	2014/09/30	2014/09/30
237	RFQ Approvals	20 days	2014/10/01	2014/10/28
238	Shortlist Issued	0 days	2014/10/28	2014/10/28
239	**Request for Proposal**	**295 days**	**2014/05/09**	**2015/07/13**
240	RFP Preparations	100 days	2014/05/09	2014/09/29
241	RfP Approval	24 days	2014/09/30	2014/10/31
242	RFP Issue	0 days	2014/10/31	2014/10/31
243	RFP Competitive Period	120 days	2014/11/03	2015/04/29
244	Evaluation	30 days	2015/04/30	2015/06/11
245	Approvals	20 days	2015/06/12	2015/07/10
246	Preferred Bidder	1 day	2015/07/13	2015/07/13
247	**Contract Preparation**	**200 days**	**2015/07/14**	**2016/04/28**
248	Negotiations	160 days	2015/07/14	2016/02/29
249	Report and Approval (TA III)	15 days	2016/03/01	2016/03/22
250	Financial Close	20 days	2016/03/30	2016/04/28
251	**Implementation**	**440 days**	**2016/04/29**	**2018/01/26**
252	Detail Design	120 days	2016/04/29	2016/10/17
253	Construction	360 days	2016/05/27	2017/10/30
254	Commissioning	60 days	2017/10/31	2018/01/26
255	**RfO**	0 days	2018/01/16	2018/01/16
256	**HYDROGEOLOGICAL MONITORING**	**1560 days**	**2012/01/31**	**2018/04/20**
257	**EXISTING MONITORING PROGRAMME**	**1560 days**	**2012/01/31**	**2018/04/20**
258	Monitoring	1500 days	2012/01/31	2018/01/23
259	Evaluation and Assessment	1500 days	2012/04/30	2018/04/20
260	**SHAFT MONITORING**	**1200 days**	**2013/03/14**	**2017/12/20**
261	STI capping of shafts	140 days	2013/03/14	2013/10/02
262	Monitoring Commences	1060 days	2013/10/03	2017/12/20

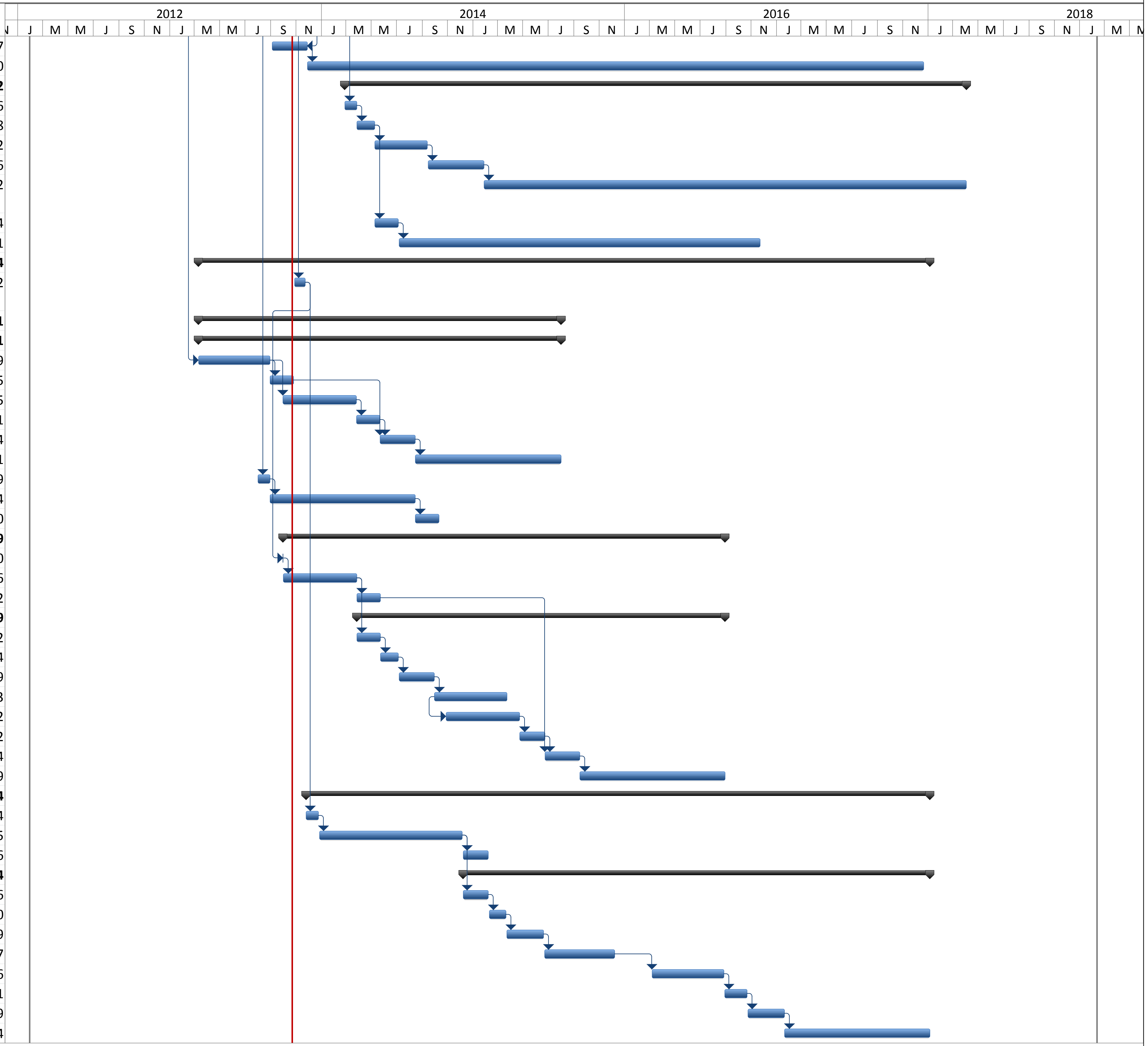


Project: AMD Implementation Plan
Edition 1
Date: 31 July 2013

Task | Milestone | Summary | Project Summary | Progress | Critical Task

AMD FEASIBILITY STUDY
IMPLEMENTATION PLAN

ID	Task Name	Duration	Start	Finish
263	LTS capping of shafts	60 days	2013/09/04	2013/11/27
264	Monitoring Commences	1020 days	2013/11/28	2017/12/20
265	**MONITORING, EVALUATION AND ASSESSMENT**	**1030 days**	**2014/02/26**	**2018/04/02**
266	Mobilise PSP	20 days	2014/02/26	2014/03/26
267	Design Near Surface Monitoring Programme	30 days	2014/03/27	2014/05/08
268	Procure Drilling Contractor	90 days	2014/05/09	2014/09/12
269	Drill Monitoring holes	90 days	2014/09/15	2015/01/26
270	Aquifer Monitoring and Sampling Commences	800 days	2015/01/27	2018/04/02
271	Design Evaluation System for all monitoring	40 days	2014/05/09	2014/07/04
272	Produce Quarterly Reports	600 days	2014/07/07	2016/11/21
273	**INGRESS CONTROL**	**1210 days**	**2013/03/11**	**2018/01/04**
274	Agree interdepartmental responsibility for additional measures	20 days	2013/10/28	2013/11/22
275	**CGS - Central Basin**	**600 days**	**2013/03/11**	**2015/07/31**
276	**Design and tender of phase 1 canals**	**600 days**	**2013/03/11**	**2015/07/31**
277	Detail Design	120 days	2013/03/11	2013/08/29
278	Procure funding for implementation	40 days	2013/08/30	2013/10/25
279	Prepare tender documents	120 days	2013/09/30	2014/03/25
280	Tender Period	40 days	2014/03/26	2014/05/21
281	Adjudicate & Award	60 days	2014/05/22	2014/08/14
282	Construction	240 days	2014/08/15	2015/07/31
283	Phase 2 FS	20 days	2013/08/01	2013/08/29
284	Detailed Feasibility Study - Phase 2	240 days	2013/08/30	2014/08/14
285	Procure funding for implementation	40 days	2014/08/15	2014/10/10
286	**CGS - Eastern Basin**	**731 days**	**2013/09/30**	**2016/08/29**
287	Mobilise CGS for FS	1 day	2013/09/30	2013/09/30
288	Detailed Feasibility Study	120 days	2013/10/01	2014/03/26
289	Procure funding for implementation	40 days	2014/03/27	2014/05/22
290	**Procure PSP for design and tender**	**610 days**	**2014/03/27**	**2016/08/29**
291	Scope of Work & RfP for PSP	40 days	2014/03/27	2014/05/22
292	Bid Period	30 days	2014/05/23	2014/07/04
293	Adjudication and Award	60 days	2014/07/07	2014/09/29
294	Detail Design	120 days	2014/09/30	2015/03/23
295	Prepare Tender Documents	120 days	2014/10/28	2015/04/22
296	Tender Period	40 days	2015/04/23	2015/06/22
297	Adjudicate & Award	60 days	2015/06/23	2015/09/14
298	Construction	240 days	2015/09/15	2016/08/29
299	**CGS - Western Basin**	**1030 days**	**2013/11/25**	**2018/01/04**
300	Mobilise CGS for FS	20 days	2013/11/25	2013/12/24
301	Detailed Feasibility Study	240 days	2013/12/27	2014/12/05
302	Procure funding for implementation	40 days	2014/12/08	2015/02/06
303	**Procure PSP for design and tender**	**770 days**	**2014/12/08**	**2018/01/04**
304	Scope of Work & RfP for PSP	40 days	2014/12/08	2015/02/06
305	Bid Period	30 days	2015/02/09	2015/03/20
306	Adjudication and Award	60 days	2015/03/23	2015/06/19
307	Detail Design	120 days	2015/06/22	2015/12/07
308	Prepare Tender Documents	120 days	2016/03/07	2016/08/26
309	Tender Period	40 days	2016/08/29	2016/10/21
310	Adjudicate & Award	60 days	2016/10/24	2017/01/19
311	Construction	240 days	2017/01/20	2018/01/04



Project: AMD Implementation Plan
Edition 1
Date: 31 July 2013

Task | Milestone | Summary | Project Summary | Progress | Critical Task