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STRATEGIC WATER PARTNERS NETWORK

Considerations Related to Using Treated Acid Mine Drainage to Close the Water Gap in a River Catchment: Final Report

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REPORT

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EXECUTIVE SUMMARY

The Thematic Working Group for Effluent and Waste Water Management (EWWM) of the Strategic Water Partners Network (SWPN) identified the issues, opportunities and constraints related to the use of treated acid mine drainage (AMD) to close the water gap in a catchment. The purpose of Phase 1 of the project was to establish the issues, opportunities and constraints inherent in the treatment and re-use of AMD in relation to water policy, institutional arrangements and water pricing models to provide an enabling environment for private sector participation in the sector.

The EWWM Working Group considered background material prepared by subject matter experts before deliberating on 18 and 19 March 2013 at Johannesburg Water, Marshalltown with the EWWM Working Group. The aim of the workshop was to reach consensus on what the issues, opportunities and challenges related to the use of AMD are in order to close the water gap on a catchment scale. The inputs from the workshop was packaged to develop this draft final report articulating a consolidated view of the issues, opportunities and constraints related to the reuse of AMD to close the water gap on a catchment scale.

The Olifants River Catchment was selected as a case study. This was to ensure that thoughts and ideas were "grounded" while still generic enough to use elsewhere. There is enormous potential to use treated AMD to close the water gap in this catchment. Reconciliation of water requirements and water available along the main stem of the Middle Olifants will in future rely on excess water from the Upper Olifants River. The Department of Water Affairs Reconciliation Strategy indicates that over time 20 – 40 million m^3/year (55 – 110 Mℓ /day) is required to augment the Middle Olifants River. On the other hand, estimates show that between 55 - 73 million m^3/a (150 to 200 Mℓ/day) of excess water could be available (making practical use of readily available storage) over the next 20 years. The AMD from the Upper Olifants is therefore, in theory, enough to alleviate the water deficit in the Middle Olifants, assuming that the water will be made available to the users in the Middle Olifants. Irrespective of where the water will be used, the AMD will need to be treated and made available for the use downstream. An estimated installed treatment capacity of 143 Mℓ/day (52.2 million m^3/a) could be operational by 2020.

There is therefore consensus that treating AMD to any "fit for use" quality is technically feasible and becoming more financially viable through rapid technological development. South Africa also has some reference installations that demonstrate the successful use of treated AMD for domestic water supply. However, using treated AMD to narrow the water imbalance on a catchment level and as part of the catchment level planning and reconciliation, is new. It will require the mobilisation of organisations that were historically not actively involved in water treatment and supply. It becomes business "un-usual" and naturally cause discomfort amongst role players because it implies working (and in some cases accepting responsibility and accountability) on a complex issue. This will require crossing many disciplinary boundaries to create a holistic approach and solutions. It is recognised that win/win solution will require trade-offs. A narrow sector approach will be constraining.

The EWWM working group highlighted the fact that there is a small (approximately 2 – 3 years) window of opportunity for a regional approach to use AMD to augment the water deficit in the Olifants River Catchment.

The enablers for this are:

- Olifants River Catchment water balance is in a deficit;
- Downstream water users that require additional water to sustain growth;
- Current knowledge confirms that this deficit can be offset by the available AMD;
- The operational mines in the Mpumalanga coalfields are willing to participate;
- There is public pressure to address the AMD problem;
- There is heightened public awareness of the effects of AMD and the water quality deterioration of the resource;

- The minister of water affairs established the SWPN and hence this initiative has political support at the highest level;
- The Olifants River Catchment will be one of the first catchments where the waste discharge charge system will be implemented this will most likely be linked to the waste load allocation in accordance to the receiving water resource quality objectives;
- It could also delay the implementation of other augmentation schemes such as the next phase of the Lesotho Highlands project;
- A regional scheme is an opportunity for smaller mines to participate and tap into the scheme; and
- The South African water sector has a proven track record for the treatment of AMD to potable water standards.

However, if the treated AMD continues to be discharged to nearest convenient stream or river, it is unlikely to reach the intended downstream user due to unlawful abstraction along the way. A coordinated, regional approach is therefore required to close the water gap in the Olifants Catchment and specifically in the Middle Olifants. No Coalfields wide institution exists to coordinate and integrate the development of mine water reclamation projects with respect to:

- Cooperation on a regional basis;
- Optimized location and sizing of infrastructure and plants;
- Selection of treatment technology;
- Collaboration with respect to the use of waste and by-products;
- Coordination on the best use of the reclaimed water; and
- Development of consistent water tariffs.

Given this context, the EWWM Working Group considered the policy, legislative, institutional and financial aspects and identified the issues, opportunities and constraints in associated with the reclamation and reuse of AMD which is contextualised in this draft final report.

From these, key messages were developed which needs to be agreed on. The key messages relate to:

- Sustainable long term planning and catchment level inter- and intra-dependencies;
- The marginal cost of any new augmentation scheme will be high;
- Transparent communication and management of public perceptions;
- Private Sector Participation in AMD Treatment Scheme;
- Opportunity for a regional scheme; and
- Enabling environment.

In conclusion, this report provides a synthesis of the current thinking related to the use of treated AMD to close the water gap at a catchment level, using the Olifants River Catchment as an example. A relatively short window of opportunity exists to harness treated AMD to address, to some extent, the water deficit in the Olifants Catchment. A regional scheme/approach was considered in which the issues, opportunities and constraints were unpacked related to (1) Policy and legislation, (2) institutional matters, and (3) financing and pricing. Key messages were developed to feed into Phase 2 of the work.

It is however, recommended that the EWWM working group develop a collective opinion on whether the focus should continue to be on using treated AMD to augment the water available in a catchment given the

relatively small window of opportunity that exists in at least the catchment considered as a case study. A discussion context was provided to consider the increased focus on the land capability of reinstated mining areas is evolving as part of the mix.

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1.0 INTRODUCTION

1.1 Project Background

The Thematic Working Group for Effluent and Waste Water Management (EWWM) of the Strategic Water Partners Network (SWPN) developed a comprehensive Phase 1 scope including the methodology and the activities in a document titled: "Using Treated Acid Mine Drainage to Close the Water Gap in the Olifants River Catchment – Issues, Opportunities and Constraints".

The original request for proposal indicated: "*Phase 1 of the project (this assignment) encompasses the identification of the issues, opportunities and challenges inherent in the treatment and re-use of acid mine drainage and in the current institutional and pricing models for wastewater treatment and re-use"*.

The secretariat of the Strategic Water Partners Network (SWPN) at the Nepad Business Foundation (NBF) appointed Golder Associates Africa (GAA) in association with Pegasys Strategy and Development (Pegasys) for Phase 1 of the project.

The secretariat of the SWPN agreed that the focus of the project be on the re-use of acid mine drainage (AMD). The re-use of domestic wastewater is not addressed at this stage as the drivers such as institutional capacity and the regulatory environment are fundamentally different from the treatment and re-use of AMD.

The purpose of this phase of the project was therefore to establish the issues, opportunities and constraints inherent in the treatment and re-use of AMD in relation to **water policy, institutional arrangements and water pricing models to provide an enabling environment for private sector participation in the sector**.

Although the Phase 1 study area is limited to the Mpumalanga Coalfields including the upper portions of Nkomati and Vaal, the Upper and Middle Olifants Catchment, the intention is to report issues opportunities and constraints in a manner that they are replicable, both geographically as well as sectorialy (mining, industrial and municipal).

The SWPN specifically requested that the methodology be focussed on a **participatory** analysis of the current situation and **joint** definition of the aspects to be addressed in AMD treatment and re-use, on both technical and institutional levels, through adaptation of institutional and pricing arrangements. Figure 1 provides an overview of the methodology that was followed to produce this Phase 1 final report.

A background document (APPENDIX A, Golder, 2013a) was developed focussing on the indicated study area as a generic case study to allow for the assessment of policy, institutional and pricing issues. The background document (Golder, 2013a) provided a high level summary of:

- The current situation with respect to generation and treatment of Acid Mine Drainage (AMD) including current initiatives and quantity of AMD;
- Treatment and re-use opportunities and the impact that such interventions could have in closing the water gap; and
- The long term sustainability issues affecting the treatment and reuse opportunities, in particular after mine closure.

Subject matter experts then developed brief discussion documents which articulated the generic policy, institutional and pricing situation in respect of AMD treatment and re-use (APPENDIX B, Golder 2013b).

The background document and discussion document (Golder, 2013ab) informed the workshop held on 18 and 19 March 2013 at Johannesburg Water, Marshalltown with the EWWM Working Group. APPENDIX C contains copies of the workshop agenda, attendance register, presentations and minutes. The aim of the workshop was to reach consensus on what the issues, opportunities and challenges related to the use of AMD are in order to close the water gap on a catchment scale. The inputs from the workshop were packaged to develop this draft final report, articulating a consolidated view of the issues, opportunities and constraints.

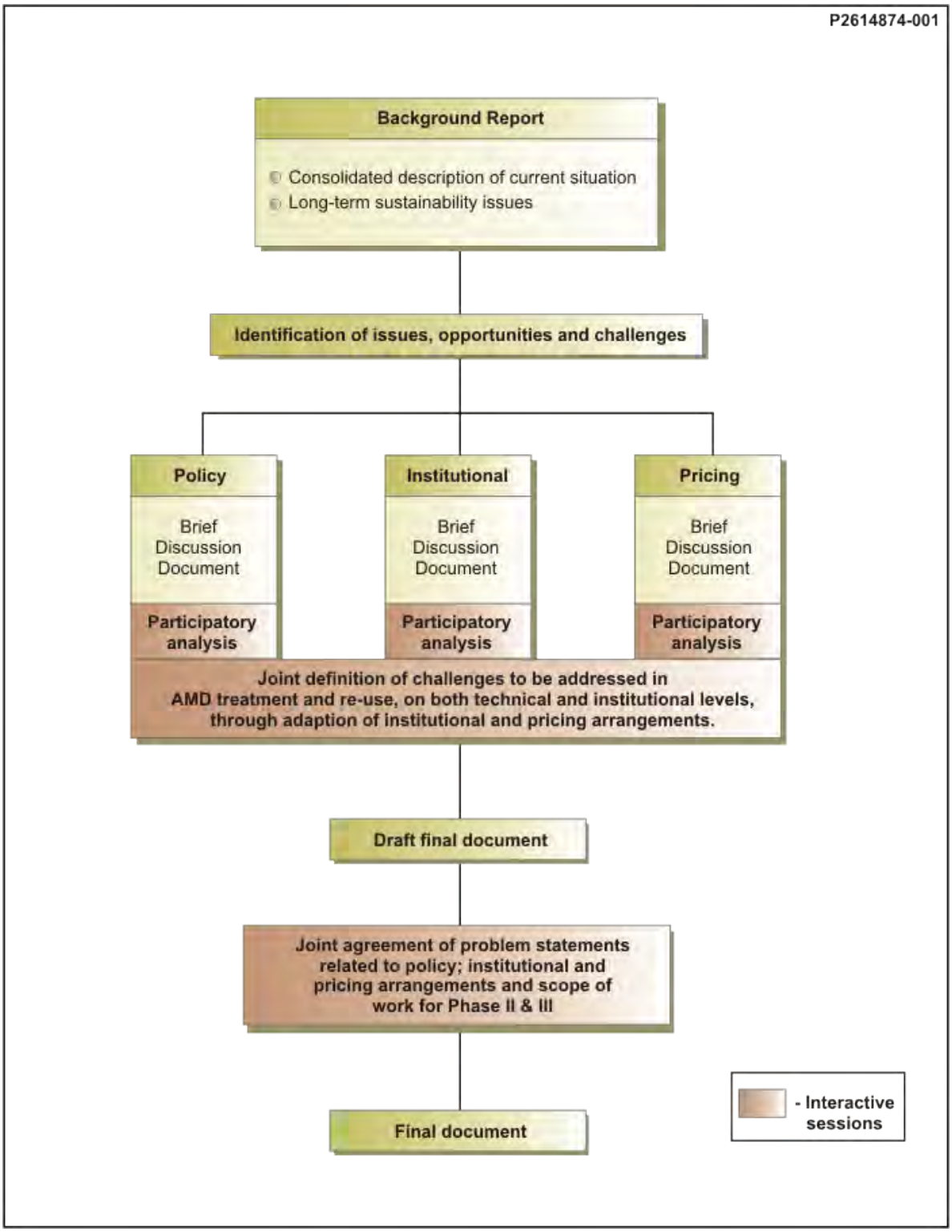

Figure 1: Study methodology and deliverable

2.0 CASE STUDY – OLIFANTS RIVER CATCHMENT

A mining impacted catchment was selected as a case study to identify the issues, opportunities and constraints associated with the reuse of AMD to close the water gap at a catchment scale. Using a case study ensured that thoughts and ideas were "grounded", while still generic enough to use elsewhere. The Olifants River Catchment was used as a case study for the following reasons:

- The EWWM Working Group specifically included the Upper and Middle Olifants Catchment in the Scope of Work;
- The Water Reconciliation Strategy for the Olifants River Catchment (DWA, 2011) specifically includes the use of treated AMD to close the water gap at a catchment level;
- The Mpumalanga Coalfield Mines include active, defunct as well as ownerless mines producing different volumes of AMD;
- There is reasonable agreement among experts on the overall recharge and volumes of excess mine water available for treatment and re-use; and
- The water deficit in the Middle Olifants is more acute than in the Upper Olifants where most of the AMD is produced and potentially treated. This adds the dimension of water trade-offs within a catchment with its associated social/economic issues.

2.1 Water Reconciliation Strategy – Olifants Catchment

DWA completed a Water Reconciliation Strategy for the Olifants River Catchment in 2011 (DWA, 2011). The Reconciliation Strategy shows that the system is projected to run into a water deficit by 2017 and interventions already need to be implemented to be effective by that time.

The Reconciliation Strategy proposes to implement a number of actions and projects in the following two categories:

- Reducing the water requirements; and
- Increasing the water resources yield.

One of the key water reconciliation strategies is the development and utilisation of the water from mining operations on the Mpumalanga Coalfields. The Reconciliation Strategy assumed that the mine water can contribute an additional water resource as reflected on Figure 2.

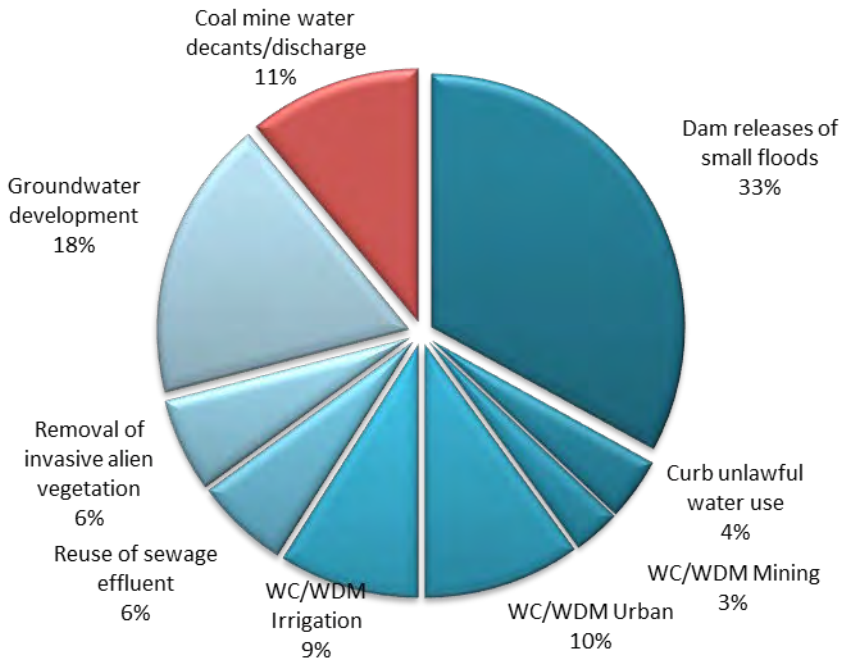

Figure 2: Water Reconciliation Strategy Actions (Contribution to Total Water Requirements for Future Growth and Development)

The successful implementation of all the proposed Reconciliation Strategy actions could result in an excess of available water in the Upper Olifants River. This water will, however be required to support the Middle Olifants River water requirements.

The Middle Olifants River is faced with significant future water deficits and the Reconciliation Strategy will require all actions to be implemented. Commissioning of the De Hoop Dam will relieve the water deficit conditions in the Steelpoort area, while the water users along the main stem of the Middle Olifants River will remain dependant on especially:

- Excess water from the Upper Olifants River;
- Reclamation and re-use of Mokopane and Polokwane sewage effluents; and
- Groundwater development (potential groundwater resources may be too far downstream of the main water stressed areas to be an economical option).

It is clear that reconciliation of water requirements and water available along the main stem of the Middle Olifants will in future rely on excess water from the Upper Olifants River. The Reconciliation Strategy indicates that over time, 20 – 40 million m^3/year (55 – 110 Mℓ /day) is required to augment the Middle Olifants River.

2.2 Mine Water Recharge in the Upper Olifants

APPENDIX A (Golder, 2013a) summarised the results of a consolidated Mpumalanga Coalfields study commissioned by the Joint Investigation Agreement (JIA) which indicated the following with respect to water make and excess mine water:

- There is a steady rise in mine water recharge (reflecting the total water arising in old and existing mine workings) from a current best estimate of 170 Mℓ/day (62 million m^3/a) eventually approaching 300 Mℓ/day (110 million m^3/a) towards the end of life of the Coalfields;

- Estimated excess water volumes in the range of 100 - 150 Mℓ/day (36 - 55 million m^3/a) is available on the Coalfields assuming that maximum utilisation of all available storage in old workings will take place; and
- A more realistic estimate of the probable excess water volume making practical use of readily available storage is in the range of 150 to 200 Mℓ/day (55 - 73 million m^3/a) over the next 20 years.

An important technical issue to address and agree on is to distinguish between the so called “old” and “new” water. The “old” water is the water that would have reported to the rivers as interflow and surface runoff under natural catchment conditions. The “new” water is the additional water that the mining operations generate due to the higher recharge rates into the mine workings (particularly opencast workings and high extraction underground mining) resulting from the disturbance of the natural surface and groundwater system. The mine operations do reduce the volumes of water reporting to the river system with the reduction of runoff and the interception of groundwater. However, the current estimates indicate that the increase in recharge due to mining exceeds the reduction in water volumes reporting to the river system. This net increase in water volume contributes to the catchment water availability for use in meeting the water requirements. The net increase in the available water volume due to mining can be quantified using the DWA’s Water Resource Planning Model.

The figures quoted above indicate that the treated AMD from the Upper Olifants could make a substantial contribution to alleviate the water deficit in the Middle Olifants. However, the AMD will need to be treated and made available for the downstream use in a manner which effectively increases the reliable yield of the Olifants catchment.

The best estimate of the projected mine water recharge volumes and the production of reclaimed AMD is shown graphically on Figure 3**.** The following conclusions are made:

- The current installed mine water treatment capacity of 40 Mℓ/day (14.6 million m^3/a) is anticipated to be expanded to 101 Mℓ/day (36.87 m^3/a) by 2015; and
- An estimated installed treatment capacity of 143 Mℓ/day (52.2 million m^3/a) could be operational by 2020.

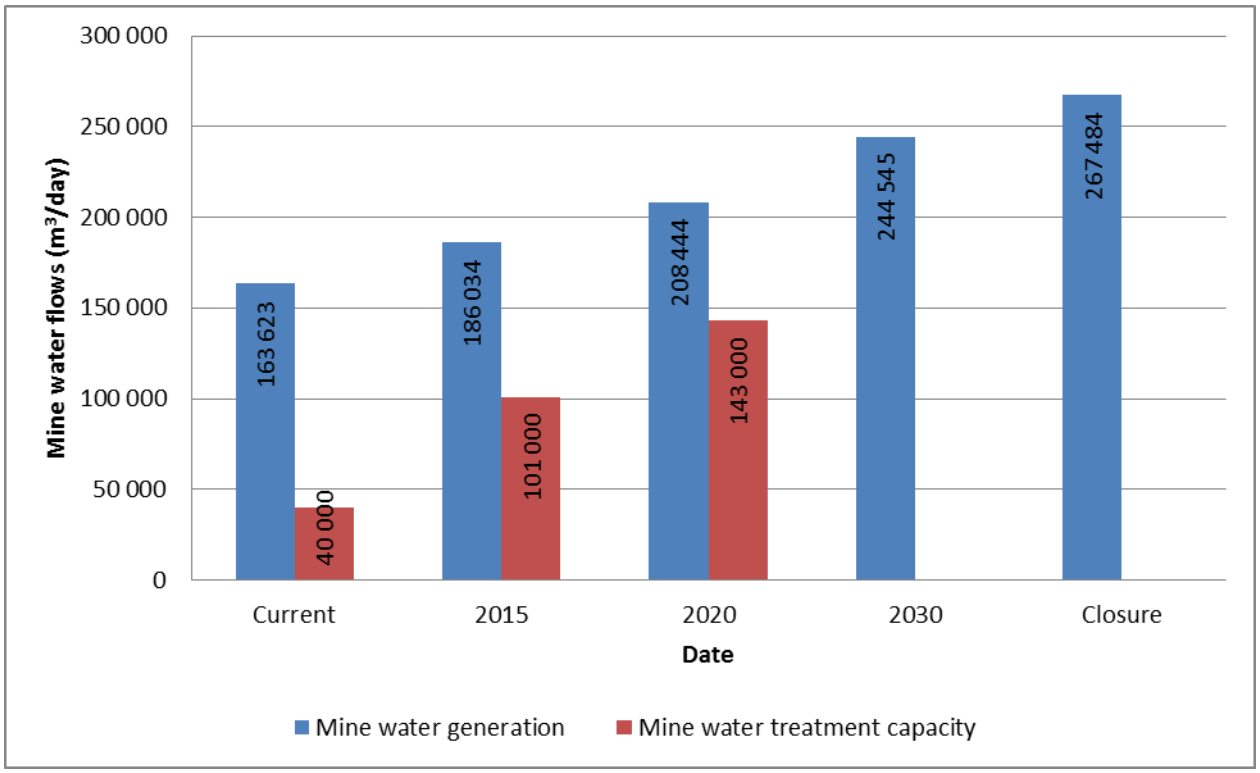

Figure 3: Estimated mine water recharge and projected installed treatment capacity

3.0 BUSINESS "UN-USUAL"

The challenges related to the use of treated AMD to close the catchment water gap are not only technical issues. Treating AMD to any "fit for use" quality is technically feasible and becoming more financially viable through rapid technological development. South Africa also has some reference installations that demonstrate the successful use of treated AMD for domestic water supply. However, using treated AMD to narrow the water imbalance on a catchment level and as part of the catchment level planning and reconciliation, is new. It may require the mobilisation of organisations or the establishment of new organisations that were historically not actively involved in mine water treatment and supply. It becomes business "un-usual" and naturally causes discomfort amongst role players because it implies working (and in some cases accepting responsibility and accountability) on a complex issue. This will require crossing many organisational and disciplinary boundaries[1] to create a holistic approach and solutions.

We could therefore be dealing with a wicked problem as defined by Ritchey (2007). A "wicked problem" is a problem that is difficult or impossible to solve because of incomplete, contradictory, and changing requirements that are often difficult to recognize because of complex interdependencies. The effort to solve one aspect of a wicked problem may reveal or create other problems.

The characteristics of a wicked problem are:

- There is no definitive formulation of a wicked problem (defining wicked problems is itself a wicked problem);
- Wicked problems have no stopping rule;
- Solutions to wicked problems are not true-or-false, but rather better or worse;
- There is no immediate and no ultimate test of a solution to a wicked problem; and

[1] Transdisciplinarity as defined by Nicolescu (2008)

- Every solution to a wicked problem is a "one-shot operation"; because there is no opportunity to learn by trial and error, every attempt counts significantly.

Any win/win solution will require trade-offs.

A narrow sector approach will be constraining i.e. forcing the mining sector to treat and discharge AMD according to their local water use license conditions through the 'polluter pays' principle. We need to move away from a narrow focus on the mining sector as a polluter only. If we consider viewing the mining sector as:

- A significant contributor to social and economic benefits;
- A water producer;
- A significant partner in water resource management; and
- Committed to treat AMD to the appropriate standards.

Then the opportunities to use the treated AMD to close the water gap could be unlocked. A similar re-definition of roles, contributions and participation by other participants in the catchment will apply. The EWWM considered this possibility and noted several opportunities and constraints related to policy, institutional, pricing and financing.

The sections that follow capture these identified opportunities and constraints.

4.0 WINDOW OF OPPORTUNITY

It is recognised that the current situation is not sustainable, especially in the study area i.e. the Olifants River Catchment.

The quantum of financial provision for mine water treatment in perpetuity cannot be sustained. At the same time the mining sector recognized and accepted that they are liable for the treatment of acid mine drainage. At the moment, local discharges from AMD treatment plants are often discharged into small tributaries followed by local unlawfully water use. This means that the treated high quality water is not used optimally in the broader interest of the catchment and according to the Reconciliation Strategy. On the other hand, the catchment is facing a deficit, especially once the Reserve is implemented for Olifants River Catchment.

The mining sector, especially large and multinational groups are implementing a range of water management strategies. DWA hierarchy with respect to mine water management is implemented. Rehabilitation of disturbed land is receiving more attention which reduces the impacted water make. They are also considering other water treatment technologies especially with regards to the management of the residues emanating from the treatment of the AMD (brines, sludges, etc.).

4.1 Enabling Environment

The EWWM Working Group highlighted the fact that there is a small (approximately 2 – 3 years) window of opportunity for a regional / catchment approach to use AMD to augment the water deficit in the Olifants River Catchment.

The drivers and enablers for this are:

- Olifants River Catchment water balance is in a deficit;
- Downstream water users that require additional water to sustain growth;
- Current knowledge confirms that part of this deficit can be offset by the available AMD;
- The operational mines in the Mpumalanga Coalfields are willing to participate;
- There is public pressure to address the AMD problem;

- There is heightened public awareness of the effects of AMD and the water quality deterioration of the resource;
- The Minister of Water Affairs established the SWPN and hence this initiative has political support at the highest level;
- The Olifants River Catchment will be one of the first catchments where the Waste Discharge Charge System will be implemented and this will most likely be linked to mining operations and practices that produce AMD and to the receiving water resource quality objectives;
- A regional / catchment scheme is an opportunity for smaller mines to participate and benefit from the scale of a regional approach;
- The South African water sector has a proven track record for the treatment of AMD to a standard fit for use; and
- Engineering, construction, funding and financing capacity exists within the country.

4.2 Considering a Regionalised Approach

Many of the existing and planned AMD treatment projects will discharge reclaimed water to the nearest convenient stream or river. This will result in discharges to relatively small streams, and not to the main stems of the Olifants River. The opportunity for run-of-river irrigation abstraction is also enhanced by such an arrangement. The result may be that substantial losses of reclaimed water may take place before the water reaches the main stem of the Olifants River and its significant tributaries such as the Klein Olifants River and Wilge River.

A coordinated, regional / catchment level approach is therefore required to close the water gap in the Olifants Catchment and specifically in the Middle Olifants. No Coalfields wide institution exists to coordinate and integrate the development of mine water reclamation projects with respect to:

- Cooperation on a regional basis;
- Optimized location and sizing of infrastructure and plants;
- Selection of treatment technology;
- Collaboration with respect to the use of waste and by-products;
- Coordination on the best use of the reclaimed water;
- Development of consistent water tariffs; and
- Discharging reclaimed water at a location and time that optimizes the catchment water availability and yield.

While the base case (following current practices) will over time address the issue of mine water related pollution and developing the mine water as a water resource, the efforts may lack integration and development of mine water as a reliable resource to the catchment.

The effective resolution of the AMD decants from the old defunct mines located around Witbank will also probably not take place. The majority of these old defunct mines are the responsibility of the State. The rehabilitation of the decades long AMD issue can best be managed as part of a larger catchment wide scheme.

Given this context, the EWWM Working Group considered the policy, legislative, institutional and financial aspects and identified the issues, opportunities and constraints associated with the reclamation and reuse of AMD. The sections that follow represent a consolidated summary from:

- The discussion document prepared by subject matter experts (APPENDIX B);
- Input provided by delegates who attended the workshop on 18 and 19 March 2013 (APPENDIX C); and,
- A Draft report titled: “Effluent & Waste Water Management Working Group - Short report on EWWM strategy process of February and March 2013” prepared by the SWPN Secretariat (APPENDIX D).

5.0 POLICY AND LEGISLATIVE CONSIDERATIONS

The EWWMP Working Group noted Chapter 1 of the Background Document (APPENDIX B) and the presentation titled ‘Policy issues, opportunities and constraints’ (APPENDIX C) prepared by Derek Weston (Pegasys Strategy and Development).

5.1 Key Governmental Role Players

The mining industry is largely regulated by National Government, but also through Provincial Departments as it applies to environmental protection and management. The most important Government Departments, in terms of establishing the policy and legislative frameworks are:

- Department of Water Affairs (DWA);
- Department of Environment Affairs (DEA); and
- Department of Mineral Resources (DMR).

5.1 Policy Principles

The current policy framework and legislative tools do not restrict the use of AMD to augment water resources at a catchment level.

The key principles in the existing policy and legislative instruments provide adequate guidance for the development of a regional / catchment scheme:

- Water is to be managed in an integrated manner and the different water sources and water uses must be coordinated. This integrated management should accept the natural catchment as the appropriate physical unit for management, while also recognizing the need for inter-catchment management where such catchments are linked;
- Water is a valuable natural resource that must be applied in a socially equitable manner, driving economic development with adequate protection of the natural aquatic ecosystems;
- DWA is the custodian of the national water resource, water cannot be owned, but a person or legal body can be granted a license to use water in a certain manner and compliant with license conditions;
- The ‘polluter pays principle’ recognises the responsibility to accept liability for water containing waste which is discharged back into the environment and creates liability for an owner or possessor of land on whose land an activity or process causing pollution has been or is being performed;
- Under licence conditions, water users are required to treat discharge to a certain standard and to return this to the environment;
- In accordance, with the intention of policy, and as laid out in the Minerals and Petroleum Resources Development Act (MPRDA, 2002) there is a clear responsibility to rehabilitate land upon completion of mining activities to minimise the environmental impacts thereafter. Responsibility for the environmental impacts after mine closure remains with the mine. In the case where a mine is found to be ownerless, then the State will, through the Minister of Mineral Resources, take up the responsibility to rehabilitate the land; and

- The liability towards environmental impacts cannot be transferred to the State.

5.2 Policy and Legislative Issues

Noting these principles and considering the scope of policy and legislation, a number of issues were identified that require consideration.

Cooperative Governance and Alignment between Different Regulatory Mandates and Actions

Whilst there is broad alignment of policy and regulatory intent, alignment between the various legislative instruments needs to be improved. The recent suggested amendments to National Environmental Management Act (NEMA, 1998) strengthen the ability to deal with non-compliant mines and this; with the revised Environmental Impact Assessment (EIA) Regulations strengthen the understanding of what is required in terms of EIAs. However, there remain challenges with regards to responsibilities between the DEA and DMR that are not fully clarified. Amendments to the MPRDA are in the pipeline. It was also noted the amendments to the NEMA may have some problems in terms of alignment with the National Water Act (NWA, 1998), which is also currently under review. This will require more analysis, but it does seem that these regulatory review and amendment processes are happening in isolation and are not thoroughly addressing the issues of alignment and clarifying matters related to regulatory responsibilities. Into future, we can expect continued regulatory process challenges.

Regulation and Oversight

As there are various pieces of policy and legislation, there is a need for some form of regulatory hierarchy. The NWRS-II (2013) indicates that DWA should take the lead in such water related matters, but nonetheless there is a need for a clarified regulatory framework. This must include arrangements for more regular monitoring and evaluation. This will obviously place a responsibility upon the discharger to provide regular information.

Recognising AMD as a Water Resource

Mine water is recognised as a potential water resource, both in the negative sense [if not properly managed will diminish use of the available resource] but also in a positive sense [can contribute to the water budget as an available water resource]. Several of the recent water re-conciliation strategies developed by the DWA (Vaal River catchment and Olifants River Catchment) recognized mine water as a resource which can contribute to closing the gap between water availability and water requirements in the catchment.

Authorisation for AMD Treatment and Reuse

In order to treat and discharge water an EIA, an Environmental Management Plan (EMP), a waste licence, an Integrated Waste and Water Management Plan (IWWMP) and a license to use water may be required. The water use (including discharge) will need to meet the required best practice guidelines and standards. It is assumed that the mines already deal with this at an individual level, but a regional scheme may require a new framework for a collective EIA, EMP, IWWMP and Water Use Licence (WUL) approach. In order to treat and sell reclaimed water for the purposes of water service provision, a form of off-take agreement may be required.

It is not clear whether the water use licence would be for removal of water from the water resource (Section 21(a) of NWA) or for removal of water or discharging water from underground (Section 21(j) of NWA). The licensing implications of this need more attention.

The mine that treats the AMD does not have the automatic ‘right’ to use the water. There may be an obligation to return the water to the resource. The DWA would need to deliberate over how the additional water is to be allocated, bearing in mind the constraints within the Middle Olifants as well as the need to provide water for local water users.

Process issues for authorisations are not entirely clear and require clarification. This needs to include inputs from interested and affected parties as well as clarity as to matters of appeal, and so forth.

Risk Management

It will be essential to manage the various risks involved. The policies do place considerable emphasis upon the need to ensure environmental quality standards and human health standards are met. It is not always clear what standards would be applied and this would depend upon whether the water is discharged back to the resource or re-used. Discharge back into the resource would have to carefully consider the impacts on water quality, water flow, instream biota and riparian vegetation.

Local Government

A contract with the local Water Services Authority (WSA) will be required to provide bulk water to the municipal sector. This would need to be negotiated with assurances of supply, required water quality standards and the tariff structure all being critical parts of that agreement. As noted above, one would require an off-take agreement in order to supply this water. This also has implications for pricing and this will require further investigation. It may be that by acting as a bulk water services provider, the charges would then need to include a catchment water management charge.

Ownerless Mines

Whilst the MPRDA does articulate the responsibility of the State to take responsibility for these mines, there is little to nothing in the policy documents that really provides a concrete description of departmental roles and responsibilities, and any procedural hierarchy regarding ownerless mines.

Post Closure Liabilities Related to Water

The possibility of long term excess water make by most of the mines on the Mpumalanga Highveld is high. Although a reduced possibility exists in the lower rainfall areas of the country, recent experience indicates that even relatively low rainfall areas such as the extreme north eastern portion of the country cannot be disregarded. These areas with routine low rainfall are subjected to sporadic extremely high rainfall events that recharge mainly open pit operations, resulting in excess water make from these operations during subsequent dry seasons.

Awareness on excess mine water make and the long term financial liability it poses has increased notably amongst mining companies, across the spectrum of small/medium to large operators. Addressing post mine closure excess water make contributes significantly to the closure financial provisions in terms of the MPRDA (2002) that mines have to make. In the higher rainfall areas of the country for operations that have a notable mix of open pit activities, the financial provision for excess water make could comprise more than of half of a mine's provision. Given this, mines are acutely aware of this liability and it has become key in upfront mine planning. Presently, mines address this risk mainly as follows:

- Avoid mining of high recharge areas such as close to major water bodies or underneath notable streams and rivers;
- Limit open pit operations to the essential for making production targets, with a preference for lower recharge underground mining. This inevitably results in lower mineral resource exploitation;
- Limit high extraction underground mining methods and in most cases evaluates this carefully to determine whether resultant increased production yield would off-set the likely increased costs of long term water treatment;
- Improved open pit in-filling and surface routing practices with specific attention to the following:
  - Surface drainage that will reduce/limit recharge to the mine workings;
  - Isolation of reactive infill material that could result in poorer water quality within the lower portions of open pits. If an operation produces excess water make, this could have a notable beneficial effect on the costs of long term water treatment; and
  - Redirection of likely surface runoff past open pit and/or high extraction underground mine workings.

Notwithstanding how well the above is implemented, in most cases excess water make cannot be fully obviated and mines have largely resided to the fact that they will have make financial provisions for on-going long term water treatment and implement the required measures to address excess water make as it manifests within the overall mining cycle. Hence, as the above precautionary measures have become the norm amongst responsible mining companies to limit their long term water related liabilities, on-going water treatment of excess water make has also become part and parcel of these operations. Rapid technology improvements and the contribution by mining itself with the operationalization of these technologies are gradually reducing the actual and perceived water treatment burden, although increased energy costs are militating against this.

The latest experience indicates that although water treatment is not core to mining, this is not begrudged as would be expected. On-site water treatment provides the mines, whilst operational, with a “clean” and steady stream of process water and in those cases where on-going long term water treatment is inevitable, allows more freedom and latitude to the mine for the in-pit disposal of mining related residues, reducing the need and requirements for on-surface disposal and the environmental protection that accompanies this. The latter has, as could be expected, a notable financial advantage. In addition, this form of residue disposal and the accompanying water treatment notably facilitates eventual mine closure and associated site relinquishment. Achieving “walk away” from decommissioned mining operations is paramount to mining companies.

The above largely reflects the current evolving landscape of the manner in which mining is addressing and coping with their post closure water related liability. How this will play out in future still has to be seen. A foreseen downside, that is highly likely, is that mines will dispose of resource assets that are close to being depleted to “uniformed” third parties and burden these with the consequential long term water related liabilities. The manner in which the already contributed/secured financial provisions for these liabilities are transferred in transactions like these needs urgent attention, as in many cases these provisions are vested in the overall holding company and is “divorced” from the actual asset that is disposed.

5.3 Policy and Legislative Opportunities

Alignment

There is a broad alignment in the various policy and legislative instruments for AMD treatment and discharge and for rehabilitation of land after mining. Water and environmental policies have been in place for over a decade and whilst adjustments could be made, there is a general ‘sense’ that the policies still hold.

Water policies and strategies [some dated] are challenged in terms of dealing with the complex issue of an unconventional water resource such as mine water. In this case, the concept of an unconventional water resource is combined with the concept of water reuse and hence opens an opportunity to revise and update existing policies and strategies to deal with this challenge.

Refinements, within the original policy framework, are articulated within strategy documents such as the National Water Resource Strategy II (NWRS-II, 2013) and the NWMS National Waste Management Strategy (NWMS, 2012), amongst others. This project also provides an opportunity to update and provide input to Department of Mineral Resources strategy on the regional mine closure from the perspective of collaboration and productive use of mine water.

NWRS-II

The draft NWRS-II is aimed at providing strategic direction for water resource management over the next decade, recognising that water resources are limited over space and time, and that water can constrain socio-economic development. In this vein, Chapter 5 of the NWRS-II focuses on alternative sources of water to supplement conventional sources of water. It is noted that accessing these non-conventional sources of water is neither easy nor inexpensive. It is important to note that in order to access these resources, key elements requiring attention include “planning, research, and technology (appropriate solutions), improved governance, leadership and management models, extended funding models and financial management, as well as timeous organising and implementation”.

The draft NWRS-II through the Core Strategy 11 notes the importance of shared water security risk. This strategy emphasises the importance of partnerships between business, government and civil society to manage these risks.

There is recognition of the benefits of water re-use. Most significantly, the latest version of the draft NWRS-II provides a technical strategy towards this end. It must be noted that clearly, this is in a relatively initial state of development, with a high level strategy being in place, however there is an opportunity to work with the DWA on the implementation and roll-out of water re-use.

Technical Strategy 7 of the draft NWRS- II promises a more enabling environment and states:

- The need to develop clear and practical guidelines for generic water re-use projects on what regulatory approvals are needed, the status of reclaimed water in terms of right to use and how these can be obtained cost and time effectively;
- The Department will work with other national Departments to align legislation, reduce the regulatory burden wherever practical, and unblock regulatory obstacles to water re-use; and
- The Department will act as the lead regulatory authorities to assist in working with other Departments in getting approval for water re-use projects.

Revision of Other Key Strategies

Both the Pricing Strategy and the Waste Discharge Charge Strategy (WDCS) are under review with a view to implementation in the short term. The opportunity to engage with these review processes now exists and to provide inputs into these strategies. The first draft of the revised Pricing Strategy is currently being developed. The WDCS is being prepared for implementation readiness and the Upper Olifants is one of the three initial catchments within which the WDCS will be implemented and demonstrated. Initiation of stakeholder engagement in the Upper Olifants is planned for 2013. There is a clear opportunity to align these strategy review initiatives to deal with constrains identified by the EWWM Working Group to address issues related to:

- Water classification and how it will influence the reuse of treated AMD;
- Strengthening the role of DWA as the lead regulatory agent;
- Cooperative governance and an enabling regulatory environment;
- Defining the roles of DMR, DEA and National Treasury;
- Clarity on water reuse pricing; and
- Policy clarity on the mobilization of the private sector and specifically mining companies in mine water resource development projects.

Some of the legislative and regulatory streamlining required to enhance AMD re-use projects, include:

- Development of AMD as an unconventional water resource within catchment with a supporting water pricing arrangement;
- Clarity on the acceptable financial arrangement related to re-use and associated pricing for the ‘sale’ of treated and reclaimed water;
- Structure and incentives for the private sector, specifically mining companies, to partner with public sector in delivering AMD projects;
- Mechanisms (financially and institutionally) to manage the post-mining water-related liabilities associated with AMD; and

- Mechanisms to mobile the private sector, specifically mining companies and the state (as an owner of mines, not the regulator) to collaborate on incorporating defunct and ownerless mines into regional AMD projects.

5.4 Policy and Legislative Constraints

Government Alignment and Cooperative Governance

Whilst the policy and legislation have a clear intent to improve the levels of 'cooperative government', in practice there is still a significant journey ahead. Policy and legal instruments do broadly support each other, but do not provide direct alignment from a regulatory process perspective and a specific project. This can result in challenges in working through the various administrative processes that are required. The fact that water use licence applications can take years to finalise, illustrates this constraint.

The current water and mining policies and strategies do not address the complex issue of developing an unconventional water resources such as mine water.

Policy clarity on the mobilization of the private sector and specifically mining companies in water resource development projects is needed.

Water Use Licences

The water users (mining, power and municipal sector) represented in the EWWM Working Group highlighted the constraints related to the timeous processing of water use licenses application. Applications often extend over several years before being issued and licence conditions are very onerous. Companies cannot take decisions to proceed with AMD treatment and reclamation projects and consequently investments are delayed.

Regulatory Capacity

Regulatory authorities' capacity to deal with multiple agencies/authorities involvement and with active participation by multiple stakeholders, some actively opposing mining operations in part of the catchment is required. The current lack of regulatory capacity manifests itself with long delays in taking decisions on water use licenses and providing guidance to mine water related aspects.

Capacity of several role-players in the water sector, specifically the local authorities and municipalities to actively participate in developing collaborative solutions and to implement and operate water infrastructure and services projects, is lacking.

There are constraints regarding the regulatory authorities' capacity to provide leadership in resolving the principle issue of mine water reuse, as well as the allocation of unconventional water sources to different competing water uses in the catchment.

Regulatory authorities capacity requires bolstering in the areas related to:

- Taking a lead role among the authorities and government stakeholders in streamlining regulatory approval of AMD projects;
- Expedite the establishment of a Catchment Management Agency;
- Facilitate a consensus among stakeholders on the best way forward to resolve the long term water issues related to the post-mining scenario on the Mpumalanga Coalfields. This includes the revitalisation of the DMR project on regional mine closure;
- Enforcement of compliance with the water and environmental regulations and water use licence conditions of several mining municipal and industrial operations;
- Control of illegal water use practices, such as run-of-stream abstractions for irrigation; and

- Implementing a strategy and plan to deal with the AMD associated with many defunct and ownerless mines for which the state carries responsibility.

6.0 INSTITUTIONAL CONSIDERATIONS

The EWWMP Working Group noted Chapter 2 of the Background Document (APPENDIX B) and the presentation titled" Institutional issues, opportunities and constraints" (APPENDIX C) prepared by Barbara Schreiner (Pegasys Strategy and Development).

6.1 Institutional Principles

It is important to examine the principles and assumptions that may underpin a sustainable institutional solution. These can be captured as follows:

- The institutional arrangements must be sustainable over the long-term to ensure the stable management of the AMD treatment and re-use;
- Liability for managing the AMD generation and rehabilitating the mined land remain with the mines;
- Responsibility for AMD management from ownerless mines resides with the State;
- The institutional arrangements should not transfer private sector risk to the State;
- A regional approach is likely to yield greater economies of scale and efficiency than a number of stand-alone treatment solutions; and
- Water is a public good that is allocated by the State for use in the public interest.

6.2 Institutional Responsibilities

DWA (or the CMA once it is established and has been delegated appropriate functions) is responsible for allocating, authorising and controlling water use under the NWA and for ensuring compliance monitoring and enforcement. This entails ensuring that water users meet their licence conditions, ensuring that Reserve requirements are met, and ensuring that water supply and demand are in balance to the best practical extent.

The DEA and the Provincial Department of Environments are responsible for ensuring that the mines adhere to requisite environmental standards.

The DMR is responsible for ensuring that the mineral resources of the country are effectively developed, that the mines adhere to their mining licence conditions and to manage mine closure.

The local WSAs are responsible for ensuring reliable access to water services for all inhabitants (and industry) within its area, which would include the decision to use mine water as a resource. The WSA may establish and/or contract a public or private body(ies) to provide bulk water services (i.e. water services provider).

The mines are responsible for discharging their mine water according to their licence, which may include monitoring and the payment of waste discharge charges.

6.3 Institutional Issues

There are various organisational issues relating to the treatment of AMD in this area. The key institutional issues revolve around:

- What body might be responsible for developing and operating AMD treatment works and its relationships with other stakeholders (particularly the mines and local government);
- The institutional capacity to provide leadership and assume the roles and responsibilities associated with a regional / catchment approach, and

- Effective co-ordination between different public and private sector organisations and companies.

6.4 Institutional Opportunities

There is an opportunity for innovative institutional arrangements to address the AMD challenge and to turn it into a reliable water resource contributing to the reconciliation of water supply and demand in the catchment. The implementation of water re-use (Roche-Kelly and Van Dyk, 2011) can take place at different scales or levels:

- At a local level involving a single facility such as a building or a factory, for a group or cluster of facilities;
- At a treatment facility level (for example, such as a municipal treatment works); or
- At a river system level (natural drainage areas/catchments).

Decision-making may vary across these applications and could involve individual or groups of businesses, municipalities and national government (including entities owned by government).

The mines have indicated their preference for a Coalfields-wide institution to coordinate and integrate the development of mine water reclamation projects with respect to:

- Cooperation on a regional basis;
- Optimized location and sizing of infrastructure and plants;
- Selection of appropriate treatment technology;
- Collaboration with respect to the use of waste and by-products;
- Coordination on the best use of the reclaimed water;
- Development of consistent reclaimed water tariffs; and
- Discharging reclaimed AMD at a location and in time that optimize the catchment water availability and yield.

Private sector project management, engineering and financing capacity, as demonstrated by several successful water re-use projects in mining and industry is well established in South Africa. International interest in local water re-use projects has been expressed. Substantial private sector capacity can be leveraged in the implementation of water re-use projects.

Other successful water related organisations, such as Water Use Associations (WUA) are well established in the Olifants Catchment. These organisation / institutions are in a position to share learnings, showcase their experience and provide mentorship in establishing, administering and managing new water institutions / organisations.

The mining industry in the Mpumalanga Coalfields evaluated a number of institutional entities / arrangements to collectively manage mine water. A formal Joint Investigation Agreement (JIA) was set up and has been operational for several years to share information, undertake collaborative studies and engage other stakeholders in an a coordinated manner.

The draft NWRS-II (2013) indicated the establishment of a CMA as a priority for the Olifants. Much work in this regards was completed in the past and this work could form a solid framework for taking the CMA initiative forward.

There is therefore the potential to develop an industry/sector-agreed evaluation/accreditation system for agencies/organisations implementing water re-use projects.

6.5 Institutional Constraints

The EWWM Working Group agreed that some institutional constrains could hamper progress. However, members agreed that none of these constraints are insurmountable and many can be converted from a constraint to an opportunity, including:

- The recent South African track record for wastewater treatment by local authorities and municipalities is not good. The performance of existing wastewater treatment plants in terms of meeting discharge standards and reliability is critical to the successful introduction of water re-use in South Africa. These facilities discharge water that impacts on the safety, economy and fitness for use by downstream users. Strict enforcement of discharge standards, and addressing the management and performance failures of municipal wastewater treatment plans is therefore critical to the future of water re-use;
- Compliance and monitoring of water use in the Olifants Catchment has been weak and will need to be strengthened to ensure the allocated and authorised use of water in the catchment (including AMD), and to protect water quality. This has implications for capacity in DWA/CMA;
- Water re-use projects have many sophisticated technical, engineering, financial, operational and maintenance requirements. A key consideration to any such project is the fact that the water typically has to be treated to improve/upgrade its quality, before it is fit for re-use by a downstream user. The downstream user must be guaranteed an appropriate quality of water to ensure designated use of the water. Re-use projects therefore require a high level of confidence in the implementation and operating agencies;
- A water re-use implementing body must be able to demonstrate a minimum threshold of capacity and competency, before it can be considered as capable of implementing a water re-use project, in terms of technical expertise, planning ability, project management capability, financial strength and rating. It must be accepted by the community and stakeholders as a reliable and trustworthy;
- Water re-use projects typically require more sophisticated treatment technology and systems compared to conventional water treatment and require trained, capable and motivated operations and maintenance staff;
- An “institutional vacuum” was listed as one of the biggest constraints to implementing water reuse projects. Water users are frustrated as they perceive a lack of clear communication channels with different spheres of government. They ask: “Who do we talk to?”; and
- An ideal institutional model to satisfy all the diverse stakeholder needs does not exist. Small mines could find it difficult to participate. Ownerless mines add additional complexity to an institutional solution. However, the EWWM Working Group agreed that a regional catchment scheme could address many of these constraints.

7.0 FINANCING AND PRICING CONSIDERATIONS

The EWWMP working group noted Chapter 3 of Background Report (APPENDIX B) and the presentation titled “Financial and Pricing Considerations: Olifants River - Closing the Water Gap by Reuse” (APPENDIX C) prepared by Kerron Johnstone (Golder Associates Africa).

7.1 Financing and Pricing Issues

7.1.1 Cost Allocation between Participating Mines

Some mine water treatment schemes have more than one mine participating. These mines usually have different volumes and qualities (measured by acidity and salinity) of polluted water requiring treatment and capital and operating costs are allocated accordingly.

The minimum requirement for mines is to treat water to a standard at which it can be discharged into the environment. If potable water is to be produced, additional infrastructure must be provided, and the cost of this infrastructure should be passed on to the potable water users.

Capital costs are driven by **peak flow and maximum quality specifications**: an AMD treatment plant should be able to operate at the maximum flow and quality inputs at any time. The effect of each of these factors (volume, salinity, acidity) on plant capital cost is calculated, and a proportion of capital expenditure is allocated to each participant based on their contribution.

Operating costs are driven by **average flow and medium quality of polluted water supplied**. The flow, salinity and acidity of the polluted water supplied by each participant are measured, and the operating costs allocated accordingly.

These principles will need to be applied to future regional AMD schemes if there are multiple participants. Cost allocations could become more difficult if new participants join later. The State may also be a participant if defunct mines, which are its responsibility are discharging to a regional scheme.

Cost Allocation between Polluters and Reclaimed Water Users

The minimum requirement for mines is to treat water to a standard at which it can be discharged into the environment, usually into a nearby river system with sufficient capacity to handle the volume without significant disruption (e.g. erosion, loss of fauna and flora) to the system. In this case, no water is sold to reclaimed water users.

The production and distribution of product water (potable or process) requires additional infrastructure such as chlorination, storage and distribution systems (pumps and pipelines), which is usually more costly than the simple discharge systems required. In addition, the different standards for potable water and discharge water may require additional AMD treatment steps. The capital and O&M costs of the additional infrastructure should be passed onto reclaimed water users of the scheme, because the scheme owners have no incentive to incur this expenditure.

This principle may also be applied to future regional schemes: the polluters pay for treatment of the AMD water to discharge standard, while reclaimed water users pay for the additional infrastructure required to bring the water to their required standard and distribute it from the AMD treatment plant to their storage reservoirs.

7.1.2 Revenue - Sale of Water and Water Price

A reasonable price of water sold by the scheme reclaimed water users is the price at which the scheme owners neither benefit from the sale of water nor are disadvantaged. If they were to make a profit, then the DWA's principles may be violated, but if they were to make a loss, then simply discharging the water would be preferable, and a potential resource would be lost to the potential reclaimed water users.

The reasonable price for the sale of water may be determined by viewing the supply of potable / process water as a separate project with its own cash flows. The revenue earned by the water supply project is the sale price per unit of water times the volume sold. The expenditure of the project is the cash flows associated with constructing, maintaining and operating the additional infrastructure required for the supply of potable / process water. The revenue and expenditure cash flows combine to give the total project cash flow. The sale price is set so that the net present value (NPV) of the project cash flows is zero, which means that capital is neither being created nor destroyed. At this sale price, the DWA's requirement that mines do not benefit from the sale of water will be met, while mines will not be disincentivised to participate in an AMD re-use scheme.

If participating mines are to provide the capital to build the additional infrastructure required to provide potable / process water in a scheme, this principle will need to be applied. Alternatively, if the reclaimed AMD users pay for the construction and operation of the infrastructure, no revenue will be required.

7.1.3 Sustainability of Mine Water Treatment Facilities

The mine water treatment facilities will only be sustainable if sufficient revenue is earned to fund capital replacement as well as operating and costs. This could be adversely affected by the following:

1) Volumes of water sold are lower than the basis of costing, leading to an under - recovery of costs;

2) Actual unit prices for the sale of water are lower than the "fair" price; and

3) Participating mines cannot pay for the treatment of AMD or cannot supply the required volume of water to the AMD treatment plants.

In all cases, the AMD treatment plant may not be able to meet its obligations and will be unsustainable. Of particular concern is the situation after mine closure – will the mines' closure funds be sufficient to fund the treatment of mine water in perpetuity?

7.2 Financing and Pricing Opportunities

Pricing

The "fair" price (paid for reclaimed AMD) does not necessarily bear any relation to the price paid for water supplied by the municipality in the area. Typically, the "fair" price for reclaimed AMD is higher than the current price being paid by consumers, and it is difficult for a scheme to negotiate a fair price with the local municipality.

However, the marginal cost of developing the next water resource is also higher than current water prices, which may make AMD treatment schemes more attractive.

Government funding or developmental funding at lower rates than commercial funding could assist certain parts of the community.

Participation in Schemes

Mines will be incentivised to participate in a regional AMD scheme if it would result in a lower life cycle based capital and operating costs. However, this would be weighed up against a potential lack of control compared to ownership of their own mine water treatment plant.

Terms of participation in a regional scheme should be reasonable, allowing participants some flexibility in volume and quality of water supplied and some involvement in the running of the scheme.

Recognition by DMR of participation in the scheme as a credible mine closure water treatment strategy for mines would enhance its attractiveness to prospective participants.

The institutional, contractual and financial arrangements for regional mine water treatment scheme would be more complex than for one owned by an individual mine. This additional complexity may cause delays in implementation (with associated financial impacts) or deter participation.

Also, depending on the nature of the participants, compliance with additional regulations such as the Public Finance Management Act and the Municipal Finance Management may be required.

As a general principle, polluters should pay for the treatment of AMD to a discharge standard. Users of the reclaimed AMD should pay for the additional treatment needed to bring the water to the required standard, to store and to distribute it.

Potential Markets

Potential markets for treated AMD include:

- Mines, for process and potable water;
- Municipalities, for municipal water supply;
- Industrial users for process water;
- Agriculture, for irrigation and process; and
- Eskom for power generation requirements.

Potential Sources of Financing

Possible sources of funding for a regional AMD re-use approach include:

- **The State:** The State has the environmental liabilities associated with many ownerless mines, and AMD arising from these mines must be treated. A regional mine water treatment scheme could provide the required capacity. In addition, the State could invest directly in a regional scheme in the same way that it does in other bulk water infrastructure schemes;
- **Mines:** Mining companies construct the treatment facilities as part of their operational requirements, and could fund part of a regional scheme to address their water treatment needs. Existing AMD collection and treatment infrastructure could be in kind contributions to a regional scheme. Finally, mines may participate in a regional scheme for closure purposes, using their closure funds;
- **Reclaimed AMD users:** Potential users of water supplied by the scheme may be prepared to invest if the scheme is an attractive alternative to developing other sources of water;
- **Private investors:** Private investors may be interested in funding the scheme if acceptable returns can be made. However, this may not be acceptable to the State;
- **Commercial banks:** Banks may be prepared to provide funding to the scheme, but it would be on commercial terms and subject to many risk management measures such as offtake agreements, liens over project assets and provision of surety by participants; and
- **Development funding agencies:** The scheme may meet the requirements of national growth and development funding agencies such as the World Bank, the DBSA and bilateral funding agencies.

7.3 Financing and Pricing Constraints

Cost of the available conventional and non-conventional water resources

The yields, costs and unit reference values (URVs) of the different options considered to increase system yield according to the Reconciliation Strategy for the Olifants River (DWA, 2011) is presented in Table 1. These include a spectrum of conventional water resources such as the dams to unconventional water resources such as desalination. These values can be compared to costs (presented below) associated with the use of treated AMD to augment the water availability at a catchment scale.

Table 1: Water yield and costs associated with options that will increase system yield (DWA, 2011)

Option	Yield (million m^3/a)	Capital Cost (R million)	URV (R/m^3)
Removal of Invasive Alien Plants	*15*	*120*	*0.76*
Dams:			
Rooipoort Dam	*59*	*1140*	*2.14*
Dam in Olifants Gorge: *Godwinton* *Chedle*	 *100* *100*	 *132* *200*	 *0.14* *0.20*
Dam in Lower Olifants: *Epsom* *Madrid*	 *286* *440*	 *4820* *8800*	 *1.58* *1.71*
Raising of Blyderivierspoort Dam	*110*	*2977*	*2.77*
Water transfers:			
*Transfer from ERWAT **	*38.3*	*1123*	*7.31*
*Transfer from Vaal Dam **	*160*	*3500*	*3.60*
Transfer from Crocodile (West):			

Option	Yield (million m^3/a)	Capital Cost (R million)	URV (R/m^3)
Pienaars – Flag Boshielo Dam	*30*	*1268*	*3.82*
Crocodile – Flag Boshielo Dam	*60*	*3926*	*6.43*
*Crocodile – Mogalakwena ***	*25*	*3728*	*14.51*
Transfer from Massingir Dam	*50*	*2000*	*4.85*
Desalination and transfer of Sea Water	*100*	*12 970*	*44.45*

* *Excludes cost of early augmentation of the Vaal System (LHFP2 (URV R6.14/m^3))*
** *This option could replace the currently planned ORWRDP-Phase 2B*
All cost estimates based on 2010 prices.

Costing related to AMD reuse

The cost implications of AMD treatment schemes are well established in South Africa. The capital, capital replacement and operation and maintenance costs are known. However, the cost of long term management of the residues (sludge, brines and by-products) is not well quantified. This is a short term constraint and a research and development opportunity. The South African research community has already responded by developing innovative technologies such as more cost effective evaporative crystallisers and eutectic freeze crystallisation. However, these need to be scaled up and more cost effective solutions need to be developed for long term management of residues, especially after mine closure.

The current capital investment required to establish an AMD treatment facility is in the range of R10 million – R20 million for each Mℓ/day of treatment capacity. The capital investment cost is project specific and sensitive to several factors:

- Capital cost of supporting infrastructure, such as AMD collection system, sludge/brine handling etc.;
- State of the AMD treatment plant; and
- AMD quality profile.

Long Term Liability

The long term liability associated with the changes in AMD quality and quantity is uncertain and could therefore limit long term commitment especially when several mines contribute to a single scheme. It should also be noted that coal mines result in different pollution loads.

Commercial Pricing

The pricing / commercial connection between the AMD producer and reclaimed AMD user is a constraint. At current real costs, any treated AMD for reuse may be unaffordable to local government. It can be assumed that the AMD producers will carry the cost of treatment based on the polluter pays principle. However, the reclaimed AMD delivery costs are not catered for in the AMD treatment schemes. The question is thus, who will finance the reclaimed AMD distribution system and delivery to the downstream user at an acceptable fit-for-use quality? Downstream unlawful water use from reclaimed AMD discharges to a common water resource may impact the financial viability, of a regional AMD scheme.

The unit cost of raw water from traditional conventional water resources, such as existing dams is low. The typical raw water cost abstracted from dams for municipal and other use is less than R1.00 per m^3.

AMD treatment limit cost, inclusive of operations and maintenance varies between R4.00 to R7.00 per m^3 depending:

- Scale/size of treatment plant;
- AMD quality profile; and

- Inclusion of replacement costs, etc.

The current reclaimed AMD delivery charge for domestic use by municipalities is in the range of R4.00 to R6.00 per m^3.

"Right" to Sell Reclaimed Water

A national policy or policy statement needs to be developed articulating the concept of selling reclaimed AMD. The sale and reuse of treated AMD will be severely limited if the "willing seller – willing buyer" principle does not apply. The EWWN Working Group acknowledged the risk that if this is the only principle that applies, the poor and marginalised water users could be disadvantaged. It was therefore suggested that the State should play the role of "referee" in these transactions.

Participation in a Regional Scheme

AMD treatment costs will presumably be shared based on volume and quality (load) contribution within a certain geographical area. In the case of active mines, this is fairly simple. These mines will presumably share the costs based on actual AMD volume and salinity/acidity load. Government will have a duel role to play: (1) oversight/regulation and, (2) an active participant because of the liability for AMD management from ownerless mines. Setting up such a regional scheme is therefore feasible. However, once the scheme is operational:

- How does a new participant join the scheme at a later stage?
- How do smaller mines with shorter life spans participate?
- How will the State manage its participation in the scheme? Will government appoint an implementing agent to manage the AMD from ownerless mines on its behalf?

Procurement Procedures

Any State participation will be governed by the Public Finance Management Act (PFMA) and if local government participates, the Municipal Finance Management Act (MFMA) will also be applicable. This could cause delays due to budget cycles, long lead times and approvals. Procurement in the private sector and large multinational companies tend to move a different and faster pace.

Pricing of Water for Downstream Water Users

Decisions will be required as to address the pricing of the reuse of reclaimed AMD by downstream water users. Options identified by the EWWM Working Group included the creation of a Catchment Raw Water Tariff similar to the one in the Vaal River Catchment and to allocate the water to a specific user. But, who pays for the social / community water?

8.0 KEY MESSAGES

Based on the outcome of the participatory process, the following key messages emerged.

Key Message 1: Participation in Policy and Legislative Review Processes

Water strategies review and catchment water reconciliation strategies recognise the importance of water re-use and the future reliance on unconventional water resources such as mine water.

Opportunities to participate in the reviews, redrafting of strategies and follow-on enabling legislation are open. Stakeholders must use the opportunities to propose solutions to current constraints to implement AMD re-use projects.

Key Message 2: Cooperative Governance and Public Private Partnership

The regulator capacity to implement the enabling legislation and regulations, cooperative governance between central Government department and between central, provincial and local government remain constraints.

Substantial capacity has been established in mining companies to implement AMD treatment and re-use projects. Public private partnerships may help alleviate some of the capacity challenges.

The window of opportunity for a regional approach to AMD treatment and re-use in Olifants catchment was discussed in Section 4.0. The opportunity for a regional scheme provides the advantages of scale, sharing resources and eliminating completion related to water treatment. The constraints related to such a regional scheme remain the legal and financial liabilities which will need to be unpacked.

Key Message 3: Conducive Institutional Landscape

The water related institutional landscape is ready to facilitate the establishment of an appropriate AMD re-use institution / organisation. The draft NWRS-II indicated the establishment of a CMA for the Olifants Catchment as a priority. Other water related institutions / organisations in the Olifants Catchment could be leveraged in terms of capacity / experience to establish a new institution.

Key Message 4: Private Sector Participation

The successful use of treated mine water to close the water gap in any catchment will require an enabling environment in which trade-offs will be required. A trusted partnership between the public and private sector has already emerged in the SWPN - EWWM Working Group and is strengthened during each interaction and different partners start to understand the private sector potential contribution. It already provides a forum for honest discussion and participation between the major stakeholders, a very important part of establishing an enabling environment.

The mining industry has substantial capacity and has investigated several institutional models for AMD reclamation and re-use on the Mpumalanga Coalfields. The mining industry participates in several existing water user associations in the Olifants Catchment. A collaborative effort between public sector (provincial and local government), mining sector and other water use sectors will be required to develop, administer and manage an AMD re-use organisation / institution.

The private sector, especially large and multinational companies have certain requirements in order to participate. It requires:

- Stable regulatory environment (including mandate definition among Government Departments);
- Long term planning;
- Clarity on partners;
- Non-conflict between different Departments' integration i.e. post closure targets;
- Government long term commitment needs to be clearly articulated;
- Company structures can be complex:
  - Capital investment will need to be done in a tax efficient manner;
  - Foreign corrupt practices legislation needs to be considered;
  - Competition issues to be dealt with;
  - Transparency / disclosure issues to be dealt with; and
  - Management of closure funds (cash and sureties).

Key Message 5: Marginal cost

The past practices of water pricing on a local level may not serve the future development of a new water resource on a catchment level.

In most catchments, the easily available, “affordable” water has been exhausted. The cost of water from any new resource development project will be significantly higher than users have been accustomed to pay. The marginal cost of any new projects will be higher. The concept of the marginal cost of further water resource development and water supply must be introduced. Water users will need to be sensitised to this fact through transparent, factual communication.

Key Message 6: Catchment based approach

A catchment approach to the pricing of a new and unconventional water resource in the Olifants River is needed. Some pricing linkage between the producers / generators of reclaimed AMD and the local water users (municipalities) and further downstream water users (Middle Olifants) must be established.

Key Message 7: Future institutional arrangements drive funding

Several different funding models and sources of funding may be considered. It is necessary to first consider / establish an AMD-related institution / organisation, before selecting the appropriate funding models / mechanisms.

Key Message 8: Sustainable Long Term Planning at Catchment Level

The EWWM Working Group emphasised that a water resource development related intervention in a particular catchment cannot be considered in isolation. The number of transfer schemes between catchments compounded by the state of stress (water allocation is higher than water availability) in most catchments means that any solution will need to be tested against a number of **broader** (across different catchments) solutions.

There is therefore a need to develop long term national and catchment wide Water Reconciliation Plan which extend beyond the life of the Coalfields (± 2045). This plan, could for the interim only address the long term view on AMD generation, treatment and use. The long term plan (> 100 years vision) should then be reviewed through the normal long term planning cycles (20 years horizon) to adjust and refine the long term vision (Figure 4). This will provide an opportunity to reconsider the best use of the available water for the Environment, agriculture, mining, industrial as well as the urban and rural domestic sectors. At the same time, a 20 year period is also a “stable” window for financial investors to invest in required infrastructure to implement the plans.

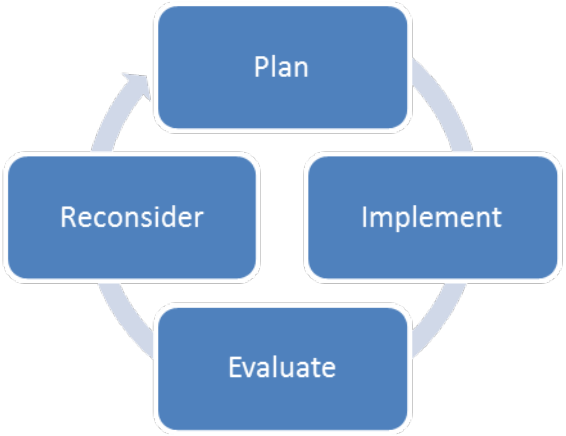

Figure 4: Long term planning cycle

Key Message 9: Communication and Management of Public Perceptions

It is of the upmost importance that all role players and the broader public be kept informed and be given the opportunity to participate in the role out of a regional / catchment scheme in which reclaimed AMD is used to alleviate the catchment water deficit. The following perceptions will need to be carefully managed:

Table 2: Perceptions to be managed

Perception	Reality
South Africa has sufficient water	■ Behaviour reflects the perception that water will always be available.
Water is cheap	■ The current cost of water does not reflect the true costs of major investments done in the past. The marginal cost of any new water resource augmentation scheme will be high.
The use of AMD for drinking purposes has a negative effect on human health	■ Technology exists to remove any of the constituents of concern found in AMD and renders it safe for human consumption.
South Africa does not have the ability to sustainably treat AMD to potable standards	■ South Africa has a poor track record for the treatment of municipal waste water informed by various media reports and the Green Drop report. The general public does not distinguish between water treatment managed by local government and other parties.
AMD treatment plants will not be operated and maintained sufficiently	■ None of the existing AMD treatment plants has experienced challenges to meet target treated water quality, which is due to a combination of the treatment technology, multiple barriers and highly skilled operators.
Mining sector are trying to shift their liability to the State	■ Any such scheme will require Government involvement. Government will need to create a framework to manage implementation and pricing.
South Africa does not do any direct or indirect recycling and reuse	■ Indirect recycling is extensively practised in South Africa. Return water flow is abstracted downstream for treatment for potable water use.

9.0 DISCUSSION AND RECOMMENDED WAY FORWARD

9.1 Recommended way forward

The outcome of this phase was directed by the scope published which requested the identification of issues, opportunities and constraints associated with the use of treated AMD to close the water gap in the Olifants River Catchment. This report provides a discussion on each of these as well as key messages developed from the input from the EWWM Working Group which feeds into Phase 2. According to the original request for proposal for Phase 1, the SWPN were tasked to support government to close the water gap by 2030, and that Phase 2 will:

"…..encompass the identification of the institutional and pricing models, an analysis of their advantages and disadvantages in respect of addressing the problems identified in Phase 1, an analysis of the changes to policy and systems required for their adoption in South Africa and a recommendation on appropriate and feasible models."

During Phase 1 of the project, it became clear that EWWM working group members were thinking beyond the scope (and timeframes) of the goal set to “close the water gap” using treated AMD by 2030”. It is therefore recommended that the EWWM working group develop the scope of Phase 2 in a facilitated session in order to agree on the principles going forward. As an introduction to this session, it is recommended that the group consider the context provided in Section 9.2.

9.2 Contextualising the next phase of the work

As the adverse effect of excess mine water make with its waste load impacts became apparent during the early 1990s, this was received with awe, followed by the response by mining that varied between denial and if it has to be addressed by mining its viability would seriously be threaten. This was followed by a period of technology development and associated customisation to address this threat, with limited take-up by mining towards full scale implementation. As water use licences included conditions on water treatment and the technology and financial challenges became more amenable to mining, full scale implementation gradually started with some flagship project leading the way. As in some cases revenue could be generated with the sale of the treated water, this indirectly subsidised mining related operational costs. In addition, with committed water treatment in place, allowed mines to commit, for instance, fewer resources towards surface rehabilitation of open pit and the reinstatement of land capability to sustain an appropriate final land use. This, coupled to legacy and poorly rehabilitated mine sites, inadvertently changed these sites in particular, but also the other mining sites not suffering from the same shortcomings, into enhanced water “harnessing” areas. This situation evolved into a water yield dimension of water resource planning, with water harnessing and associated treatment forming the core of water supply augmentation to water deficit areas surrounding key mining areas (the focus of this report).

Concurrent to the above mining driven water augmentation taking shape, increased focus on the land capability of reinstated mining areas is evolving. Sustaining food security and environmental related goods and services are central to achieve predetermined land capability requirements. This requires greater emphasis on regional land use planning in areas of “intensive” mining to ensure that “zero net loss” in terms of the desired performance related attributes is achieved. This approach invariably requires greater attention to surface rehabilitation of mining related disturbed areas that reduces the water harnessing potential of these areas.

As the above two approaches could be in conflict with each other, if not managed appropriately, it is recommended that these be addressed in a regional context. It could be argued that mining related enhance water harnessing areas could be regarded as a dedicated and legitimate land use and be addressed as such in the regional land use planning. Similarly, improving the land capability of mined areas to sustain food supply and/or to contribute to environmental related performance, also demands consideration in the land use planning.

10.0 CONCLUSIONS

This report provides a synthesis of the current thinking related to the use of treated AMD to close the water gap at a catchment level, using the Olifants River Catchment as an example. A relatively short window of opportunity exists to harness treated AMD to address, to some extent, the water deficit in the Olifants Catchment. A regional scheme/approach was considered in which the issues, opportunities and constraints were unpacked related to (1) Policy and legislation, (2) institutional matters, and (3) financing and pricing. Key messages were developed to feed into Phase 2 of the work.

It is however, recommended that the EWWM working group develop a collective opinion on whether the focus should continue to be on using treated AMD to augment the water available in a catchment given the relatively small window of opportunity that exists in at least the catchment considered as a case study. A discussion context was provided to consider the increased focus on the land capability of reinstated mining areas is evolving as part of the mix.

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HS/AvN/mc

APPENDIX A

Background Document

June 2013
Report No. 12614874-11975-3

Golder Associates

March 2013

NEPAD BUSINESS FOUNDATION

Project: Institutional Models and Pricing for Re-Use of Treated Effluent Rev1

Background Document: Using Treated Acid Mine Drainage to Close the Water Gap in the Olifants River Catchment – Issues, Opportunities and Constraints

REPORT

Submitted to:
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Report Number. 12614874-11909-1

Distribution:

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Golder Associates

Executive Summary

The Thematic Working Group for Effluent and Waste Water Management (EWWM) of the Strategic Water Partnership Network (SWPN) developed the scope of work for the development of the Phase 1 document titled: “Using Treated Acid Mine Drainage to Close the Water Gap in the Olifants’s River Catchment – Issues, Opportunities and Constrains”. The purpose of this phase of the project is to establish the issues, opportunities and constraints inherent in the treatment and re-use of acid mine drainage (AMD) in relation to policy, institutional arrangements and pricing models to provide an enabling environment for private sector intervention in the sector. The study area is limited to the Mpumalanga Coalfield including the Upper portions of Inkomati and Upper Vaal, the Upper and Middle Olifants Catchment.

The SWPN specifically requested that the methodology be focussed on a participatory analysis of the current situation and joint definition of the problems to be addressed in AMD treatment and re-use, on both technical and institutional levels, through adaptation of institutional and pricing arrangements. In order to capitalise on the organisational and individual knowledge of all the members of the EWWM working group, a certain common level of understanding is required. This inception report is an information document aimed to create a baseline understanding. The inception report provides a description of:

- The study area (Olifants river catchment, Upper Vaal catchment and Upper portions of the Inkomati catchment) giving a high level perspective of the water balance;
- Proposed reconciliation actions showing the need for the treatment of AMD to augment the water requirements in the Upper and Middle Olifants in particular;
- An explanation of how AMD is formed and why it can be considered “new” water, not previously included as part of the available water in the catchment reconciliation studies;
- The best estimate of how much AMD is available (Overall recharge and excess mine water); and
- Existing and planned mine water treatment schemes in the Mpumalanga coalfields.

In order to move forward on identifying the issues, challenges and opportunities to use treated AMD to close the gap in the Olifants river catchment, it is recommended that the EWWM consider a regional AMD treatment programme as a possible solution. The rest of the report assumes the EWWM working group will agree to this approach and then highlights sustainable development considerations related to a regional AMD treatment scheme including the social, economic, ecological and, reputational considerations.

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FIGURES

1.0 INTRODUCTION

1.1 Project background

The Thematic Working Group for Effluent and Waste Water Management (EWWM) of the Strategic Water Partnership Network (SWPN) developed a comprehensive Phase 1 scope including the methodology and the activities in a document titled: "Using Treated Acid Mine Drainage to Close the Water Gap in the Olifants's River Catchment – Issues, Opportunities and Constraints". The secretariat of the Strategic Water Partnership Network (SWPN) at the Nepad Business Foundation (NBF) appointed Golder Associates Africa (GAA) in association with Pegasys Strategy and Development (Pegasys) for the Phase 1 of the project.

The purpose of this phase of the project is to establish the issues, opportunities and constraints inherent in the treatment and re-use of acid mine drainage (AMD)[1] in relation to water policy and, institutional arrangements and water pricing models to provide an enabling environment for private sector participation in the sector.

The study area is limited to the Mpumalanga Coalfields including the Upper portions of Nkomati and Upper Vaal, the Upper and Middle Olifants Catchment[2].

The SWPN specifically requested that the methodology be focussed on a **participatory** analysis of the current situation and **joint** definition of the problems to be addressed in AMD treatment and re-use, on both technical and institutional levels, through adaptation of institutional and pricing arrangements. Figure 1 provides an overview of the methodology that will be followed. This Inception Report provides a high level executive report summarising the:

- A description of the current situation with respect to generation and treatment of Acid Mine Drainage (AMD) including:
  - Current initiatives;
  - Quantity and quality of AMD; and
  - Treatment and re-use opportunities and the impact that such interventions could have in closing the water gap.
- An assessment of the long term sustainability issues affecting the treatment and reuse opportunities, in particular after mine closure; and
- An articulation of the relevant policy, institutional and pricing situation in respect of AMD treatment and re-use.

Experts will then compile three brief discussion documents and presentations on the current understanding of the AMD treatment and reuse in the context of:

- Institutional arrangements;
- Pricing/financial issues; and
- Policy issues.

This Inception Report together with the discussion documents will feed into focused workshops with the EWWM Working Group to achieve consensus on:

- What the issues, opportunities and challenges related to generation and treatment of AMD are; and

[1] The re-use of domestic wastewater is not addressed at this stage as the drivers such as institutional capacity and the regulatory environment are fundamentally different from the treatment and re-use of AMD

[2] The intention is to write the deliverables in a manner that they are replicable, both geographically as well as sectorially (mining, industrial and municipal)

- What the inherent constraints in the current policy, institutional and pricing arrangements for the reuse of AMD are.

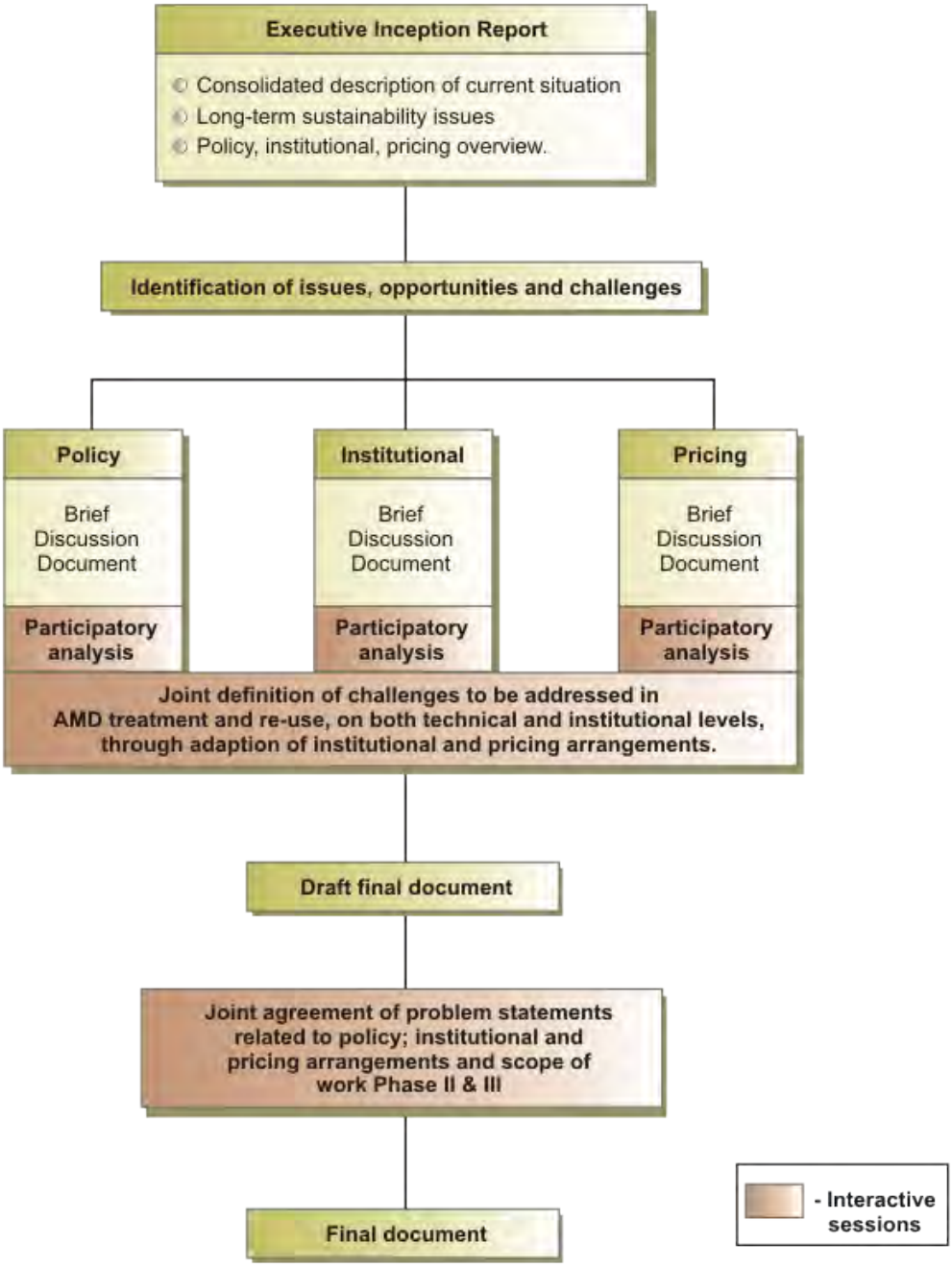

Figure 1: Methodology of Proposed Study

1.2 Business "un-usual"

The challenges related to the use of treated AMD to close the water gap are not only technical issues. Treating AMD to any "fit for use" quality is technically feasible and becoming more financially viable through rapid technological development. South Africa also has some reference installations that demonstrate the successful use of treated AMD for domestic water supply. However, using treated AMD to narrow the water

imbalance on a catchment level and as part of the catchment level planning and reconciliation, is new. It will require the mobilisation of organisations that were historically not actively involved in water treatment and supply. It becomes business “un-usual” and naturally cause discomfort amongst role players because it implies working (and in some cases accepting responsibility and accountability) on a complex issue. This will require crossing many disciplinary boundaries[3] to create a holistic approach and solutions.

1.3 Purpose of the Inception Report

It is recognised that each member of the EWWM Working Group and the organisations they represent bring a different perspective informed by their level of reality. The typical issues, opportunities and challenges vary amongst role players (Figure 2). This represents a wealth of information and most likely the ultimate solutions. However, in order to capitalise on the organisational and individual knowledge of all the role-players, a certain common level of understanding is required. This Inception Report is an information document aimed to create a baseline understanding (inclusive level of reality) from which we collectively work from (Adapted from concepts by Nicolescu, 2008).

Figure 2: Issues, opportunities and constraints in using treated AMD to close the water gap in the Olifants Catchment

The sections that follow provide an overview of:

- The study area (Olifants river catchment, Upper Vaal catchment and Upper Nkomati catchment) giving a high level perspective of the water balance;
- Proposed reconciliation actions showing the need for the treatment of AMD to augment the water requirements in the Upper and Middle Olifants in particular;

[3] Transdisciplinarity as defined by Nicolescu (2008)

- An explanation of how AMD is formed and why it can be considered potential water resource, not previously included as part of the available water in the catchment reconciliation studies;
- The best estimate of how much AMD is available (Mines recharge and excess mine water); and
- Existing and planned mine water treatment schemes in the Highveld Coalfields.

In order to move forward on identifying the issues, challenges and opportunities to use treated AMD in closing the gap in the Olifants River catchment, it is recommended that the EWWM should consider a regional AMD treatment and use approach as a possible way forward. The rest of the report assumes the EWWM Working Group will agree to this approach and then highlights sustainable AMD development considerations related to a regional AMD treatment and use approach including:

- Social;
- Economic;
- Ecological; and,
- Reputational considerations.

2.0 STUDY AREA

The study area is defined to include the Highveld Coalfields including the upper portions of Nkomati and Upper Vaal, the Upper and Middle Olifants Catchment (Figure 3).

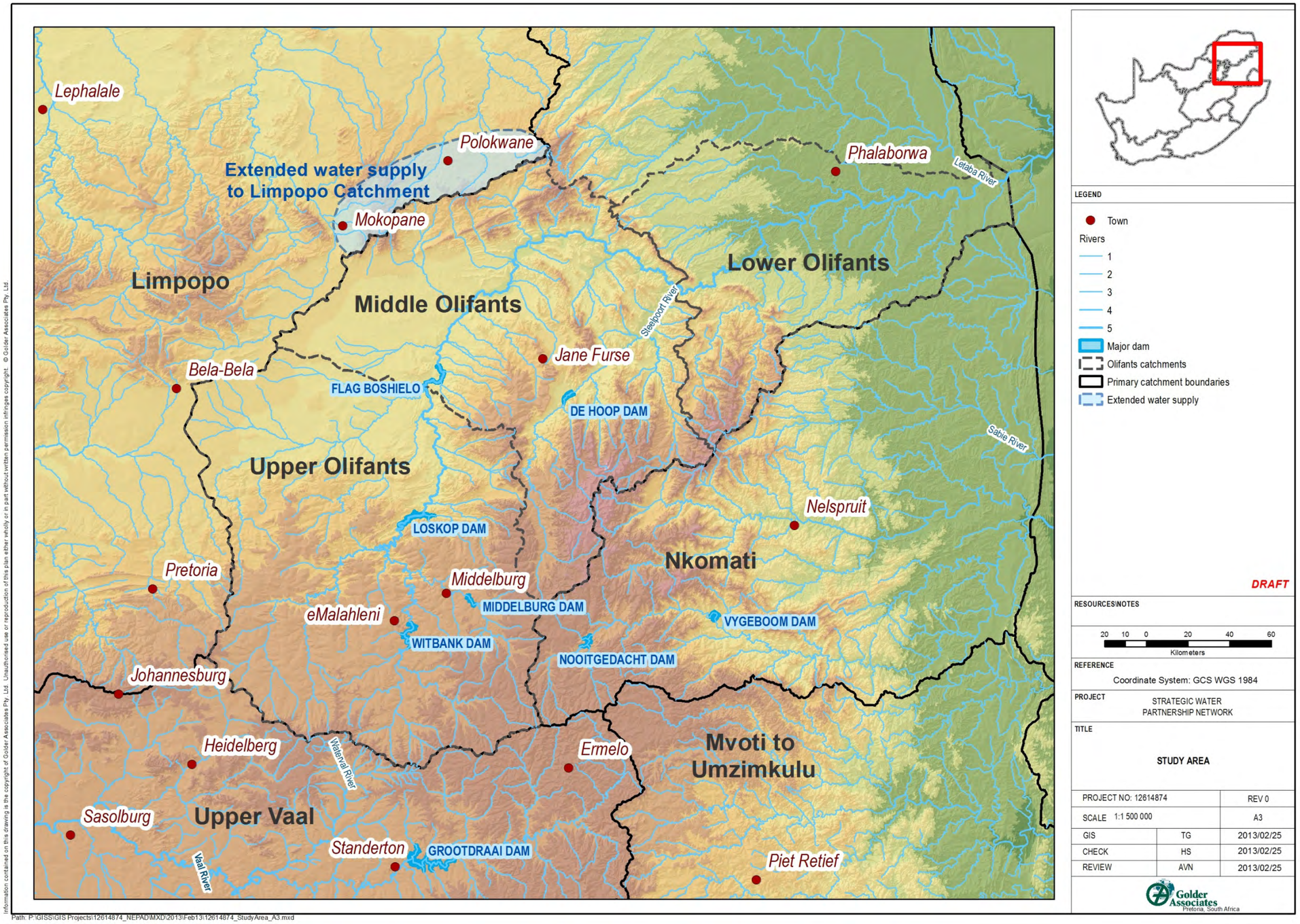

Figure 3: Study area showing the major rivers, dams and towns in the Upper portions of Inkomati and Upper Vaal, the Upper and Middle Olifants Catchment

AMD as a potential source of water is directly linked to mining operations, specifically coal mining areas. Within the study area, concentrations of coal mining operations are present within the following catchment areas:

- Upper part of the Olifants River catchment, in the Emalahleni Local Authority and the Steve Tshwete Local Authority areas. The area is generically referred to as the Highveld Coalfields;
- Upper Vaal River catchment, upstream of the Grootdraai Dam. Some old and several closed and defunct coal mining operations exist in this area; and,
- Upper reaches of the Inkomati River catchment. Coal mining operations from the Highveld Coalfields have started stepping across the watershed into the Nkomati River catchment. These relatively new operations are still relatively small compared to the bigger Highveld Coalfields operations.

2.1 Olifants River Catchment

The Olifants River and tributaries support a large number of water use sectors and economic activities.

The geographical configuration of catchment shown in Figure 4 and is split into the following:

- Upper Olifants River, down to Flag Boshielo Dam; and
- Middle Olifants River, down to and including the confluence with the Steelpoort River.

Lower Olifants River down to the Kruger National Park, crossing into Mozambique.

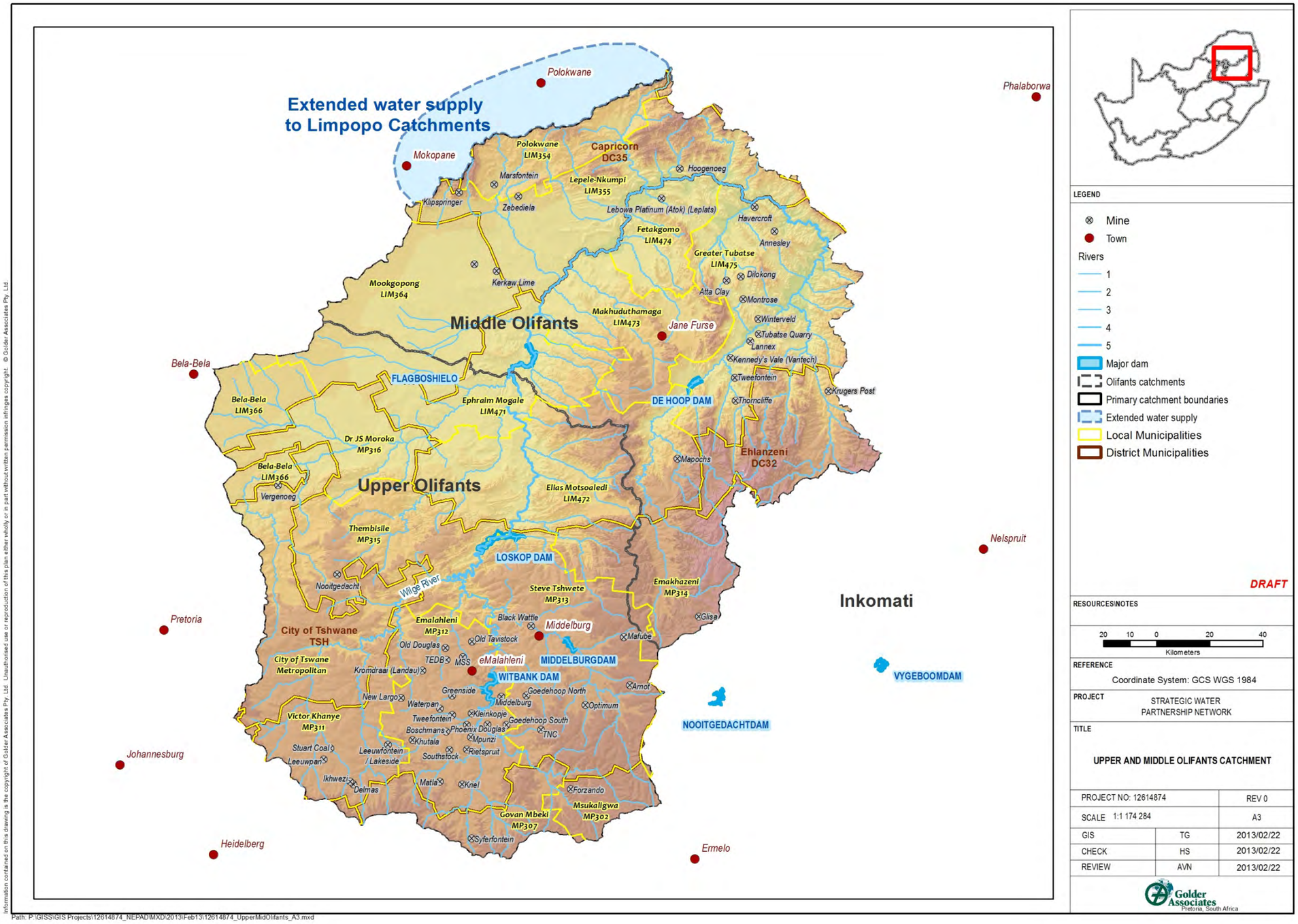

Figure 4: Geographical configuration of Upper and Middle Olifants Catchment

Major water resource development projects continue to further enhance and optimise the best use of local water resources including the following:

- De Hoop Dam on the Steelpoort River to supply urban, rural and mining water users. Linked to this dam project, several water supply projects are under development in the Eastern Limb of the Bushveld Igneous Complex, supporting communities and mining;
- Mine Water Reclamation Plants on the Highveld Coalfields to produce reclaimed water fit for downstream use; and
- Numerous municipal water supply and water treatment projects.

The current and projected future (year 2035) water use and requirements are summarized in Table 1 (all stated at a 98% assurance of supply, Lebalelo WUA, 2012).

Table 1: Current and projected future water use

			Future Projections			
Water use	**Current**		**Low Growth**		**High Growth**	
Upper Olifants River:	**million m^3/a**	**Mℓ/day**	**million m^3/a**	**Mℓ/day**	**million m^3/a**	**Mℓ/day**
Irrigation	249	682	249	682	249	682
Urban	93	255	107	293	113	310
Rural	4	11	5	14	6	16
Industrial	9	25	9	25	9	25
Mining	26	71	26	71	26	71
Power Generation	228	625	228	625	228	625
Total	609	1668	624	1710	631	1729
Middle Olifants River:	**million m^3/a**	**Mℓ/day**	**million m^3/a**	**Mℓ/day**	**million m^3/a**	**Mℓ/day**
Irrigation	81	222	81	222	81	222
Urban (Mokopane & Polokwane)	56	153	77	211	100	274
Rural	22	60	29	79	39	107
Mining	28	77	72	197	91	249
Total	187	512	259	710	311	852

The anticipated growth in water use sectors mainly relate to:

- Urban and rural in Upper Olifants River;
- Urban and rural in Middle Olifants River; and
- Mining in Middle Olifants River.

A current and future water balance of the Upper Olifants River and Middle Olifants River, with the commissioning of the De Hoop Dam and the release of water to partially satisfy the Environmental Water Requirements confirm that these parts of the catchment may continue to have a negative water balance (Table 2, Lebalelo WUA, 2012).

Table 2: Current and Future Water Balance of Upper and Middle Olifants River

	Upper Olifants River				Middle Olifants River			
	2010		2035 (high growth)		2010		2035 (high growth)	
	million m^3/a	Mℓ/day	million m^3/a	Mℓ/day	million m^3/a	Mℓ/day	million m^3/a	Mℓ/day
Water Requirements	609	1668	631	1729	187	512	311	852
Available Water Resources	630	1726	641	1756	185	507	284	778
Environmental Water Requirements	40	110	40	110	57	156	57	156
Surplus/(Deficit)	(19)	(52)	(30)	(82)	(59)	(162)	(84)	(230)

Without some water resources intervention schemes, a water deficit will continue to exist in parts of the Upper and Middle Olifants River catchment. DWA completed a Water Reconciliation Strategy to map a way forward in terms of reliable water supply to all user groups from a finite water resource in 2011 (DWA, 2011). The Reconciliation Strategy shows that the system is projected to run into a deficit by 2017 and interventions already need to be implemented to be effective by that time.

The Reconciliation Strategy proposes to implement a number of actions and projects in the following two categories:

Reconciliation actions related to reducing the water requirements:

- Water conservation/water demand management (WC/WDM) in the irrigation, urban and mining sectors; and
- Elimination of unlawful water use, specifically related to recent expansion of irrigation areas in mainly the Upper Olifants River.

These reconciliation actions mainly rely on capacity within the Department of Water Affairs and Local Authorities for implementation. For example, the elimination of unlawful irrigation use is dependent on the validation and verification process to be implemented by the Department of Water Affairs. Making water available to the catchment from WC/WDM in the irrigation sector may require water trading of present water entitlements. The Department of Water Affairs must still complete a policy and guideline document on this type of reconciliation action.

Reconciliation actions related to increasing the water resources yield:

- Removal of invasive alien plants, which will require a sustained effort over many years due to the need to control re-growth;
- Development of further groundwater resources with the highest potential along the Eastern Escarpment, which is relative far down the catchment;
- Reclamation and beneficial use of mine water decanting and pumped from the Mpumalanga Highveld Coalfields, (the Strategy assumed 60Mℓ/day could be available);
- Treated wastewater re-use in the Mokopane and Polokwane area to supply the growing local platinum mining industry. This reconciliation action can be implemented as the urban water use and associated return flows increase; and

- Reliance on local catchment run-off rather than specific releases from surface dams to provide the Environmental Water Requirements associated with small floods.

One of the key water reconciliation strategies is the development and utilisation of the water from mining operations on the Highveld Coalfields. The Reconciliation Strategy assumed that the mine water can contribute an additional water resource as reflected on Figure 5.

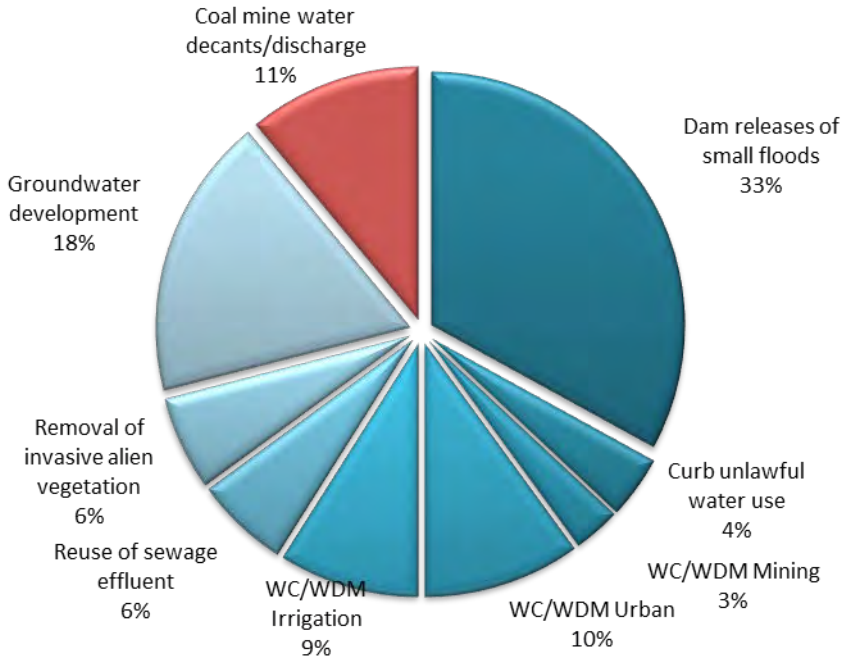

Figure 5: Water Reconciliation Strategy Actions (Contribution to Total Water Requirements)

The successful implementation of all the proposed Reconciliation Strategy actions could result in an excess of available water in the Upper Olifants River. This water will, however be required to support the Middle Olifants River.

The Middle Olifants River is faced with significant future water deficits and the Reconciliation Strategy will require all actions to be implemented. Commissioning of the De Hoop Dam will relieve the water deficit conditions in the Steelpoort area, while the main stem of the Middle Olifants River will remain dependant on especially:

- Excess water from the Upper Olifants River;
- Reclamation and re-use of Mokopane and Polokwane sewage effluents; and
- Groundwater development (this may be too far downstream of the main water stressed areas to be an economical option).

It is clear that reconciliation of water requirements and water available along the main stem of the Middle Olifants will in future rely on excess water from the Upper Olifants River. The Department of Water Affairs Reconciliation Strategy indicates that over time 20 – 40 million m^3/year (55 – 110 Mℓ /day) is required to augment the Middle Olifants River.

The potential for the use of treated AMD to close this water gap in the Olifants catchment is the main focus of the project.

2.2 Upper Vaal and Upper Portions of Inkomati

Although a wealth of information exists on the Vaal and Inkomati Catchments, specific studies dedicated to the collection and treatment of AMD to close the water gap has not been published. It is recommended that the EWWM Working Group members be requested to supply unpublished relevant (non-proprietary) work, to enhance the data base and understanding in these areas.

2.2.1 Upper Vaal Catchment

The Reconciliation Strategy of the Vaal River System (DWAF, 2009) includes the following reconciliation assessments:

- Develop water requirement and return flow scenarios;
- Determine the potential for WC/WDM by concentrating on the main urban areas;
- Estimate the irrigation water requirements and compile possible future water use scenarios;
- Identify and assess potential large scale water re-use options;
- Provide an initial indication of how the implementation of the Ecological Reserve Requirements could influence the projected water balance situation; and
- Analysis of water quality management options relating to blending, dilution and water re-use.

The treatment and reclamation of AMD from the Witwatersrand gold mining basins constitute a key component of the Vaal Reconciliation Strategy in several respects:

- Removal of the salt load contribution associated with the treated AMD decants from the Vaal River will reduce the need for additional water releases to achieve the salinity related water quality objectives, specifically in the middle Vaal River;
- A drop in the need for additional water to effectively dilute the AMD associated salinity load has the potential to postpone the need for the next major water augmentation project, which will probably involve inter basin transfer of water to the Vaal; and
- Treated AMD would constitute an additional source of high-quality reclaimed water in the Gauteng heartland, which is the single biggest water user node in the Vaal River system.

It is also clear that the reclaimed AMD from the Witwatersrand mining basins would form an integral part of the Vaal River water resource and it is unlikely that this water would be available to close the gap in water availability in the adjacent Olifants River catchment.

The Grootdraai Dam (Figure 6) in the Upper Vaal is of strategic importance as it supports the water needs of SASOL Secunda, ESKOM's, Tutuka Power Station as well as the Matla Power Station and Kriel Power Station located on the Highveld Coalfields. According to the Reconciliation Strategy (DWAF, 2009), the salinity in the Grootdraai Dam is currently acceptable and meets the water user requirements. However, the water quality in Grootdraai Dam is under threat from mining in particular decants from closed and defunct mines in the catchment.

Water is already transferred from the upper Vaal (Grootdraai Dam) to users in the upper Olifants River catchment specifically to the petrochemical and power generation sectors. Assistance to satisfy the water needs In the Olifants River catchment therefore already takes place. The biggest threat to this water transfer is the risk of deterioration in water quality. It is unlikely that the relatively small mines in the upper Vaal, many of which are closed and defunct could supply significant water volumes to the Olifants River catchment.

The water requirements for the Upper Vaal catchment will need to be extracted from the available published data and compared to the predicted generation and treatment of AMD to assess the potential use of treated mine-water to close the water gap in the Upper Vaal catchment. The AMD data has been requested from the Department of Water Affairs and will be incorporated.

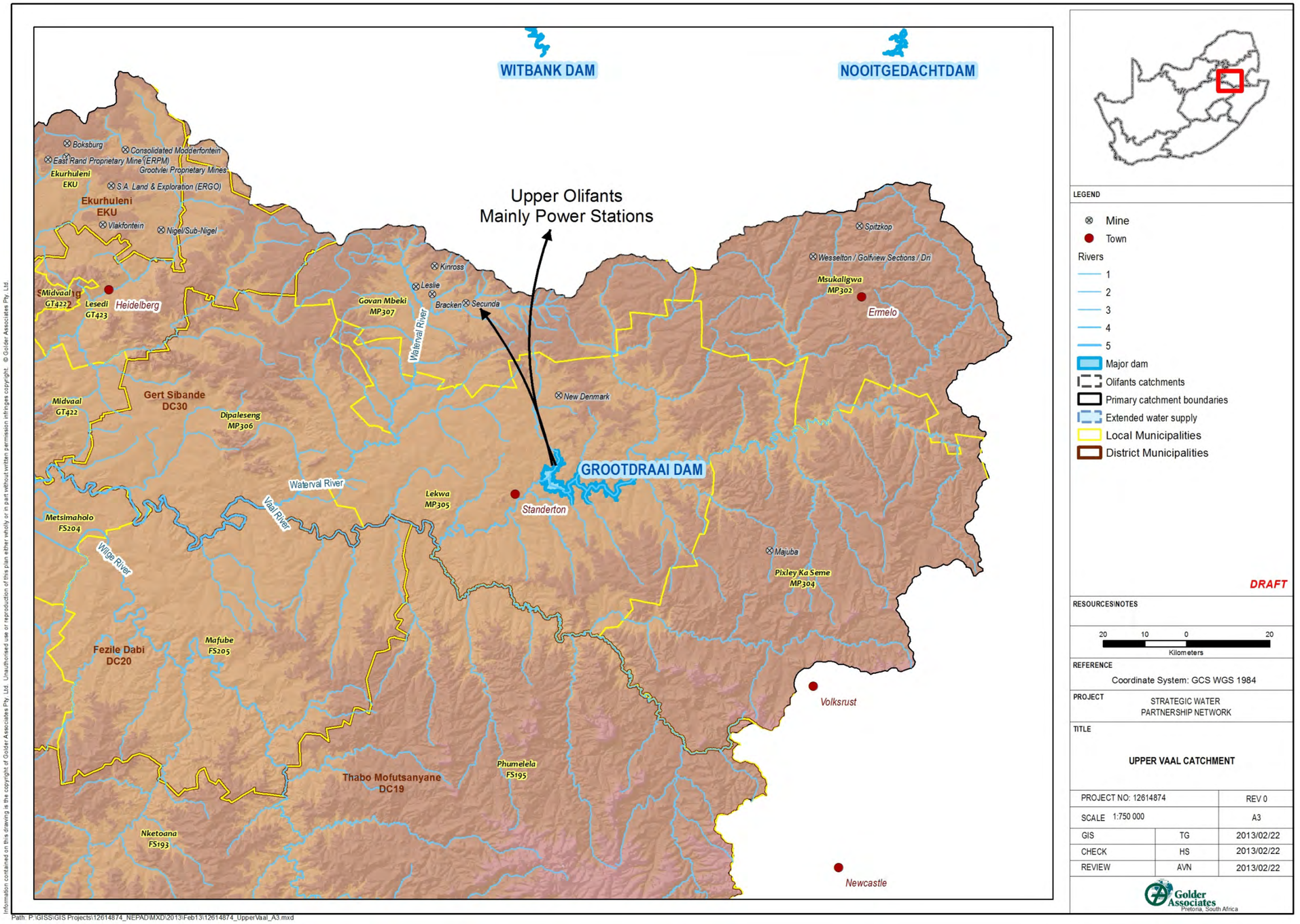

Figure 6: Geographical configuration of Upper Vaal Catchment

2.2.2 Upper portions of Nkomati Catchment

According to the Inkomati Catchment Management Strategy (ICMS, not dated), the latest Inkomati Water Availability Assessment Study confirms that the Inkomati Catchment is also in a state of stress (water allocation is higher than availability), especially once the Ecological Reserve is implemented. The significant dams are the Vygeboom Dam and the Nooitgedacht Dams in the Upper Komati (Figure 7) that supply water for strategic use by Eskom power stations located on the Highveld Coalfields, via an inter-basin transfer scheme.

Mining is limited in the Inkomati Catchment, located in the Crocodile East and the Komati west area. It is mainly dominated by Manganese, Nickel, Coal, and Gold production with several quarries around the catchment. According ICMS (not dated), the coal mining activities pose a significant threat to the water resources in the upper Komati catchment. Underground mining operations in general decant to both surface and underground water sources. Seepage water which fills the mines, which is then pumped from the mines to the surface and discharged to the existing surface water systems.

The ICMS (not dated) indicates that although the water quality is currently good, there is a significant threat from proposed coal mining activities in the region. This could be compounded by the changes in the river flows due to the transfers from the Vygeboom and Nooitgedacht Dams for Eskom.

Table 3 provides a high level water balance for the upper portion of the Nkomati (Komati – West of Swaziland) according to the Internal Strategic Perspective for the Nkomati catchment (DWAF, 2004).

Table 3: Reconciliation of water requirements and available water for the year 2003 for the Nkomati (West of Swaziland) sub-catchment

Description		Volume (million m^3/a)	Volume (Mℓ /day)
Available water	Local yield	118	323
	Transfer in	0	0
	Total	118	323
Water requirements	Local requirements	50	137
	Transfers out	109	299
	Total	159	436
Balance		(41)	(113)

This sub-catchment water reconciliation confirms that this part of the Nkomati River Catchment already has a deficit, mainly due to the substantial transfer of water from the catchment. Potential additional sources of water, such as treated AMD should therefore preferentially be used to satisfy local water requirements.

Existing interbasin transfer from the Nkomati River Catchment back to the Olifants River catchment augments the water supply to specifically the power generation sector users on the Highveld Coalfields. While coal mining activities are now established at the headwaters of the Nkomati River catchment, it is unlikely that treated AMD would constitute a significant additional water resource. The biggest threat to this water resource remains the potential impact on the water quality and the fragile eco systems associated with potential AMD decants to the natural water systems.

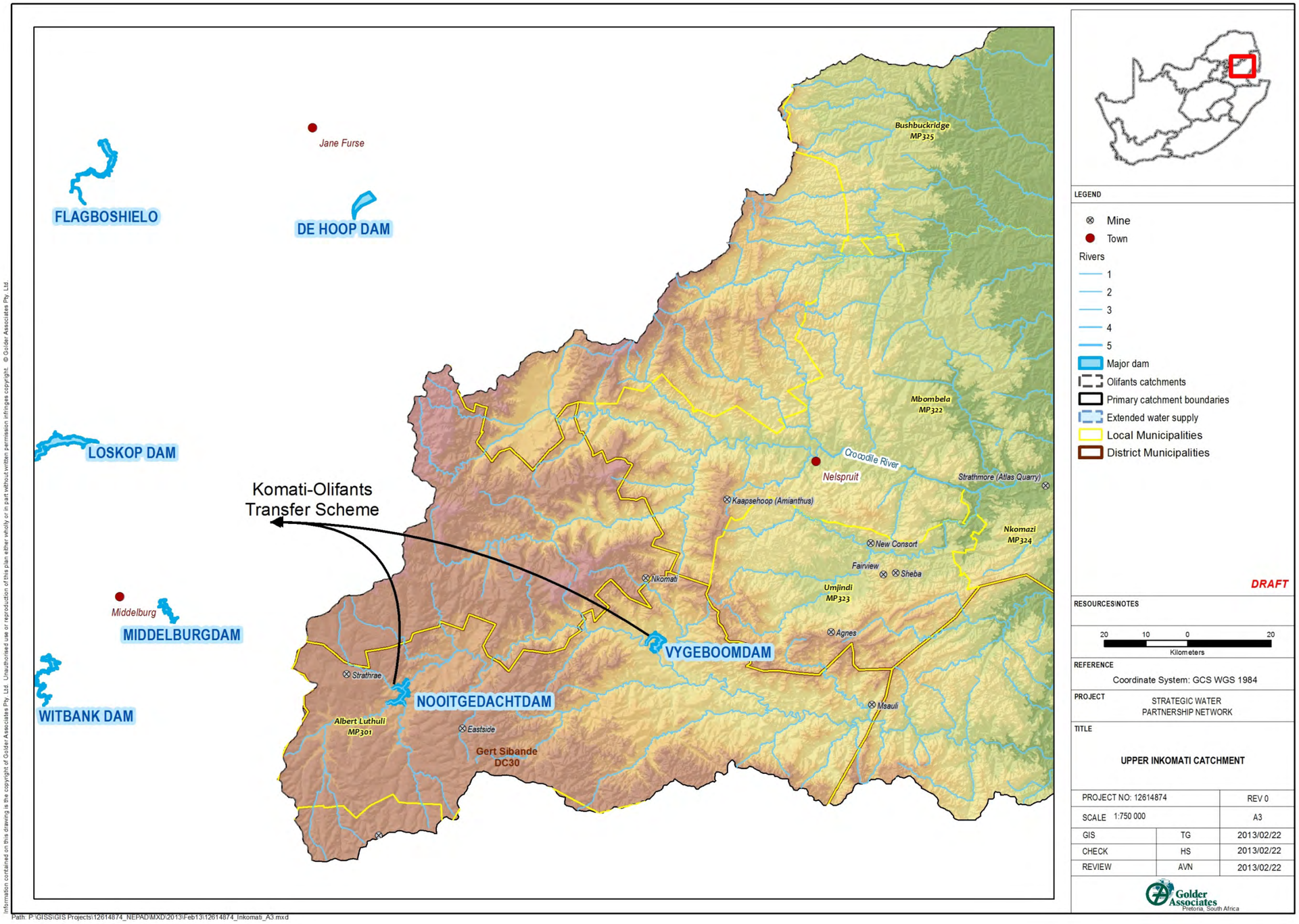

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Figure 7: Geographical configuration of Upper portions of Inkomati

3.0 GENERATION AND TREATMENT OF ACID MINE DRAINAGE

3.1 Generic description of AMD Generation

Mine water as a water resource is a relatively new concept to traditional water resource managers. The phenomenon of mining generating additional water over and above the natural catchment yield is still being investigated and quantified. Substantial work in this regard has been done for selected areas of the Olifants River catchment. In order to get a common understanding amongst all the members of the EWWM Working Group, this brief section was included to outline the generic interaction between mining and the catchment water environment.

In the coal mining process, the natural groundwater and surface water are impacted and intercepted, leading to the situation where water accumulates in mines and must be pumped out in order to allow safe and economical mining to continue.

The economic viability of coal mining in the Highveld Coalfield has progressively improved due to the local and international demand for coal which has resulted in mining of previously marginal coal reserves. Areas previously mined by the conventional bord-and-pillar method as depicted in Figure 8 have now become economically viable to extract the remaining coal resources by opencast methods. Before these reserves can be exploited, the water accumulated in the old mines workings as shown in Figure 8 must be removed ahead of mining.

The ultimate re-use and storage of excess mine water will be dependent on the details of the specific coal seam mining and the local water environment. At mine start-up and subsequent to start-up (years 6-10), water must be pumped out and stored in order to access the coal reserves. During this period, it is likely that the water recharge will be similar to the water pumped out and the volume stored will not change. Excess mine water will therefore be available (Figure 8 a and b).

As new mining blocks are opened, the old mined-out areas can act as storage facilities, so that mine water can be pumped from the new workings and stored in the voids of the old workings. At this time there will be no or limited excess mine water as the volume of water stored in the old workings progressively increases (Figure 8 c).

In the final years and beyond closure of the mine, the storage space will be filled up and the mine water will need to be pumped elsewhere to avoid uncontrolled water decanting (Figure 8 d). It is therefore important to take cognisance of the dynamic situation with respect to mine water pumped or stored over the life of a mine, when evaluating the available mine water as a resource.

Conceptual models for excess and stored mine water have been prepared for most mining operations (compiling a water balance is typically a condition of a Water Use License) to highlight the following aspects of mine water systems:

- Mine water ‘make’ is proportional to the mined or disturbed area;
- The water stored on a mining operation depends on the mine age, coal deposit location and mining method;
- Excess mine water may be variable over time, and sensitive to the ability of the mine to store water in old workings; and
- Mine water availability is determined by the recharge to mines and should not be confused with the excess water decanting from the mine site.

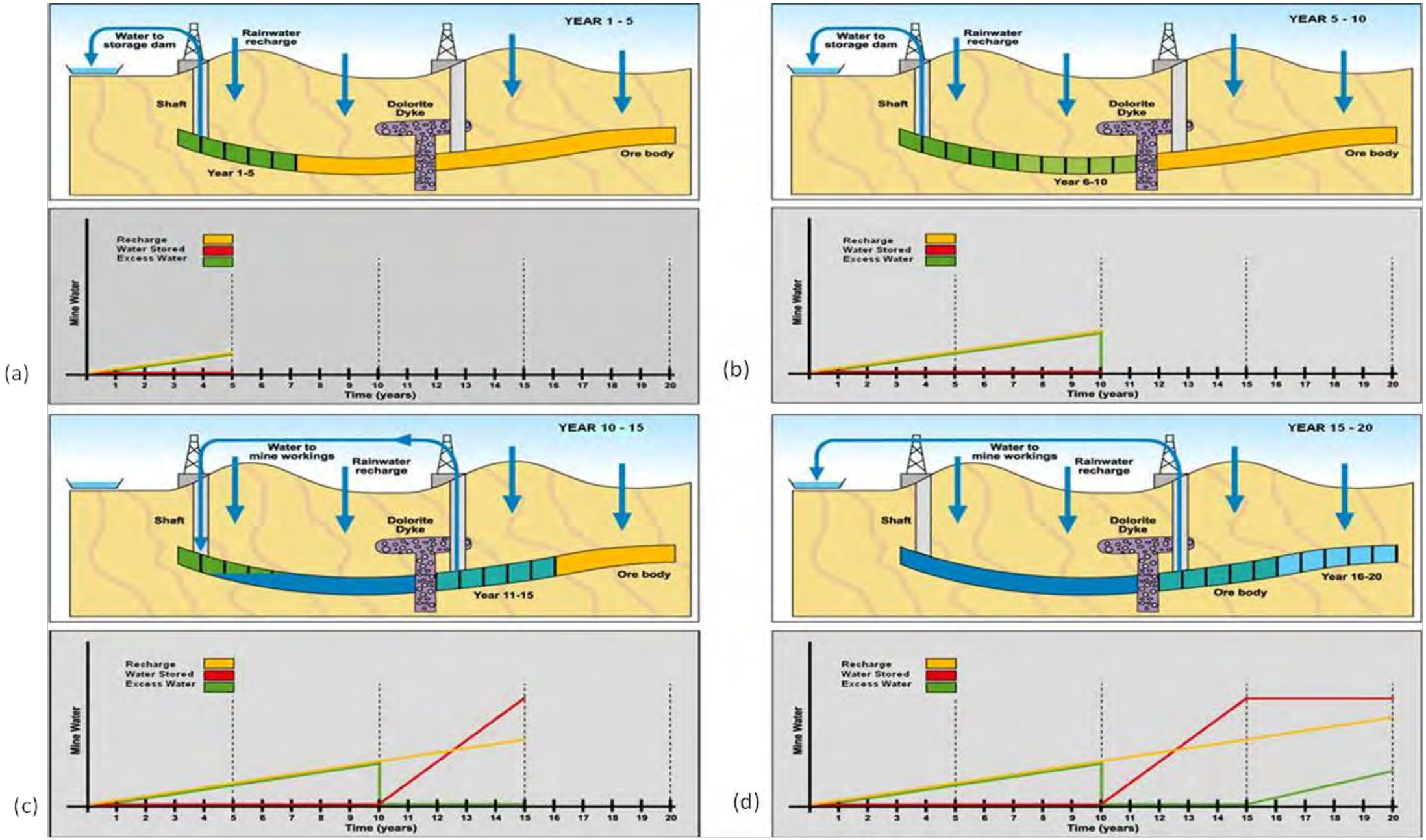

Figure 8: (a-d): Basic principles of mining: impact on excess water production

3.2 Olifants Catchment

3.2.1 Mine water recharge in the upper Olifants

Previous studies were undertaken to evaluate mine water volumes and quantities on all the major mining operations located on the Highveld Coalfields. A recent study, communicated by the Joint Investigation Agreement (JIA) established by the major mining companies and ESKOM consolidated the available information for the entire Highveld Coalfields. A Coalfields wide water situation was quantified by evaluating the water balance information at the level of individual mines. This was then aggregated to the level of sub catchment and for the entire upper Olifants catchment. The key outputs of the study were quantification of the following:

- Mine water recharge which quantifies the total volume of water which enters mining operations via direct run-off, infiltration through rehabilitation covers of opencast mining, ingress via overburden to underground mining, natural groundwater flow towards mining operations and other water ingress mechanisms. The recharge volume therefore reflects the total water volume captured directly or indirectly by mining operations;
- Water arising in mine workings is typically used for mining and coal processing operations, rehabilitation or is stored in old non-operational workings;
- Water accumulated in mine workings which cannot be used or cannot be stored therefore becomes available for external use and is referred to as excess mine water; and
- Different ways of calculating excess mine water can be applied ranging from maximum utilisation of available storage (which typically require substantial pumping and conveyance of water across the mining operations) and which may decrease the volume of excess water available. There is however a practical limit to the mine water storage that can feasibly take place on an operation.

The consolidated mine water situation on the Highveld Coalfields was quantified in terms of the following parameters (Figure 9):

- Mine water recharge (total water volume potentially arising in mine workings);
- Excess mine water with maximum use of all available storage in old / defunct mine workings;
- Excess water with practical use of available storage in old / defunct mine workings; and
- Water stored in underground workings.

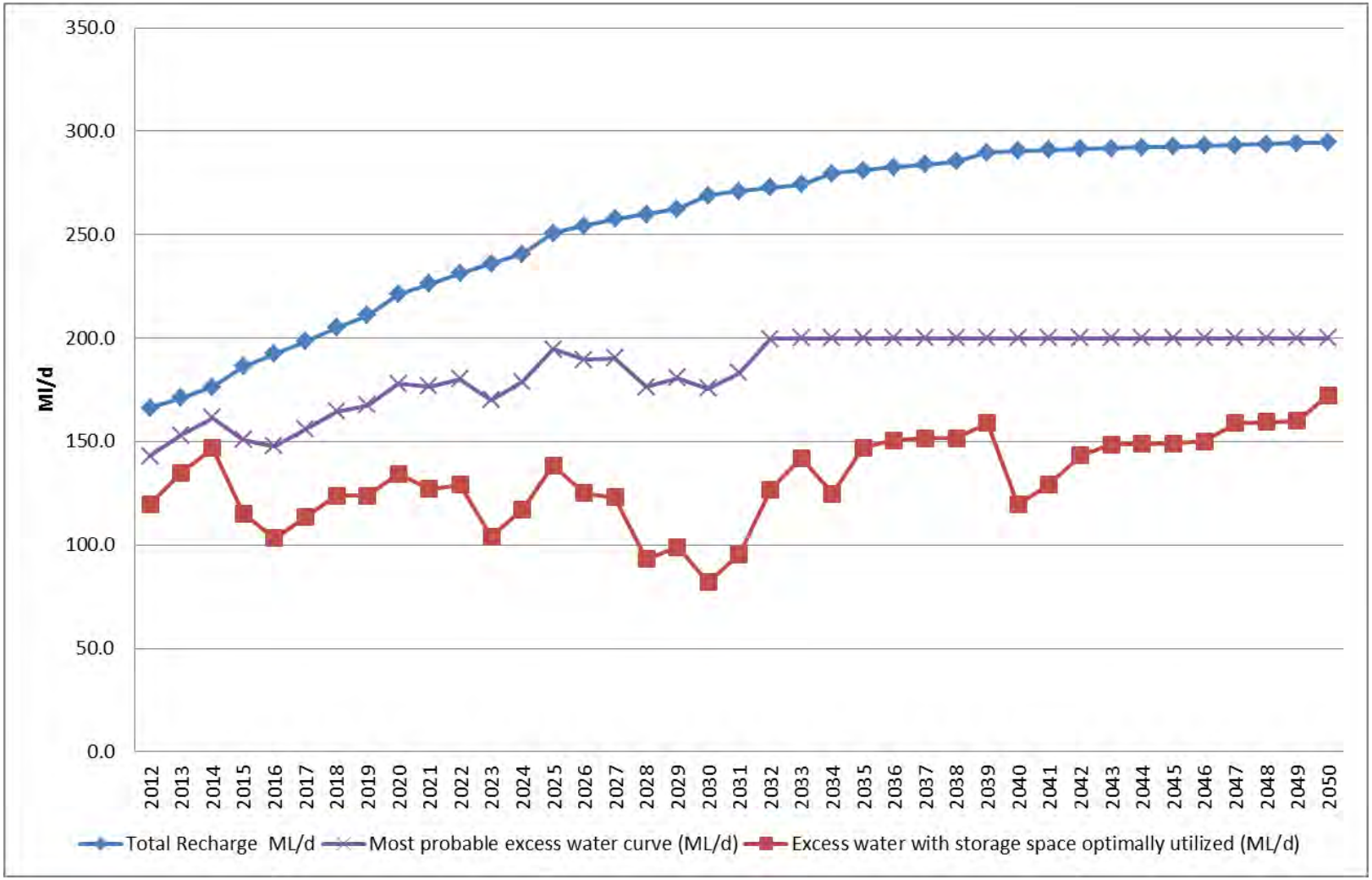

Figure 9: Overall recharge and excess mine water (ML/d) in the Upper Olifants River study area

Results of the JIA consolidated Highveld Coalfields study indicated the following with respect to water make and excess mine water:

- There is a steady rise in the mine water recharge (reflecting the total water arising in old and existing mine workings) from a current best estimate of 170 Mℓ/day (62 million m^3/a) eventually approaching 300 Mℓ/day (110 million m^3/a) towards the end of the life of the Coalfields;
- Estimated excess water volumes in the range of 100 - 150 Mℓ/day (36 - 55 million m^3/a) is available on the Coalfields assuming that maximum utilisation of all available storage in old workings will take place; and
- A more realistic estimate of the most probable excess water volume making practical use of readily available storage is in the range of 150 to 200 Mℓ/day (55 - 73 million m^3/a) over the next 20 years.

An important technical issue to address and agree on is to distinguish between the so called “old” and “new” water. The “old” water is the water that would have reported to the river as interflow and surface runoff. The “new” water is the additional water that the mining operation generates due to the higher recharge rates into the mine workings (particularly opencast workings) resulting from the disturbance of the natural perched aquifer system. The mine operation does reduce the volumes of water reporting to the river system with the reduction of runoff and the interception of groundwater. However the current understanding is that the increase in recharge due to mining exceeds the reduction in water volumes reporting to the river system. This net increase in water volume contributes to the water availability for use in meeting the water requirements. The net increase in the available water volume due to mining must be quantified using the Water Resource Planning Model before volumes of mine water can be made available to meet water requirements.

3.2.2 Existing and planned Mine Water Treatment Schemes on the Highveld Coalfields

Mining operations on the Highveld Coalfields implement water management plans which incorporate a range of water management actions:

- Minimization of impacted water by the rehabilitation of disturbed mined lands;
- Separation of clean and impacted water;
- Recycling of impacted water for a variety of process applications, specifically the processing of coal;
- Storage of impacted waters in old underground and opencast mine workings; and
- Controlled release of mine water under favourable hydrological conditions to the local streams and rivers.

An increasing number of mining operations incorporate mine water reclamation (WRP) and beneficial use of the reclaimed water. These projects are in different stages of the project pipeline and include:

- eMalalheni WRP – Module 1 operational and Module 2 under construction;
- Brugspruit WRP – operational since 1996, but only implemented lime neutralisation with discharge of saline water;
- Optimum WRP – operational since 2011;
- Xstrata WRP – in feasibility study stage;
- New Largo WRP – in feasibility study stage;
- Middelburg WRP – under construction;

- Matla WRP – in pre-feasibility study stage;
- Kriel WRP – in pre-feasibility study stage;
- Eikeboom WRP – In feasibility study stage; and
- Mafube WRP – in concept study stage.

The general location of the existing and planned water reclamation plants is shown in Figure 10.

The status and reclaimed water production capacity of each of the ten existing and planned mine water reclamation projects in the Highveld Coalfields are reflected in Table 4.

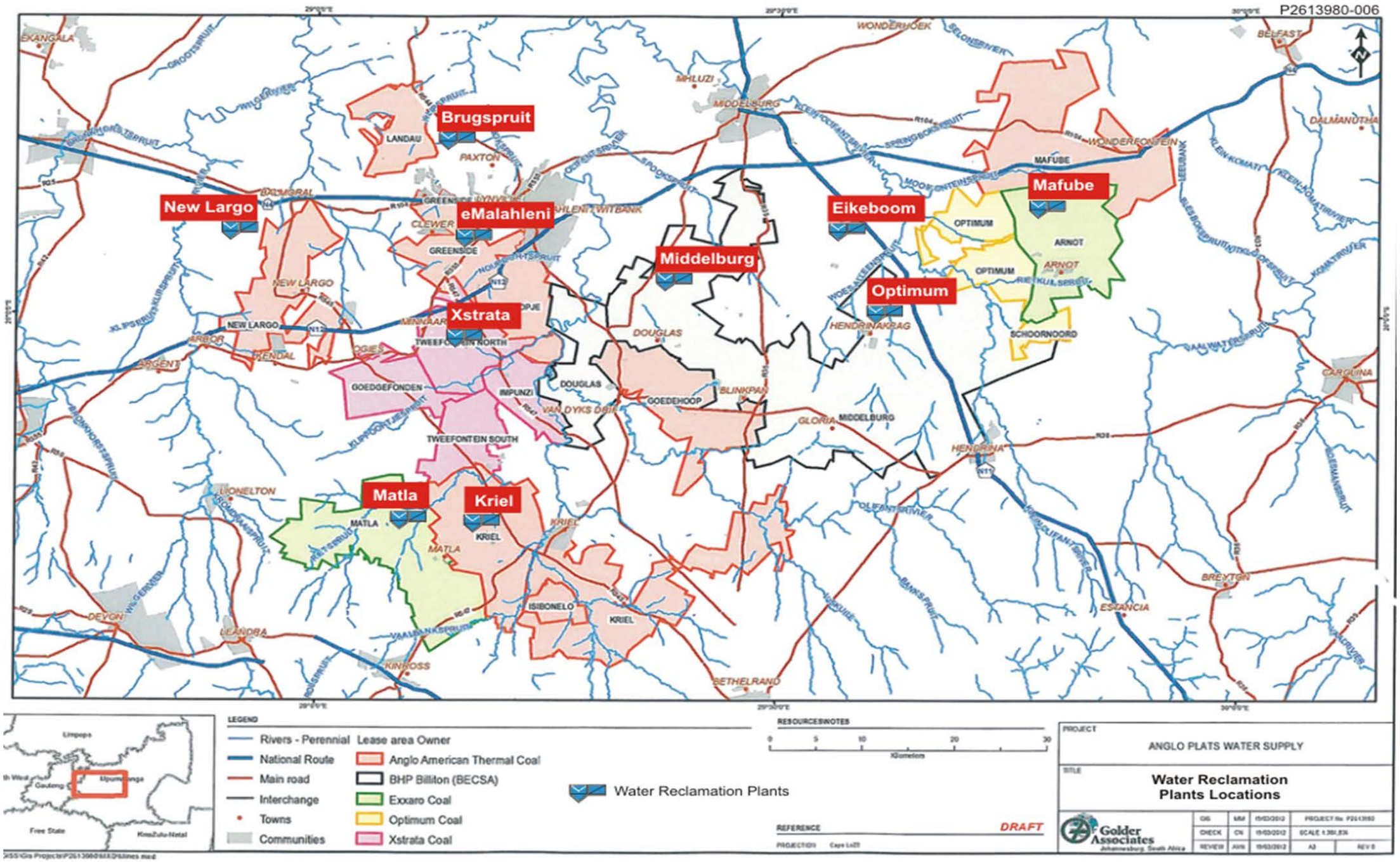

Figure 10: Location of Existing and Planned Mine Water Reclamation Plants

Table 4: Summary of Mine Water Reclamation Projects

Scheme/Project	Status and Volume (Mℓ/day)					Reclaimed Water Use Planned
	Concept Study	Pre-feasibility Study	Feasibility Study	Construction/ installation	Operational	
Emalahleni;						
■ Module 1					25	16 Mℓ/day to Witbank Town. 9 Mℓ/day discharged to Noupoortspruit.
■ Module 2				25		25 Mℓ/day discharged to Noupoortspruit.
Optimum WTP					15	3.5 Mℓ/day to Hendrina Town. 11.5 Mℓ/day discharged to Woestalleenspruit.
Middelburg WTP				15		15 Mℓ/day discharged to Spookspruit.
Xstrata MWTP			15			4 Mℓ/day for internal use. 11 Mℓ/day discharged to river.
New Largo WTP			4			4 Mℓ/day discharged to Saalboomspruit.
Matla WTP		10				10 Mℓ/day to Matla Power Station, or river.
Kriel WTP		12				12 Mℓ/day to Kriel Power Station, or river.
Optimum: Eikeboom			6			3.5 Mℓ/day for process use and discharge to Coetzerspruit.
Mafube	16					16 Mℓ/day to Arnot Power Station, or river.
Total (Mℓ/day)	**16**	**22**	**25**	**40**	**40**	
Total (million m^3/a)	**5.8**	**8.0**	**9.1**	**14.6**	**14.6**	

The best estimate of the projected mine water recharge volumes (refer to Section 3 of this report) and the production of reclaimed water is shown graphically on Figure 11**.** The following conclusions are made:

- The current installed mine water treatment capacity of 40 Mℓ/day (14.6 million m^3/a) is anticipated to be expanded to 80 Mℓ/day (29.2 million m^3/a) by 2015; and
- An estimated installed treatment capacity of 143 Mℓ/day (52.2 million m^3/a) could be operational by 2020.

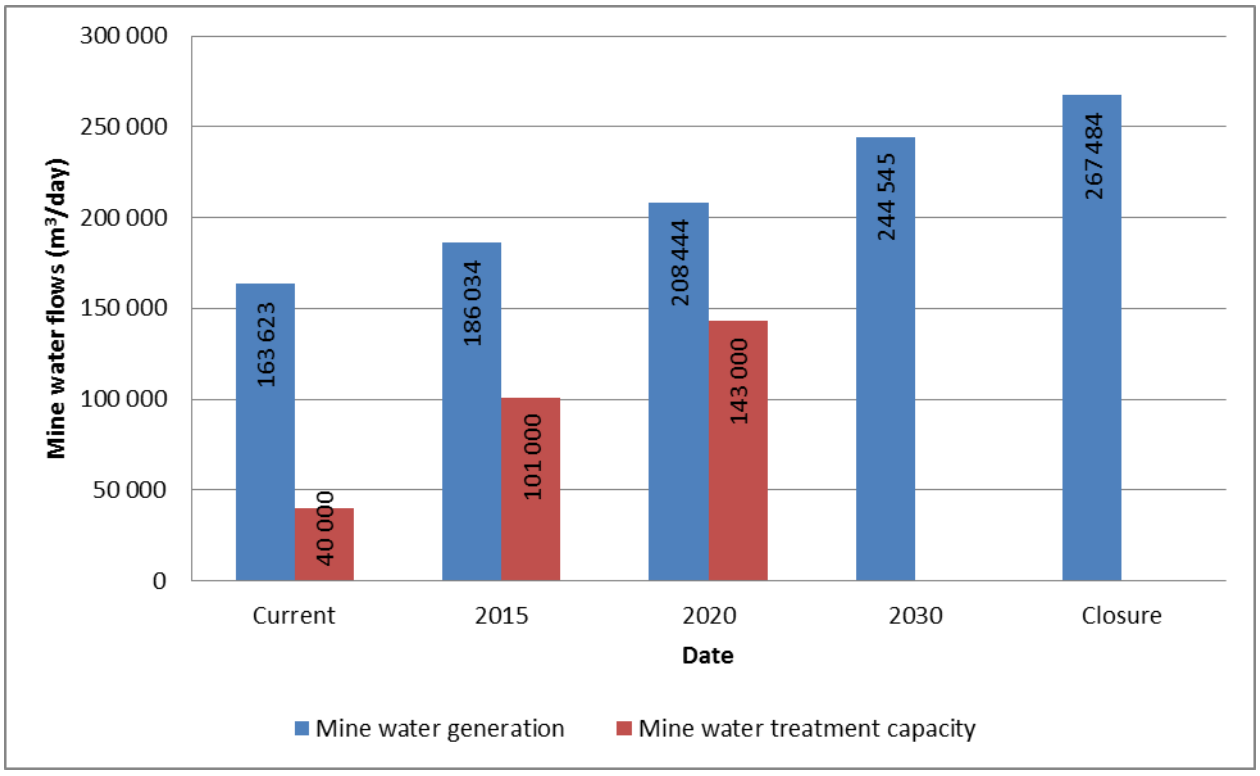

Figure 11: Estimated mine water recharge and projected installed treatment capacity

4.0 CONSIDERING A REGIONALISED APPROACH

Many of the existing and planned projects (Table 4) will discharge excess reclaimed water to the nearest convenient stream or river. This will result in discharges to relatively small streams, typically with multiple small dams constructed. The opportunity for run-of-river irrigation abstraction is also enhanced by such an arrangement. The result may be that substantial losses of discharged reclaimed water may take place before the water reaches the main stems of the Olifants River and its significant tributaries such as the Klein Olifants River and Wilge River.

A coordinated, regional approach is therefore required to close the water gap in the Olifants Catchment and specifically in the Middle Olifants. No Coalfields wide institution exists to coordinate and integrate the development of mine water reclamation projects with respect to:

- Cooperation on a regional basis;
- Optimized location and sizing of infrastructure and plants;
- Selection of treatment technology;
- Collaboration with respect to the use of waste and by-products;

- Coordination on the best use of the reclaimed water; and
- Development of consistent water tariffs.

While the base case (following current trends) will over time address the issue of mine water related pollution and developing the mine water as a water resource, the efforts may lack integration, and optimization.

The effective resolution of the AMD decants from the old defunct mines located around Witbank will also probably not take place. The rehabilitation of the decades long AMD issue can best be managed as part of a larger catchment wide scheme.

If we agree that this is an appropriate way forward, the EWWM Working Group will need to consider the sustainability factors. Section 5.0 is dedicated to the sustainable development considerations to guide the EWWM Working group in identifying the issues, challenges and constraints associated with the reclamation and reuse of AMD.

5.0 SUSTAINABLE DEVELOPMENT CONSIDERATIONS

Sustainable development relies on achieving the maximum positive impacts in each of the economic, social and ecological dimensions of a project, whilst minimizing the negative impacts to the ecology, people and economic growth (Figure 12). Good performance in one dimension does not substitute for underperformance in another.

Importantly, the positive impacts should *endure beyond project closure*, a critical aspect identified in the published scope of work. This is the challenge for project planners and operators, and the ultimate test of sustainable development. If the benefits cease upon project closure, sustainable development is not achieved. This requires the traditional focus of minimizing negative impacts to shift to the enhancement of benefits, so that there is a net positive benefit profile which endures beyond the end of a project or development (Figure 13).

Because local needs and circumstances differ for every project, and could even differ within the project zone of influence, involvement of stakeholders in project design and in the identification of opportunities provide project planners with the benefit of years of local knowledge to apply to the project development. The EWWM Working Group already plays this high level role.

A regional AMD treatment programme has the potential to contribute substantially to sustainable development, and to contribute to the development goals outlined in the National Planning Commission's 2011 *National Development Plan, Vision for 2030*.

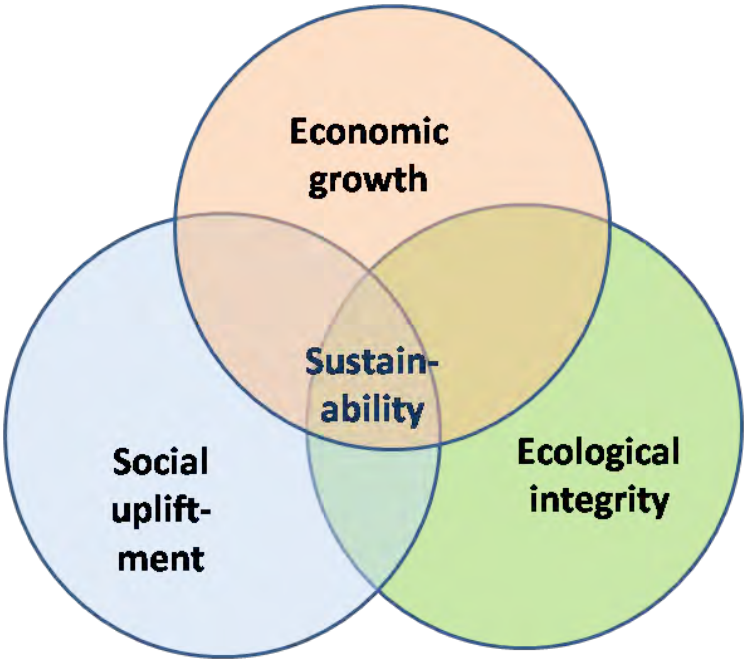

Figure 12: Sustainable development relies on achieving the maximum positive impacts in each of the economic, social and ecological dimensions of a project, whilst minimizing the negative impacts

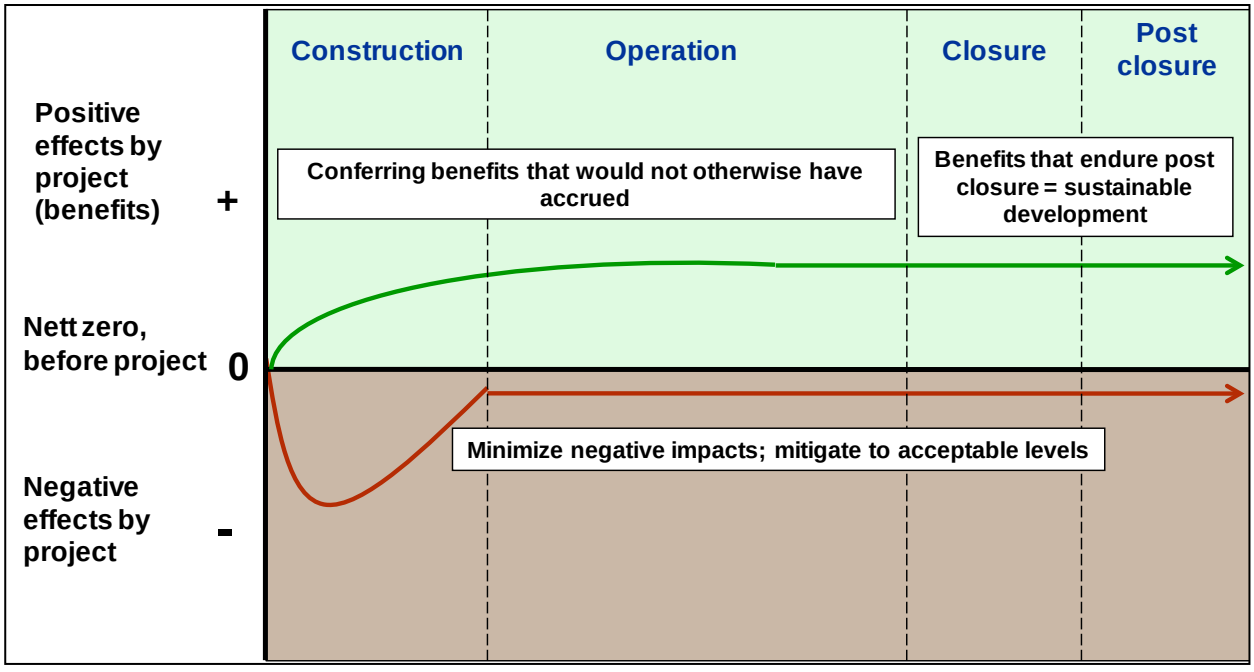

Figure 13: Sustainable development requires the traditional focus of minimizing negative impacts to shift to the enhancement of benefits during project construction and operation, so that the benefits endure post closure

5.1 Social considerations

5.1.1 Current social circumstances

Currently, social circumstances in parts of the Mpumalanga and Limpopo project areas are not conducive to development and improved livelihoods. In some areas, poverty is rife with no or little opportunities. Small communities and farm workers were displaced in the past to make way for mining, resulting in negative social impacts and contributing to informal settlements around towns where basic services such as water

supply and sanitation are lacking. Unemployment is estimated at 27% and 28% respectively, in the Mpumalanga and Limpopo project areas. Both of the project areas are in locations where available water is over allocated, meaning there are few local development opportunities based on water.

The concentration of coal reserves within Mpumalanga is Highveld, the country's recent energy crisis and the resulting increased local demand for coal (for coal-fed power stations) have led to an increase in prospecting activities as well as mining rights applications in that province. Consequently, mining and agriculture on the Highveld Coalfields are in competition for land. Ongoing concern is expressed by organised agriculture about the negative short and long term impacts of mining on agriculture and food security, principally because mine rehabilitated land does not achieve pre-mining levels of agricultural production. These concerns often manifest as negative press for the mining industry and result in irritable relations between the two sectors.

Farm owners experience many pressures which may include increased cost of water and other farming inputs, deteriorating roads mainly as a result of coal transportation, crop and stock theft, ongoing farm murders, and uncertainty as a result of their land overlying coal deposits. Both minerals and water now belong to the State and not to surface rights holders. Many farmers claim that their water allocations are insufficient to make a decent living, and some revert to unlawful water use.

5.1.2 Potential negative social impacts

Unless mitigated, a regional AMD treatment programme could have negative social impacts. In a worst case scenario, if all available water is conveyed to the Middle Olifants for use by the downstream water users, the communities, municipalities and agricultural activities on the Highveld Coalfields will be deprived of excess water that they otherwise could have used to satisfy growing basic needs or to stimulate development and social benefits.

A regional AMD treatment programme will bring focus to current unlawful water use within Upper Olifants catchment. Where unlawful water abstraction for purposes of irrigation takes place, the removal of available (excess) water from a catchment will result in a shortfall in water in the downstream catchment.

Deteriorating roads, dust, delays, nuisance, noise, accidents and even deaths as a result of coal trucks on local roads is a current and ongoing negative social impact to people on the Highveld. The potential AMD scheme will support the continuation of viable mining on the Highveld Coalfields, and thus could be said to be linked to these impacts.

5.1.3 Potential positive social impacts

A regional AMD treatment approach has considerable potential for creating sustainable development through water provision, security of water supply and long-term livelihoods improvement based on water availability and water treatment. Should the scheme include water off-takes and making water available to where it is needed to supply basic needs and for socio-economic development now and in the future, social benefits can be expected in both project areas.

A more secure water supply could bring about the following benefits in both catchments:

- Better water and sanitation service delivery;
- Improved livelihoods through community development; and
- BEE opportunities in small, micro and medium enterprises (SMME) based on water.

Benefits that relate to employment creation include:

- Temporary jobs during scheme construction in both catchments, and which, if coupled with skills development, could create further opportunities for temporary workers in the marketplace;
- Permanent jobs on water treatment plants and water management on the Highveld; these jobs would endure beyond mine life should the treatment plants remain after mine closures; and

- Related employment benefits in the mining and industrial sectors in Limpopo, both as construction and permanent jobs.

Since highly experienced and trained specialists in water reclamation and treatment will operate the treatment plants and scheme, ongoing skills transfer and capacity building of local government personnel could be another benefit. Building human capacity is key to creating enduring benefits.

5.2 Economic considerations

5.2.1 Current economic circumstances

The mining industry is dominant in both Mpumalanga Highveld and parts of Limpopo. The Highveld region of Mpumalanga is largely driven by power generation and associated coal mining, with smaller economic inputs from commercial agriculture. Limpopo is rich in mineral deposits such as platinum-group metals, coal, diamonds and iron ore, although many of these deposits still require development. In 2010, mining and quarrying contributed 19% and 23% of Gross Value Added (GVA) in Mpumalanga and Limpopo respectively – a measure of the value of goods and services produced in an area. Financial services and government are the second and third most dominant economic contributors in both provinces. Employment distribution figures for 2010 reveal a lower impact of mining in relation to job creation with 9% in Mpumalanga and 12% in Limpopo. Wholesale and retail trade is the highest employer in both provinces, representing 25% of employment opportunities. Education levels are very similar in Mpumalanga and Limpopo with about 20% of the population of working age with no schooling and 19% in Mpumalanga and 15% in Limpopo completed secondary school education.

Mpumalanga is South Africa's largest (in terms of quantity) coal producing province. It is estimated that Mpumalanga accounts for 83% of South African coal production and coal exports account for 28% of coal production. The province is the third largest coal exporter in the world and Witbank alone is the biggest coal producer in Africa. Although South Africa has 19 official coal fields, it is estimated that 70% of recoverable reserves lie in the Highveld, Waterberg and Witbank fields. Eskom operates 13 coal-fired power stations in the country, of which 11 are situated in Mpumalanga.

5.2.2 Potential negative economic impacts

As with social considerations, negative economic impacts could result from a regional AMD treatment approach programme should all available water be transferred for use by water users in the Limpopo Province, and should no surplus be left to stimulate economic development within Mpumalanga catchments. Unless there is flexibility in agreements with due consideration for the post mining environment in both project areas, there will be foreclosure of opportunities to return available water for use by commercial agriculture, municipalities and communities.

Although the treated mine water may be cheaper than importing further water from the Vaal or Komati systems, it will be more expensive than the municipalities' current costs of abstracting from dams and rivers and treating the water for potable use. The cost of the reclaimed mine water could thus negatively affect municipalities as water services authorities and providers, who may pass the costs onto their customers, unless another mechanism can be found to account for the differential in cost.

The power generation industry, on the other hand, currently obtains water from the adjacent Vaal, Usutu and Komati systems. Increased cross-basin water transfers are expected to be expensive. The power sector will thus have an eye on the treated AMD, because in the long term the costs of their current supply may increase even further. If power generation cannot get access to the treated AMD, it may negatively impact the cost of power, which will be passed onto consumers country-wide.

The latter is a macro-economic issue on a national scale that will require further study, i.e. assessing the comparative benefits and 'disbenefits' of the increase of cost of power vs the economic benefits of mining and industrial development in Limpopo Province. Different cost considerations would have to be carefully weighed up against one another to reach a realistic scenario of maximum benefits and minimum negative impacts to all sectors. Off-sets for socio-economic development would have to be investigated. The

Department of Water Affairs in consultation with other parts of government has to take a strategic decision on this matter.

5.2.3 Potential positive economic impacts

Positive economic impacts of a regional AMD treatment approach are many, and include:

- Reclaimed AMD will be cheaper than importing water from the Vaal, Usutu or Komati systems, benefiting all sectors that will have access to the treated water;
- Coal mining on the Highveld, and the economic activity that it generates, will be able to continue once able to resolve water quality issues. This will secure current jobs and ongoing generation of economic stimulus in the Mpumalanga Province. Coal mining is expected to continue until at least 2040, contributing to ongoing economic growth in Mpumalanga;
- There will be sufficient water to generate a substantial future mining sector in the Limpopo Province, creating long-term employment and economic activity. The projection is that platinum mining could extend to about 2100, which create opportunity to extend the economic benefit associated with water treatment 60 years after the decline of the Highveld coal mining industry. Equally important, this provides a long-term user for excess water coming from coal mines and will allow the post closure water quality to stabilise in many of these coal mines if the abstraction levels are appropriately managed;
- Several AMD treatment plants on the Highveld Coalfields will create an additional economic sector. Water treatment plants need chemicals, maintenance, transport, housing, health and safety systems implementation and a range of other services, some as simple as fencing and grass-cutting; and
- There is also an opportunity for BEE depending on the institutional model selected. All concessions, for example are inherently BEE compliant.

5.3 Ecological considerations

5.3.1 Current ecological circumstances

There has been widespread deterioration in the quality of the water resource in catchments within Mpumalanga (DWAF, 2011). The contribution of mining includes both active coal mines and a considerable contribution of acidic and/or saline water from defunct coalmines. In the latter case, the State now carries the environmental and legal liabilities. In places, the environmental system is no longer fit for any water use (e.g. the Klipspruit system). This situation has been the subject of numerous studies and initiatives over the past two or more decades. The Brugspruit Pollution Control Works, for example, was constructed in 1996 to collect and treat acidic saline mine drainage from defunct mines to the north-west of Witbank. This is a neutralisation plant only. Other initiatives such as the Emalahleni and Optimum Colliery treatment plants, which rely on reverse osmosis technologies to deliver potable water, are mentioned earlier in this report.

At the same time, available water quantity in the Upper Olifants has not increased. Use of water by the power generation, mining and agricultural sectors has reduced water volumes for both local and downstream use. The situation is exacerbated by water retention within mining properties due to interception of rainfall within active mining areas, increased infiltration into rehabilitated opencast areas and containment of storm water runoff in dirty water management areas on mine and industrial sites.

Although in most instances, more recently established coal mines on the Highveld have practiced active rehabilitation of mined-out areas, ecological deterioration in addition to water quality impacts has taken place. The agricultural sector has been particularly concerned about environmental impacts from mining, and of course diminished availability of land for agriculture. Although some farmers have been able to successfully grow crops, using mine water with a high salt content, ecological concerns include subsidence, impacts to soil quality, soil erosion, deterioration in quality of land for grazing and crops, diminishing biodiversity and a reduction in ecosystems goods and service levels, due to potential impacts on wetlands and other important land types.

5.3.2 Potential negative ecological impacts

Potential negative impacts on ecology associated a regional AMD treatment approach includes;

- The collection of various mine water sources, treatment of these waters and discharge of treated water will interfere with and modify the natural riverine environment in selected rivers and streams that will be used as conduits through which treated water will be routed to receiving impoundments. This stands to create atypical seasonal flow patterns within such river systems, which will have an influence on stream aquatic ecology;
- Conversely, there may be an impact on smaller riparian systems in which current flow levels are reduced. These systems will be particularly vulnerable to exploitation and less able to accommodate contaminated water release when under reduced flow environments. This impact will be more pronounced in smaller riparian systems. It may thus be prudent to continue to sustain some of the smaller tributaries and their associated wetlands and ecosystems with treated AMD, following evaluation of ecological sensitivity of these systems;
- Construction of the proposed scheme will result in ecological disturbance associated with construction. This includes clearance of land for siting of construction roads, access roads, infrastructure etc. with resultant soil erosion, siltation of local water courses, loss of habitat, etc. Mitigation measures will need to be designed during environmental impact assessment, taken up in an Environmental Management Plan, and strictly adhered to by construction contractors; and
- Lastly, the water released through the proposed project stands to unlock opportunity for new mining development in the Limpopo Province. Such mining development may result in additional environmental impact. This is an indirect consequence of the proposed project and does warrant consideration, particularly in terms of water and waste management in order to ensure the development of the platinum resources within the Limpopo Province does not itself result in a situation akin to that being experienced in Mpumalanga, although presumably much of it would be underground mining, would have the typical ecological impacts associated with mine construction, infrastructure such as processing plants, access roads, haul roads, crushers etc. New mining in that area would trigger a range of activities that will require environmental assessment prior to authorisation.

5.3.3 Potential positive ecological impacts

Treatment of AMD water will improve water quality throughout the catchment. The clean-up and restoration of water quality on the Highveld Coalfields would be the largest single ecological benefit of the proposed scheme. The treated clean water would further benefit the system through providing diluting volumes to reduce the negative effects of poorly performing sewage treatment plants.

The Upper Olifants River is a target for the Department of Water Affairs to implement waste discharge charges in accordance with the National Water Act. The proposed treatment scheme could be a mechanism for mines to reduce waste discharge charges, thus the scheme could be an incentive for mines to participate, and potentially also be an incentive for non-participating mines to improve their practices, with ecological benefits.

There is an option to tie the clean-up and rehabilitation of at least some old defunct mines on the Highveld Coalfields into the proposed regional AMD treatment scheme. Many defunct mines are surrounded by poor communities that harvest coal from historical coal discard dumps, but the water from the defunct mines is unusable. It would be a large benefit, ecologically, socially and economically, if at least some reclamation of defunct mines could be accommodated within the scheme.

5.4 Institutional and governance considerations

Should the proposed scheme act as an incentive for mines to participate to reduce waste discharge charges, the project may remove the urgency to go ahead with implementation of waste discharge charges in the Upper Olifants systems, allowing the Department of Water Affairs to focus its limited resources elsewhere.

Careful consideration would be required to avoid negative institutional and governance considerations as a consequence of the new scheme. Potential for conflict between sectors competing for the treated AMD is high, both within the Highveld Coal field and between the Upper Olifants and Limpopo water users. This situation will be compounded by the diverse perspectives, needs and capacity of the wide range of water users and other stakeholders that will be interested in or affected by the proposed scheme. Considerable technical investigation coupled with stakeholder engagement and incorporation of local knowledge, needs and circumstances into the design, construction and operation of the scheme will be required to agree on a preferred option for scheme design and operation. Complete transparency on all aspects by all stakeholders will be required, coupled with constructive dialogue and visioning started well before any regulatory process to authorise a particular scheme option.

A suitable institutional model will be required in which a wide range of stakeholders from both the water donor and water receptor areas can constructively participate, to form a governance body for the scheme as a 'social compact' between all role players. This could take the form, for example, of a Water User Association (WUA), for which the mandate and functions are already clarified by the National Water Act and through lessons learned from operating WUAs over many years. There are options to establish a new WUA for this project, or to expand the mandate of an existing WUA, or to build the capacity of local government to operate the scheme, or to investigate a new institutional body altogether.

5.5 Regulatory considerations

The Department of Water Affairs as national custodian of water in South Africa would need to take decisions on the allocation of the treated AMD, as per the National Water Act. The Act determines that water as an economic good should be allocated, after satisfying basic needs, to its highest beneficial use. Inefficient use by the power, municipal and irrigation agriculture sector would need to be weighed up against use by the mining and industrial sector in the Limpopo Province. At the same time, the National Water Act emphasises sustainable development, including social and economic upliftment, through water as an economic good. Decisions would thus need to be based on an array of variables.

Unlawful use of water through illegal abstraction by irrigation occurs in some parts of the catchment. If considerably more treated water is released, albeit in the larger water courses, unlawful use may increase. The Department has little capacity to prevent police and curtail this unlawful use.

From a regulatory perspective, the scheme will require various authorisations, not only in terms of the National Water Act but also the National Environmental Management Act and a range of other acts that would be triggered by potential impacts of the scheme. Sufficient time needs to be allowed for the regulatory processes to run their course.

5.6 Social (reputational) risk associated with a regional AMD Scheme

'Social risk' refers to the risk caused by people to a project as a result of public opposition and pressure. Social risk is invariably caused by loss of credibility by project implementers and operators, resulting in lack of trust by the public.

Lack of public trust manifests in many different ways: unwillingness to participate in project conceptualisation and assessment, negative press, social media campaigns, lobbying politicians, pressure on Government to delay decision-making or refuse authorisation. In severe cases, as has been experienced by the water sector in South Africa, lack of public trust can manifest in work stoppages and vandalism, with escalating conflict brought about by arrests and fines. These actions cause reputational risk for a project, and eventually the loss of 'social licence to operate'.

The mining industry, in particular, is already the focus of negative public perceptions, and on the Highveld Coalfields especially from the agricultural sector. Government in South Africa, and in this case particularly the Department of Water Affairs, has come under severe public scrutiny and criticism in recent years, in many instances linked to the mining industry. The AMD situation on the Witwatersrand, and more recently linked to coal mining in Mpumalanga, are cases in point.

No doubt the issue of social justice will be raised, as is usually the case with water schemes. Water is an economic good with potential for social upliftment and security. People ask whether it is fair to have water in their catchment, flow down to a neighbouring downstream catchment. In areas of water scarcity there is great perceived unfairness in this practice. Political parties are quick to politicise such issues, and depending on the scheduling of project studies, the project could become a political tool during elections.

Local government, on the other hand, may fear that the proposed scheme will disempower them, and usurp their role as water services authorities, a perception that needs to be managed.

These, and other issues, could pose a social risk to planning, constructing and operation of the scheme and would need to be pro-actively managed. Transparency, genuine involvement of stakeholders in options analysis and planning, and long-term stakeholder engagement will be required. This will include good communication to make stakeholders aware of the context and the nature of the project, the options to be investigated and how they can participate. Stakeholders would need to understand the focus on enhancement of benefits, and how negative impacts will be mitigated, but without creating undue expectations especially among poor communities. Local and District Government need to be keenly involved, and will require capacity building to integrate the project within their own remit.

6.0 WAY FORWARD

This Inception Report is an information document aimed to create a common baseline understanding from which we collectively work. It is based on the best available published information. Members of the EWWM Working Group are encouraged to submit relevant information to fill in knowledge gaps which can be added to the final report. Based on the concepts articulated in the Inception Report, the facilitators will generate three brief discussion documents in which they outline an expert opinion on what the issues, opportunities and challenges are related to the policy, institutional and pricing aspects. The Inception Report as well as the 3 discussion documents will feed into the workshop scheduled for 18 and 19 March 2013.

The workshop programme will include:

- Day 1:
  - A detailed presentation based on the material contained in the Inception Report;
  - A workshop on the institutional aspects; and
  - A workshop on the policy aspects.
- Day 2:
  - A workshop on the financial aspects;
  - An integration workshop to agree on the issues, opportunities and challenges; and
  - Consolidation session articulating the agreed way forward.

7.0 CONCLUSIONS

The information contained in this inception report will ultimately feed into the Phase 1 final document titled: “Using Treated Acid Mine Drainage to Close the Water Gap in the Olifants’s River Catchment – Issues, Opportunities and Constrains”. It is therefore important that the EWWM members comment on the report and correct and/or add information where required.

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APPENDIX A

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APPENDIX B

Discussion Document

June 2013
Report No. 12614874-11975-3

Golder Associates

March 2013

NEPAD BUSINESS FOUNDATION

Discussion Document: Considerations Related to Using Treated Acid Mine Drainage to Close the Water Gap in the Olifants River Catchment

Submitted to:
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REPORT

Report Number. 12614874-11933-2

Distribution:

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APPENDICES

APPENDIX A
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1.0 POLICY AND LEGISLATIVE CONSIDERATIONS

This chapter was developed by Derek Weston (Pegasys Strategy and Development)

1.1 Background

There are a number of acts and regulations which are relevant when considering the treatment and re-use of Acid Mine Drainage (AMD). The mining industry is largely regulated by National Government, but also through Provincial Departments as it applies to environmental protection procedures that are required. For the purposes of this study the most important Government Departments, in terms of establishing the policy and legislative frameworks are, therefore:

- Department of Water Affairs (DWA);
- Department of Environment Affairs (DEA); and
- Department of Mineral Resources (DMR).

The relevant policy, legislation and regulations that have significance and create the policy framework within which AMD treatment must be considered, are shown in Table 1.

Table 1: Applicable policy, legislation and regulations

Policy & Legislation	Key Points of Relevance
Environment Policy for SA, 1996	■ South Africa has relatively high levels of waste and pollution impacting on air, land and water. Waste disposal practices are unsatisfactory. Ineffective waste management and poor regulatory controls allow waste producers to externalise waste management costs on to the environment and society. ■ Those responsible for environmental damage should pay the repair costs both to environmental and human health, and the costs of preventative measures to reduce or prevent pollution and environmental damage. (Also known as 'the polluter pays principle').
National Water Policy for SA, 1997	■ Equity in access to water resources. ■ Equity in access to the benefits accrued from water use. ■ The intention of “environmentally sustainable water use” is to balance water use with the protection of the resource in such a way that the resources are not degraded beyond recovery. ■ The process of balancing social and economic benefits as well as of determining environmental objectives should involve those affected, or their representatives, in weighing up the options on an informed basis. ■ Protection of water resources will be enforced through a system of source-directed measures, including the registration of sources of impact, standards for waste discharges, best management practices, permits and impact assessments. ■ To encourage a reduction in pollution, a system of economic incentives will be put in place, in which charges will be introduced for the discharge of waste into water bodies. This will encourage the development of low-waste and non-waste technologies. Funds raised in this way should be used for resource quality management and protection activities.

Minerals and Mining Policy for SA 1998	■ Three key areas for policy and regulation: ▪ The environmental impact of exploration; ▪ The environmental impact over the life of a mine and the provision of financial assurances for current and future mine site rehabilitation; and ▪ Rehabilitating sites where mining activity has ceased. ■ Government will have to ensure that the costs of environmental impacts of the mining industry are not passed over to the community. ■ The principle of 'the polluter pays' is relevant to the regulation and enforcement of environmental impact management measures and standards. ■ Under the Minerals Act, prospecting and mining operations may not be conducted without an environmental management programme (EMP) in respect of the land concerned having being approved by the authorities. To assist prospecting and mining companies to comply with this requirement, the Environmental Management Programme Report (EMPR). The EMPR incorporates not only an impact assessment, but also a management plan in relation to impacts. ■ The mining industry will be encouraged to reduce problems of pollution by promoting a culture of waste minimisation through creative employment of re-cycling, and re-use of waste products. This will also be favourable to job creation. Waste management and minimisation of waste will be performed as part of sectoral environmental management.
South African Constitution (No. 108 of 1996)	■ Every person has the right to a clean and healthy environment. ■ The environment is to be protected for the benefit of present and future generations.
The National Water Act (No. 36 of 1998) - NWA	■ Emphasises the effective management of South Africa's water resources through the basic principles of Integrated Water Resources. ■ Management. ■ Seeks to achieve social equity, economic efficiency and ecosystem sustainability. ■ Obliges any user of water to avoid/minimize pollution of water resources. ■ Stipulates that water use authorizations must be obtained for all water uses. ■ Provision for penalties.
The National Environmental Management Act (No. 107 of 1998) - NEMA	■ Provides the guiding legislation and framework for environmental management in South Africa. ■ Obliges anyone who pollutes or degrades the environment to take reasonable measures to stop doing it.

	■ If pollution cannot be reasonably avoided, to minimise and put right the damage.
The Minerals and Petroleum Resources Development Act (Act 28 of 2002) - MPRDA	■ Legislates the official policy concerning the exploitation of the country's mineral resources. ■ Provides for the environmental sustainability of the mining industry. ■ Requires that an environmental impact assessment be undertaken for mining operations. ■ Enables penalties for non-compliance.
National Environment Management: Waste Management Act (2009) - NEMWA	■ Aims at protecting health, wellbeing and the environment. ■ Encourages minimisation of consumption of natural resource. ■ Avoidance and minimisation of the generation of waste. ■ Reuse/recycling and recovery of waste. ■ Treatment and disposal as a last resort. ■ Aims to set standards on a national, provincial and local level for waste generation.
Water Use Regulations (Government Notice No. 704)	■ Provides regulations on the use of water for mining and related activities aimed at the protection of water resource.
Water Conservation and Water Demand Strategy for the Industry, Mining and Power Generation Sectors (2004)	■ Promotes efficient use of water through water conservation and water demand management. ■ Provides some best practice.
National Water Resource Strategy (NWRS) (2013)	■ Provides core strategies for water resource management for the next five years. ■ Core strategy to optimize and stretch the available water resources (groundwater, water re-use, desalination (including seawater), water systems optimization and rainwater harvesting). ■ Provides a technical strategy for water re-use.
National Waste Management Strategy (NWMS) (2012)	■ Follows the waste management hierarchy. ■ Presents a long-term plan for addressing key issues, needs and problems experienced with waste management in South Africa.
Environmental Management Plan for prospecting rights or mining permit (May 2004)	■ Supports the standardisation of Environmental Management Plans. ■ Provides alignment with Regulation 52 of the Minerals and Petroleum Resource Development Regulations (2004).

Best Practice Guidelines for Water Resource Protection in the South African Mining Industry (DWAF, Series A, G and H) (2008)	■ A series of guidelines providing best practice relating to water resource management and resource protection for various mining operations and activities. ■ Provides clear visual and technical Checklists for best practice are provided.

1.2 Key Principles

From the policy and legislative instruments a number of key policy principles emerge. These are important in providing the framework within which we must work when considering the options for the treatment and re-use of AMD.

These principles are:

- Water is to be managed in an integrated manner and the different water sources and water uses ought to be coordinated. This integrated management should accept the natural catchment as the appropriate physical unit for management, while also recognizing the need for inter-catchment management where such catchments are linked.
- Water is a valuable natural resource that must be applied in a socially equitable manner, driving economic development with adequate protection of the natural aquatic ecosystems.
- Department of Water Affairs is the custodian of the national water resource, water cannot be owned, but a person or legal body can be granted a license to use water in a certain manner and compliant with license conditions.
- The polluter pays principle recognises the responsibility to pay for water containing waste which is discharged back into the environment and creates strict liability for an owner or possessor of land on whose land an activity or process causing pollution has been performed.
- Under licence conditions, you are required to clean your discharge to a certain standard and to return this to the environment.
- In accordance, with the intention of policy, and as laid out in the MRPDA (2002) there is a clear responsibility to rehabilitate land upon completion of mining activities to minimise the environmental impacts thereafter. Responsibility for the environmental impacts after mine closure remains with the mine. In the case where a mine is found to be ownerless, then the state will, through the Minister of Mineral Resources, take up the responsibility to rehabilitate the land.
- The liability towards environmental impact cannot be transferred to the State.

1.3 Emergent Issues

Noting these principles and considering the scope of policy and legislation, a number of issues arise that require consideration. These include:

- **Cooperative governance and alignment** between different regulatory mandates and actions: Whilst there is broad alignment of policy and legal intent, alignment between the various legislative instruments needs to be improved. The latest suggested amendments to NEMA strengthen the ability to deal with non-compliant mines and this with the revised Environmental Impact Assessment (EIA) Regulations seem to strengthen the understanding of what is required of EIAs. However, there remain challenges with regards to responsibilities between the Departments of Environment Affairs and Mineral Resources that are not yet clarified. Amendments to the MPRDA appear to be in the pipeline. It has also been noted the amendments to NEMA may have some problems in terms of alignment with the NWA, which is also currently under review. This will require deeper analysis, but it does seem that

these processes are happening in isolation and are not thoroughly addressing the issues of alignment and clarifying matters of roles and responsibilities. Into the future, we can expect continued process challenges.

- Mine water is recognized as a **potential water resource**, both in the negative sense [if not properly managed will diminish the available resource] but also in a positive sense [can contribute to the water budget as an available water resource. Several of the recent water re-conciliation strategies recently developed by the Department of Water Affairs [Vaal River catchment and Olifants River Catchment] recognized mine water as a resource which can contribute to closing the gap between water availability and water requirements in the catchment.

- **Clarity of Authorisation for Water Reuse**: There will be a clear requirement to obtain the necessary regulatory authorisations. In order to treat and discharge water one will require an EIA, and an Integrated Waste and Water Management Plan (IWWMP) and a license to use water. That water use (including discharge) will need to meet the required standards. In most instances, one would assume that the mines already have this at an individual level, but some form of regional scheme would require a new EIA, IWWMP and licence. At this initial stage, it appears that in order to treat and sell as a bulk water supplier for the purposes of water service provision, that some form of off-take agreement may be required.

- It is not clear whether the water use licence would be for removal of water from the water resource (Section 21(a)) or for removal of water or discharging water from underground (Section 21(j)). The implications of this need more thorough research.

- Therefore, one has to carefully consider that one does not have the automatic 'right' to use the water. There is an obligation to return the water to the resource. The DWA would need to deliberate over how that additional water is to be used, and bearing in mind the constraints within the Middle Olifants as well as the need to provide water for redress, the DWA would consider this issue carefully.

- **Process issues for authorisations** are not entirely clear and do seem to require clarification. This needs to include inputs from interested and affected parties as well as clarity as to matters of appeal, and so forth. This will need clarification.

- **Regulation and oversight**: As there are various pieces of policy and legislation there is a need for some form of regulatory hierarchy. The NWRS-2 articulates that DWA should take the lead in such matters, but nonetheless there is a need for clarified regulatory framework. This must include arrangements for more regular monitoring and evaluation. This will obviously place a responsibility upon the discharger to provide regular information.

- **Regulatory capacity** to deal with multiple regulatory agencies/authorities and with active participation by multiple stakeholders, some of which actively oppose mining operations in part of the catchment. The current lack of regulatory capacity manifests itself at the cross roots level with very long delays in taking decisions on water use licenses and providing guidance to mine water related aspects.

- **Capacity** of several role-players in the water sector, specifically the local authorities and municipalities to actively participate in developing collaborative solutions and to implement and operate water infrastructure and services projects.

- **Managing risk:** It will be essential to manage the various risks involved. The policies do place considerable emphasis upon the need to ensure environmental and human health standards are met. It is not clear what standards would be required and this would depend upon whether the water is discharged back to the resource or re-used. Discharge back into the resource would have to carefully consider the impacts on water quality, flow, instream biota and riparian vegetation.

- **Contracts and agreements**: In order to provide bulk water supply to the Municipalities one would require a contract with the water services authority. This would need to be negotiated with assurances of supply, required water quality standards and the tariff structure all being critical parts of that process.

As noted above, it does appear that one would require an off-take agreement in order to supply this water. This also has implications for pricing and this will require further investigation it may be that by acting as a bulk services provider that the charges would then need to include an infrastructure charge.

- **Ownerless mines**: Whilst the MPRDA does articulate the responsibility of the State to take responsibility for these mines, there is little to nothing in the policy documents that really provides some form of description of Departmental roles and responsibilities, and any procedural hierarchy regarding ownerless mines.

1.4 Opportunities

- **Strategic intent**: There is a broad alignment in the various policy and legislative instruments that one has to take responsibility for the discharge and for the rehabilitation of land after completion of mining. Water and environmental policy have been in place for over a decade and whilst small adjustments could be made, there is a general 'sense' that the policy still holds. Subsequently, refinements in approach, within the policy frameworks, are articulated within strategy documents such as the NWRS-2 (2013) and the NWMS (2012), amongst others.

- NWRS-2 is aimed at providing strategic direction for water resource management over the next 20 years recognising that water resources are limited over space and time, and that water can constrain socio-economic development. In this vain, Chapter 5 of the NWRS-2 focuses in on alternative sources of water to supplement our conventional sources of water. It is noted that accessing these non-conventional sources of water is neither easy nor inexpensive. It is important to note that in order to access these resources key elements requiring attention include "planning, research, and technology (appropriate solutions), improved governance, leadership and management models, extended funding models and financial management, as well as timeous organising and implementation".

- **Shared risk**: NWRS-2 through Core Strategy 11 notes the importance of shared water security risk. This strategy emphasises the importance of partnerships between business, government and civil society to manage these risks.

- **Water re-use:** There is recognition of the benefits of re-use. Most significantly, the latest version of the NWRS 2 (2013) provides a technical strategy towards this end. It must be noted that clearly, this is in a relatively initial state of development, with a high level strategy being in place, however there is an opportunity to work with the Department of Water Affairs in a cooperative manner on this.

  Technical Strategy 7 of the draft NWRS 2 does note:

  - The need to develop clear and practical guidelines for typical water re-use projects on what regulatory approvals are needed, the status of reclaimed water in terms of right to use and how these can be obtained cost and time effectively;
  - The Department will work with other national departments to align legislation, reduce the regulatory burden wherever practical, and unblock regulatory obstacles to water re-use; and
  - The Department will act as the lead regulatory authority to assist in working with other Departments in getting approval for justifiable water re-use projects.

- **Revision of key strategies**: Both the Pricing Strategy and the Waste Discharge Charge Strategy (WDCS) are under review with a view to implementation in the coming period. The opportunity to engage with these processes now exists to provide inputs into these strategies. The first draft of the revised Pricing Strategy is currently being developed. The WDCS is being prepared for implementation readiness and the Upper Olifants is one of the three initial catchments within which the WDCS will be implemented. Stakeholder engagement in the Upper Olifants is yet to begin, but it will probably take place in April 2013. There is a clear opportunity to align initiatives.

- Water resources in the **Olifants River catchment** are over-allocated with limited options to reconcile the available water and the water requirements. Mine water as an unconventional water resource holds potential and there is an opportunity to develop this new water resource to the benefit of the entire catchment. This opportunity is captured within the NWRS-2 together with other reconciliation options.
- **Water policies and strategies** [some dated] are challenged in terms of dealing with the complex issue of an unconventional water resource such as mine water. If one combines the concepts of an unconventional water resource with the concepts of water reuse, the opportunity exists to revise and update existing policies and strategies to deal with this challenge.
- This project provides an **opportunity** to update and provide input to Department Mineral Resources strategy on the regional mine closure from the perspective of collaboration and productive use of mine water.

1.5 Constraints

- **Government alignment**: Whilst the policy and legislation have a clear intent to improve the levels of 'cooperative government' one does recognise that in practice there is still a significant journey ahead. Policy and legal instruments do broadly support each other, but do not provide direct alignment from a process perspective. This can result in challenges in working through the various administrative processes that are required. At possibly the most extreme end of the scale, is the fact that licence applications can take years to finalise.
- The current water and mining **policies and strategies** do not address the complex issue of unconventional water resources such as mine water.
- There are concerns regarding the **regulatory capacity** to provide leadership in resolving the principal issue of mine water reuse, as well as the allocation of unconventional water sources to different competing water uses in the catchment.
- Policy clarity on the **mobilization of the private sector** and specifically mining companies in water resource development projects is needed.

2.0 INSTITUTIONAL CONSIDERATIONS

This chapter was developed by Barbara Schreiner (Pegasys Strategy and Development)

2.1 Introduction

"The current challenges to effective treatment of AMD are not scientific or technical, but relate to institutional arrangements and funding." (Jo Burgess)

Mining operations in the basin have resulted in significant water pollution and acid mine drainage which is causing negative environmental impacts and negative impacts on other water users. This water must be treated either to discharge standards or to potable standards for bulk supply to municipalities.

This chapter addresses the key institutional issues to be addressed in order to ensure the sustainable management of the pollution and the effective use of the treated AMD. In this regard, the institutional options to be examined depend to some extent on whether the water is to be treated to discharge standards or to potable standards, and for what use it is intended, although there are significant commonalities in either scenario.

"South Africa's acid mine drainage pollution inaction "come from problems identifying who is responsible for paying for or doing the treatment, and deciding what type of water we want to produce by treating AMD".

2.2 Institutional Principles and Assumptions

It is important to examine the principles and assumptions that underpin any sustainable institutional solution. These can be captured as follows:

- The institutional arrangements must be sustainable over the long-term to ensure the management of the AMD generation for as long as it continues.
- Liability for managing the AMD and rehabilitating the mined land remains with the polluters.
- Responsibility for AMD management from ownerless mines resides with the State.
- The institutional arrangements should not transfer private risk to the public sector.
- A regional approach is likely to yield greater economies of scale and efficiency than a number of stand-alone treatment solutions.
- Water is a public good that is allocated for use by the State in the public interest.

2.3 Institutional Responsibilities

DWA (or the CMA once it is established and has been delegated appropriate functions) is responsible for allocating, authorising and controlling water use under the NWA and for ensuring compliance monitoring and enforcement. This entails ensuring that water users meet their licence conditions, ensuring that reserve requirements are met, and ensuring that water supply and demand are in balance to the best extent possible.

The DEA and the Provincial Department of Environment are responsible for ensuring that the mines adhere to requisite environmental standards.

The DMR is responsible for ensuring that the mineral resources of the country are effectively developed, and that the mines adhere to their operating conditions and to approve mine closure certificates.

The Water Services Authority (WSA, or the local council/s in this region) is responsible for ensuring access to water services for all inhabitants (and industry) within its area, which would include the decision to use mine water. The WSA may establish and/or contract a public or private body(ies) to provide bulk water services (i.e. bulk water services provider).

The mines are responsible for discharging their mine water according to their authorisation conditions, which may include monitoring and the payment of waste discharge charges.

2.4 Outline of Institutional Opportunities and Constraints

There are various organisational opportunities and constraints relating to the treatment of acid mine drainage in this area.

The key institutional issues revolve around:

- what body might be responsible for developing and operating AMD treatment works and its relationships with other groups (particularly the mines and local government);
- the institutional capacity to carry out the necessary roles and responsibilities, and
- effective co-ordination between relevant bodies.

2.4.1 Opportunities

"While many mines have established ad hoc chemical, biological or physical processes to treat localised water pollution, South Africa urgently needs a regional, consolidated approach to AMD". (Pat Manders)

There is an opportunity for innovative institutional arrangements to address the AMD problem and to turn it into an opportunity to contribute to the balance of supply and demand in the catchment. The implementation of water re-use can take place at different scales or levels:

- at a very local level involving a single facility such as a building or a factory, for a group or cluster of facilities,
- at a treatment facility level (for example, such as a municipal treatment works) or
- at a river system level (natural drainage areas/catchments).

Decision-making will vary across these applications and could involve individual or groups of businesses, municipalities and national government (including entities owned by government).

The mines have indicated their preference for a coalfields-wide institution to coordinate and integrate the development of mine water reclamation projects with respect to:

- Cooperation on a regional basis;
- Optimized location and sizing of infrastructure and plants;
- Selection of treatment technology;
- Collaboration with respect to the use of waste and by-products;
- Coordination on the best use of the reclaimed water; and
- Development of consistent water tariffs.

Private sector management, engineering and financing capacity, as demonstrated by several successful water re-use projects in mining and industry is well established in South Africa. International interest in local water re-use projects has been expressed. Substantial private sector capacity can be leveraged in the implementation of water re-use projects.

There is the potential and the will to streamline the licensing and monitoring processes between DWA, DMR and DEA.

There is the potential to develop an industry/sector-agreed evaluation/accreditation system for agencies/organisations implementing water re-use projects.

2.4.2 Constraints

The performance of existing wastewater treatment plants in terms of meeting discharge standards and reliability is critical to the successful application of water re-use in South Africa. These facilities discharge water that impacts on the safety, economy and fitness for use by downstream users. Strict enforcement of discharge standards, and addressing the management and performance failures of municipal run wastewater treatment plans is therefore critical to the future of indirect water re-use.

Compliance and monitoring in the water management area has been weak and will need to be stronger to make ensure the allocated and authorised use of water in the WMA (including AMD), and to protect water quality. This has implications for capacity in DWA/CMA.

Water re-use projects have many sophisticated technical, engineering, financial, operational and maintenance aspects. A key consideration to any such project is the fact that the water typically has to be treated to improve/upgrade its quality, before it is fit for re-use by a downstream user. The downstream user must be guaranteed an appropriate quality of water to protect designated use of the water. Re-use projects therefore require a high level of confidence in the implementation and operating agencies.

An implementing body must be able to demonstrate a minimum threshold of capacity and competency, before it can be considered as capable of implementing a water re-use project, in terms of technical expertise, planning ability, project management capability, financial strength and rating. And it must be accepted by the community and stakeholders as a reliable organisation.

Water re-use projects typically require more sophisticated treatment technology and systems compared to conventional water treatment and are high risk unless trained, capable and motivated operations and maintenance staff is available.

2.5 Challenges faced by the Western Utilities Corporation (WUC)

There were a number of challenges faced in the failed process to establish the WUC. While no clear reasons were given by the IMC for their rejection of the proposal, some of the possible issues are raised below:

- It was seen as transferring private risk to the public sector;
- The Inter-ministerial Committee did not support the proposal and the necessary licences and approvals were not given by the state;
- The plant would take two and a half years to functionality which was seen as taking too long. In addition, the sludge treatment plant was only going to come on stream 8 years down the line;
- The approach would result would create a private monopoly of a water resource, that would be responsible for treating AMD across three basins and which was seen as intended to make a profit from the treatment of water; and
- There was a concern about the longevity of the mining companies that were the core shareholders of the WUC.

"The threat of AMD to the environment will not be solved in the short to medium term, and is likely to persist for centuries to come. It is also not solved by a single intervention, but will require the integrated implementation of a range of measures. Such measures include active water treatment … passive water treatment systems (e.g. constructed wetlands), controlled placement of acid-generating mine waste, and prevention of water ingress into mine voids and of AMD loss from mine" (Pat Manders).

Reference: Roche-Kelly G,D and Van Dyk L (2011): Acid Mine Drainage (AMD) in the Witwaters and basins of the Johannesburg area: Towards an institutional framework that could enable private companies to treat this water.

3.0 FINANCING AND PRICING CONSIDIRATIONS

This chapter was developed by Kerron Johnstone (Golder Associates Africa)

3.1 The economics of mine water treatment schemes

Before considering financial and pricing issues, we present some information on the economics of mine water treatment plants (MWTPs) based on the existing situation at some MWTP projects in the Witbank area. Current experience with operational plants will be informative for possible future schemes.

3.1.1 Basic Costs

The cash flows associated with MWTPs are:

- **Capital expenditure**, (capex) which includes all costs associated with feasibility studies, design, engineering, procurement, construction and commissioning of the MWTP initially, and expansion and replacement capital expenditure later in the life of the MWTP.
- **Operating and maintenance costs**, (O&M) which includes all overhead, personnel, electrical, chemical, maintenance and other costs for the day-to-day running of the MWTP and associated infrastructure; and
- **Revenue**, which is earned from (i) the possible sale of water to customers such as municipalities, mines and power stations, and (ii) fees charged to participating mines for the treatment of their polluted water.

The exact capex and O&M numbers vary from plant to plant due to factors such as time of construction, degree of pollution of the water and daily volume treated.

Table 2 shows illustrative figures for MWTPs treating AMD in the Witbank area over the expected 20 year life.

Table 2: Typical life cycles costs for a MWTP (Illustrative)

Item	Unit cost (R/m^3)
Capital - initial	5.75
Capital – replacement	3.30
O&M	7.65
Total cost	**16.70**
Less: Revenue	-5.00
Net cost	**11.70**

The typical costs of AMD MWTPs are R16.70/m^3 over the life of the plant. Assuming all of the water produced by the plant can be sold, revenue of R5.00/m^3 offsets this cost for a net cost of R11.70/m^3.

MWTPs therefore require substantial contributions from participants to collect and treat the polluted mine water, and the loss of any of these contributions will threaten sustainability. This is even more so for schemes that do not sell any water.

3.2 Cost Allocation

Some MWTPs have more than one mine participating. These mines usually have different volumes and qualities of polluted water requiring treatment, and capital and operating costs are allocated accordingly.

The minimum requirement for mines is to treat water to a standard at which it can be discharged into the environment. If potable water is to be produced, additional infrastructure must be provided, and the cost of this infrastructure should be passed on to beneficiaries of the scheme.

3.2.1 Between participating mines

Where more than one mine participates in a scheme, capital and operating costs are allocated according to the volume and quality (measured by acidity and salinity) of the polluted water supplied by each mine.

Capital costs are driven by **peak volume and quality specifications**: the MWTP should be able to operate at the maximum volume and quality inputs expected at any time. The effect of each of these factors (volume, salinity, acidity) on plant cost is calculated, and a proportion of capital expenditure is allocated to each participant based on their contribution to those factors.

Operating costs are driven by **volume and quality of polluted water supplied in a period**. The volume, salinity and acidity of the polluted water supplied by each participant are measured, and the operating costs allocated accordingly.

These principles will need to be applied to future regional schemes if there are multiple participants. Cost allocations could become more difficult if new participants join later. The State may also be a participant if defunct mines which are its responsibility are members of a scheme.

3.2.2 Between polluters and beneficiaries

The minimum requirement for mines is to treat water to a standard at which it can be discharged into the environment, usually into a nearby river system with sufficient capacity to handle the volume without significant disruption (e.g. erosion, loss of fauna and flora) to the system. In this case, no water is sold to beneficiaries.

The production and distribution of product water (potable or process) requires additional infrastructure such as chlorination, storage and distribution systems (pumps and pipelines), which is usually far more costly than the simple discharge systems required if water is not sold. In addition, the different standards for potable water and discharge water may require changes to the MWTP design. The capex and O&M costs of the additional infrastructure and plant specifications should be passed on to beneficiaries of the scheme, because the scheme owners have no incentive to incur this expenditure.

This principle may also be applied to future regional schemes: the polluters pay for treatment of the AMD water to discharge standard, while beneficiaries pay for the additional infrastructure required to bring the water to their required standard and distribute it from the MWTP to their storage reservoirs.

3.3 Revenue

3.3.1 Sale of water and water price

A reasonable level for the price of water sold by the scheme to beneficiaries is the price at which the participants neither benefit from the sale of water nor are disadvantaged. If they were to make a profit, then the DWA's principles would be violated, but if they were to make a loss, then simply discharging the water would be preferable, and a potential resource would be lost to the environment.

The reasonable price for the sale of water may be determined by viewing the supply of potable water as a subproject with its own cash flows. The revenue earned by the water supply subproject is the sale price per unit of water times the volume sold. The expenditure of the project is the cash flows associated with constructing, maintaining and operating the additional infrastructure required for the supply of potable water are identified. The revenue and expenditure cash flows combine to give the subproject cash flow. The sale price is set so that the net present value (NPV) of the subproject cash flows is zero, which means that capital is neither being created nor destroyed. At this sale price, the DWA's requirement that mines do not benefit from the sale of water will be met, while mines will not be disincentivised to participate in the scheme.

If participating mines are to provide the capital to build the additional infrastructure required to provide potable water in a scheme, this principle will need to be applied. Alternatively, if the beneficiaries of the scheme pay for the construction and operation of the infrastructure, no revenue will be required.

3.3.2 Water treatment fees

Because each mine participating in the MWTP contributes its portion of capital expenditure, the only recovery required by the MWTP from the participants is O&M costs. These are calculated by allocating actual costs in a period to each participant on the basis of the volume, acidity and salinity of the water they supply to the MWTP.

3.4 Sustainability of MWTPs

MWTPs will only be sustainable if sufficient revenue is earned to fund operating costs. This could be adversely affected by the following:

1) Volumes of water sold are lower than the basis of costing, leading to an under recovery of costs;

2) Actual unit prices for the sale of water are lower than the "fair" price; and

3) Participating mines cannot pay for the treatment of water or cannot supply the required volume of water to the MWTP.

In all cases, the MWTP may not be able to meet its obligations and will be unsustainable. Of particular concern is the situation after mine closure – will the mines' closure funds be sufficient to fund the treatment of mine water in perpetuity?

3.5 Issues, opportunities and constraints

3.5.1 Pricing

In Section 3.3.1, the method of calculation of a “fair” price is discussed. However, this price does not necessarily bear any relation to the price paid for water supplied by the municipality in the area. Typically, the “fair” price for water is higher than the price being paid by consumers, and it is difficult for a scheme to negotiate a high enough price with the local municipality.

However, the marginal cost of additional capacity for new municipal water treatment plants is also far higher than current water prices, which may make MWTP schemes more attractive.

Government funding or developmental funding at lower rates than commercial funding could reduce the required price.

3.5.2 Participation in schemes

Mines will be incentivised to participate in a regional scheme if it would result in a lower capital and operating costs. However, this would be weighed up against a potential lack of control compared to ownership of their own MWTP.

Terms of participation in a regional scheme should be reasonable, allowing participants some flexibility in volume and quality of water supplied and some involvement in the running of the scheme.

Recognition by DMR of participation in the scheme as a credible mine closure water treatment strategy for mines would enhance its attractiveness to prospective participants.

The institutional, contractual and financial arrangements for regional MWTP scheme would be more complex than for one owned by an individual mine. This additional complexity may cause delays in implementation (with associated financial impacts) or deter participation.

Also, depending on the nature of the participants, compliance with more regulations such as the Public Finance Management Act and the Municipal Finance Management may be required.

As a general principle, polluters should pay for the treatment of AMD to a discharge standard. Users of the water should pay for the additional treatment needed to bring the water to the required standard, to store and to distribute it.

3.5.3 Potential markets

Potential markets for treated mine water include:

- Mines, for process and potable water;
- Municipalities, for municipal water supply;
- Industrial users for process water;
- Agriculture, for irrigation and process; and
- Eskom for power generation requirements.

3.5.4 Potential sources of financing

Possible sources of funding for a regional MWTP include:

- **The State:** The State owns the environmental liabilities associated with many defunct mines, and AMD arising from these mines must be treated. A regional MWTP scheme could provide the required capacity. In addition, the State could invest directly in the regional scheme in the same way that it does in other water infrastructure schemes;

- **Mines:** Mining companies sometimes build MWTPs as part of their operational requirements, and could fund part of a regional scheme to address their water treatment needs. Existing MWTPs could be in kind contributions to a regional scheme. Finally, mines may participate in a regional scheme for closure purposes, using their closure funds;
- **Beneficiaries:** Potential users of water supplied by the scheme may be prepared to invest if the scheme is an attractive alternative to developing other sources of water;
- **Investors:** Private investors may be interested in funding the scheme if acceptable returns can be made. However, this may not be acceptable to the State;
- **Commercial banks:** Banks may be prepared to provide funding to the scheme, but it would be on commercial terms and subject to many risk management measures such as offtake agreements, liens over project assets and provision of surety by participants. Involvement of private sector companies in the scheme would be preferred;
- **Development funding agencies:** The scheme may meet the requirements of development funding agencies such as the World Bank, the DBSA and bilateral funding agencies.

GOLDER ASSOCIATES AFRICA (PTY) LTD.

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IWWMP Consultant

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Principal

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APPENDIX A

Document Limitations (to follow)

At Golder Associates we strive to be the most respected global company providing consulting, design, and construction services in earth, environment, and related areas of energy. Employee owned since our formation in 1960, our focus, unique culture and operating environment offer opportunities and the freedom to excel, which attracts the leading specialists in our fields. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees who operate from offices located throughout Africa, Asia, Australasia, Europe, North America, and South America.

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Golder Associates

APPENDIX C

18 / 19 March Workshop Procedure

OLIFANTS RIVER - CLOSING THE WATER GAP BY REUSE.

Date: **18 and 19 March 2013**

Venue: **To be confirmed**

Time: **9:30**

Workshop theme:

Using Treated Acid Mine Drainage (AMD) to close the Water Gap in the Olifants River Catchment - Formulation and documentation of Issues, Opportunities and Constraints.

Purpose of the workshop:

The purpose of this phase of the project is to establish the issues, opportunities and constraints inherent in the treatment and re-use of acid mine drainage (AMD) in relation to water policy, institutional arrangements and water pricing models to provide an enabling environment for private sector participation in the sector.

Workshop aim:

The aim of the workshop is to arrive at a **collective** definition of the problems to be addressed in AMD treatment and re-use, considering water policy and strategy issues, through adaptation of institutional and pricing arrangements.

GOLDER ASSOCIATES AFRICA (PTY) LTD.

Heidi Snyman

Andre van Niekerk

HS/AMvN/mc

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Workshop agenda:

DAY 1: 18 MARCH 2013

Time	Activity	Facilitator/Speaker
9:30	Registration	Strategic Water Partnership Network Secretariat
10:00	Welcome and project background	Mr Nandha Govender (ESKOM) Chairman: Strategic Water Partnership Network: Thematic Working Group for Effluent and Waste Water Management
10:15	Setting the scene - Using Treated Acid Mine Drainage to Close the Water Gap in the Olifants River Catchment	Dr André van Niekerk (Golder Associates Africa)
10:45	Drivers and objectives – Perspective from different sector role-players	Dr Heidi Snyman (Golder Associates Africa)
11:20	Comfort break	
11:30	Theme 1: Policy and Legislation Issues, Opportunities and Constraints	Mr Derek Weston (Pegasys Strategy and Development)
13:00	Lunch	
14:00	Theme 1: Policy and Legislation Issues, Opportunities and Constraints (Continued)	Mr Derek Weston (Pegasys Strategy and Development)
14:30	Theme 2: Institutional Issues, Opportunities and Constraints	Ms Barbara Schreiner (Pegasys Strategy and Development)
15:30	Tea break	
15:50	Theme 2: Institutional Issues, Opportunities and Constraints (Continued)	Ms Barbara Schreiner (Pegasys Strategy and Development)
17:00	Closure	

DAY 2: 19 MARCH 2013

Time	Activity	Facilitator/Speaker
9:00	Registration	Strategic Water Partnership Network Secretariat
9:30	Recap of Day 1	Dr Heidi Snyman (Golder Associates Africa)
10:00	Theme 3: Financing Issues, Opportunities and Constraints	Mr Kerron Johnstone (Golder Associates Africa)
11:15	Tea break	
11:45	Theme 3: Financing Issues, Opportunities and Constraints (Continued)	Mr Kerron Johnstone (Golder Associates Africa)
13:00	Lunch	
14:00	Consolidation ■ Agree on the issues, opportunities and challenges ■ Articulating the agreed way forward	Dr André van Niekerk (Golder Associates Africa)
15:30	Closure	

Strategic Water Partnership Network
SOUTH AFRICA

Project on Institutional Models & Pricing for Re-use of Treated Fffluent Consultation Meeting - 18 March 2013

Name	Company	Contact No.	Signature
Alan Sarkis	AVENG Group		
Andre Kruger	ABSA Capital		Attended
Andre van Niekerk	Golder Associates	082 - 552 2601	
Antonino Manus	~~Joburg Water~~ City of Joburg	0713621260	
Barbara Schreiner	Pegasys ✓		
Bertus Bierman	Anglo American	0834557109	
Clinton Lee	BHP Billiton	0824588756	
Derek Weston	Pegasys		Attended
Gugu Stewart	Eskom		
Harry Singleton	Murrob	082 884 5952	
Heidi Snyman	Golder Associates		Attended
Jenny Leigh	NEPAD Business Foundation		
John Samuel - Day 1	Turner & Townsend		
Jones Mnisi	Joburg Water		
Marius Keet	DWA		
Mula Phalanndwa	Eskom		

Name	Company	Contact No.	Signature
Nandha Govender	Eskom		
Nick Tandi	NEPAD Business Foundation	0791711483	
Noddy McGeorge	BHP Billiton		Attended
Pieter Viljoen	DWA	0824600692	Attended
Richard Holden- Day 1	TCTA	082 451 4796	
Ritva Muhlbauer	Anglo American	0827999206	
Stanford Macevele - Day 2	DWA		
Vicki Shaw	Xstrata Coal		
Ariel Mafugare	Tobera Water	011 688 1481	
TONY SEEF	Golder	082 358 1509	
Stewart Gibson	GIZ	0826517601	

Strategic Water Partnership Network
SOUTH AFRICA

Project on Institutional Models & Pricing for Re-use of Treated Fffluent Consultation Meeting - 19 March 2013

Name	Company	Contact No.	Signature
Alan Sarkis	AVENG Group		
Andre Kruger	ABSA Capital		
Andre van Niekerk	Golder Associates		
Antonino Manus	~~Joburg Water~~ City of Johannesburg	0713621260	
Barbara Schreiner	Pegasys		
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Derek Weston	Pegasys		
Gugu Stewart	Eskom		
Harry Singleton	Murrob		
Heidi Snyman	Golder Associates		
Jenny Leigh	NEPAD Business Foundation		
John Samuel - Day 1	Turner & Townsend		
Jones Mnisi	Joburg Water		
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Name	Company	Contact No.	Signature
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Nick Tandi	NEPAD Business Foundation		
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Pieter Viljoen	DWA		
Richard Holden- Day 1	TCTA		
Ritva Muhlbauer	Anglo American	0827799206	
Stanford Macevele - Day 2	DWA		
Vicki Shaw	Xstrata Coal		
Thabani Myeza	Sembcorp Utilities		
Tony Seef	Golder		
Kerron Johnstone	Golder Associates	0112544862	
Valerie Naidoo	WRC	012-3309038	

MINUTES OF THE EWWM-WORKING GROUP WORKSHOP HELD ON 18 AND 19 MARCH 2013 IN JOHANNESBURG

Project No: 12614874

Date: 18 March 2013

WORKSHOP THEME:

Using Treated Acid Mine Drainage (AMD) to close the Water Gap in the Olifants River Catchment - Formulation and documentation of Issues, Opportunities and Constraints.

PURPOSE OF THE WORKSHOP:

The purpose of this phase of the project is to establish the issues, opportunities and constraints inherent in the treatment and re-use of acid mine drainage AMD) in relation to water policy, institutional arrangements and water pricing models to provide an enabling environment for private sector participation in the sector.

WORKSHOP AIM:

The aim of the workshop was to arrive at a **collective** definition of the problems to be addressed in AMD treatment and re-use, considering water policy and strategy issues, through adaptation of institutional and pricing arrangements.

MINUTES

1. PRESENT

An attendance register was circulated
All introduced themselves

2. APOLOGIES

Apologies were noted especially from the DWA as this is water week

3. WORKSHOP DAY ONE

- Dr Ritva Muhlbauer (Anglo American) represented the Chairperson of the EWWM Working Group in opening the meeting and briefly described the background and reason for this workshop.

4. SETTING THE SCENE

- Dr. A van Niekerk (Golder Associates Africa) presented on the overview on the technical aspects and how AMD was identified as a water resource to augment the water deficit in the Olifants River Catchment.

Comments that were raised based on the technical presentation:

- The mining sector is doing their utmost to reduce ingress of water into operations to avoid pollution. They implementing the DWA hierarchy to prevent pollution and reduce treatment. It is also noted that it is more cost effective to rehabilitate during operation. AMD could be in the long term the resource may become limited as rehabilitation technologies improve.

- The Upper Olifants also need water. Therefore, not all treated AMD can be made available for the Middle Olifants – as additional water is needed in the Upper Olifants i.e. eMalahleni and communities surrounding the mines.

- It is noted that looking only up to 2035 is too short a period to include in this study as this project will have long term impacts (100+ years).

- The marginal cost of any augmentation scheme will be high.

5. SECTOR REQUIREMENTS

- Dr. H Snyman facilitated a discussion to understand the different sector perspectives to be considered should AMD be treated and used to close the water gap in the Olifants River Catchment. The following sectors reported:

5.1 Regulator (DWA)

- Finding the best financial and sustainable solution.
- Monitoring the water quality to ensure that it will not decrease over the long term.
- Full cost of mining need to be considered, i.e. the impacts on agricultural use of land, social aspects etc.
- Financial provision agreement for mining water treatment plants and the support thereof could be revised.
- Considerations of water requirements for local municipalities.
- Regulating the price of water.
- Involvement on an institutional model to manage the catchment water.
- Taking a proactive responsibility of ownerless and abandoned mines.

5.2 Eskom

- Concerned about the deteriorating water quality.
- Establishing a relationship with coal mines by partnering on projects.

5.3 Financial Sector

- Strong partners will be needed to provide a stable environment for long term certainty.
- It will be essential to understand what national government's long term roles / commitments are.
- A clear understanding of identifying the market will need to be established.
- Financial risk: Feasibility and sustainability over the full life cycle of the project life (very long term) options could be to review project financing at strategic periodic intervals.

5.4 Mining sector

- The mining sector identified as the water generators.
- Priorities for the mines are to be in line with waste minimisation hierarchy which focus on prevention rather than treatment.
- Difficulties that need to be addressed include:
  - Sustainability of RO treatment plants which generate water but generating large

volumes of waste. This is not sustainable. In some cases, the legislative drivers result in behaviour that is technically incorrect, but implemented to remain compliant – policy revision should be considered;

- Addressing sustainability as the operations of water treatment into perpetuity is exorbitantly costly;
- The treated water is mostly discharged into local tributaries and not benefitting potential users. The environment is not conducive to recover treatment costs as it is not practical in some instances;
- Support for a strong institutional arrangement for the catchment management; and
- Small mines have low water requirements and generate smaller quantities of waste.

5.5 Water users

- Water users need to be identified.
- Consideration for the cost of getting water to the end users must be carefully communicated.
- Look at the possibility of supplying users with water at a cheaper cost than using treated water.
- AMD is a currently a hot issue which can be changed to into an opportunity.
- The Polokwane area charges users R50 per kℓ once the 20 kℓ mark has been exceeded due to the water scarcity in the area.
- The Polokwane effluent treatment plant receives less water despite a positive population growth. The cost of water is therefore changing the behaviour of the users.
- There have been issues of maintenance and upgrading of effluent treatment plants. AMD treatment plants should be maintained and managed effectively.
- A suggested tariff model:
  - Domestic users (rural or lower end users) receive 6kℓ at no charge;
  - Users who can afford the water can manage their requirements ito an equitable volume at a good and equitable price; and
  - Industries and mining users will use large volumes of water and charged an acceptable tariff.

5.6 Implementers

- Costs for treating effluent are higher than the average cost of supplying the treated water to users.
- Maintaining the schemes – Summary of Infrastructure Plans (SIP3 and SIP5).
- The Olifants River Catchment should not be considered in isolation - other catchments must also be considered.
- There is ample capacity to support any engineering and construction – with focus on

feasibility studies, designing, building, operating and commissioning a plant. Generate operations and maintenance manuals for the water treatment plant/s.

5.8 Social

- Tariffs need to be considered for water users.
- Communities surrounding the mines need to benefit.
- Participation of this scheme could assist with social responsibility credits.

6. POLICY AND INSTITUTIONAL ISSUES

- Mr Derek Weston (Pegasys Strategy and Development) presented on policy matters pertaining to this project.
- Ms Barbara Schreiner (Pegasys Strategy and Development) presented on institutional matters pertaining to the project.
- *Comments that were raised based on the policy presentation:*

6.1 Implementer

- An institution needs to be identified to drive the whole process.
- The market for the water needs to be identified.
- The role of the regulator and the cooperating spheres of government need to be clear.
- The project presents an opportunity to look at the bigger scheme and not just the Olifants Catchment.
- Window of opportunity. Costs of alternatives could be higher.
- Costs could be spread to offset treatment and infrastructure costs (regional tariffs).

6.2 Regulator

- The regulator agreed to look into the current licence conditions and Receiving Water Quality Objectives (RWQO) to make discharge of treated water into tributaries more feasible. It was noted that in some cases, the current discharge quality standards are set at drinking water quality and discharge takes place to already dirty streams.
- Regulator should become a partner in the scheme.
- Opportunity – single biggest source of pollution are the ownerless mines that must be included in this scheme. This will have marked positive environmental effects.
- The Department of Mineral Resources (DMR) should be actively involved in this project.
- Key questions:
  - How do mines join the scheme at a later stage?
  - How are smaller mines with shorter life spans accommodated?

- How do different mining sectors fit into this scheme?
- How are municipalities incorporated in this scheme?

- Capitalise on the support from political leaders for the Strategic Water Partnership Network (SWPN).
- SWPN is prepared to assist government.
- Local authorities in the Upper Olifants Catchment have more capacity than some others. They are aware that if the water gets exported they may lose it. The reconciliation strategy should consider the financial implication as municipalities can only take on what they need.
- Water transfer from the Mpumalanga Province to the Limpopo Province will gain a lot of public attention.
- Long term planning (100+ years) is required.

6.3 Financial

- Pricing policy is currently under review.
- Water pricing for the municipal sector is complicated.
- Public and private institutions – difference in pricing structures as there are different purposes for the water use.
- A water users association and/or a joint venture will help implement this type of project and is considered a positive from a banking perspective.

6.4 Mining

- A narrow view on the polluter pays principal could be prohibitive as the costs to operate and maintain treatment plants into perpetuity becomes exorbitantly expensive.
- Small scale mines cannot afford to invest in large infrastructure projects.
- Once size does not fit all. Large and small mines do not generate the same volume and pollution.
- Mines will become smaller in the future.
- Distinguish between the actual funds versus a book entry for rehabilitation and closure. Provisions can over time become large sums of money that needs to be managed.
- Tax efficient investment opportunity can be a potential opportunity for mines.
- Rehabilitating the land to the same state prior to mining may not be the best technical option for water management purposes.
- Foreign corrupt practices policies and unfair competition rules for mines could be a constraint. Because water is not a mine's main business, involvement could be scrutinised in terms of the above.

- External lobby groups play an important role as an independent watch dog.
- Mines are committed to find a better way to utilise the water resource.

7. WORKSHOP DAY TWO

- Dr. H Snyman (Golder Associates Africa) presented a summary of the deliberations of the first day of the workshop.

Comments that were raised on the presentation:

- Any new resource development will in itself be expensive ito R/m^3.
- Water treatment during the life of mine it is more affordable.

The following issues regarding the management of public perceptions were identified:

- Believed perceptions:
  - There is a perception that it is not possible to treat AMD to potable standards;
  - A perception is that mines are just trying to move their liability on to the public. Mines understand their liability and also recognize that there is AMD water available for a stressed water catchment and they want to assist in meeting the catchment water requirements needs;
  - Perception that we have enough water in this country – so people don't understand why they should be drinking treated AMD or other effluent;
  - Perception that treated AMD for potable uses has negative health implications; and
  - Public have a lack of understanding regarding desalination technology.
- Public perception is often informed by the media which create inaccurate perceptions.
- Message of the water scarcity should be addressed on a national scale. Such messages should come from "honest brokers" such as WRC (Supported by the same message from DWA and WISA as well).
- The AMD message should be presented in a manner that the person on the street can clearly understand what reuse of treated AMD entails.
- Messages cannot be once off. It needs to be a long term communication drive.
- A trust worthy institution needs to be developed for this type of scheme to work optimally to address public concerns.

8. FINANCIAL AND PRICING CONSIDERATIONS

K Johnstone (Golder Associates Africa) presented on financial and pricing considerations for this project.

Comments that were raised based on the key points presentation:

- Water will become more expensive irrespective of the option pursued.
- Interventions will be an attractive option to private investors at the right economy of scale.
- Bilateral arrangements may be more profitable than a regional scheme. Feasibility studies will inform the best financing options.
- There needs to be an incentive to tap into a regional scheme compared to the status quo, each mine man ageing their own problems which is easier.
- Not all coal is the same, different coal and mining methods cause different pollution. This should be kept in mind when it comes to costing.
- Rapid advances in technology - flexibility to adapt as technology improves.
- Waste generation forms part of the total cost. This is an R&D opportunity to investigate waste minimisation and revenue generation from waste products.
- Waste discharge charge standards could be linked to tariffs.
- The salt load in the coalfield basin is at a critical level. Pollution management need to be carefully planned.
- A competent operator will be required to manage the treatment plant should be implemented by a trustworthy institution – institutional arrangement.
- Opportunity to identify new markets for the treated water.
- Regulator needs to develop the “rules of the game” regarding water pricing.
- Different pricing/business model are to be investigated.
- It is important to understand the elasticity of the price for water before implementing a price tariff.
- Water scarce areas will be priced higher and users will be prepared to pay the premium.
- It should be established how government will participate with regards to the defunct mines.
- The institutional arrangement should include members from the DWA and DMR.
- A regional scheme would financially assist the small mines.
- A Water User Association (WUA) was set up for the Middle Olifants representing the mines, local municipalities and the DWA. Treasury was involved in the funding through reimbursement. Learnings from this case study should be documented.
    - DWA used the private sector to construct maintain and operate the local scheme; and
    - Reimbursement is based on take-off agreements for the water guaranteed by treasury.
- The pricing model needs to be structures in a fair manner. The private sector should pay for their liability and public sector pays to get the water to a “fit for use” standards and

delivery.

- The solution needs to be sustainable.
- Clarity on how costing is structured should be clearly communicated to stakeholders (transparency).

9. WRAP UP AND THE WAY FORWARD

- Institutional arrangement – the water users will have to proactively get organized and deal with this. The institutional arrangement will need strong involvement from municipal, agriculture, DWA and the mining sector.
- We need to get clarity on what we are actually talking about – assets operating models and provide clarity on options being considered.
- A water policy and strategy need to be developed.
- The business case – this should help to move towards sustainability.
- WSPN need to be actively maintained and supported.
- Combatting a perception of AMD – communication strategy plan need to be developed and implemented.

GOLDER ASSOCIATES AFRICA (PTY) LTD.

H. Snyman

IWWMP Consultant

HS/mc

https://afpws.golder.com/sites/p2614874nepadswspphase1/meetingsandminutes/minutes/12614874_min_002_workshop_18mrch13.docx

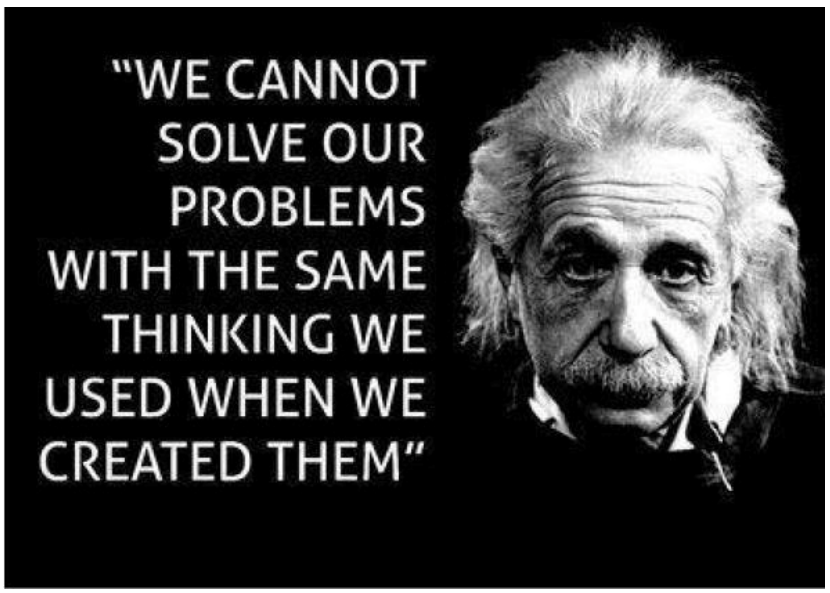
www.wildcard.co.za

Effluent and Waste Water Management (EWWM) of the Strategic Water Partnership Network (SWPN)

Using Treated Acid Mine Drainage to Close the Water Gap in the Olifants River Catchment - Issues, Opportunities and Constraints

NEPAD BUSINESS FOUNDATION

Golder Associates



April 9, 2013

Background

- EWWM of the SWPN developed Phase 1 scope of work
- The secretariat of the SWPN at the Nepad Business Foundation appointed Golder Associates Africa in association with Pegasys Strategy and Development for the Phase 1 of the project
- The purpose of this phase of the project is to establish the **issues**, **opportunities** and **constraints** inherent in the treatment and re-use of AMD to provide an enabling environment for private sector participation in the sector in relation to:
  - Water policy
  - Institutional arrangements
  - Water pricing models
- The study area: Mpumalanga Coalfields including the Upper portions of Nkomati and Upper Vaal, the Upper and Middle Olifants Catchment

Methodology

- Executive background document
- Identify issues, opportunities and challenges
  - Discussion documents
  - Participatory analyses

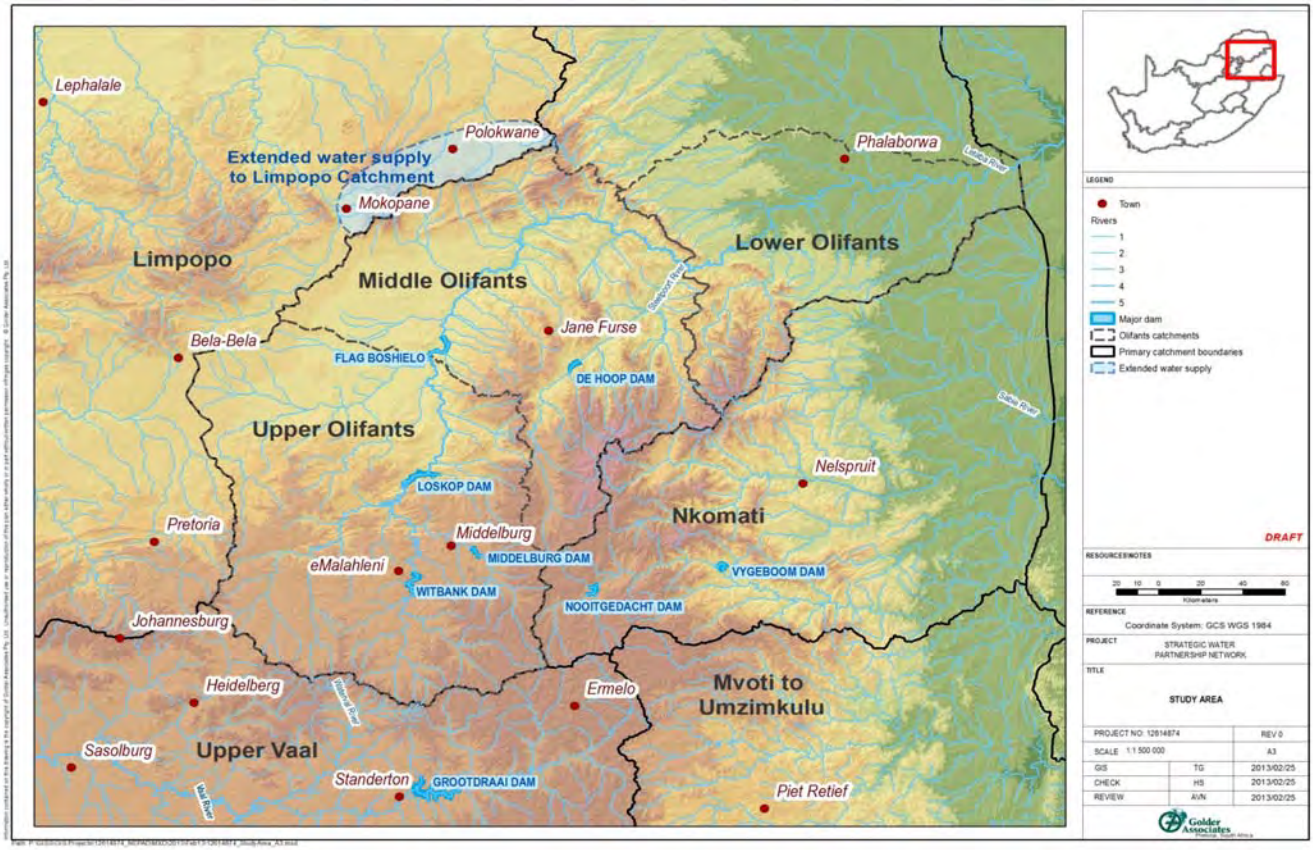
Key outcome: Joint definition of problems to be addressed in AMD treatment and re-use, on both technical and institutional levels, through adaptation of institutional and pricing arrangements

- Final document including agreed problem statement and Scope of phase II and III

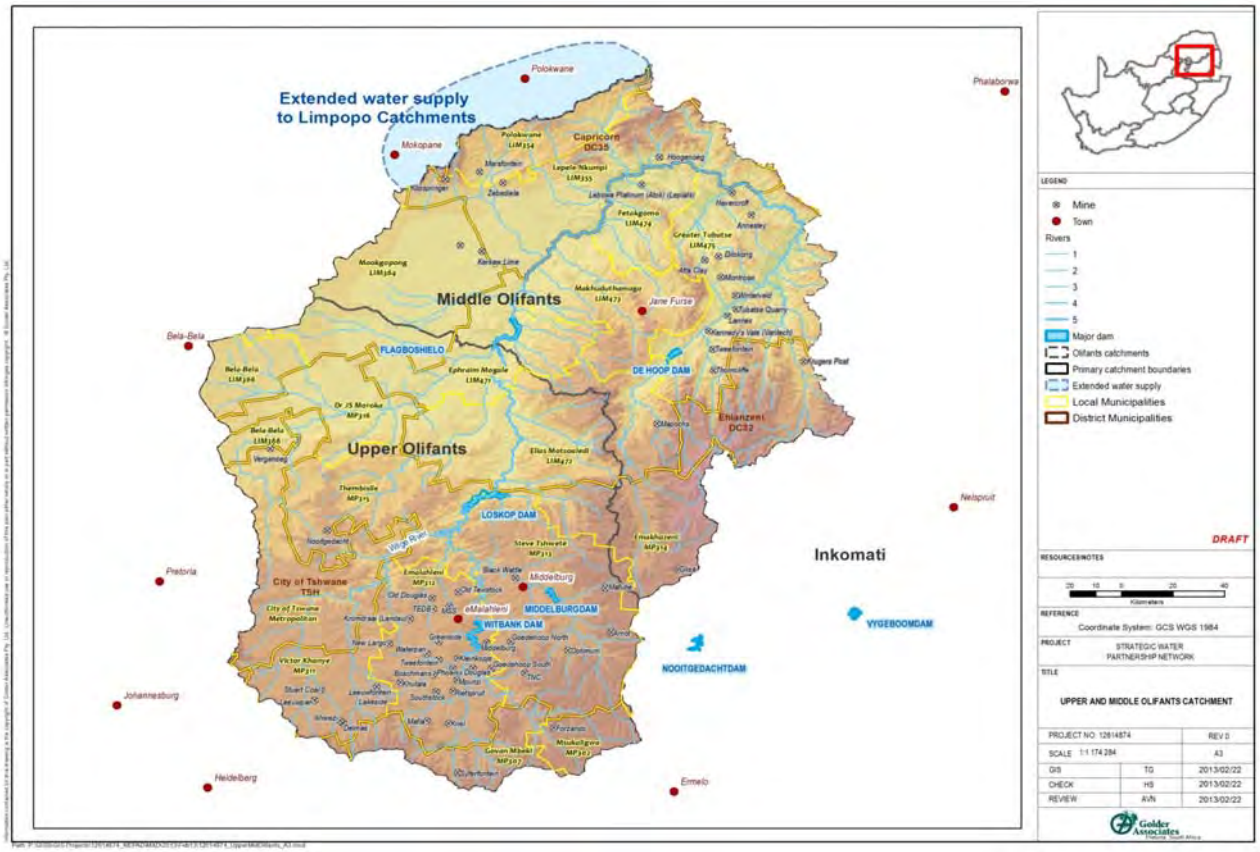
Business “un-usual”

- Not new: AMD treatment and re-use is technically feasible
- New: Using treated AMD to narrow the water imbalance on a **catchment level** and as part of the **catchment level planning and reconciliation**
  - Need to mobilise organisations that were historically not actively involved in water treatment and supply.
  - It’s business “un-usual” and naturally cause discomfort amongst role players because it implies working (and in some cases accepting responsibility and accountability) on a complex issue.
  - Requires crossing many disciplinary boundaries to create a holistic approach and solutions
- Purpose of inception report: Information document aimed to create a baseline understanding (inclusive level of reality) from which we collectively work from

Study area



Upper and Middle Olifants Catchment



Upper and Middle Olifants Catchment

Current and Future Water Balance of Upper and Middle Olifants River

	Upper Olifants River				Middle Olifants River			
	2010		2035 (high growth)		2010		2035 (high growth)	
	million m^3/a	Mℓ/day	million m^3/a	Mℓ/day	million m^3/a	Mℓ/day	million m^3/a	Mℓ/day
Water Requirements	609	1668	631	1729	187	512	311	852
Available Water Resources	630	1726	641	1756	185	507	284	778
Environmental Water Requirements	40	110	40	110	57	156	57	156
Surplus/(Deficit)	(19)	(52)	(30)	(82)	(59)	(162)	(84)	(230)

- Without some water resources intervention schemes, a water deficit will continue to exist in parts of the Upper and Middle Olifants River catchment

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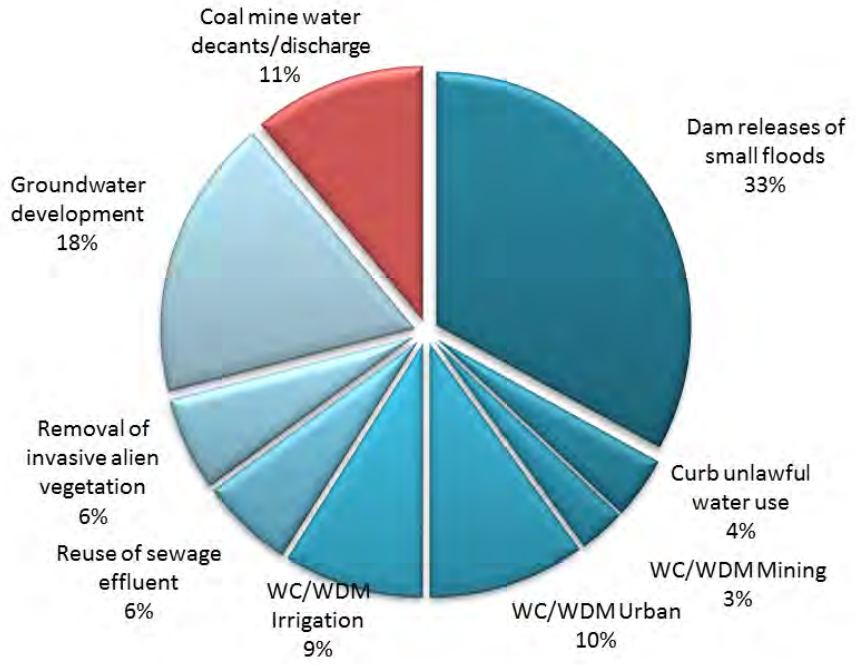
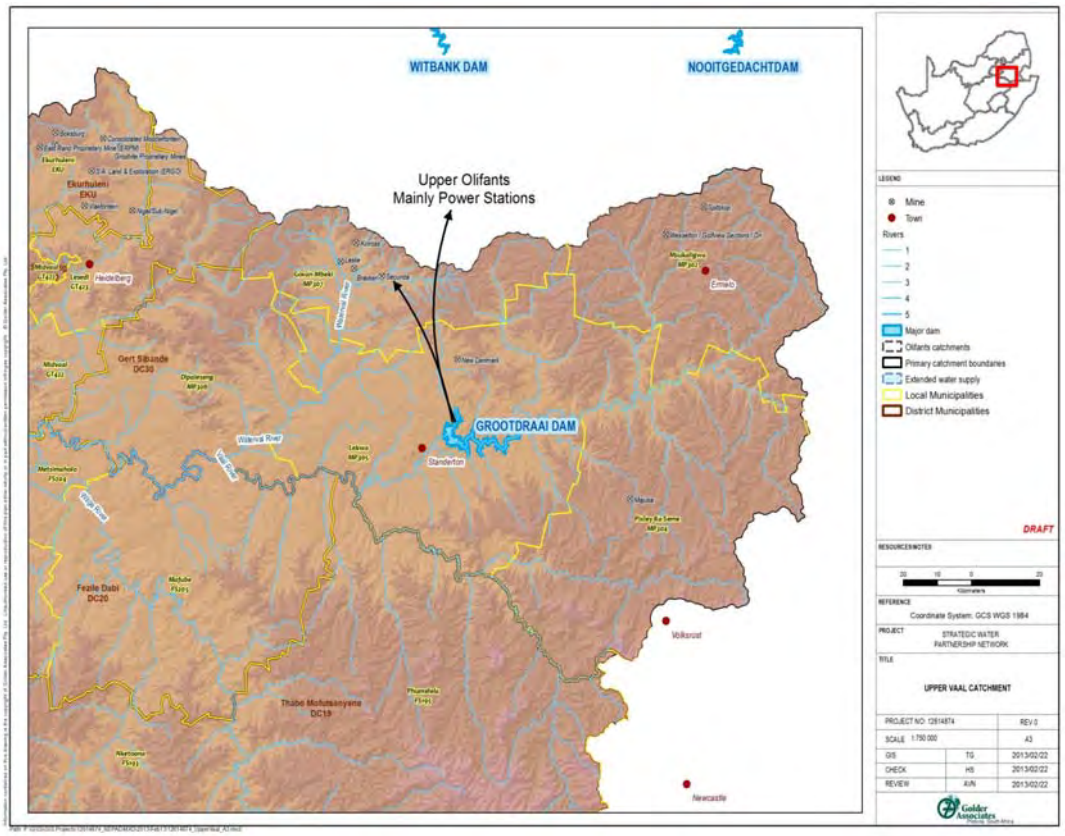
Reconciliation strategy – proposed actions



Olifants Reconciliation Strategy

- The successful implementation of all the proposed actions could result in an excess of available water in the **Upper** Olifants River but this water will be required to support the **Middle** Olifants River.
- The **Middle** Olifants River is faced with significant future water deficits.
- Commissioning of the De Hoop Dam will relieve the water deficit conditions in the Steelpoort area, while the main stem of the **Middle** Olifants River will remain dependant on:
  - Excess water from the **Upper** Olifants River
  - Reclamation and re-use of Mokopane and Polokwane sewage
  - Groundwater development (this may be too far downstream of the main water stressed areas to be an economical option).
- DWA Reconciliation Strategy indicates that over time **20 – 40 million m^3/year (55 – 110 Mℓ /day)** is required to augment the **Middle** Olifants River

Upper Vaal Catchment



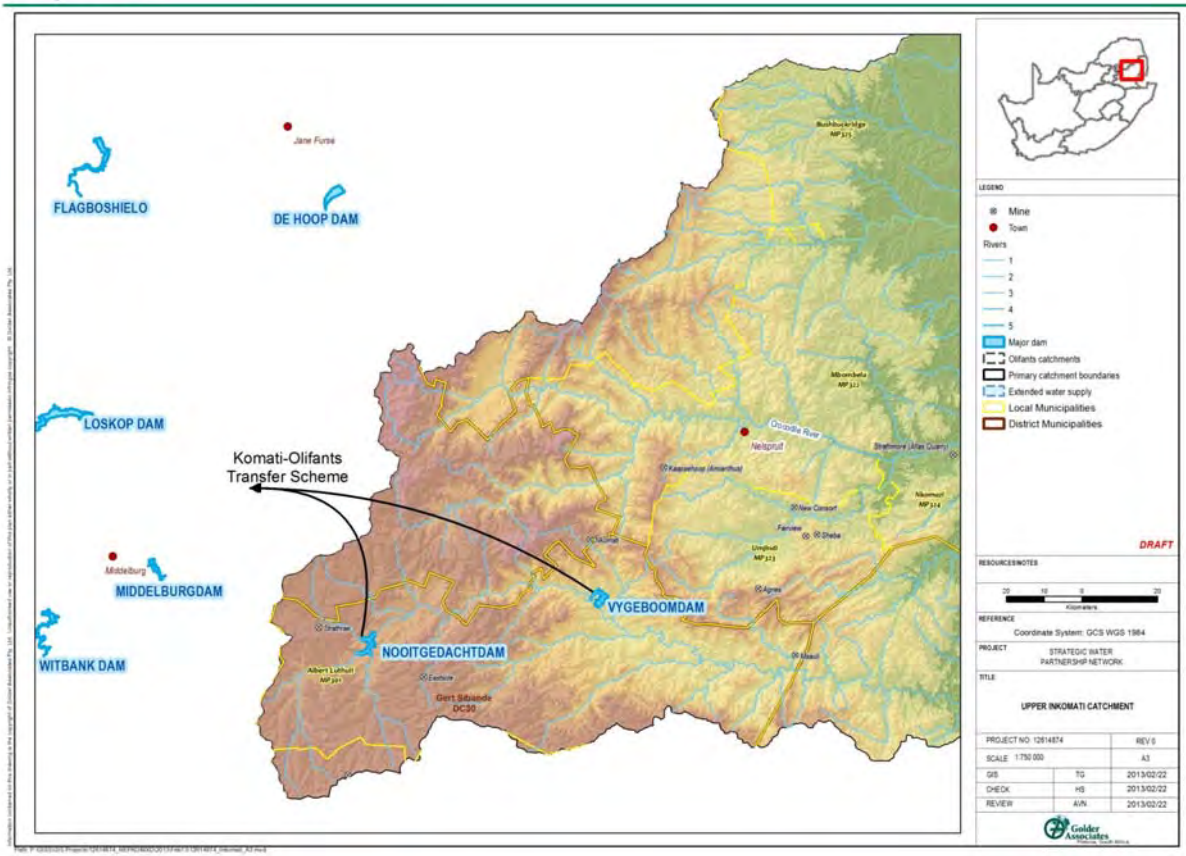
Upper Vaal Reconciliation

- Reclaimed AMD from the Witwatersrand mining basins would form an integral part of the Vaal River water resource and it is unlikely that this water would be available to close the gap in water availability in the adjacent Olifants River catchment.
- The treatment and reclamation of AMD from the Witwatersrand gold mining basins is key:
  - Removal of the salt load contribution
  - A drop in the need for additional water to effectively dilute the AMD associated salinity load has the potential to postpone the need for the next major water augmentation project, which will probably involve inter basin transfer of water to the Vaal
  - Treated AMD would constitute an additional source of high-quality reclaimed water in the Gauteng heartland, which is the single biggest water user node in the Vaal River system.

Upper Vaal Reconciliation

- Water is already transferred from the upper Vaal (Grootdraai Dam) to users in the upper Olifants River catchment specifically to the petrochemical and power generation sectors.
- Assistance to satisfy the water needs In the Olifants River catchment therefore already takes place.
- The biggest threat to this water transfer is the risk of deterioration in water quality. It is unlikely that the relatively small mines in the upper Vaal, many of which are closed and defunct could supply significant water volumes to the Olifants River catchment.

Upper portions of the Nkomati



Upper portions of the Nkomati - Reconciliation

- Inkomati Catchment is also in a state of stress (water allocation is higher than availability), especially once the Ecological Reserve is implemented.

Reconciliation of water requirements and available water for the year 2003 for the Nkomati (West of Swaziland) sub-catchment

Description		Volume (million m^3/a)	Volume (Mℓ /day)
Available water	Local yield	118	323
	Transfer in	0	0
	Total	118	323
Water requirements	Local requirements	50	137
	Transfers out	109	299
	Total	159	436
Balance		(41)	(113)

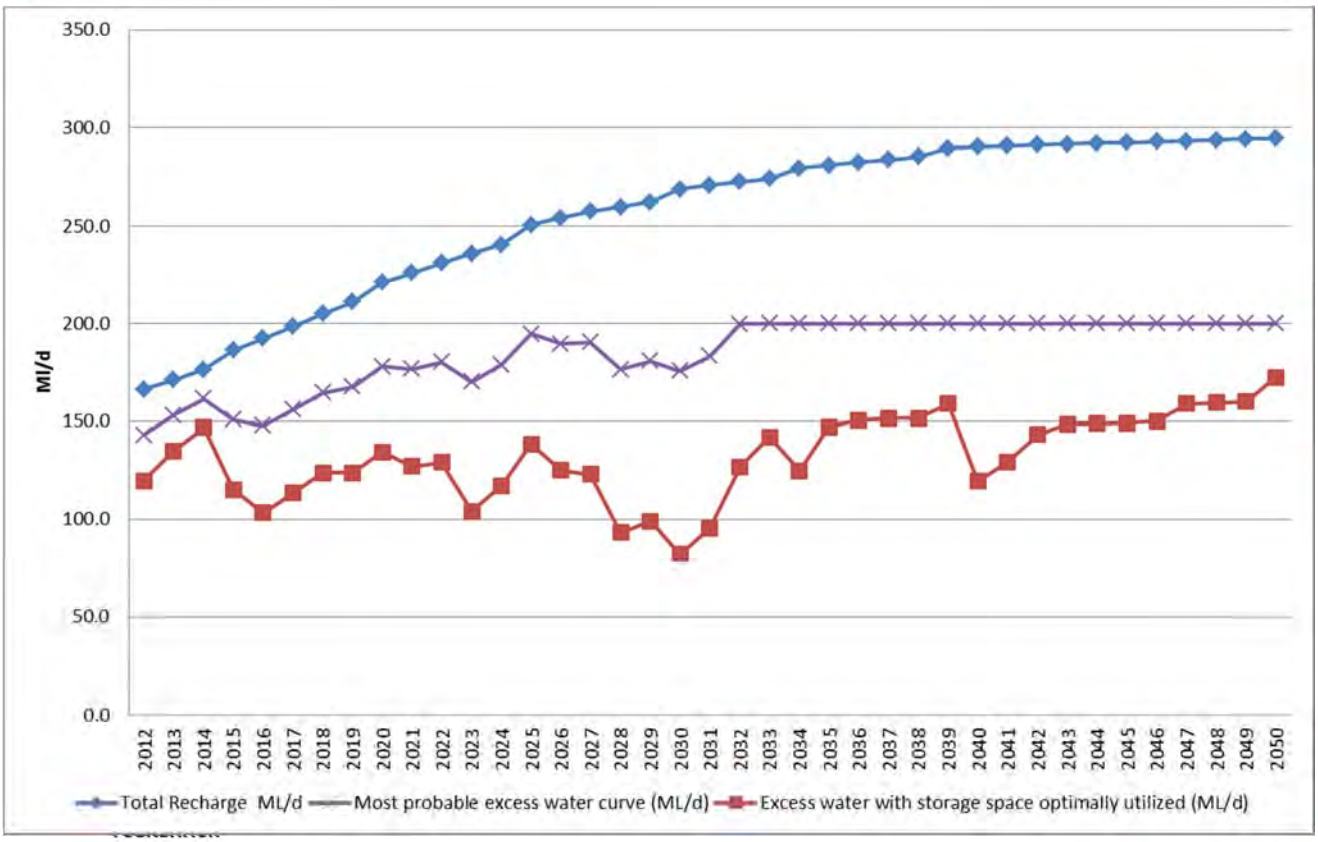
Upper portions of the Nkomati - Reconciliation

- This part of the Nkomati River Catchment already has a deficit, mainly due to the substantial transfer of water from the catchment.
- Potential additional sources of water, such as treated AMD should therefore preferentially be used to satisfy local water requirements.
- Existing interbasin transfer from the Nkomati River Catchment back to the Olifants River catchment augments the water supply to specifically the power generation sector users on the Highveld Coalfields.
- While coal mining activities are now established at the headwaters of the Nkomati River catchment, it is unlikely that treated AMD would constitute a significant additional water resource.
- The biggest threat to this water resource remains the potential impact on the water quality and the fragile eco systems associated with potential AMD decants to the natural water systems.

Generation and treatment of AMD

- Generic description of AMD generation
- Mine water recharge in the Upper Olifants
- Joint Investigation Agreement (JIA) established by the major mining companies and ESKOM consolidated the available information for the entire Highveld Coalfields.
- A Coalfields wide water situation was quantified by evaluating the water balance information at the level of individual mines.
- This was then aggregated to the level of sub catchment and for the entire upper Olifants catchment

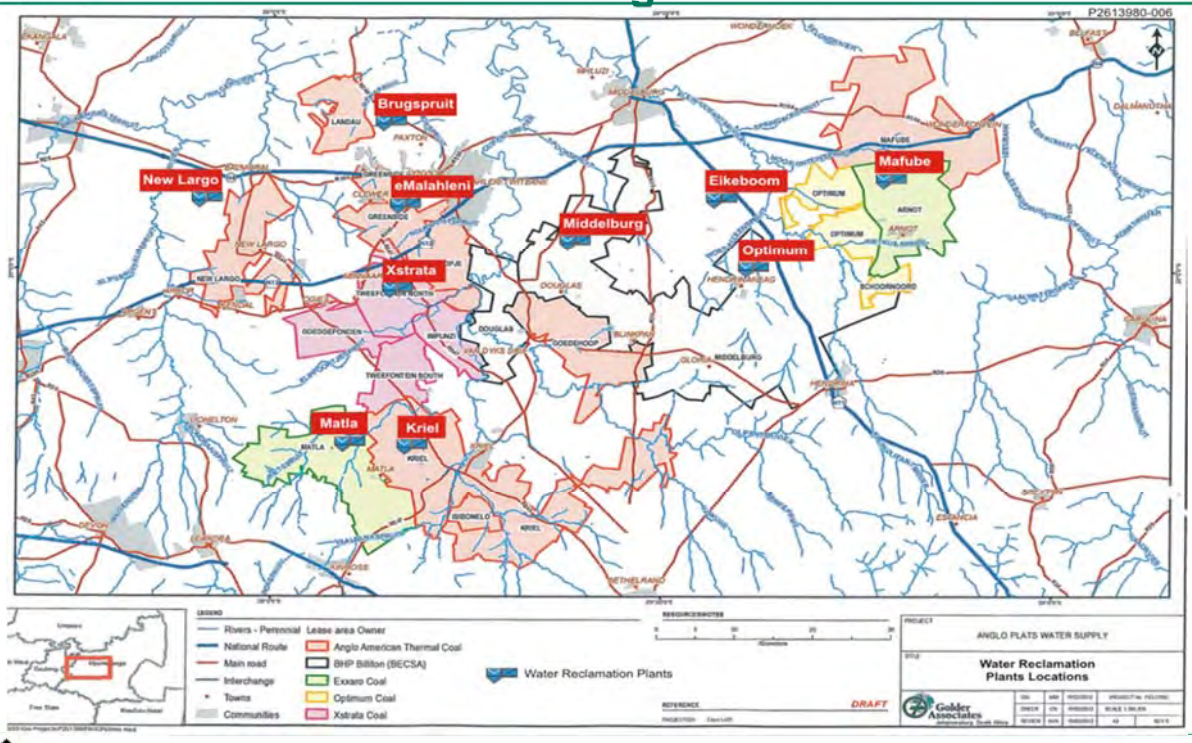
Overall recharge and excess mine water (ML/d) in the Upper Olifants River study area



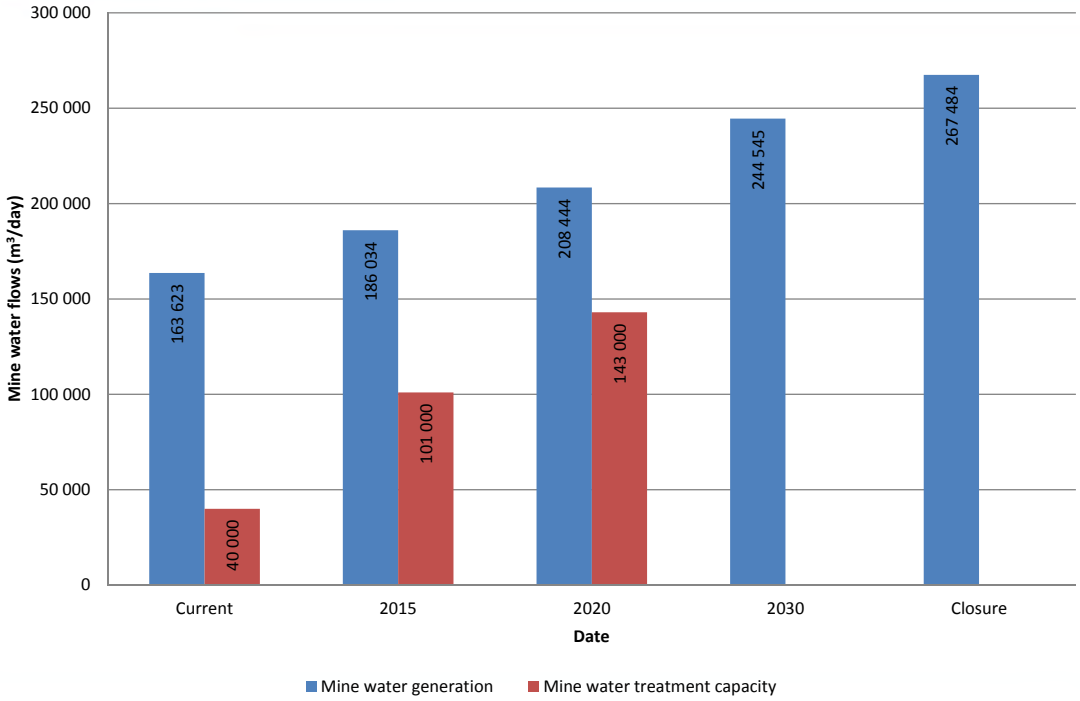
Best estimates - water make and excess mine water

- There is a steady rise in the mine water recharge (reflecting the total water arising in old and existing mine workings) from a current best estimate of 170 Mℓ/day (62 million m^3/a) eventually approaching 300 Mℓ/day (110 million m^3/a) towards the end of the life of the Coalfields;
- Estimated excess water volumes in the range of **100 - 150 Mℓ/day (36 - 55 million m^3/a)** is available on the Coalfields assuming that maximum utilisation of all available storage in old workings will take place; and
- A more realistic estimate of the most probable excess water volume making practical use of readily available storage is in the range of **150 to 200 Mℓ/day (55 - 73 million m^3/a)** over the next 20 years.
- An important technical issue to address and agree on is to distinguish between the so called “old” and “new” water.

Existing and planned Mine Water Treatment Schemes on the Highveld Coalfields



Estimated mine water recharge and projected installed treatment capacity



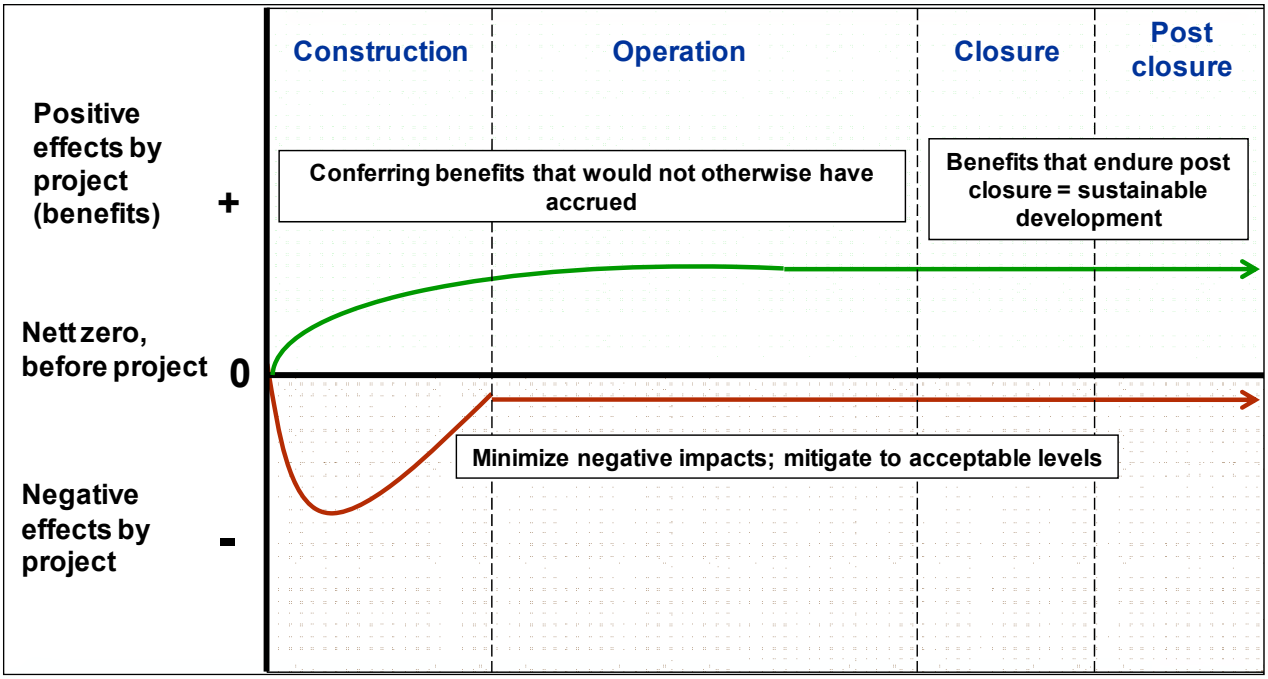
Considering a Regionalised Approach

- Many of the existing and planned projects will discharge excess reclaimed water to the nearest convenient stream or river
- This results in discharges to relatively small streams, typically with multiple small dams constructed
- The opportunity for run-of-river irrigation abstraction is enhanced
- The result may be that substantial losses before the water reaches the main stems of the Olifants River
- A coordinated, regional approach is therefore required to close the water gap in the Olifants Catchment and specifically in the Middle Olifants

Considering a Regionalised Approach

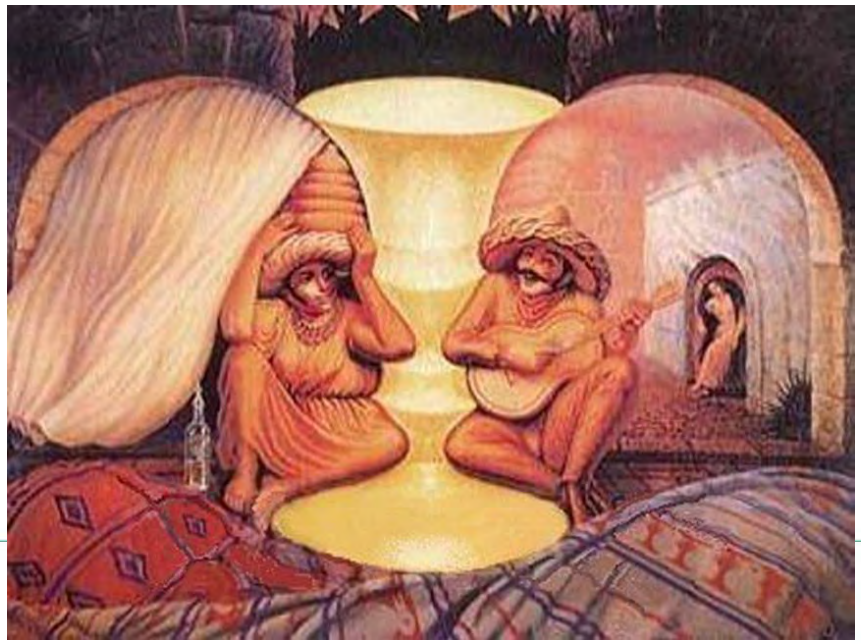
- No Coalfields wide institution exists to coordinate and integrate the development of mine water reclamation projects with respect to:
  - Cooperation on a regional basis
  - Optimized location and sizing of infrastructure and plants
  - Selection of treatment technology
  - Collaboration with respect to the use of waste and by-products
  - Coordination on the best use of the reclaimed water
  - Development of consistent water tariffs

Sustainable development considerations



This workshop

- We tend to jump into solution mode
- We all expect a different output
- We see things differently …. And change our minds



New thinking

"If you want new thinking, ask new questions."

Lee Clow's Beard

LHBS

Questions and comments

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Ap

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Policy issues, opportunities and constraints

Derek Weston

PEGASYS Strategy and Development

Introduction

- There are a number of policy instruments which are relevant when considering the treatment and re-use of Acid Mine Drainage (AMD).
- Largely, the mining industry is regulated by National Government, but also through Provincial Departments where applicable and this largely applies to environmental protection procedures that are required.
- For the purposes of this study the most important Government Departments, in terms of establishing the policy and legislative frameworks are, therefore:
  - Department of Water Affairs;
  - Department of Environment Affairs; and
  - Department of Mineral Resources.

Policy Instruments

Policy & Legislation	Key points of Relevance
South African Constitution (No. 108 of 1996)	▪ Every person has the right to a clean and healthy environment. ▪ The environment is to be protected for the benefit of present and future generations.
Environment Policy for SA, 1996	▪ South Africa has relatively high levels of waste and pollution impacting on air, land and water. Waste disposal practices are unsatisfactory. ▪ Those responsible for environmental damage should pay the repair costs both to environmental and human health, and the costs of preventative measures to reduce or prevent pollution and environmental damage
National Water Policy for SA, 1997	▪ Equity in access to water resources. ▪ Equity in access to the benefits accrued from water use. ▪ Balance water use with the protection of the resource in such a way that the resources are not degraded beyond recovery. ▪ The process of balancing social and economic benefits as well as of determining environmental objectives should involve those affected, or their representatives, in weighing up the options on an informed basis. ▪ Protection of water resources will be enforced through a system of source-directed measures, including the registration of sources of impact, standards for waste discharges, best management practices, permits and impact assessments. ▪ To encourage a reduction in pollution, a system of economic incentives will be put in place…….Funds raised in this way should be used for resource quality management and protection activities.

Policy Instruments

Policy & Legislation	Key points of Relevance
Minerals and Mining Policy for SA 1998	▪ Three key areas for policy and regulation: the environmental impact of exploration; the environmental impact over the life of a mine and the provision of financial assurances for current and future mine site rehabilitation; and rehabilitating sites where mining activity has ceased. ▪ Government will have to ensure that the costs of environmental impacts of the mining industry are not passed over to the community. ▪ The principle of 'the polluter pays' is relevant to the regulation and enforcement of environmental impact management measures and standards.
The National Environmental Management Act (No. 107 of 1998) - NEMA	▪ Provides the guiding legislation and framework for environmental management in South Africa. ▪ Obliges anyone who pollutes or degrades the environment to take reasonable measures to stop doing it. ▪ If pollution cannot be reasonably avoided, to minimise and put right the damage.

Policy Instruments

Policy & Legislation	Key points of Relevance
The National Water Act (No. 36 of 1998) - NWA	▪ Emphasises the effective management of South Africa's water resources through the basic principles of Integrated Water Resources Management. ▪ Seeks to achieve social equity, economic efficiency and ecosystem sustainability. ▪ Obliges any user of water to avoid/minimize pollution of water resources. ▪ Stipulates that water use authorizations must be obtained for all water uses. ▪ Provision for penalties.
The Minerals and Petroleum Resources Development Act (Act 28 of 2002) - MPRDA	▪ Legislates the official policy concerning the exploitation of the country's mineral resources. ▪ Provides for the environmental sustainability of the mining industry. ▪ Requires that an environmental impact assessment be undertaken for mining operations. ▪ Enables penalties for non-compliance.

Policy Instruments

Policy & Legislation	Key points of Relevance
National Environment Management: Waste Management Act (2009) - NEMWA	▪ Aims at protecting health, wellbeing and the environment. ▪ Encourages minimisation of consumption of natural resource. ▪ Avoidance and minimisation of the generation of waste. ▪ Reuse/recycling and recovery of waste. ▪ Treatment and disposal as a last resort. ▪ Aims to set standards on a national, provincial and local level for waste generation.
Water Use Regulations (Government Notice No. 704)	▪ Provides regulations on the use of water for mining and related activities aimed at the protection of water resource.
Water Conservation and Water Demand Strategy for the Industry, Mining and Power Generation Sectors (2004)	▪ Promotes efficient use of water through water conservation and water demand management. ▪ Provides some best practice.

Policy Instruments

Policy & Legislation	Key points of Relevance
National Water Resource Strategy (NWRS) (2013)	▪ Provides core strategies for water resource management for the next five years. ▪ Core strategy to optimize and stretch the available water resources (groundwater, water re-use, desalination (including seawater), water systems optimization and rainwater harvesting). ▪ Provides a technical strategy for water re-use.
National Waste Management Strategy (2012)	▪ Follows the waste management hierarchy. ▪ Presents a long-term plan for addressing key issues, needs and problems experienced with waste management in South Africa.
Environmental Management Plan for prospecting rights or mining permit (May 2004)	▪ Supports the standardisation of Environmental Management Plans. ▪ Provides alignment with Regulation 52 of the Minerals and Petroleum Resource Development Regulations (2004).
Best Practice Guidelines for Water Resource Protection in the South African Mining Industry (DWAF, Series A, G and H) (2008)	▪ A series of guidelines providing best practice relating to water resource management and resource protection for various mining operations and activities. ▪ Provides clear visual and technical Checklists for best practice are provided.

Principles and assumptions

- Water is to be managed in an integrated manner and the different water sources and water uses ought to be coordinated.
- Water is a valuable natural resource that must be applied in a socially equitable manner, driving economic development with adequate protection of the natural aquatic ecosystems.
- Department of Water Affairs is the custodian of the national water resource, water cannot be owned, but a person or legal body can be granted a license to use water in a certain manner and compliant with license conditions.
- The polluter pays principle recognises the responsibility to pay for water containing waste which is discharged back into the environment and creates strict liability for an owner or possessor of land on whose land an activity or process causing pollution has been performed.

Principles and assumptions

- Under licence conditions, you are required to clean your discharge to a certain standard and to return this to the environment.
- Mines have responsibility to rehabilitate land upon completion of mining activities so as to minimise the environmental impacts thereafter. Responsibility for the environmental impacts after mine closure remains with the mine.
- In the case where a mine is found to be ownerless, then the state will, through the Minister of Mineral Resources, take up the responsibility to rehabilitate the land.
- The liability towards environmental impact cannot be transferred to the State.

Key policy issues

- **Cooperative governance and alignment** : Broad alignment of policy and legal intent, there is a need to improve the alignment between the various instruments.
- Mine water is recognized as a **potential water resource**, both in the negative sense but also in a positive sense
- **Clarity of Authorisation for Water Reuse**: There will be a clear requirement to obtain the necessary regulatory authorisations.
  - There is not the automatic 'right' to use the water. There is an obligation to return the water to the resource. The DWA would need to deliberate over how that additional water is best used
  - What type of water use licence required?
  - As a bulk water supplier for the purposes of water service provision, a form of off-take agreement may be required?

Key policy issues

- **Process issues for authorisations** are not entirely clear and do seem to require clarification.
- **Regulation and oversight**: The regulatory hierarchy is not clear. The NWRS-2 articulates that DWA should take the lead.
- **Regulatory capacity** to deal with multiple regulatory agencies/authorities and with active participation by multiple stakeholders…already see long delays in taking decisions on water use licenses and limited guidance given to mine water related aspects
- **Capacity** of several role-players in the water sector, specifically the local authorities and municipalities
- **Managing risk:** It will be essential to manage the various risks involved. The policies do place considerable emphasis upon the need to ensure environmental and human health standards are met.

Key policy issues

- **Contracts and agreements**: Would require a contract with the water services authority, for bulk water supply
- **Ownerless mines**: Little to nothing in the policy documents that really provides some form of description of Departmental roles and responsibilities, and any procedural hierarchy regarding ownerless mines.

Opportunities

- **Strategic intent**: There is a general 'sense' that the policy still holds. Subsequently, refinements in approach, within the policy frameworks, are articulated within strategy documents such as the NWRS-2 (2013) and the NWMS (2012), amongst others.
- **Chapter 5 of the NWRS-2** focuses in on alternative sources of water to supplement our conventional sources of water. It is noted that accessing these non-conventional sources of water is neither easy nor inexpensive.
- **Shared risk**: NWRS-2 through Core Strategy 11 notes the importance of shared water security risk. This strategy emphasises the importance of partnerships between business, government and civil society to manage these risks.
- **Water re-use:** There is recognition of the benefits of re-use. Most significantly, the latest version of the NWRS 2 (2013) provides a technical strategy towards this end. Technical Strategy 7 of the draft NWRS 2 does note:
  - The need to develop clear and practical guidelines
  - The Department will work with other national departments to align legislation, reduce the regulatory burden wherever practical, and unblock regulatory obstacles to water re-use; and
  - The Department will act as the lead regulatory authority

Opportunities

- **Revision of key strategies**: Both the Pricing Strategy and the Waste Discharge Charge Strategy (WDCS) are under review with a view to implementation in the coming period.
- Water resources in the **Olifants River catchment** are over-allocated with not many options to reconcile the available water and the water requirements.
- The opportunity exists to revise and update existing policies and strategies
- Project provides an **opportunity** to update and provide input to DMR strategy on the regional mine closure from the perspective of collaboration and productive use of mine water.

Constraints

- **Government alignment**: Departments still seem to be working in silos and policy amendments still seem piecemeal. Can expect disjointed and lengthy processes
- The current water and mining **policies and strategies** do not address the complex issue of unconventional water resources such as mine water.
- There are concerns regarding the **regulatory capacity** to provide leadership in resolving the principal issue of mine water reuse, as well as the allocation of unconventional water sources to different competing water uses in the catchment.
- Policy clarity on the **mobilization of the private sector** and specifically mining companies in water resource development projects is needed.

Conclusion

- There is a broad policy alignment on matters relating to the polluter pays principles, the need to redress impacts, and aspects of liability.
- The policy falls short in terms of dealing with aspects of water re-use as well as use of non-conventional sources. NWRS-2 opens the door but there is still much to do.
- Policy amendments often done in isolation. Seems that suggested amendments are almost working against each other.
- Clarity on regulatory hierarchy and roles needed

Institutional issues, opportunities and constraints

Barbara Schreiner

PEGASYS Strategy and Development

Introduction

"The current challenges to effective treatment of AMD are not scientific or technical, but relate to institutional arrangements and funding." (Jo Burgess)

South Africa's acid mine drainage pollution inaction "comes from problems identifying who is responsible for paying for or doing the treatment, and deciding what type of water we want to produce by treating AMD".

Institutional issues…

- Who does what and through what structures/organisations

Principles and assumptions

- Institutional arrangements must be sustainable over the long-term to ensure management of AMD for as long as it continues
- Liability for managing AMD and rehabilitating mined land remains with the polluters/ land owners
  - What is the responsibility after mine closure?
- Responsibility for AMD management from ownerless mines resides with the State.
- Institutional arrangements should not transfer private risk to the public sector.
- Water is a public good that is allocated for use by the State in the public interest.

Institutional responsibilities

- DWA / CMA
  - allocating, authorising and controlling water use under NWA
  - ensuring compliance monitoring and enforcement
  - ensuring water users meet their licence conditions,
  - ensuring reserve requirements are met, and
  - ensuring water supply and demand are in balance to best extent possible.
- Dept of Environmental Affairs /Provincial Department of Environment
  - ensuring mines adhere to requisite environmental standards.

Institutional responsibilities

- Dept of Mineral Resources
  - ensuring that mineral resources of country are effectively developed
  - ensuring mines adhere to operating conditions
  - approve mine closure certificates
- WSA
  - ensuring access to water services for all inhabitants (and industry) within its area
  - would include decision to use mine water (or not)
  - may establish and/or contract a public or private body(ies) to provide bulk water services (i.e. bulk water services provider).
- Mines
  - discharging mine water according to authorisation conditions
  - monitoring
  - payment of waste discharge charges

Institutional issues

- What body(ies) might be responsible for developing and operating AMD treatment works
  - relationship with other groups (particularly the mines and local government);
- Scope
  - local level - single facility such as a building or a factory, for a group or cluster of facilities,
  - treatment facility level (for example, such as a municipal treatment works) or
  - river system level (natural drainage areas/catchments).
- Institutional capacity to carry out roles and responsibilities,
- Effective co-ordination between relevant bodies

Institutional issues

- Decision-making
  - Individual / groups of businesses, municipalities, national government, pubic entities
- What is the liability of mines after closure?
- What are the available institutional models
  - Is there a role for TCTA, water board, WUA?
  - Is a PPP an option?

Opportunities

- *"While many mines have established ad hoc chemical, biological or physical processes to treat localised water pollution, South Africa urgently needs a regional, consolidated approach to AMD". (Pat Manders)*
- Opportunity for innovative institutional arrangements to address the AMD problem and to turn it into an opportunity to contribute to the balance of supply and demand in the catchment.

Opportunities

- Coalfields-wide institution
  - coordinate and integrate development of mine water reclamation projects w.r.t:
    - Cooperation on a regional basis;
    - Optimized location and sizing of infrastructure and plants;
    - Selection of treatment technology;
    - Collaboration with respect to the use of waste and by-products;
    - Coordination on the best use of the reclaimed water; and
    - Development of consistent water tariffs.
- Private sector management, engineering and financing capacity
  - demonstrated by several successful water re-use projects in mining and industry
- International interest in local water re-use projects
- Potential and will to streamline licensing and monitoring processes between DWA, DMR and DEA
- Potential to develop industry/sector-agreed evaluation/ accreditation system for agencies/organisations implementing water re-use projects.

Constraints/challenges

- Weak management and performance of municipal run wastewater treatment plants
- Compliance and monitoring in the water management area is weak
  - to ensure compliance with authorised use of water in the WMA (including AMD),
  - to protect water quality
- Water re-use projects have sophisticated technical, engineering, financial, operational and maintenance aspects.
  - requires high level of confidence in implementation and operating agencies.
  - implementing body must be able to demonstrate minimum threshold of capacity / competency, before being considered capable of implementing water re-use project,
    - technical expertise, planning ability, project management capability, financial strength and rating
  - must be accepted by the community and stakeholders as a reliable organisation.
- Water re-use projects are high risk unless trained, capable and motivated operations and maintenance staff is available.
- Ensuring small mines are part of the process

Challenges faced by WUC

- Why did the Western Utilities Corporation fail?
- No clear reasons given by IMC for their rejection of the proposal
- Possible concerns :
  - Seen as transferring private risk to the public sector;
  - Necessary licences and approvals were not given by the state;
  - The plant would take two and a half years to functionality which was seen as taking too long.
  - Sludge treatment plant would take 8 years
  - Would result in a private monopoly of a water resource, that would be responsible for treating AMD across three basins and which was seen as intended to make a profit from the treatment of water;
  - Concern about the longevity of the mining companies that were the core shareholders of the WUC.

Some questions...

- Do we understand the water demands and availability sufficiently?
- Who makes the decisions?
  - Water quality standards
  - Water allocation
- Who enforces the decisions and rules?
- Who implements the treatment and through what institutional arrangements?
- Who pays?
- How does one handle long-term sustainability from the institutional perseptive?
- What can we do differently?

Conclusion

"The threat of AMD to the environment will not be solved in the short to medium term, and is likely to persist for centuries to come. It is also not solved by a single intervention, but will require the integrated implementation of a range of measures. Such measures include active water treatment ... passive water treatment systems (e.g. constructed wetlands), controlled placement of acid-generating mine waste, and prevention of water ingress into mine voids and of AMD loss from mine"

(Pat Manders).

FINANCIAL AND PRICING CONSIDERATIONS

OLIFANTS RIVER - CLOSING THE WATER GAP BY REUSE

Economics of Mine Water Treatment Schemes

- Illustrative lifecycle capital, maintenance and operating costs, and revenue:

Item	Unit cost (R/m^3)
Capital - initial	5.75
Capital – replacement	3.30
O&M	7.65
Total cost	**16.70**
Less: Revenue	-5.00
Net cost	**11.70**

Cost Allocation

- Between participating mines:
  - Capital costs are allocated by peak volume and quality specifications
  - Operating costs are driven by volume and quality of polluted water supplied
  - Revenue is allocated by volume

- Between polluters and beneficiaries:
  - Mine's obligation to treat to discharge standard
  - Supply of potable water requires changes to process and additional infrastructure
  - Additional costs should be passed onto consumers

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Revenue considerations

- Sale of product water:
  - A reasonable level for the price of water sold by the scheme to beneficiaries is the price at which the participants neither benefit from nor are disadvantaged by the sale of water
  - "Reasonable" price is that at which the NPV of the water supply subproject is zero
  - Capital is neither created or destroyed

- Water treatment fees:
  - O&M costs: actual costs in a period are allocated to each participant on the basis of the volume, acidity and salinity of the water they supply to the WTP

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Sustainability of MWTPs

- MWTPs will only be sustainable if sufficient revenue is earned to fund operating costs
- This could be adversely affected by the following:
  - Volumes of water sold are lower than the basis of costing, leading to an under recovery of costs
  - Actual unit prices for the sale of water are lower than the "reasonable" price
  - Participating mines cannot pay for the treatment of water or cannot supply the required volume of water to the MWTP

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Issues, opportunities and constraints (1)

- **Pricing:**
  - Discrepancy between "reasonable" price and unit prices for the sale of water by municipalities
  - But marginal cost of additional capacity for new water treatment plants is also higher than current water prices

- **Participation in regional schemes:**
  - Trade-off between economies of scale and loss of control
  - Terms of participation should allow some flexibility in water supply and say in the running of the scheme
  - Recognition by DMR as acceptable mine closure water treatment strategy
  - Institutional, contractual and financial arrangements for regional schemes more complex than individual mine schemes

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Issues, opportunities and constraints (2)

- **Participation in regional schemes (cont.):**
  - Local/national Government participation will require compliance with additional legislation such as PFMA and MFMA
  - Provides Government with a means of treated AMD from defunct mines

- **Potential markets :**
  - Mines, for process and potable water
  - Municipalities, for municipal water supply
  - Industrial users for process water
  - Agriculture, for irrigation and process
  - Eskom for power generation requirements

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Issues, opportunities and constraints (3)

- **Potential sources of financing :**
  - The State: The State could participate to treat AMD arising from defunct mines, and/or could invest directly in a regional scheme as with other water schemes
  - Mines: Mining companies could fund part of a regional scheme to address their water treatment needs or contribute existing MWTPs to a regional scheme
  - Closure funds: Mines may participate in a regional scheme for closure purposes, using their closure funds
  - Beneficiaries: Users of water supplied by the scheme may be prepared to invest instead of developing other sources of water

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Issues, opportunities and constraints (4)

- **Potential sources of financing (cont.):**
  - Investors: Private investors may be interested in funding the scheme for acceptable returns
  - Commercial banks may provide funding to the scheme, but it would be on commercial terms and subject to many risk management measures
  - Development funding agencies: The scheme may meet the requirements of development funding agencies such as the World Bank, the DBSA and bilateral funding agencies.

Discussion

- Questions?

Workshop Day 1

Key Points from Yesterday's Session

Status quo

- Current situation / sustainability
  - Challenges to the current AMD treatment
  - Who will pay?
  - Municipalities cannot afford the water
  - Local discharges – down stream unlawful water use
  - What happens after closure
  - Perpetuity financial provision (quantum) very high
- Mines are rethinking water management
  - DWA water management hierarchy is confirmed and realised
  - Rehabilitation is receiving more attention
  - Minimization of polluted water make
  - Other treatment technologies (reduce waste)

Key messages

- Olifants river catchment not in isolation – connected - whatever the solution is, needs to be tested against broader solution
- Any new resource development project will in itself be expensive (R/m^3)
- All new projects marginal costs are high

Massive opportunity – “Perfect storm”

- Enabling environment to establish a viable regional scheme
  - Catchment in deficit
  - Heightened public awareness of AMD – water quality deterioration
  - Down stream water users who need water
  - Operational mines willing to do something
  - Political support for initiative
  - Private sector capacity and track record (engineering, construction, funding, financing)

Are we dealing with a wicked problem?

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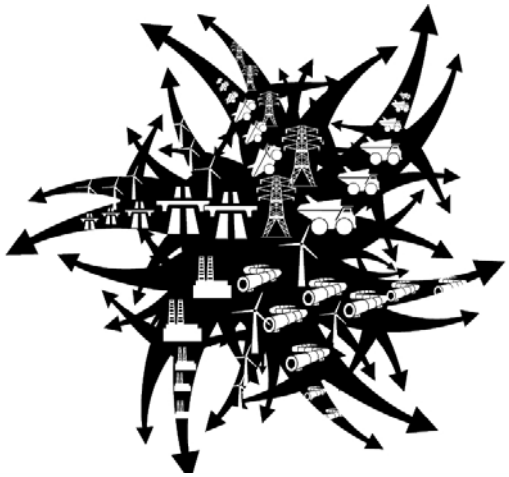
Wicked problem!

- "Wicked problem" is a problem that is difficult or impossible to solve because of incomplete, contradictory, and changing requirements that are often difficult to recognize.
- Because of complex interdependencies, the effort to solve one aspect of a wicked problem may reveal or create other problems.



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Characteristics of wicked problems

- There is no definitive formulation of a wicked problem (defining wicked problems is itself a wicked problem).
- Wicked problems have no stopping rule.
- Solutions to wicked problems are not true-or-false, but better or worse.
- There is no immediate and no ultimate test of a solution to a wicked problem.
- Every solution to a wicked problem is a "one-shot operation"; because there is no opportunity to learn by trial and error, every attempt counts significantly.

Ritchey (2007)

Are we dealing with a wicked problem?

- Any win/win solution will require a trade off(s)
- Narrow sector approach can be constraining
- We need move away from a narrow focus on mining (polluter pays – “whipping the willing”) we need an inclusive approach to benefit all - a win/win solution
- This is not about AMD treatment *per se*, it is about best use of that resource (catchment approach to be implemented)

Long term planning

- Water reconciliation strategy too short term (2035) what happens later, beyond coalfields life (+ 2045)
- >> 100 years horizon
- Long term planning (20 years) – plan implement evaluate reconsider
  - Opportunities to reconsider best use of water
    - Ecology
    - Agriculture
    - Mining
    - Urban
    - Rural
- Keep our options open (recon strategies reviewed every 5 years)

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Private Sector Participation

- Private sector need certain requirements to participate
  - Stable regulatory environment (including mandate definition among Government departments)
  - Long term planning
  - Clarity on partners
  - Non-conflict between different departments integration i.e. post closure targets
- Government long term commitment …. Needs to be articulated

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Rules of the Game

- Multinational / large private companies have certain rules of the game
- Company structures can be complex
  - Capital investment, needs to be done in a tax efficient way
  - Foreign corrupt practices legislation
  - Competition issues
  - Transparency / disclosure issues
  - Management of closure funds (cash and guarantees)

Water Regulatory approaches and practices

- Processing of water use licenses application a challenge
- Regulator to consider realistic discharge standards
- Regulator capacity is a problem
- Water classification process is happening and could influence this project
- An opportunity to deal with waste discharge charges
- DWA is the water regulator, but cooperative governance with other Departments is essential (a big potential constraint) need an enabler DMR / DEA / Treasury

Institutional Opportunities & Constraints

- Institutional Opportunities
  - We have an opportunity to set up the appropriate institution now and the implementation models can follow
  - Regional / catchment scale has benefits in terms of costs
  - Catchment management agency is foreseen ito NWRS2 – for Olifants in the next three years
  - It cannot be a solely private venture
    - It will require collaboration between private and public role players.
  - Other examples in the catchment such as water user associations
  - Need to be all inclusive mines, municipalities, agriculture
  - Can expand (later) to deliver other water services (sewerage water treatment)

Institutional Opportunities & Constraints

- Institutional Constraints
- Who do we talk to? - There is an institutional vacuum
- Small mines, challenge for them to participate (short lifed) but also opportunity, a scheme that they can fit into
  - Remember a one size fits all may not apply
- Ownerless Mines
  - DMR is not part of water related initiatives
  - DMR regional closure strategies not finalised
  - BUT regional catchment scheme could be a solution

Social Considerations

- Social, Community and Labour contributions
  - Mining has many downstream positive social and economic benefits
  - Opportunity to get credits
  - Social water linked to mine water projects
  - Communities directly around mines need to have some benefit (social license to mine)

APPENDIX D

Effluent & Waste Water Management working group - Short report on EWWM Strategy Process of February and March 2013" (SWPN Secretariat)

Strategic Water Partnership Network
SOUTH AFRICA

Effluent & Waste Water Management working group

Short report on EWWM strategy process of February and March 2013

1 STRATEGY DEVELOPMENT METHODOLOGY

Two strategy sessions were held. The session were held on 8 February 2013 and 8 March 2013.

Participatory process and techniques were used to

- Identify the drivers in effluent and wastewater management in SA in recent years
- Develop an uncertainty matrix and selecting deal breakers
- Prepare a SWOT analysis
- Develop a positive scenario for wastewater management and reuse
- Define a role for the SWPN in the effluent wastewater management arena in SA.

Four groups were formed. The four groups developed water games. These were used these to "discover" the underlying forces and some of the characteristics of the other players, and to establish uncertainties. The games developed are shown in Figure 1 to 4 overleaf. Also shown in the Figures are the drivers and processes identified for each game.

From the games the "drivers" of wastewater management and reuse in South Africa, key uncertainties /risks were extracted. In addition, strengths, weaknesses, opportunities and threats were identified during the feed-back process.

After discussion the key risks / uncertainties were prioritized and the two with the highest impact and probability were used to develop scenarios. The positive scenario was fleshed out and the interventions required to move from the current situation to the scenario identified.

Based on these interventions, the EWWM identified its role in achieving the positive scenario.

Figure 1: Game 1: Wastewater three-team world cup

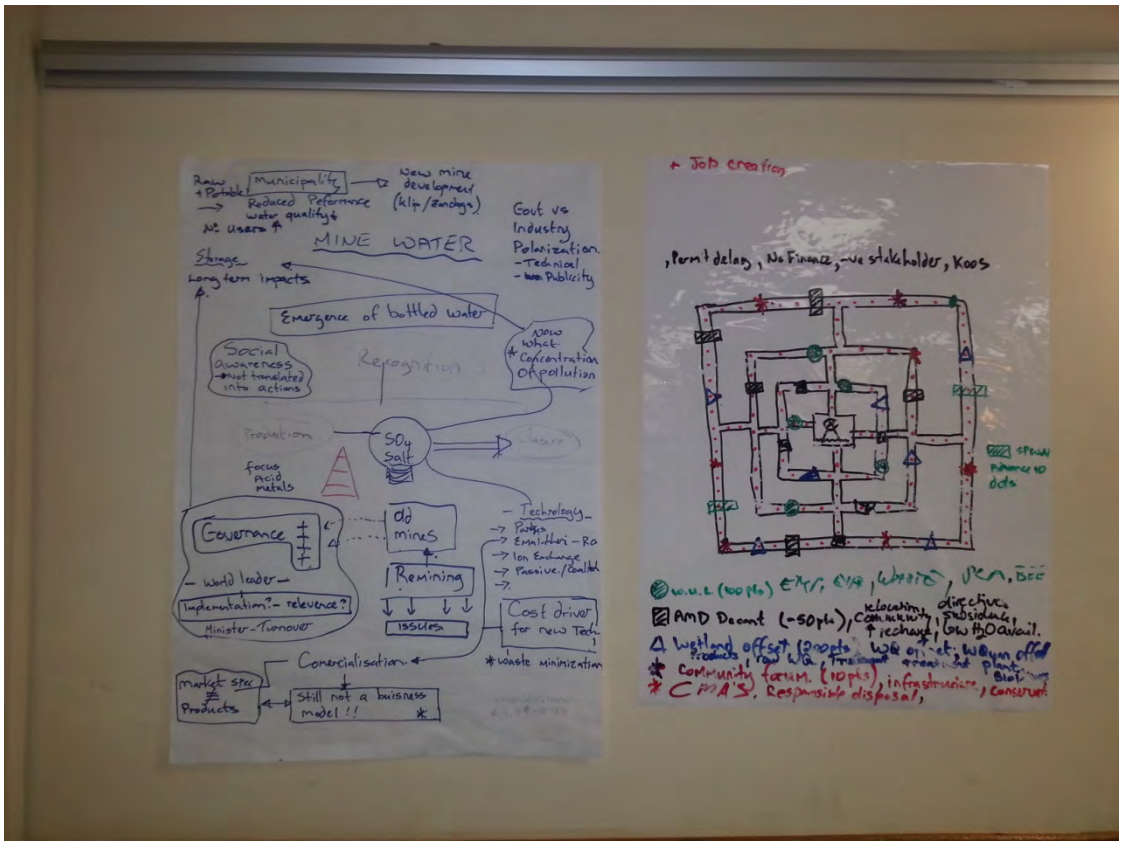

Figure 2: Game 2: Minewater Pokemon

Figure 3: Game 3: Water tower

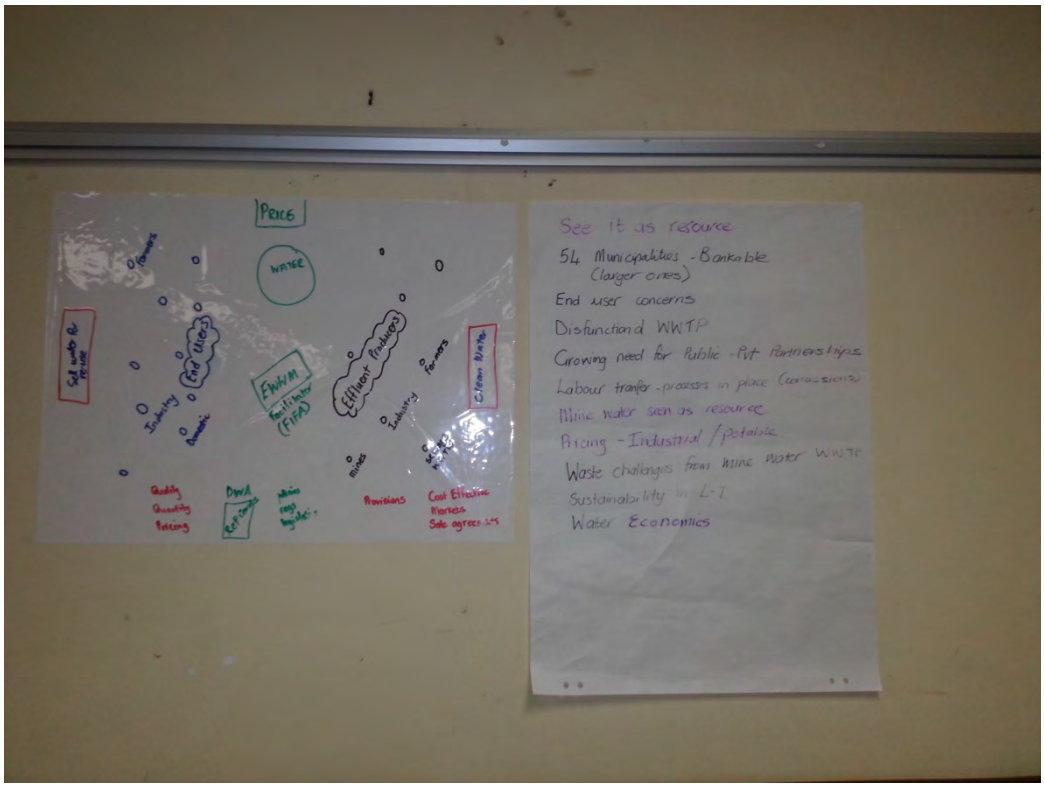

Figure 4: Game 4: Effluent soccer

2 IDENTIFICATION OF DRIVERS IN WASTEWATER MANAGEMENT AND RE-USE

The drivers extracted from the feedback on the games are shown in Figure 5 and listed in Table 1, grouped into similar issues.

Figure 5: Board showing drivers identified

Table 1: Drivers identified

Drivers/rules of the game in effluent and waste water management	
Sustainability	**Civil society, awareness and community**
The need for sustainability in business	• Vocal civil society • Social awareness by citizens of the health risks emanating from pollution • Wastewater and reuse becoming a hot topic • Publicity (by media) of the issues has become elevated • Community engagement by companies • Intervention with publicity value being questioned for impact on water management/security • Reputational issues • Polarization in society • Politics influencing water
Resource constraints	**Pollution management challenges**
• The limits of the water resource: New water needed	• Dwindling availability and dilution capacity • Abandoned mines

Drivers/rules of the game in effluent and waste water management	
• Waste water now a resource	• Increased pressure on municipal treatment systems • Municipal waste quality decline • Environmental
Regulation	**Operational**
• Regulation of closure of mines • Mining permits drive water management behaviour • Mining regulation • Compliance with Blue drop and Green drop • Penalties for non-compliance	• Water core to mining .Shift from thinking that water is only an issue in production but also mine closures • Cleaner production cycles • AMD decant • Long term planning of mines. Sustainability/life cycle cost • Water management not a business model • Business cost is biggest driver /water economics • Quality, quantity and pricing triangle • Penalties for not investing in mitigation risk
Collaboration / partnership	**International trends**
• Necessity drives collaboration. We are impacting on each other • Re-use moving outside factory fence	• Compliance with international standards and best practices. Some products have to be sold on the global market • Voluntary peer review/environmental certification of products and services • Environmental responsibility and governance trends
Technology	**AMD crisis**
• Technologies improving • Cost of water a driver for technology development & collaboration • Technology advances R&D investment • Technology is available	**Privatization of water**

3 IDENTIFICATION OF UNCERTAINTIES /RISKS IN WASTEWATER MANAGEMENT AND RE-USE

From the feedback, uncertainties were identified. The full list of uncertainties are listed in Table 2. Figure 6 shows the ranking of the uncertainties (risks) related to the success of the EWWM/ SWPN according to likelihood and impact. The risks with the highest impact and likelihood were identified as shown in table 3 and Figure 6.

Table 2: Uncertainties identified

Uncertainties	
Government capacity • Lack of co-operative governance /lack of institutional alignment • Capacity gaps in government can lead to inconsistency in the application of regulations. Outcomes of engagement dependant on who it is (person in authority) that is engaged • Lack of appropriate skills for challenges • Staff turnover in DWA • Lack of capacity to implement good policy and legislation	**Investment and pricing** • Investment capital needed • Pricing models • Financial models • Commercial/institutional models for business entities to become involved in treatment and reuse • Joint funding models needed
Market for treated effluent • Cultural resistance to treated effluent • Market for treated effluent	**Government / institutional** • DWA player & referee • Mandate of mining & water affairs within government go in different ways • CMA's - institutional change • Lack of capacity in the system • Lack of institutional models • Lack of incentives
Stakeholder issues / dynamic around water • Fine line on social responsibility • Unrealistic expectations on responsibility • Multiple perspectives on issues	**Legislative** • Legislation review • Length of existing allocation permits
Success of engagement	**Political will**
Abandoned mines	**Many created the problem; few have to solve it**
Leadership	**Winner is biggest saver**
Commodity prices	**Competition among players**

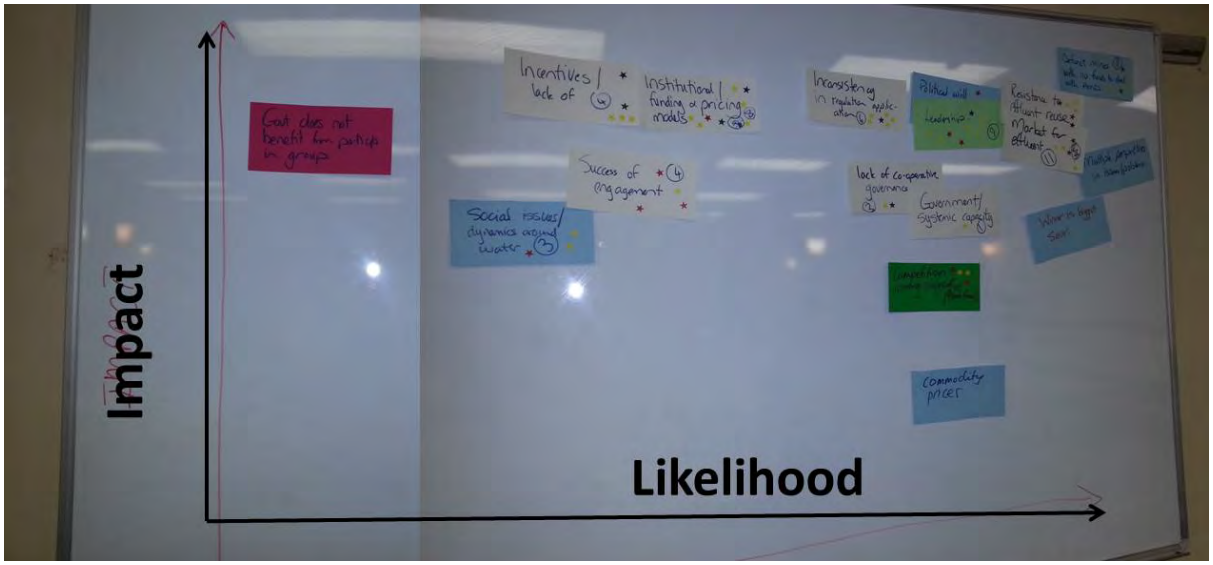

Figure 6: Likelihood / Impact ranking of risks to EWWM success

Table 3: Highest impact and likelihood risks for the EWWM/SWPN

Uncertainties	
Government capacity • Capacity gaps in government can lead to inconsistency in the application of regulations. Outcomes of engagement dependant on who it is (person in authority) that is engaged • Lack of capacity to implement good policy and legislation	**Investment and pricing** • Pricing models • Commercial/institutional models for business entities to become involved in treatment and reuse
Market for treated effluent • Cultural resistance to treated effluent • Market for treated effluent	**Government / institutional** • Lack of institutional models • Lack of incentives
Stakeholder issues / dynamic around water • Multiple perspectives on issues	**Success of engagement**
Abandoned mines	**Political will / Leadership**
Commodity prices	**Winner is biggest saver**
	Competition among players

The risks with voted as the most significant to the SWPN/EWWM success were

- Institutional and pricing models are in place for EWWM and re-use
- There is a market for treated effluent.

4 SCENARIO DEVELOPMENT

The axes of the matrix are formed by risks voted to be the most significant and most likely for the SWPN/EWWM. The resulting scenarios are shown in Figure 7.

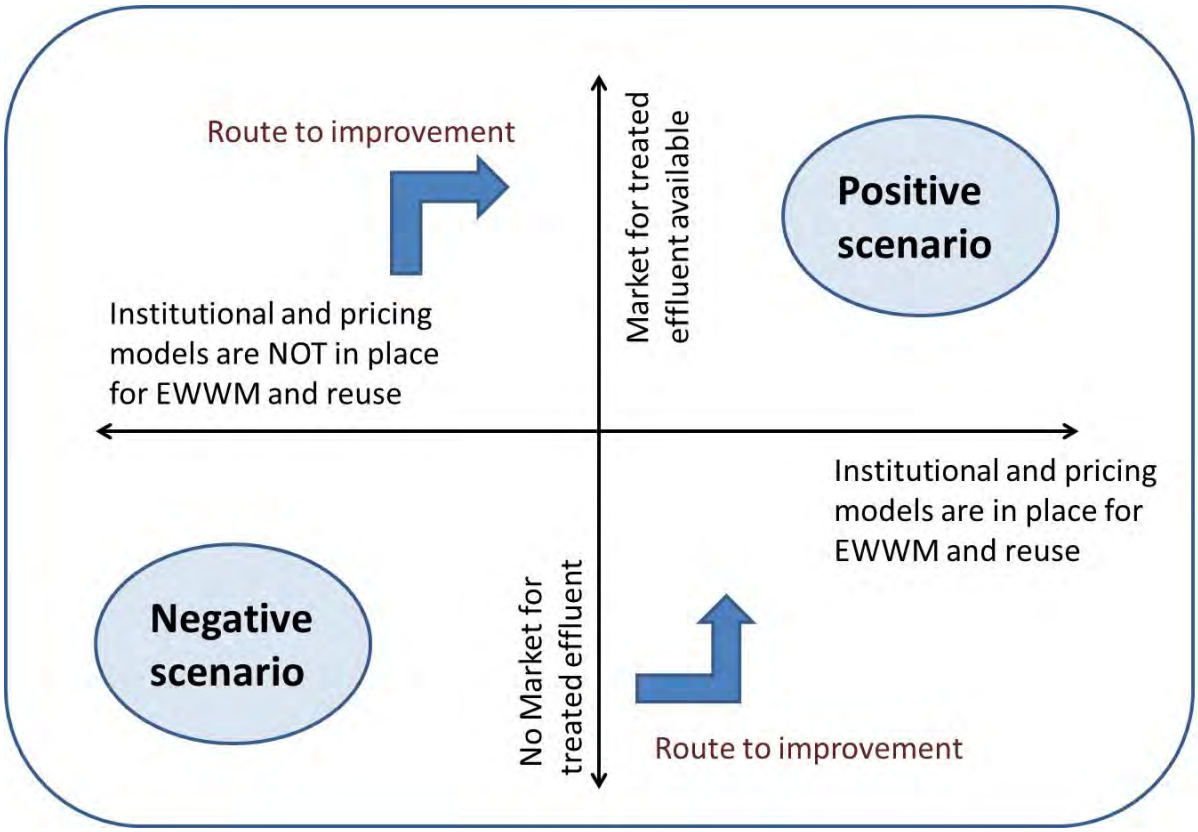

Figure 7: Scenarios

In the second strategy session, three? groups were formed. Each group developed the positive scenario characteristics, and then looked at how to move from one of the other scenarios to the positive scenario (thus identifying the changes required).

Figures 8 to 11 show the scenario sheets developed.

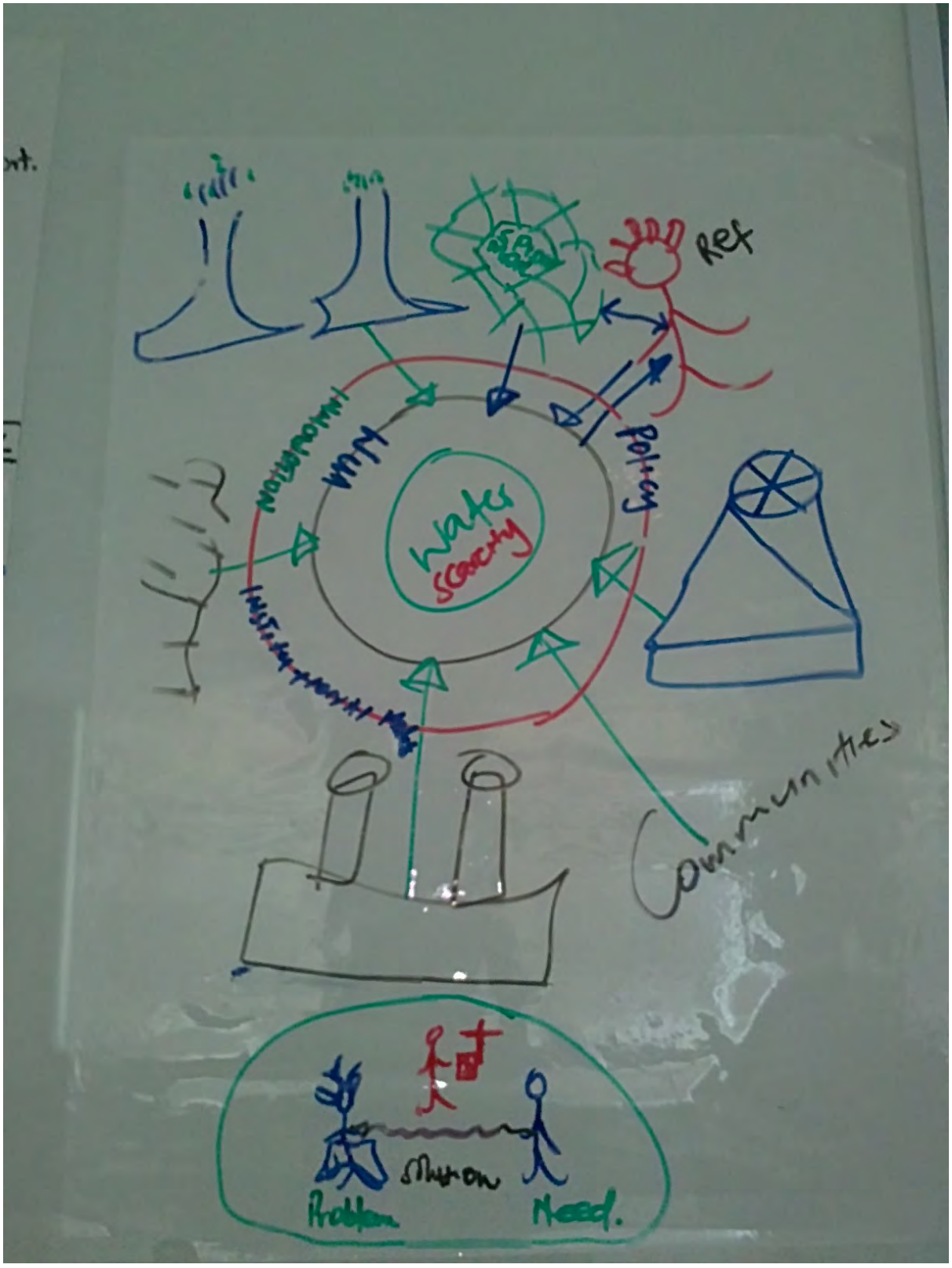

Figure 8: Scenario from group 1

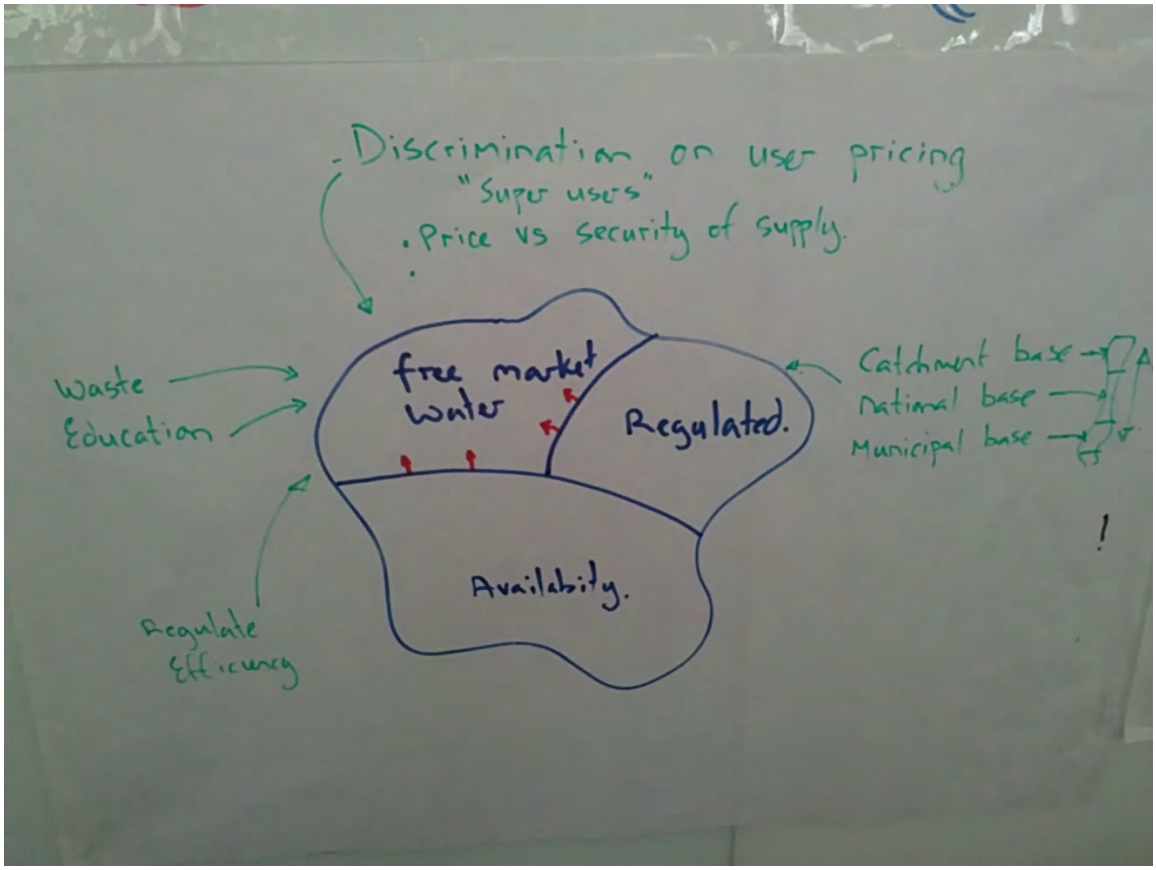

Figure 9: Scenario from group 2

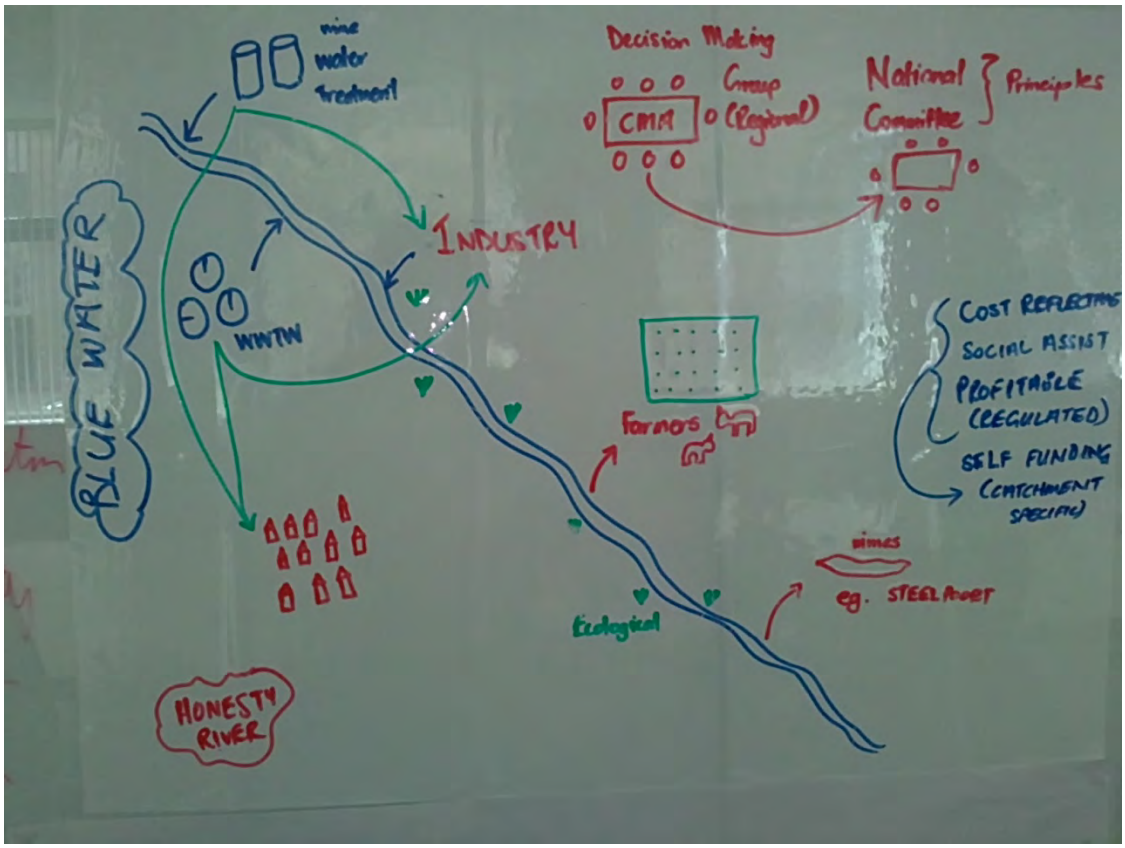

Figure 10: Scenario from group 3

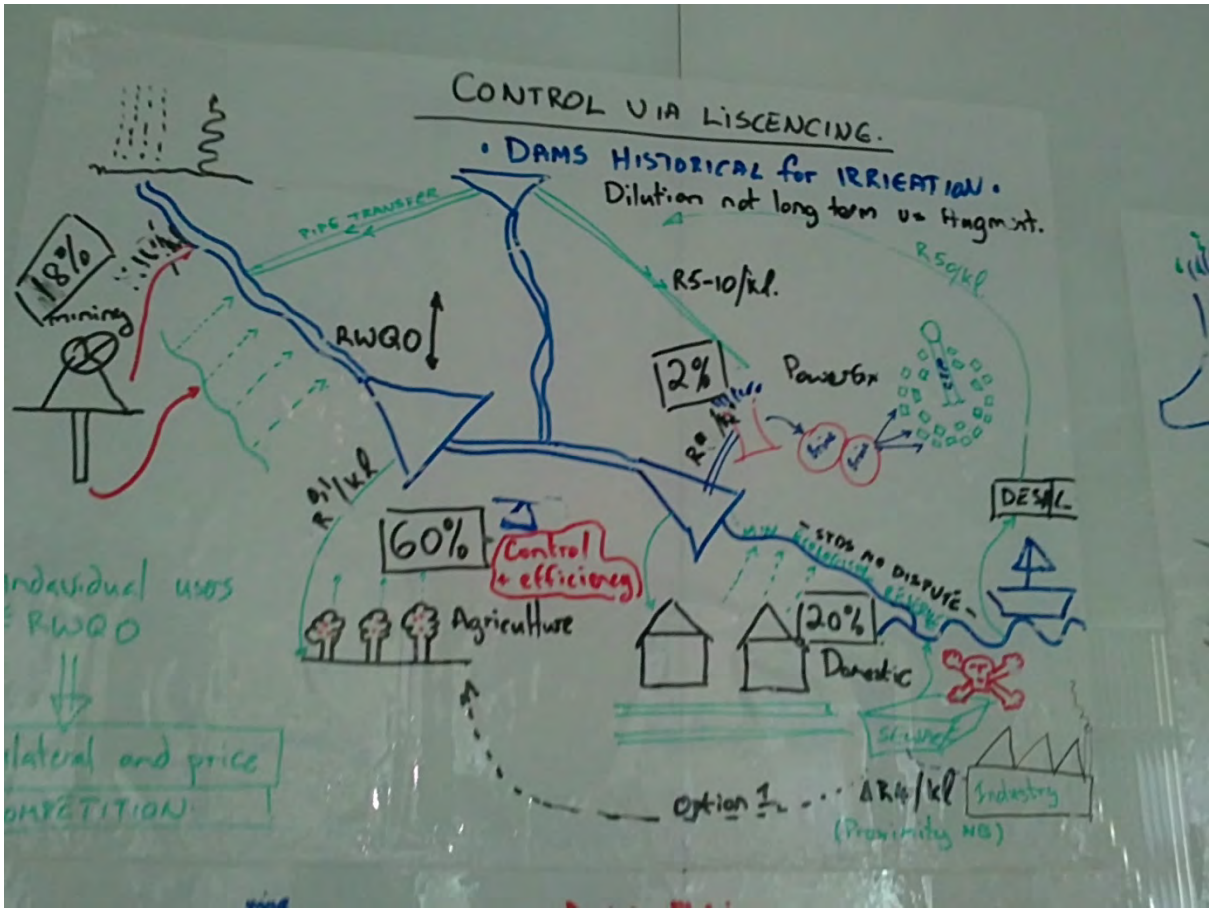

Figure 11: Scenario from Group 4

???? – pics from Jenny for 8/3?

5 SWOT Analysis

In evaluating the water games the feedback was also used to identify strengths, weaknesses, opportunities and threats. The issues identified under these headings were checked in the second sessions. The SWOT for the EWWM is shown in Table 4.

Table 4: SWOT Analysis of EWWM

Strengths	Weakness
• EWWM facilitation is reducing competition, and increasing co-operation • SWPN provides glue and direction • There is benefit in network and collaboration • More energy efficient plants • Financing possibilities exist • A lot of municipalities can access finance to improve waste water operations • Support base of organisations is good • Extensive and expanding knowledge base	• Dysfunctional waste water treatment plants • Integrated solutions not yet prominent • There is no training in water resources management at undergraduate level. On the job training required • Awareness and education inadequate • DWA staff skills development needed • Managing AMD treats symptoms and not cause • Engagement among ourselves and skills for engagement still weak
Opportunities	**Threats**
• Innovation in policy and finance that incentivises collaboration • Drought will change the perceptions on the availability of water and drive change • Concessions for waste water treatment • Need to maximise opportunities across the waste water value chain e.g. gypsum bricks • Local and international learning and lessons sharing • Opportunity to treat water for other purposes other than drinking • Networking and contacts within the network Development of mitigation measures • Local and central (large scale coordinated) treatment options exists • Collaboration between stakeholders • Waste products are not disposable and will drive reductions in waste generation • Investment in treatment • Beneficiation of waste equals zero waste • Technology has commercial value, hampering sharing among mines. This can be changed with as companies see benefits of collaboration.	• Different challenges for different industries • Local government: not a priority for reuse • Need to manage perceptions • Scale. Catchment is the system and smaller scale solutions not always effective • "Mining for waste water" • Re-concentrating pollution • Systemic capacity gaps • Education needed • Permitting delays • Mind-set change • Technology focused on concentrating pollutants (and not improving production cycle issues) • Labour costs

5 ROLE OF THE EWWM

The EWWM group were asked to consider their role in changing to the positive scenario, given the preceding analysis of the situation, the risks, the desired positive state and the groups SWOT analysis. Table 5 shows the results of the group discussion.

Role of EWWM	
Provide access to Minister and DG to get specific submissions considered	Sharing and networking between water users in sector
Influence DWA to propose / promote private sector participation	Pilot what we recommend
Fund strategy / feasibility study for private sector involvement in EWWM	Bring in users in catchment
Provide recommendation on how to manage water going forward	Influence private sector
	Apply influence to get decisions

ANNEXURE: WORKSHOP PHOTOGRAPHS

APPENDIX E

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