A.T. Kearney

The Call for Clean Water

South Africa's water is scarce and acid mine drainage is creating further shortages. While the problem is treatable, it has still not been addressed. A multi-stakeholder partnership of companies, government, and non-governmental organizations may be the answer.

Water collecting in abandoned mines mixes with iron pyrite and oxygen to create sulphuric acid. This water is highly acidic, which allows it to absorb heavy metals. This is what we know as acid mine drainage, or AMD water. Flowing from abandoned mines, coal discard dumps, slurry dams, and waste rock dumps, AMD poses one of the most serious threats to our environment. The quality and availability of residential, industrial, and agricultural water supplies are all threatened. This is an urgent challenge.

AMD does not have to be a problem. The water can be treated to produce drinkable quality, and the polluting elements can be turned into useful products. However, finding a way to finance a solution that balances the rights and obligations of all the parties involved has proved extremely difficult.

Water is regarded as a human right in South Africa, secured by the constitution. Protecting this right means making affordable water available to everyone. While there are simple technical solutions available for cleaning AMD water, these incur significant costs. Combining the need for low-cost universal access to water with fully-funded solutions has complicated the implementation of treatment processes.

The government has yet to find a way to structure and finance its own comprehensive solution to the problem. And, despite the best efforts of the dozens of parties active in this area, from non-governmental organizations (NGOs) to mining companies, none has had the combined scale, resources, and credibility to fully resolve the issue.

Figure 1

Areas susceptible to the formation of acid mine drainage

Sources: Philip Hobbs and Keith Kennedy, Council for Scientific and Industrial Research (CSIR), South Africa, 2011; A.T. Kearney analysis

The Source of the Problem

AMD water is laden with heavy metals—specifically uranium, cadmium, copper, zinc, arsenic, cobalt, and nickel—and sulphates, and is now beginning to reach groundwater supplies and emerge at the surface to "decant" across South Africa. Seven provinces are susceptible to AMD (see figure 1 on page 2). As a result, its effects are beginning to be felt system-wide, starting with the pollution of water sources, and spreading to threaten communities, industries, agriculture, and nature.

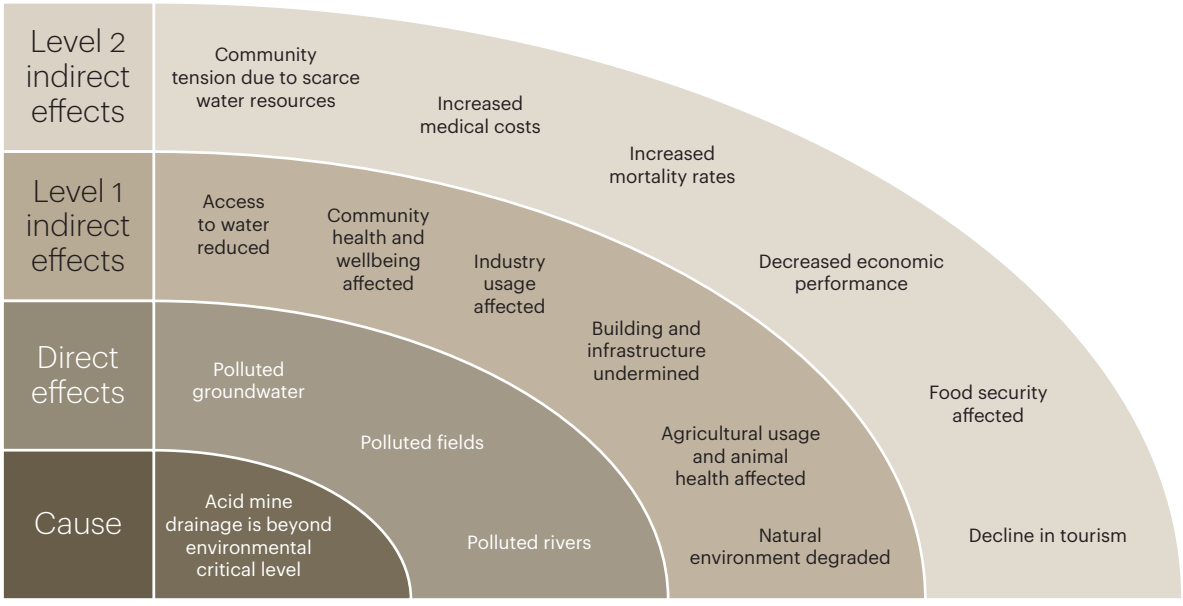
Among the most affected areas is Gauteng Province. The AMD sources here sit atop the continental watershed, the waters of which ultimately drain into the Vaal, Orange, and Limpopo rivers. The three main AMD sources within Gauteng are the Western, Central, and Eastern Basins.

Hardest hit is the Western Basin, which began decanting in 2002 and, due to the high levels of uranium in the surface water, has been declared an access-restricted radiation area. The pumping and treating capacity is inadequate for controlling the rate of decant.[1]

The Central Basin is expected to begin decanting next year, and the Johannesburg central business district is expected to be directly in the path of the AMD runoff. Should this happen, it may have an even more serious effect than the Western Basin due to its urban location. Finally, rising water levels in the Eastern Basin could lead to both environmental damage similar to that seen in the Western Basin and the formation of sinkholes as underground limestone in the area dissolves in acid mine water and creates cavities in the rock.

While its reach is widespread and growing, the effects of AMD on the entire water system and the human and natural environments are not widely known. Since it was first identified as an issue in

Figure 2
The direct and indirect effects of acid mine drainage



Source: A.T. Kearney analysis

[1] Report to the Inter-ministerial committee on AMD, December 2010

the 1970s, it has been partly ignored and partly misunderstood, with potentially costly implications across the entire ecosystem (see figure 2 on page 3). Following are just a few of the effects of AMD:

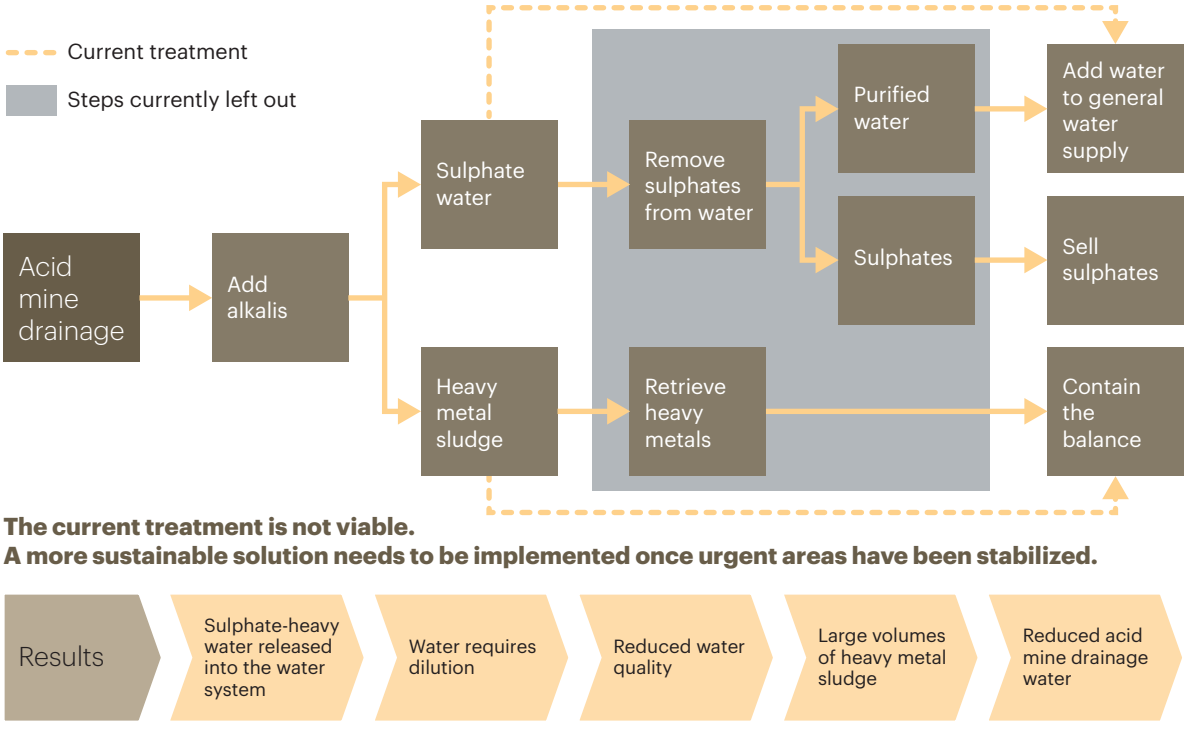
- **Health.** People living in towns, villages, informal settlements, and farms depend on water from dams, streams, and boreholes that are contaminated with AMD water. Exposure to heavy metals can result in severe neurological disorders; uranium can cause radiation poisoning.
- **Environment.** Heavy metals from water or contaminated soil are taken up by plants and transferred to animals and humans through the food chain.
- **Economy.** AMD affects commercial agriculture production, power generation, industrial production, and ultimately tourism and the consumer economy. It has the potential directly to impinge upon the livelihoods of millions of people.

Industries that require water as a major input to their processes are also exposed to operational risks as a result of AMD. If electricity producer Eskom, for example, received water with high salinity levels, it would have to treat the water to ensure the quality was sufficiently high for its processes.

The need to act is urgent. Three areas within the Witwatersrand area alone are already decanting, or will be doing so within the next 12 months. Fortunately, simple technical solutions are available. By adding alkalis to raise the pH (acidity) level to neutral, or about 7, the heavy metals fall out of solution to create a disposable sludge (see figure 3). The remaining water, which is heavy in sulphates, can then be desalinated, leaving drinkable water.

Figure 3

The current treatment for acid mine drainage neutralizes rather than desalinates the water[1]



[1] The desalination process is currently performed in Witbank.

Source: A.T. Kearney analysis

Treatment costs can potentially be recovered by selling the sulfur that results from the desalination process and by retrieving and selling the heavy metals that are present in the sludge.

One Meaningful Solution

The solutions that have been implemented to date are inadequate and do not have the scale to handle the full flow of decanting water. The treatment mainly consists of neutralization; only in Witbank is the water also desalinated to produce potable quality. Once AMD is neutralized, there are few comprehensive plans for dealing with the heavy metal sludge. Yet if it is not contained in sealed areas, it will simply seep back into the environment.

In most cases where acid mine water is decanting, it runs back into rivers, lakes, and wetlands. When acid water is only neutralized, the sulphate-heavy water is added to rivers to dilute it. In Gauteng Province, this means adding the water to the Vaal system and diluting it with water from the Lesotho Highlands.

Since first identified as an issue in the 1970s, **AMD has been partly ignored and partly misunderstood**, with potentially costly implications.

However, as the volumes of water being decanted increase, dilution in rivers will not be sustainable. From 2015, the levels of Gauteng Province acid mine water will exceed the ability of the Vaal to absorb it safely for human use.

The government has devised immediate and short-term solutions and begun the process for finding a long-term solution to the problem:

- **Immediate solution.** Instituting emergency measures to neutralize water that threatens to decant in the vicinity of important areas such as the Johannesburg central business district
- **Short-term solution.** Establishing more stable neutralization facilities until a long-term solution can be found
- **Long-term solution.** Engaging an engineering consulting company to prepare a study on potential long-term solutions

This division between types of solutions is an artificial split due to financial and time constraints. These constraints have necessitated the prioritization of different basins, with the most serious being addressed first, a triage approach. In the final analysis, there is only one meaningful solution to the problem: complete neutralization and desalination of the full discharge of AMD waters.

Many groups have been active in bringing this problem to light and trying to find solutions. So far, though, no one has come up with an answer that is satisfactory to all parties. Various committees have been formed by both the government and the private sector to address the issue but despite its urgency, little action has been taken to date. The government is financially

restricted and lacks the resources and capacity needed to develop rigorous solutions—its current and planned activities in South Africa are only 50 percent funded.

We believe there should be just one overarching and enduring solution. This would combine neutralization and desalination and be comprehensive across all sources of acid mine drainage.

Opportunities for Problem Solvers

As much as AMD poses an extreme threat to South Africa's water supply, it also provides a potential solution to some of its water problems.

Chief among these problems is the fact that Gauteng Province is expected to be short of water by 2015, when demand will outstrip supply. This assumes that no additional infrastructure will be built to increase supply; however, it also excludes the supply-reducing effects of AMD. In this precarious situation, a single drought would create a water crisis in the region.[2]

Treating acid mine water could help relieve this water shortage. It could also create opportunities for industrial water users such as Eskom, mining companies, and agricultural users that are short of water.

To jointly relieve the water shortage and be able to dilute high volumes of AMD, the Department of Water Affairs is planning a capacity increase to the Lesotho Highlands project. Should this acid mine water be fully treated, this $7.9 billion (62 billion ZAR) investment, and future planned investments, could potentially be postponed by several years.

Many groups have been active in bringing this problem to light ... **so far, no one has come up with an answer that is satisfactory to all parties.**

Furthermore, while acid water comes from abandoned mines with no operator or company to take responsibility, the wider mining community is still seen as having some responsibility to solve the problem. Helping to solve this situation will assist mining companies in addressing the risks presented by water management—from reducing the risk of future community health claims to improving their status as responsible corporate citizens and ensuring they retain a license to operate.

The Multi-Stakeholder Answer

At A.T. Kearney, we believe a multi-stakeholder partnership is the most effective way to address the problem. A partnership involving water is a unique one that involves balancing social, economic, financial, environmental, and political elements and, as such, needs to be developed

[2] Eskom and petrochemical company Sasol issued a warning regarding the increasing scarcity of the Gauteng water supply at the World Water Forum in Marseille in March 2012.

in a way that addresses South Africa's specific needs such as its current economic and social circumstances. The greatest benefits are derived from a partnership that includes the most suitable, committed, and able partners.

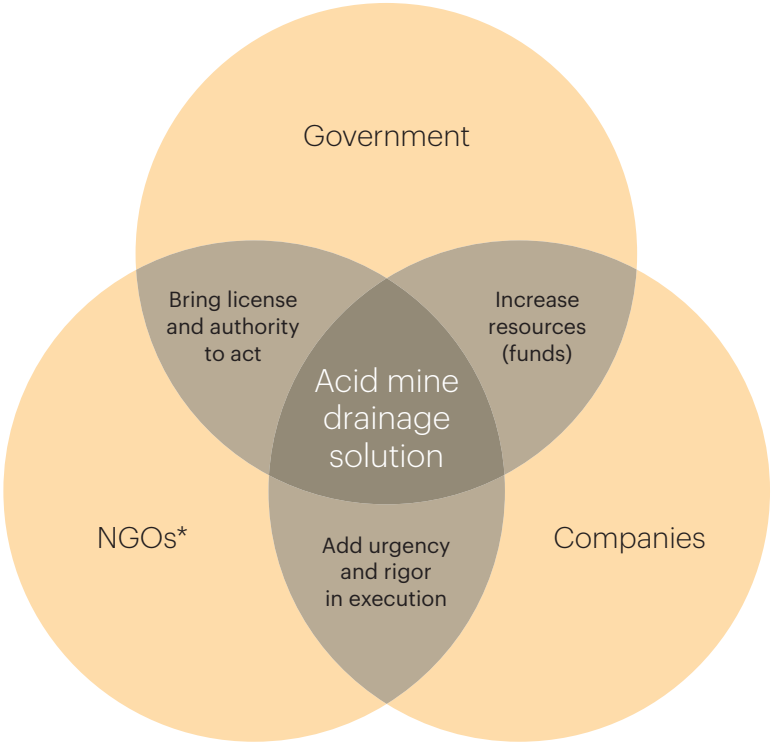
Combining the resources of government, NGOs, and companies would quickly bring the right mix of technical, financial, and policy assistance to bear, allowing comprehensive solutions to be implemented before AMD discharge reaches severely damaging levels (see figure 4). Following are some of the attributes that each party contributes:

- **Government.** Authority to make decisions and implement and resources (such as staff and funding)
- **NGOs.** Credibility, independence, and urgency in regard to implementing a solution. Some also bring experience from other geographies
- **Companies.** Expertise, execution capabilities, and resources (such as staff and funding)

A partnership model would bring together diverse parties with complementary capabilities and interests and combine these capabilities to address the AMD issues. A partnership structure is also an effective means of addressing conflicts and aligning the interests of stakeholders.

Three examples will help illustrate the success of multi-stakeholder partnerships. All three are discussed in more detail in the Appendix on page 10.

Figure 4
Multi-stakeholder partnerships will deliver technical and financial solutions to South Africa's water problems



*NGOs are non-governmental organizations.
Source: A.T. Kearney analysis

In the Philippines, a tripartite partnership developed by the government, an NGO, and a private company, successfully addressed industrial and agricultural pollution issues experienced in Lake Laguna de Bay. All three partners worked together to achieve more than they could have individually. Today, the Conservation of Laguna de Bay's Environment and Resources (CLEAR) is recognized in the international community as a credible organization that delivers its commitments, and has the support of many different stakeholders and partners.

In Europe, the pollution of Lake Constance began in the 1950s, mainly from chemical detergents and phosphate-based fertilizers. It was later recognized as a problem that could seriously impact the health of the Lake. In 1990, the Lake Constance Project was formed, comprising NGOs, local authorities, and industrial, political, and community groups. The partnership put Lake Constance on a more sustainable footing, and has since addressed other issues and invested in further water initiatives.

Combining the resources of government, NGOs, and companies will quickly bring the right mix of technical, financial, and policy assistance to bear.

In Singapore, the government partnered with private companies to develop water technologies. The partnership has been so successful that it led to the development of an export market. The experience and knowledge gained from the partnership enabled it to offer its services as a complete package to other countries.

Implementing a partnership to address the problem of South African AMD means finding the optimal mix of parties and capabilities to solve the problem. International partnerships of a similar nature can be used as benchmarks to learn from their mistakes and exploit their successes.

The primary challenge a partnership of this nature faces is governance: There may be difficulties in aligning diverse parties and obtaining delegated authority from a critical mass of stakeholders, especially for an implementation partnership. Such challenges can be overcome with a clear mandate for the partnership and detailed policies that state the scope and type of activities permitted.

The partnership's activities would be financed by a combination of government funds, private sector funds, and the sale of by-products from the treatment process, with the long-term intention that the project be self-sustainable.

Commitments to the partnership could be determined by the complementary capabilities and willingness of the parties, building upon the demands of the proposed solution. This partnership would bring added rigor, quality solutions, and the necessary credibility and scale to the need. The various parties would contribute the resources necessary for developing treatment options, build infrastructure solutions, treat the water, and dispose of by-products and waste, thus creating an end-to-end solution.

For the partnership to be successful, the participants must have the following:

- Relevant, complementary skills
- Motivation to work together
- Sufficient technical and financial resources

Further, the partnership needs to be adequately monitored and governed to ensure its credibility and to build public confidence and support.

The Bottom Line

Acid mine drainage is a threat to large parts of South Africa's environment and society. It has direct effects on local communities and the environment where it emerges from the ground; as it spreads out through groundwater, rivers, and lakes it has an indirect effect. Through the water system acid mine drainage affects city water supplies, agricultural irrigation and food supplies, industrial production, power generation, and the wide, natural environment.

Government, business, and civil society can and must unite to find a solution. Simple technical solutions are available; what remains to be determined is how these are funded and who should manage their implementation.

Rather than one party trying to find the way, we believe that the answer lies in a multi-stakeholder solution that combines the best aspects and capabilities of all of the parties, their expertise, resources, and energy to create a sustainable solution.

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Appendix: Powerful Partnerships that Work

Before we end our discussion, we want to share three case studies of successful international initiatives concerning water challenges. Drawn from *Living Lakes, A Global Network of Partnerships for the Future*, and the *Association for Sustainable and Responsible Investment in Asia*, these cases offer lessons learned to those considering their own international partnerships.

New Life for the Lake

Laguna de Bay, the largest inland body of water in the Philippines, is used for fishing, irrigation, power supply, recreation, and drinking, and is under constant pressure from the effects of development activities. The most pressing problems are siltation and pollution from domestic, agricultural, and industrial wastes.

A tripartite partnership, Conservation of Laguna de Bay's Environment and Resources (CLEAR), successfully addressed the industrial and agricultural pollution issues. Composed of Laguna Lake Development Authority (LLDA), Unilever Philippines, and the Society for the Conservation of Philippine Wetlands, Inc. (SCPW), the partnership is seen as a pioneering effort between government, civil society, and the private sector. It is recognized in the international community as a credible organization that delivers its commitment, and has the support of many different stakeholders and partners.

Its activities largely complement government efforts to manage the lake wisely with a focus mainly on information, education, and communication and other capacity-building strategies.

What makes the CLEAR partnership work? Three factors in particular:

- Designating the SCPW (the NGO) as the Secretariat, which ensures its sustainability and promotes credibility. It also ensures efficient documentation, transparency in fund management, and representation of the partnership at many engagements and events.
- Working as one entity, which ensures the primary image perceived by the stakeholders. At the same time, the individual roles and resources contributed by the three sectors are recognized.
- Drawing on the dedication and technical know-how of the SCPW, the resources and commitment of Unilever Philippines, and the authority and expertise of LLDA.

The strength of the partnership derives from the synergy resulting from the combined power of the three partners.

A Ripple Effect

Lake Constance, or Bodensee, is Europe's second largest freshwater lake. It is the source of drinking water for more than 4.5 million people, half of whom live within its watershed. The pollution of the lake began in the 1950s, mainly due to chemical detergents and phosphate-based fertilizers. By the mid-1970s it was clear that the health of the lake was in jeopardy, and wildlife threatened, largely due to nutrient pollution from sewage and other sources. In 1990 the Deutsche Umwelthilfe, an independent non-profit association with a focus on the protection of nature and environment, joined forces with Lever Fabergé (subsequently acquired by Unilever) to create the Lake Constance Project. More than 20 years later, a combination of NGOs, industrial and political groups, local authorities, and community efforts have put Lake Constance on

a more sustainable footing. Population levels continue to rise, but pollution levels are contained. Wildlife thrives again.

Besides providing funds, the collaboration helped form a platform for a new working relationship between Lever and major NGOs in three countries. A dialogue began that had a ripple effect, resulting in new, more environmentally sustainable products; water conservation initiatives; new relationships with consumers and environmental groups; sponsored programs around the lake; and company awareness programs.

Selling Water Services to the World

In Singapore, the government's partnership with private companies in developing water technologies was so successful that it led to an export market in which Singapore offers its water services as a complete package to other countries.

Government officials believe the steps taken to develop water expertise will provide future growth opportunities. In July 2006, Singapore inaugurated the Research, Innovation and Enterprise Council (RIEC). Chaired by Singapore's prime minister, the council committed approximately $887 million between 2006 and 2010, of which $207 million was allocated to support environmental and water technologies.

Through public-private partnerships (PPP), companies have built up their own planning, operation, and maintenance experience and now offer a complete package of water services to clients, with China, the Middle East, and India as prime target markets. And Singapore's Public Utilities Board has been an active partner with local companies in promoting public private partnerships for large-scale projects.

Singapore's first PPP project was with Hyflux in 2005 to design, build, own, and operate the country's first desalination plant. Hyflux has since won a contract for the Dagang desalination plant in Tianjin, China.

Singapore is also active in underwriting water technology research by providing companies access to government facilities to test new technologies and to R&D support from leading universities.

AT Kearney

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The signature of our namesake and founder, Andrew Thomas Kearney, on the cover of this document represents our pledge to live the values he instilled in our firm and uphold his commitment to ensuring "essential rightness" in all that we do.