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Competition Policy and Privatisation in the South African Water Industry

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Abstract

The aim of this working paper is to investigate the optimal regulatory routes from a competition and public interest point of view for the South African water industry.

The working paper presents the basic conditions of the water sector by outlining the main characteristics of water, providing an historical and international overview of water management in South Africa. The particular structure of the industry within the South African context is examined, describing the domestic market, the supply chain for water and institutional arrangements for water resource management and service provision.

The conduct of the industry is explored through an analysis of domestic demand for water, and costs of water provision. Existing tariff structures, investment requirements, institutional funding and the presence of public-private partnerships (PPPs) are also discussed. Efficiency and delivery in the industry are assessed in order to highlight key performance indicators of the industry. Finally, the paper discusses the options available to policy-makers in South Africa, focussing on deregulation, price caps and price structure.

Introduction

This working paper was submitted in the context of the Competition Board's commission for sectoral papers on privatisation. The optimal regulatory routes from a competition and public interest point of view, for the South African water industry are investigated throughout the paper.

Section 1 of this working paper presents the *structure* of the water sector. It covers the main characteristics of water and provides an historical overview of water management in South Africa. It further provides an *international overview* of the industry, contextualising the issues around privatisation and pointing to some of the problems and policy options identified in this industry.

Section 2 examines the particular *structure* of the industry within the South African context, describing the domestic market, the supply chain for water and institutional arrangements for water resource management and service provision.

Section 3 explores the *conduct* of the industry. It examines domestic demand for water, and costs of water provision. Existing tariff structures and investment requirements are briefly covered. Investment requirements, institutional funding and the presence of public-private partnerships (PPPs) are also discussed.

Section 4 examines the performance indicators by assessing efficiency and delivery in the industry.

Section 5 explores the options open to policy-makers in South Africa, looking at deregulation, price caps and price structure in the light of the issues flagged above.

1. Background

1.1 Basic conditions

Water plays an important role in society, through not only meeting basic and fundamental human needs, but also because of its diverse uses in industry and agriculture. Current water requirements in South Africa are equivalent to about 60 percent of the maximum available yield in the country. Projected water requirements, given current use patterns, will exceed the maximum yield by the year 2030. This will coincide with increasing costs of water supply, as larger schemes are required to transfer available water to growth centres in the metropolitan areas (Eberhardt and Pegram 2000).

The distinguishing features of water as a commodity in South Africa are:

- The country is water poor, with a rainfall level that is 58 percent of the world mean.
- Water in small quantities is a basic need guaranteed in the constitution.
- Water demand rises with household and national income.
- In much of South Africa, water demand exceeds local water supplies at current prices, the balance being achieved through inter-catchment water transfers.
- Rainfall in South Africa is erratic, consequently approximately half the mean runoff is captured in dams for later use. The supply of water may therefore appear as either a stock (water available for use at any point in time) or as a flow.
- Although water is widely used, it is not necessarily destroyed or lost through use. As a result of return flows, it may become available to other users though sometimes in a degraded form.
- Water is not a homogeneous commodity. Variations in quality, quantity and timing of water supplies influence their value to users.

Water has many separate and varied uses. Many of these have their own separate markets. Any economic analysis should take cognisance of the number of users of water and of variations in

household and municipal abilities to pay. It must also recognise the distinctions between water as a basic need whose supply is guaranteed in the constitution, water as a factor of production, and water as a luxury good. The point being stressed here is that water is not a single homogeneous product, but a set of related and to some extent substitutable goods with differing characteristics, each of which influences value. Each form of water (untreated, potable, underground, grey etc.) may have a different but nonetheless appropriate pricing mechanism.

Each type of water has its own suppliers and consumers. Domestic water use is strongly related to access to water services. In South Africa, access to domestic water services is highly unequal and is a significant factor constraining water demand. On the other hand, access to water by commercial and industrial enterprises is generally good. The costs of service provision depend on both the level of service provided and on water demand. However, water demand itself is also a function of the level of service provided and the price of water. The total investment requirement to make up the services backlog and to provide for new services is significant, though its absolute magnitude is uncertain. Furthermore, the cost of new water resource development is increasing rapidly.

Inter-basin transfers mean that there may also be a geographic effect in the allocation and provision of water. Urban consumption in Gauteng depletes the supply available in some areas and increases it in others, there is no certainty that the return flows direct water to the catchments from which the water originated. The economic analysis of these issues must address the pattern of incentives, including transactions cost that may lead to perverse or unanticipated results in the national water system.

Water quality must also feature in analyses, especially of catchment and return flow management: the return flows following the use of water often lower the downstream quality of water.

Water and water supply are regulated at both the national and municipal level. The national Department of Water Affairs and Forestry is responsible for overseeing, monitoring and otherwise guiding the strategic (national) planning of water. Municipal tiers of government are responsible for implementing service provision, collection of tariffs associated with domestic and industrial water use, and otherwise administering the locales in a manner consistent with national objectives. These national objectives include a further aspect that will drastically affect the supply chain in the short to medium-term: selective privatisation and PPPs. The government has encouraged the latter in all relevant legislation in an effort to increase the efficiency rates with respect to service provision and maintenance.

The following section addresses the history of local water institutions and water law. It may be omitted without loss of meaning by those familiar with the topic.

1.2 Regulation and its history in South Africa

The legal, commercial and bureaucratic aspects of water provision have evolved to suit the changing needs of the South African economy. The movement has been towards increased state involvement. Typically, the greater the pressures on the resource, the more extensive the powers that have been vested in the state to control it.

As a low density primarily agricultural economy of South Africa prior to 1875, water management was effectively private - the state played a minor role. In 1875, the first impetus was given to more ordered water development and a hydraulic division under the commissioner of Public Works in the Cape colony was formed.

In 1904, irrigation departments were created in the Cape and Transvaal primarily to allocate and manage agricultural and irrigation water. Shortages had already been experienced in the Witwatersrand goldfields by this stage.

Unlike English law which allows all owners of riparian land common rights to the water, South African law only allowed access to water if it rose (or fell) on the landowner's own soil. Since irrigation may require more than this allocated amount; the allocation problem was met by the formation of Irrigation Boards and Water Courts to apportion water and to determine individual rights. The legislation for irrigation boards was drawn up in 1877. It led to the Irrigation and Conservation of Water Act of 1912, which also encouraged the construction of dams and transfer systems.

The labour intensive Public Works Programmes of 1929 and the 1930s extended the network of dams and transfer systems. During the years following the Second World War, subsidies for municipal water schemes were introduced to improve standards of supply. This particularly benefited smaller municipalities lacking their own water capacity and financial resources. Regional water supply schemes such as the Saldanha Regional Water Supply Project (1943), and the Orange Goldfields Scheme, were provided by the government at this stage (DWAF 1986).

The fast growing needs of mining, urbanisation and industry after the war meant increased competition for water resources. The Irrigation and Conservation of Water Act, 1912, which had been developed to support irrigation, consequently became obsolete. A commission of enquiry was set up leading to Act 54 1956, (the previous Water Act). The stated intention was to assure equitable distribution for industry and other competing users. By 1986, however, renewed State level enquiry was needed to resolve water management issues.

While acknowledging private ownership and all water court awards, the 1956 Water Act introduced the concept of state control of water and took power from the Water courts. New units were formed in the Department to undertake the scientific, engineering and economic investigations necessary to optimise the implementation of these wide powers in the short and long term.

In addition to the increasing scarcity and opportunity cost of water, property rights to water were incompletely allocated. Underground water was effectively an open-access resource except on designated aquifers, and non-point source pollution through return flows was unregulated.

The response prior to 1994 was simply increased state involvement in the allocative process. The potential of the market mechanism was recognised but remained controversial in the white paper on water policy of November 1994 ("Water Supply and Sanitation Policy: Water - an indivisible national asset", RSA 1994). This was followed by the "White Paper on a National Water Policy for South Africa" (DWAF 1997).

These legislative frameworks aimed at remedying the incomplete allocation of property rights in the water sector. This was finally achieved through the 1998 National Water Act, which vested the ownership of all water in the hands of the state. This act [no 36 of 1998] has thus given the state monopoly power. At present, policies are being refined and regulations related to the actual and proposed legislation are being developed. The key point is that as of 1998 no fresh water, even underground or rainfall, has been or will be *res nullius*.

The Water Policy and National Water Act (1998) are based upon the principles of equity, sustainability and efficiency. The resource protection approach supports the sustainable use of water resources in a water scarce environment, while the efficiency and equity considerations of water allocation and pricing systems are required to manage a scarce resource, taking into account past discrimination and its effects on access to water.

As far as pricing policy is concerned, it has been found that it has a profound impact on total investments because it affects the patterns of use and demand, and determines the distribution of costs and benefits between sectors. However, pricing policy must also reflect the scarcity of the resource. In this regard, the resource and source direct measures of water law allow for the

internalisation of the major external environmental costs associated with water supply and effluent discharge. Of course, this translates into increasing costs for water, which will have to be balanced with equity considerations.

Three important aspects of the new system deserve mention:

- Despite state ownership of the resource, water can be allocated via the market, indeed pricing strategies for the sale of water in wholesale markets are provided for in section 56(1) of the act, with further details presented in government gazette 20615 of 12/11/99. The new water law therefore makes provision for privatisation and competition at various levels along the supply chain of water.
- The new act recognises basic human water needs and ecological needs as priorities. Regarding the latter, the act created an “ecological reserve” sometimes referred to as an “instream flow requirement” that is not available for abstraction.
- Regarding the human right to clean water, the state is obliged to fund the provision of water and the development of water infrastructure, particularly in impoverished rural areas.

The last two points provide a rationale for regulation in the broader context. These issues are also addressed in the Municipal Infrastructure Investment Framework (DCD 1997).

With the implementation of the new Water Services Act (Act 108 of 1997), considerable scope is present to restructure and rationalise past levels of provision and service, and provide more equitable access and delivery of water. This will play a key role in the future development of rural communities.

One of the most important challenges in realising this will be the level of investment in infrastructure and service provision. Estimates of total investment requirements for providing water services provided in the National Infrastructure Investment Framework (NIIF) (RDP 1995) indicated that between R35 billion and R50 billion was required for the five-year period 1995 to 2000. As yet, this figure has not been met. Thus, future attempts to meet demand projections will need to increase investment levels in the supply of water and water service provision.

It has been further argued that if the water needs of all citizens are to be met, the public purse alone is inadequate: a private sector commitment is needed. Under the new system, PPPs are being invited to ease the fiscal burden of financial losses by government-owned water companies, to ease the funding of necessary capital improvements and to consequently lower the cost to the state of meeting expected future water demand. Draft regulations concerning PPPs have been gazetted.

1.3 International Overview

Privatisation in the water sector is a fairly recent development in the developing countries, and as such there are few case studies available. Not many programmes have been running long enough to observe their effectiveness. This section will present some of the issues and cases that have been identified. Issues of equity will be addressed first, followed by efficiency and then case studies.

1.3.1 Equity

There are two schools of thought with respect to equity considerations in water supply. One school of thought argues that addressing income inequality should be kept separate from resource pricing, in other words water prices should not be subsidised. The other school of thought explicitly incorporates an equity objective into the planning of water development projects. Two approaches to the latter are generally recognised:

- The use of water availability and pricing as tools to raise productivity and hence incomes in poor rural communities (see Marglin and Stephen 1963).

- Interpreting 'equity' to mean equal access to water or equitable charges for it. The last mentioned could be based on any of four principles:
 - Ability to pay
 - Benefit
 - Supply cost
 - Historical costs

The appropriate principle depends on the objective, which is in turn a function of the location, the user and the use to which the water is being put.

In recent years, there has been a move away from the use of income distributional weights in project selection, the argument being that economic efficiency should be the prime objective, with redistribution being effected by more conventional tools thereafter. However, there is not yet consensus on this. That the two need not be antithetical is shown by Sampath (1992). He argues that the productivity of agricultural land varies inversely with the size of holding. Consequently, allocating additional water to the poor, who only have small areas under cultivation is justified on *efficiency* as well as *equity* grounds.

1.3.1.1 Status of irrigation water pricing and cost recovery in developing countries

Tsur and Dinar (1995) suggest that water rates in developing countries may include one or more of the following:

- Demand charges based on volume.
- Per hectare water rate based on crop grown.
- Additional land tax based on benefit of irrigation.
- Betterment levy based on increase in land value from having access to irrigation.
- Per hectare irrigation fee (option value) to pay regardless of whether the right is exercised or not.
- Indirect financing mechanisms.
- Maintenance fee covering actual annual maintenance costs – locally this would include the new catchment management levy.

1.3.1.2 Water pricing for efficiency

In the absence of public goods and externalities, economic theory suggests that, given the existing distribution of income, the most efficient means of allocating scarce resources is via the market mechanism. To the extent that water has a public goods dimension, generates positive and negative externalities, and is a necessity to both rich and poor, one can argue for state involvement.

On the other hand, Somach and Hitchings (1996) point out that as long as government organisations have significant regulatory power in the water market, they have the potential to do as much harm as anticompetitive monopolies. Nieuwoudt (2000) argues that there is no conflict between an active market in the use of water (usufructuary rights), and the public ownership of the resources. This is a central insight for the interpretation of the 1998 Water Act.

1.3.1.3 Resources and water suppliers

The state may elect to be the exclusive financier and provider of infrastructure services. Alternatively, it may merely facilitate and regulate services provided by private companies. There is growing evidence, mostly from the World Bank, that private companies tend to provide infrastructure of a higher quality. Moreover, private initiatives reduce the burden on constrained public finances. The result has been a shift to increased private sector involvement. Between 1990 and 1998, more than 150 developing countries introduced private participation in at least one infrastructure sector involving over 1,700 projects.

1.3.1.4 Willingness and ability to pay for water

In a third world setting, the “(in)ability to pay” argument is one of the objections made to the use of water prices and water markets to ration this scarce resource. In its extreme form this argument contends that since poor people cannot afford to pay for it, water should be free.

In reality, the poor may be willing to pay for more than suspected: responses based on the stated willingness to pay for water by households in the developing world can be developed using contingent valuation method (CVM) studies (including some very convincing ones by Whittington in Rogerson 1996). The essential point is that even poor households are both willing and able to pay for a small amount of potable water, a view that is reinforced by the international extent of informal water vending.

Informal vendors supply a significant portion of the urban water supplies of various cities and villages in the developing world (Rogerson 1996). Rogerson quotes several studies summarised in Table 1.

The data on water vending has important implications: it suggests a rule of thumb that households can afford to spend about 2 to 3 percent of their income on water. Where vending is highly competitive (as in Kenya), consumers will make all the substitutions available to them, leaving the market price of water as its real opportunity cost.

1.3.2 Efficiency

Inefficiency due to market failure is the primary concern of the policy-maker trying to ascertain whether or not the state should intervene in a market. Monopoly, like missing markets and externalities, need not engender welfare losses nor result in inefficient use of resources. This section reviews elementary theory, international opinions and experiences in water markets.

The issue of ‘regulation’ in the water industry divides those who believe the market to be an efficient allocation mechanism from those who believe that the state should intervene to allocate water. Thus Sampath (1992), taking the pro-government position, argues that irrigation water has certain public good properties that argue for its supply by government. He bases his argument on the existence of economies of scale in distribution and conveyance, the presence of externalities resulting from irrigation and the absence of pure property rights for water. The existence of scale economies in the industry leads to the next issue.

1.3.2.1 Natural monopolies

Natural monopoly is observed when, as a result of steadily increasing returns to scale, production costs are lower under monopoly than under competition. As a result a large firm can always undercut a smaller one and market concentration is likely to increase steadily.


Table 1: Water vending in the developing world

Country	Study	Key findings
Jakarta, Indonesia	Lovei & Whittington 1991 in Rogerson 1996	32 percent of the city's 8 million inhabitants buy drinking water from street vendors. When purchasing water from vendors, households pay up to 50 times what they would pay for piped water.
Rural Tanzania	Whittington <i>et al</i> 1989 in Rogerson 1996	When villagers buy water from vendors instead of fetching water from traditional sources they save significant amounts of time.

Ukunda, Kenya	Whittington <i>et al</i> 1989 in Rogerson 1996	Wholesale (permanently located) and retail (roving) vendors supply 45 percent of water consumed in Ukunda. Average annual expenditure on water per capita equals \$30 (1989 dollars). The amount spent on water is about 9 percent of average annual income. Water vending is a competitive industry and vendors do not make excessive profits.
Onitsha, Nigeria	Whittington <i>et al</i> 1991 in Rogerson 1996	In Onitsha, about 1 percent of the population have access to piped water. The rest rely on water vendors. Water vending is highly monopolised and vendors make excessive profits. Poor households spend about 18 percent of their income on water in the dry season.

Source: Rogerson, C.M. 1996. Willingness to pay for water: The international debates. *Water SA* 22(4): 373-380

For a monopoly, as for any other market form, allocative efficiency requires that output occur where the price of the last unit sold equals the incremental cost of producing that unit (that is price equals marginal cost). However, a profit maximising single price monopolist produces where marginal revenue equals marginal cost; thus output is too low and price too high. Varian (1993: 410) typifies the conventional view of the appropriate policy response - regulating to eliminate the inefficiency is a simple matter of enforcing marginal cost pricing:

 *"The regulator has to set price equal to marginal cost and profit maximisation will do the rest."*

Marginal cost pricing faces one major problem: persisting scale economies (a steadily falling average cost) means that marginal cost is less than average cost. If price equals marginal cost, then by definition price is less than average cost and the firm makes a loss. If a regulator insists on production where price equals marginal cost, then in the long run the natural monopoly will go out of business unless offered a subsidy.

The generally accepted second best option for pricing a natural monopoly is average cost pricing. With average cost pricing, water supply is sub-optimal, but at least the natural monopoly can stay in business in the long run. This is the situation achieved when a water authority acts as a non-profit enterprise trying only to cover its costs.

From a theoretical welfare perspective, the ideal solution is to operate where price equals marginal cost and provide a lump-sum subsidy to keep the water agency going (Varian 1993). This scenario achieves efficiency and keeps the service going in the long run, but has practical problems. A private monopoly has an incentive to misrepresent its costs in an effort to increase the subsidy, while state run monopolies are notoriously poor at minimising their costs. Moreover, it may be as hard to estimate government's costs, as it is to estimate those of a private monopoly.

Water provision appears a classic example of a public utility in which high initial costs are spread and more of the product is provided, and consequently average costs decline. In certain cases, however, the natural monopoly aspect here may be illusory. There is no doubt that local water supply tends to be a monopoly. Moreover, if there is no shortage and no new dams are planned, then it is a true natural monopoly in which optimal supply requires a price subsidy (see section 5.1). This situation is not universal and consequently social efficiency (and hence marginal cost pricing) need not always require the payment of subsidies. Two common cases should be considered:

- The case where the local water infrastructure is fully amortised. Marginal cost is then largely the cost of pumping and purification. In such a situation there is no *a priori* reason for declining average costs. Marginal cost may exceed average cost, and consequently setting the price of water equal to the marginal cost of providing it may not require a subsidy.
- The case where local supplies are augmented by a series of increasingly expensive water transfers from distant catchments (as is the case for water supplied in Gauteng). Here the first dams built were obviously the closest and cheapest, and each successive source of water has

been more expensive. From the first, therefore, incremental costs have been above average costs, pulling the latter up and ensuring that marginal cost pricing can be profitable without any subsidy whatsoever.

An alternative view of efficiency in the distributive process is presented by allocation using opportunity cost pricing. Here the price of water is determined by the productivity of the last unit consumed when used in the most productive of the alternative uses available (price of water equals the marginal revenue product of water). In a competitive world, the price of water equals the value of its marginal product. This is a result that could be simply and cheaply achieved by auctioning water rights in a competitive market.

Before such an optimal result could be achieved through regulation, a substantial amount of data would have to be available to the decision maker. In particular, matrices of water values with market conditions, rainfall, season, crop/industry and location as determinants would be required. Other important factors could be levels of fertiliser, pesticides, cropping pattern etc. Such data would be difficult to obtain in the decision period available, and the complexity of analysis would test the administrative capabilities of any water supply agency. The administrative burden of opportunity cost pricing may simply outweigh any efficiency benefits.

Regulated water allocation also presents demand side problems. Efficient water use is precluded when complex systems are rejected or misunderstood by farmers.

Although it is clearly cheaper to allocate water through tradable quotas than to achieve efficient rationing using regulation, the state may still have a role. Most obviously it facilitates the water trading process. Though this function need not be lost through privatisation, two other roles may be.

First, removing irrigation subsidies may undo other legitimate policy objectives like providing low cost food to urban areas, achieving agricultural self-sufficiency or international competitiveness, and therefore cannot be decided in isolation. *Second*, large state funded water projects are often intended to reduce uncertainty in water supply. Water security is non-rival in consumption, and is therefore a public good which government should provide.

1.3.2.2 Externalities and Missing Markets

Externalities take two forms, technological and pecuniary. The latter is observed when an upstream activity causes a change in the market price of water. They are not economically problematic since the market mechanism is still allocating the resource efficiently. The former results from missing markets or the incomplete allocation of property rights and are cause for concern. Typical among these are quality effects, for example, those caused by return flows of polluted water.

Some of the uses of water also present negative externalities and consequently have a public good dimension. A classic case is water-borne sewage. This has public health benefits, which are rarely incorporated fully in the price of water paid by households, but also generates negative externalities through return flows of inferior quality water to the system. Where the marginal social cost diverges from the marginal private cost observed in the market, marginal cost pricing will not provide allocative efficiency.

For the market to achieve efficient allocation, private property rights have to be fully extended (and thus by definition externality free). In the case of water, the definition of property rights necessarily includes issues of quantity, quality, location and time of use. For property rights to guarantee efficient market allocation, competition must be ensured, usually through the presence of many buyers and sellers and the transaction cost of transfer must be low.

The conventional method is to create a market in individual tradable quotas. The key feature of such a system is that where water is a factor of production competed for by producers across

sectors (including households), the most productive users will bid it away from the least productive users. The sole problem occurs where water is used at a basic needs level by poor households. In this regard, however, Whittington (in Rogerson 1996) shows that even these households are often willing and able to pay for potable water.

The most common property rights systems for water are riparian rights, prior appropriation and public allocation. The riparian rights system restricts water rights to land adjacent to streams. This system is prevalent in water rich areas. Under prior appropriation, water rights are earned over time through actual use. Prior appropriation developed in water scarce areas like the American West. Government/public allocation is state intervention to provide the system of water access priorities that is absent from a simple riparian rights structure.

1.3.3 International case studies and conduct of privatisation

Following privatisation, technical efficiency in the reticulation of water is expected to increase. The distribution of these gains can be controversial depending largely on the balance of power between the authorities, the enterprise and the consumers. Sir Patrick Brown, administrator of England's water privatisation in 1989, conceded,



"the customer should have done better... for the future we ought to be looking to see how the consumer and the company can benefit from the efficiencies they make – a division of the spoils if you like." (BBC 2 special report on water privatisation (24 March 1998, 21.00 GMT.)

Private participation in providing water infrastructure is starting to emerge around the world. Between 1990 and 1997, 97 projects were completed in 35 developing countries. Table 2 indicates that Latin America and the Caribbean lead in terms of number of projects and Asia and the Pacific secured private sector investments with the largest dollar value (Silva *et al* 1998).

Table 2: Private water and sewerage projects in developing countries, by region, 1990-1997

Region	Projects	Value of projects (1997 US\$ millions)
East Asia and the Pacific	30	11 913
Europe and Central Asia	15	1 499
Latin America and the Caribbean	40	8 225
Middle East and North Africa	4	3 275
Sub-Saharan Africa	8	37
Total	97	24 950

Source: Silva, G, N Tynan and Y. Yilmaz. 1998. Private Participation in the Water and Sewerage Sector – Recent Trends. *Public Policy for the Private Sector*. Note number 147, August 1998. World Bank, Washington, DC.

Note, however, that only 5 percent of all water projects involve water distribution, the majority of private initiatives involving water treatment of some kind.


The relevant authority should consider the following issues before privatisation is publicly suggested:

- Information about the utility's assets should be good enough to serve as a base for long-term contracts. In particular, the current level and standard of service, the condition and serviceability of assets, the human resources and the utility's financial performance.
- The existing local regulatory framework, in particular pricing and quality restrictions or standards.
- Stakeholder support and opposition to privatisation, and the availability of mechanisms to mitigate local concerns.
- Financial viability of continued control by the authorities. Typical issues include current viability and whether existing management could improve efficiency without increasing tariffs.
- Consumer willingness and ability to pay for existing and for improved services.

Common privatisation options in the water sector include, service contracts, management contracts, leases, concessions, divestitures and greenfield projects that private companies (or PPPs) build and operate. Assuming process honesty and transparency, the key problem with the first three remain 'value for money', one function of the audit process being to address this particular issue. The final three present rather different concerns.

1.3.3.1 Concessions

The dominant avenue of privatisation are concessions; they allow companies to capture the full gains of hands on management. They offer,




"...the advantages of significant private sector involvement, particularly in the financing of new infrastructure or the rehabilitation of existing infrastructure, while permitting governments to retain ownership of the physical assets. Concessions can therefore be politically more palatable than other forms of partnerships that involve full or partial private ownership. Concessions also involve transferring full operating responsibility and full commercial risk to the private partner, thus maximising the concessionaire's incentives to increase efficiency and improve both the extent and quality of service"
(Palmer Development Group: October 1999)

1.3.3.2 Divestiture

Divestiture involves the sale to a private company of an equity stake in a state enterprise. Full divestiture has been rare outside the UK and US. Where the state enterprises are unprofitable or encumbered by significant debts and arrears, purchasers face high levels of risk. The inducements to the private sector necessary to achieve divestiture in such a situation may warrant attention.


1.3.3.3 Greenfield projects

Most Greenfield projects take the form of *build-operate-transfer*, whereby project ownership reverts to government after the contract period. In the interim the project is managed by the private contractor, the advantages being the same as those of concessions. An alternative contract is *build-operate-own*, which leaves the operation in the hands of the private contractor. According to the World Bank,



"BOTs tend to work well if the main problem a utility faces relates to water supply or wastewater treatment. But if the problem is a faulty distribution system or poor collections performance, a BOT is unlikely to remedy it - and may even aggravate it." (Uganda: Inception Report 1999)

A critical point was made in a recent World Bank review of private sector options in the water and sanitation sector.



"All forms of private sector participation can be designed to improve technical and managerial capacity. But whether the other objectives (e.g. investment, social concerns, expansion of service coverage) can be met depends on which option is chosen and whether the government can do a good job on the enabling and regulating environment. A poor job can lead to dissatisfied customers and difficult renegotiations with the private partner."

The following section covers a number of international case studies where different forms of privatisation or PPPs have been implemented.

Box 1: Colorado case study

Water markets in Colorado (Nieuwoudt 2000)

The Northern Colorado Water Conservancy District controls the South Platte River basin north of Denver, Colorado in the United States of America. In this basin mountain run-off (local water or base flow) is supplemented with transfers across the Rocky Mountains and by groundwater pumping. The Northern Colorado Water Conservancy District operates a water market for some classes of water.

A water right is specified with respect to priority date, volume to be diverted, diversion point and place and purpose of use. The quota of water to be delivered to each unit of water right differs from year to year and is set annually by the directors of the water agency.

Ownership - The United States is the owner of the project (and the water) but the right to use all water is granted perpetually to the water agency. The Board of Directors of the agency has the power to make and enforce all regulations necessary to operate the project, including regulations that govern water transfers.

Transfers - Water from the inter-basin transfer can be transferred with ease, subject to the approval of the Northern Colorado Water Conservancy District. Transfers are routinely approved upon establishing the need of the receiver, and upon establishing access to local water (base flow). The reason for inter-basin transfer water to be freely tradable is that it is considered "new water" on which no third party claims can be made. Before transfer a seller has to demonstrate that his/her sale does not reduce flows to any third parties.

If water is transferred, without considering third parties, only the so-called consumptive use will be allowed to transfer. The distinction between diverted and consumptive use implies that water which a particular rights holder may have diverted, but which percolated from his lands back to the stream is not transferred so as to not infringe on third party claims.

Consumptive use is estimated from historical return flow data and is calculated for each application. The water court, granting the application, bases its decision on reports from the government water engineers. The additional transaction costs of transferring local water and the availability of inter-basin transfer water, causes very little local water rights to change hands.

Cost recovery - All water rights holders pay an annual levy on irrigated land. This levy covers operation and maintenance cost and capital costs associated with the infrastructure.

Transactions costs - It is estimated that transaction costs make up as much as 10 percent of the sale price of water if brokers are involved, and as little as 1 percent of the sale price if sales take place directly. A water lease within the boundaries of a ditch (single distribution canal) can be arranged by telephone in a matter of minutes and 1000 cubic meters of water costs \$12 for a single season. A permanent transfer of rights is completed in two to three months and has to be registered with the Northern Colorado Water Conservancy District.

The agency itself does not broker any transactions, but several private brokers are active. Additionally, local newspapers carry advertisements in part of the property section, so one can conclude that information search cost is low.

The value of water - In 1998 the market attached a value of \$2400 per 100 cubic meters. This price represents a return on investment of 0.5 percent. Nieuwoudt explains that the reason for this low return on investment is urban areas are reserving water for future use. In the short run these water rights are then leased back to agriculture at low cost.

Box 2: Lao case study

Policy Reform in the Rural Water Sector (World Bank 2000)

Recent policy developments - For various reasons, including poor communication and rugged terrain, rural water supply and sanitation in Lao has been slow. The 1990's has seen a rapid expansion of access of the poor to water and sanitation services, but it was mostly the more accessible low-land provinces that benefited and the process was mostly externally driven instead of controlled by the Lao people themselves. In 1993 the government responded with a unified sector proposal responding largely on demand from communities.

The past 30 months was spent investing in participation processes on the national, provincial, district and village level. It was the first time that participation was actively pursued in the water sector and much time was spent on building mutual confidence.

Some of the important lessons include:

- A tendency to over-focus on reorganisation as a cure-all for sector reform. In the Lao case it was worthwhile to delay decisions, for example financial decisions, until clear goals, objectives and strategies have been agreed on. While being worthwhile, this change of focus was one of the hardest to achieve.
 - The temptation to focus on output-based measures of performance. Instead of pushing for quick visible output, planners and funding agencies must encourage and wait for the processes that will lead to lasting change.
 - The most important lesson was that to build national ownership of a strategy takes time.
-

Box 3: Ghana case study

Community water and sanitation project (World Bank 1997)

Ghana's Community Water and Sanitation Program was introduced as part of a wider social and economic reform. The backlog in service delivery smoothed the way for introducing the World Bank's demand responsive approach to rural water supply.

The projects are characterised by extensive community participation, including participation by women. The government's reservations about introducing change among vast numbers of poor illiterate rural people have proved unfounded. In exchange for choosing the service level, communities have to pay for operation and maintenance of the scheme.

The role of the Government (Community Water and Sanitation Division) is to make national policy and create an enabling environment for all stakeholders. Overall success is clear. About half the districts in the project area have formed district water and sanitation teams and about 78 percent of the population with access to water have benefited from the project.

Box 4: Pakistan case study

A New Way of Doing Business (World Bank 1997)

Northern Pakistan is a semi-desert mountainous area. The region's great rivers contribute little to the water problems faced by local communities who rely on gravity fed schemes to channel snowmelt to settlements below. Water supply schemes controlled by government, are only about 70 – 85 percent functional.

Partnerships with Private Parties - The basis for the partnership was that effective and sustainable rural water supply and sanitation projects have to involve communities as equal partners. Local Water and Sanitation Committees were formed that were involved with planning, contributed labour and local materials during construction and will ultimately be responsible for maintenance of the schemes.

Cost sharing arrangements – Various cost sharing arrangements exist in northern Pakistan:

- The Local Bodies and Rural Development (government) Department provides skilled labour, technical supervision, construction materials and transport of materials.
- The Local Water and Sanitation Committee provides free unskilled labour and free local materials mobilised from the community.
- On completion of the scheme the government department provides a free toolkit to the village plumber.
- The government department pays 10 percent of the cost of the project to Aga Khan Rural Support Programme (NGO) for their role in facilitating the process.
- The local Water and Sanitation Committee sets and collects user charges and controls their own bank account. User charges cover operation and maintenance costs and pay for the services of the local plumber.

Important lessons - Some of the important lessons include:

- The NGO provided a neutral referee to manage project implementation and to enforce mutually agreed on rules.
- Partnerships should emphasise devolving responsibility to the district level instead of the traditional centralised government structures.
- Careful compliance to the rules of the game builds mutual trust. This is even more important during the initial stages of project identification, when trust is still absent.
- Regular flow of funds and timely procurement of materials are still important.

Box 5: Hermanus and Kurgersdorp case study

Control of household water use

The Hermanus and Krugersdorp municipalities tested a suite of demand management strategies with mixed results. Among these were attempts to educate water users on the use of increasing marginal prices. This showed that strategies best suited for use by the small-scale (municipal level) retailers, are also typically those suitable for state control.

2. Structure of the Industry

The elements in the structure of the industry can be described by three components:

- The domestic market.
- Physical characteristics of service provision, referred to as the supply chain.
- Institutional arrangements that deal with
- water resource management structures according to the National Water Act (1998) and
- water service provision according to the Water Services Act (1997).

2.1 Domestic market

Domestic water use is strongly related to access to water services. In South Africa, access to domestic water services is highly unequal and is a significant factor constraining water demand. On the other hand, according to Eberhard (1999), access to water by commercial and industrial enterprises is generally good.

Two properties of water that distinguish it from other commodities are:

- Although water is widely used, it is not necessarily destroyed or lost through use. As a result of return flows it may become available to other users though sometimes in a degraded form.
- Water is not a homogeneous commodity. Variations in quality, quantity and timing of water supplies influence their value to users.

The Water Conservation/Demand Management strategy for water services identifies four types of user groups in the domestic market, namely

- Former white towns and cities.
- Former urban black townships.
- Rural areas.
- Peri-urban areas.

It is estimated that 25 percent of the country's population is without adequate basic water services whilst more than 50 percent of water service institutions are in financial trouble due to inefficiency and non-payment of services (DWAF 2000). Estimates of inter-sectoral water use in South Africa are shown in Table 3.

Table 3: Inter-sectoral allocation of water (million kilolitres per annum)

Sectors	1980	1990	2000	2010	2030
Urban and domestic	1500	2 280	3 220	4 480	6 940
Mining and industrial	1780	2 400	3 400	4 510	3380
Irrigation and afforestation	10 100	11 410	12 860	13 940	15 870
Environmental	2 950	2 950	2 950	2 960	4 230
Total	16 300	19 050	22 440	25 890	30 420

Source: Eberhard, R. and Pegram, G. 2000. The Water Sector: A Position Paper. WWF, Macroeconomic Reforms and Sustainable Development.

Consumption of water is affected by the tariff charged, which in turn reflects the costs of water. In a study on the impacts of price reform in the urban water sector, Pegram *et al* (2000) suggests the following ranges of price elasticities, based on international literature:

- Domestic use for low-income households (0).
- Indoor domestic use for middle and high income households (-0.1 to -0.3).
- Outdoor use for middle and high income households (-0.3 to -0.7) industrial use in urban areas (-0.1 to -0.4).
- Industrial use outside urban areas (-0.1 to -0.5).

Overall demand for water is inelastic with respect to price according to these estimates.

These elasticities were applied to current domestic and industrial water use patterns in the country. Assumptions were made about potential increases in water tariffs associated with the new pricing strategy. Pegram *et al* (2000) found that total urban water use would be reduced by 7 to 22 percent, if tariffs increased by 60 to 100 percent over the next five years nationally (zero tariff increases were assumed for low-income households).

Where expenditure on water forms a small component of a household's budget or a firm's variable costs, one would expect their demand to be relatively inelastic. While this is certainly true of industrial demand, observations suggests that affluent households which demand water as a luxury good rather than as a necessity may be responsive to the signal presented by price. Only where a firm's expenditure on water is a major component of its variable costs, or where the firm is on the margin of survival would one expect industrial demand to be responsive to price.

2.2 The Supply Chain

The physical structure of the South African water industry is described by Basson *et al* 1997 and in Conradie, Eckert and Leiman (DBSA forthcoming). As far as market structure is concerned, we can differentiate the supply of water into the following sub-sectors:

- Initial capture.
- Water storage (dams, micro-storage, etc.).
- Purification and treatment (to produce potable water).
- Reticulation and sale to final end users.
- Wastewater collection, treatment and disposal or re-use.

Each of these sub-sectors raises numerous supply possibilities. There may accordingly exist in different markets for the supply of water (with different technologies and different suppliers), which may be substitutable. This is important from a competition perspective, as it may be optimal to privatise one component of such a market, while leaving the rest under the ambit of government, national, provincial and/or local government.

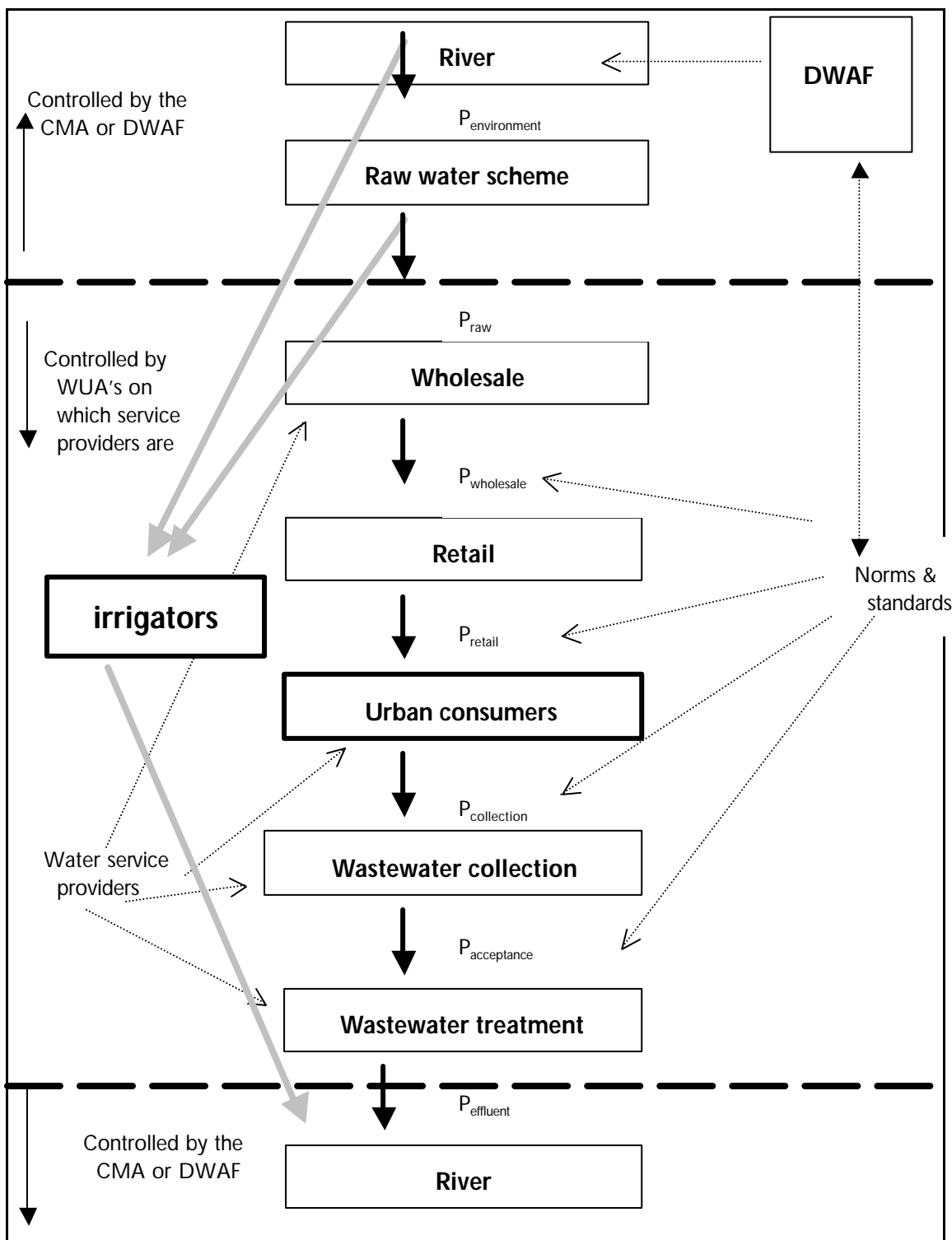
An ideal analysis of the supply chain would encompass the production and cost functions of water, however, these vary substantially between catchments. In the Western Cape, much of the water derived through natural run-off from mountain catchments, is relatively clean and is stored in dams to which the public is generally denied access, although this phenomenon is changing.

In Natal, by contrast, the open access river systems used by the Umgeni Water Board carry relatively high loads of silt and coliform bacteria. Settling and purifying the water is a more complex and expensive operation. There is a substantial body of Water Research Commission literature on the country's different catchments and their water production functions. This should be consulted before decisions are made regarding the development or privatisation of a water structure or source in any specific catchment or area.

The nature of the contract used, dictates the consequences for price and efficiency of delivery of any change in the ownership or management of the water supply chain. If we assume that water supply is a natural monopoly, consequently there is an argument for its provision by the authorities.

Where they are unable to deliver efficiently, the privatisation of an existing service, or an agreement to allow the private sector to provide new facilities, are logical alternatives. Which form is more efficient will depend on the provisions and policing of the contract involved. There is no simple rule of thumb and every case and contract will have to be judged on its merits. Performance indicators are discussed in Section 4. Figure 1 represents the physical flow of water and the institutional interactions involved.

Figure 1: Water supply flowchart



Source: Eberhard, R. 1999. Pricing of Urban Water in South Africa: Summary Report. Report to the Water Research Commission on the Project: "Pricing water as an economic resource: Implications for South Africa" WRC Report no 678/1/99 Volume 1.

The national custodian of the department of water affairs or the relevant Catchment Management Authority (CMA) determines the price of water abstracted from the environment ($P_{environment}$). This is normally referred to as the catchment management charge. The price of bulk water (P_{raw}) or the water development charge is determined by DWAF or alternatively by the owner of the raw water

scheme (such as a water board, and or other Water Service Provider, local government or private entity).

In the case of irrigation, users within a Water Users Association, will extract water directly from the river, and therefore face only a catchment management fee, or from the raw water scheme, in which case they will also face a water development charge.

In the case of municipal use, the wholesale price of water ($P_{\text{wholesale}}$), will be determined through negotiation between the Water Service Authority(s) and the contracted Water Service Providers (WSPs). Similarly the retail price (P_{retail}) of water is negotiated between each Water Service Authority (WSA), Water Service Provider (WSP) and the water users. Billing is officially done by the WSA, but can also be subcontracted to a third party.

The Water Service Authority is responsible for water collection and treatment at its final stage before it becomes return flow to either the resource or the river. The WSA may, however, subcontract a Water Service Provider to perform the function of water treatment. The price for wastewater collection ($P_{\text{collection}}$) is determined by the Water Service Authority, while the charge for treatment ($P_{\text{acceptance}}$) is negotiated between the WSA and the contracted WSP.

In terms of the National Water Act, 1998, wastewater returned to the ecosystem is deemed a water use, which could impact the water quality and or quantity of the receiving ecosystem and will thus also be allocated a water use charge. DWAF may require that additional effluent charges (P_{effluent}) be paid as penalty and may also revoke the water use licence of the WSA in question should the effluent transgression continue.

The institutional arrangements that guide interaction of governing bodies in the water sector are discussed in the next section.

2.3 Institutional Arrangements

Institutional arrangements that govern the water sector can be defined in terms of

- water resource management structures according to the National Water Act (1998) and
- water service provision according to the Water Services Act (1997).

Although DWAF will still be the over-arching authority responsible for the nation's water resources and its strategic management as stipulated in the preamble to the National Water Act, two other water management institutions and/or agents lie at the centre of the new system of water management prescribed by the National Water Act (1998). These are Catchment Management Agencies (CMAs) and Water Users Associations (WUAs). As CMAs and WUAs are phased in, they will timeously replace many of the functions of the old department and irrigation boards, respectively. New institutional arrangements are described below, and are related to the old institutions and their functions.

CMAs will cover all catchments within South Africa. A CMA is responsible for overall water resource management in a Water Management Area, which could include more than one primary catchment and/or could only include certain secondary catchments of a primary system, depending on the logical unit of management. CMAs may take over what was traditionally DWAF's role of day-to-day managing, protection, use and development, conservation and operation and maintaining the ecosystem and the resource.

It also has the role of a monitoring authority in checking that any abstraction and return flows to the system is done in accordance with the Act. Some of these functions (for example licensing) will remain with DWAF for the moment (during transition), but many functions may be assigned or delegated to CMAs. The CMA has full stakeholder representation and its first task is to draft an integrated catchment management plan. It will eventually be the licensing body for the water use

in a catchment and therefore presides over the allocation of water to different users. The CMA can allocate water to any water user for a maximum of 40 years whereafter the water use rights may revert to the resource for allocation. Licences are reviewed on a five yearly basis. The CMA is thereby responsible for longer-term sustainable use of the resource.

The delegation of authority to CMAs is a move towards a more democratic and decentralised approach, but it must be noted that some CMAs could experience initial difficulties due to skills deficiencies, thus it would seem that the seconding of current DWAF personnel to a CMA for the transition phase of approximately 5 years might be a foregone conclusion. Each CMA board also has to generate its own finances through means of water charges.

A WUA will control a localised resource and other water uses that may occur within their jurisdictional area or could have an impact on their current source. These institutions replace the old irrigation boards. Irrigation boards represented irrigation farmers who had water rights to a specific local water source and/or works and its distribution.

The same idea persists, but with extended stakeholder involvement, including race and gender and other water users; for example industrial and/or domestic. Under the previous dispensation (irrigation boards), water in a river or dam was diverted via a water works to scheduled users (end-users).

Under the new dispensation a Water Users Association may operate and control abstraction and/or distribution; manage certain dams, rivers/streams, groundwater use and effluent control within a quaternary, tertiary and/or secondary catchment that could have a detrimental impact on their source. The area of management and duties in the form of delegated or assigned functions are therefore enlarged. The long-term objective is that WUAs be established in most catchments to do the local management of water use under delegated authority from the CMAs.

Again the institution is more democratic than that which preceded it, but skills shortages remain a problem. An important change is that WUAs formalise water provision to all domestic and industrial water users within their jurisdictional area, including the water supply to farm workers, rural communities and/or schools. In the past such water was generally provided informally by farmers from their irrigation supplies. Now that the rural poor are formally represented on the WUA, farmers are obliged to provide water services for their workers, but will also be able to charge their workers for it.

The water legislation parallels the Constitution (Act 108 of 1996) and new labour legislation that prescribes such minimum service conditions. The current transition of irrigation boards to Water User Associations should be completed by June 2001. Any new groups of water users [Water Use – according to Section 22 of the National Water Act, Act 36 of 1998] may however in future submit applications in order to become their own WUA.

The Water Services Act (1997) forms the second tier of the institutional arrangements that comprises the latest legislation. It serves as an enabling mechanism that gives local or district authorities the ability to manage their own water supply. Currently Water Service Authorities (WSAs) have the power to appoint themselves, the district municipality or any contractor (including a Water Board) as the water service provider.

Water service providers (WSPs) are therefore contracted by the WSA to provide specific services, which may range from water storage, reticulation and sales to treatment of return flows. WSPs may include municipalities, district councils and Water Boards. The functions of these institutions therefore remain largely unchanged. As before they impound, purify, and reticulate water. Under the new legislation, they are licence holders entitled to abstract given amounts of water at certain points in catchments. Until such a point of abstraction, control of the water is in the hands of DWAF and/or the CMA, thereafter the water service provider controls it. The WSA is obliged to

appoint the WSP that provides sustainable and reliable services at the most competitive rates, which assures the high quality of the commodity while at the same time keeping costs as low as possible for the consumer.

Water boards supply 60 percent of bulk domestic water (DWAF 2000). There are currently 18 water boards around the country. South Africa's two largest water boards, Rand Water and Umgeni Water combined with Western Cape Metro whose function is similar to a water board, represent approximately 70 percent of the water supplied by the Water Services Sector.

The Water Services Act of 1997 and the National Water Act of 1998, have distinct effects on the functions of water boards. In the past, water boards were typically large, technically complex systems selling bulk water to financially secure municipalities and/or rural farmers for domestic and stock watering. Smaller settlements in rural areas that may be economically impoverished communities should now also be served, if a more suitable and/or sustainable water source can not be developed that would make it more economically viable for the end water user/consumer. This change may bring with it financial default risk that can threaten viability. This has given rise to demands for cross-subsidisation of water services.

The Water Services Act redefines the roles of water boards to that of Water Service Providers. Section 29 of the Water Services Act (1997) states that the main work of water boards are to "*provide water services to other water service institutions within its service area*", that is selling of bulk potable water. The implications are that there should be greater customer accountability, relationships with local authorities and rigorous reporting requirements. At the same time, this arrangement provides a means for water boards to explore business opportunities in a much more formal manner (Wilson 1999).

DWAF has also indicated that the operation of local bulk water transfer schemes should preferably be handed over to water boards and local government where the capacity exists. This has given rise to the establishment of new water boards such as Ikangala (Mpumalanga) and Amatola (Eastern Cape).

Water boards are encouraged to move towards vertical integration. In the case of Umgeni for instance, bulk water is provided and sold to Durban Metro who acts as the retailer and sells to the consumer. Umgeni and Durban Metro are moving towards partnerships to provide more cost effective and reliable service delivery.

2.4 Potential for privatisation and public-private partnerships

An important feature of the new law is the emphasis on developing a regulatory framework to facilitate PPPs in water provision. A number of areas where such partnerships have been successfully established are discussed in section 3.

Water and water services are provided primarily by the state, and as such constitute a monopolistic market structure. Increasingly, however, municipalities are pursuing PPPs for certain functions, which is in line with national policy objectives. Consequently, the increasing role of the private sector in municipal administration will remain within the ambit of national guidelines.

PPPs refer to a range of different partnering arrangements – corporatisation, service contracts, out-sourced management, concessions, build-operate-transfer and lease agreements. A number of alternative ways of delivering services involving partnerships are listed in the Municipal Infrastructure Investment Framework (MIIF) (DCD 1997):

- Public ownership and operation in the form of municipal service departments - still the most common arrangement - where infrastructure services within a local authority are separated into autonomous business units and given the financial autonomy to pursue those objectives.

- Public ownership and operation either partially through demonopolisation and new entry - the opening up of a market segment, or totally through the sale of public assets.

Under this typology, government remains responsible for deciding on the quality and quantity of public goods (which have far-reaching social ramifications), though need not necessarily be involved in the delivery of those goods. This thinking is in line with the World Bank-type argument that the role of the state is to facilitate the right environment for markets to operate optimally. This means that there needs to be balance between private sector goods and public rights.

According to the MIIF the municipality, together with the major stakeholders should agree on certain goals it wants to achieve with respect to delivery (DCD 1997). These may include extending services to those previously excluded, restraining prices, ensuring that decision making is transparent and that decision makers are accountable. Once common goals have been formulated, the municipality and stakeholders should set about determining which form of service will best achieve these goals. The municipality's institutional capacity to deliver services in a competitive manner, the ability of government to create an enabling environment for private action, and the private sector's interest and response will determine the optimal form of service delivery (DCD 1997).

3. The conduct

3.1 Costs of service provision and tariff setting

Bulk water has a very low value-to-weight ratio and its transport over long distances may be expensive. Consequently, one can expect water to sell in many separate local markets rather than in a single unified national one. Although it may be scarce and now ostensibly belong to the state, rainwater is available free of charge. Water companies sell a product that they capture, store and then distribute to users.

Potable urban water has, by contrast, a relatively high value/volume ratio. The supply costs (incurred in financing and operating the abstraction, transmission, treatment and distributions systems) are relatively high while the opportunity costs (imposed on others as a result of the initial abstraction) are relatively low. Low quality return flows and aquatic pollutants may, however, impose significant costs on downstream users.

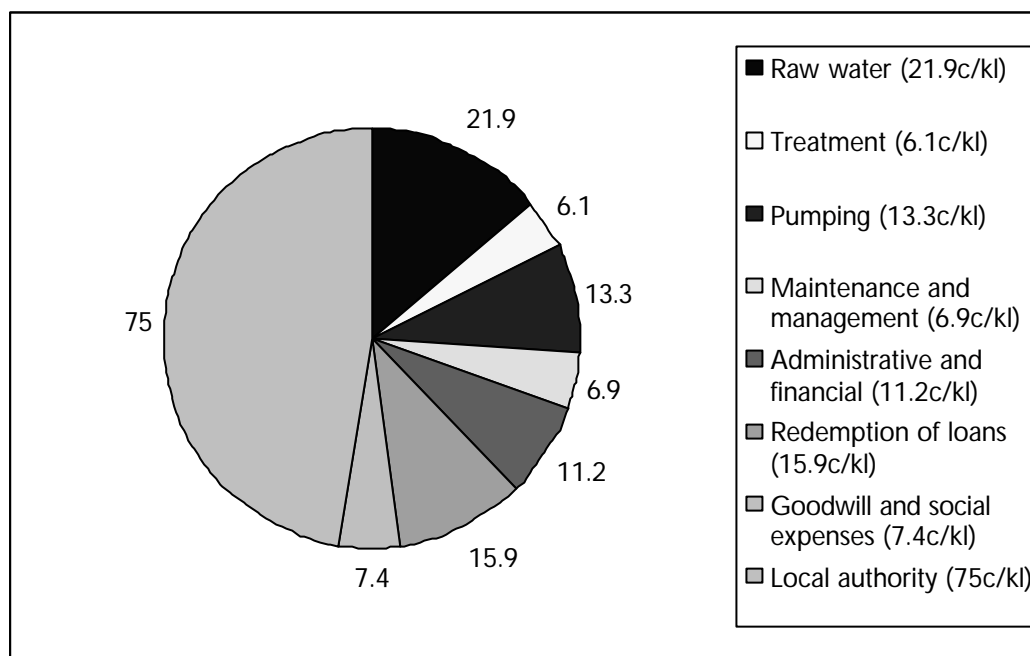
The capital costs related to investment in water services are dependent on service level, estimated future consumption, settlement characteristics, property size, topography and geology, existing infrastructure, labour costs, material costs, distance to the water source, technical efficiency and economies of scale (Eberhard and Pegram 2000). Increasing demand for water in Gauteng has called for transfer of water supply from increasingly further locations. As a result successive schemes are more expensive due to increased distance and inflationary increases (Fowler *et al* 1997). Capital costs therefore vary significantly between service levels and from place to place.

In a case study provided by Fowler *et al* (1997) of the Rand Water Distribution system the cost of water supplied by Rand Water comprises the following:

- Raw water purchase from the state.
- Treatment and disinfection.
- Pumping.
- Distribution.
- Maintenance and management.
- Administrative and Financial.
- Redemption of loans for infrastructure development.
- Allocation of funds.
- Goodwill and social expenses.

Bulk water by Rand Water is currently supplied to consumers at a single tariff that is found by summing all the factors listed here, and by dividing by the total quantity of water supplied. In Figure 2, the average cost (158 c/kl) of water to Johannesburg in 1994 are broken down into various components.

Figure 2: Components to the cost of water for Gauteng 1994 (cents per kilolitre)



Source: Fowler, T.G, Mason, H.J. and Stephenson, D. 1997. Optimisation of Rand Water's Distribution System, WRC report No 488/1/97

Current wholesale and retail tariffs by major urban area and for the industrial water use category are presented in Pegram *et al* (2000). Price discrimination by water retailers means that retail tariffs may vary greatly within any supply area, for instance industrial prices, the prices charged to low-income households and conventional household prices may differ substantially.

The New Water Law leaves the tariff setting-up process to negotiation between the WSA, the WSP and the users. Various pricing policies can be followed. Most municipalities charge a metered rate, except in low-income areas where a flat rate is charged irrespective of the volume of water consumed. In most of these areas, levels of payment are very low. In general, levels of unaccounted for water and inefficient water usage are very high.

In the case of state-owned dams, the CMA responsible for the bulk sale of water may only charge for the service rendered. Large municipalities (WSA) can conversely appoint private/international companies to provide bulk water supply (also see BOT schemes, greenfields projects, etc in section 2). In these cases, the contracted party has the right to add profit margins to service delivery. Where infrastructure is currently largely owned by a water board, it is unlikely that a local or district municipality would be able to provide reticulation services at more competitive prices than the existing water board.

Modified tariffs have been suggested, by various local authors, to subsidise those communities that cannot afford to pay the full cost of water supply. The difference between the tariff (amount paid by the consumer for water) and the cost (to the supplier of producing and delivering the water) is generally used to smooth tariff fluctuations or for cross subsidisation of other services (Fowler *et al* 1997). Various options for pricing and tariff setting are discussed in Section 5.

3.2 Water quality and the costs of purification

Agricultural runoff as well as recreational use of dams has a significant impact on quality of dammed water. "Lake water quality clearly has a significant impact on the cost of treating water..." and treatment costs can accordingly vary by 100 percent (Graham *et al* 1998).

While treatment costs rise with turbidity, they also rise with increasing concentrations of aluminium, manganese, suspended solids, potassium, sulphates and/or ganic carbon. Purification costs also rise as the PH level rises or falls, and with levels of blue-green algae that can impart taste or smell to the water. The latter can be stimulated by phosphate rich runoffs.

Thus, it is clear that there are externalities associated with land use in catchments that supply water to urban areas. Internalising these costs is one way of achieving economic efficiency. This is easily managed in the Western Cape where impoundments tend to be close to the sources of the rivers, and the catchments involved are mountainous and relatively small. It is far more difficult in Natal and Gauteng. In these areas even though control over large stretches of the rivers has been given to water authorities, purification costs still vary substantially between impoundments (*ibid*).

The new water law enables the use of effluent charges, based on the quantity and quality of the effluent and the potential impact on the receiving environment. This may serve as an incentive to curb the negative water quality impact from waste disposal, while it may also encourage demand side management options, such as internal recycling.

3.3 Institutional funding and Investment requirements

The MIIF five-year estimates for total investment requirements were R35 billion to R50 billion for all water and sanitation services, and R23 billion to R33 billion for water services only. These estimates included the cost of water resource development and are given at 1995 prices (DCD 1997).

Pricing policy has direct bearing on total investment requirements. The pattern of demand for connections, in particular the distribution of demand for different service levels will be impacted upon by the pricing policy. Pricing policy may further affect demand itself, hence influencing the timing of investments in new capacity. Lastly, pricing policy will affect the distribution of the cost and benefits, depending on how it allocates revenue responsibility to meet the costs of investments (Eberhard and Pegram 2000).

The major metropolitan urban areas increasingly dominate urban water use in South Africa, which makes it important that water pricing and water management issues in the metropolitan areas receive priority attention. Projected population growth in urban areas suggests that demands for new infrastructure will be highest in these areas. Investments in infrastructure made in urban areas should be sustainable.

Some of the water supply projects in existence are not self-sustaining, and are in need of funds. Although the Department of Water Affairs and Forestry has access to central government funding for water services, municipal water funding remains limited. Donor programmes require guarantees that municipalities often cannot meet. The equitable share (and grants such as Consolidated Municipal Infrastructure Programme [CMIP] and Inter-governmental Grants [IGGs]) cannot ensure viability owing to unevenness in the distribution of capacity.

Currently in South Africa, the price of water covers running (operating) costs, but ignores the sunk costs of infrastructure. Where these are no longer part of the fixed cost structure (i.e. where infrastructure has been fully amortised), they should be irrelevant to the pricing decisions of both state managed and private sector enterprises. However, this will not be the case for new or future projects. Although agricultural water may be sold at prices that cover costs, the provision of piped water to rural households will generally remain financially unviable. Consequently, the management

of rural water supplies is likely to remain in the public domain whilst urban supply may be privatised.

Table 4: Recent/pending Investments in the Water Sector

Name of Project	Nature of Project	Authority	Status
Cape Town – Water & Sanitation	PPP	Cape Metro Council	Conceptual
Skuifraam Dam, Western Cape	PPP	Greater Cape Metro Council	Conceptual (4 year project life)
Dolphin Coast – Water & Sanitation	Sub-contract	French Water Company	Cost: US\$76.087m (30 year project life)
GJMC Water & Sanitation	Sub-contract	GJMC	Conceptual
Harrismith – Water & Sanitation	Sub-contract	Harrismith City Council	Conceptual
Nelspruit Water & Sanitation	Sub-contract	Department of Constitutional Dev.	Cost: US\$164m (30 year project life)
Nkadimeng rural water supply scheme	PPP	DWAF, Lapelle Northern Water Board	Contract negotiation
Plettenberg Bay – water, sanitation & waste disposal	PPP	Local authority	Conceptual
Port Elizabeth Water & Sanitation	PPP	PE Metropole	Conceptual
Rand Water Upgrade – Daleside & Ennerdale	State Project	Rand Water	Tender Awarded (3 Year project life)
Richards Bay – waste water disposal	PPP	Richards Bay Town Council	Conceptual
Water Pipeline, Freestate	PPP	Bloemfontein Water	Tender Awarded (44 week project life)

Source: Business Map, Development Finance database.

3.4 Public-Private Partnerships

The need for supply augmentation is great, which bodes well for prospective corporations looking to enter the sector through PPPs or other contractual arrangements. To date, a range of municipalities have provided opportunities to the private sector through PPPs or sub-contractual relationships. Table 4 highlights a number of these developments.

It is evident from Table 4 that PPPs are already prominent in both the supply of water (Skuifraam Dam, and projects relating to supply upgrades) and in projects related to service provision. One foreign company has already won a successful bid in the form of the French Water Company (in partnership with a local empowerment consortium). Furthermore, it is evident that the potential cost implications of involvement in the sector are large, yet the implications associated with this as far as tariffs are concerned remains unknown. There are important repercussions for the sector.

4. Performance Indicators

We understand performance indicators to imply various measures of efficiency, affordability and access to water. The discipline of economics usually defines three types of efficiency: allocative, technical and economic. Allocative efficiency is addressed elsewhere in this report and not repeated here.

Technical efficiency is similar to engineering efficiency in that it seeks to find the best and most productive techniques in the purification and delivery of water. There is not necessarily only one way that a product can be produced. We might be able to produce a similar product by using different production techniques and therefore different combinations of labour, capital and other resources.

Economic efficiency differs from technical efficiency in that while economic efficiency requires technical efficiency it also demands that the choice of technique is the least cost combination of labour, capital and other resources.

The existence of necessary political and social objectives complicates the choice and range of indicators. There is the need to achieve some technical efficiency. There is also the need to achieve economic efficiency. The challenge is that the provision of water is a basic need (enshrined in the constitution) and the industry is a natural monopoly. Consequently, while there are a variety of performance indicators the achievement of one particular objective will be at the expense of another.

We outline below the key performance indicators of the water industry and address potential policy conflicts.

4.1 Financial indicators

There are a number of key financial indicators:

4.1.1 Profit and return on capital

Profit and return on capital are the key indicators that allow us to interpret whether economic efficiency is being achieved. In a market with relative ease of entry and where there is no price regulation, competition will ensure that economic efficiencies are achieved.

Private operators in industry like water supply, where there can be little competition, need a “fair” return on capital. Similarly, for public sector operators a “sensible” return on capital is important. For any given water tariff, a very low return on capital implies overuse of capital. In other words, capital is being wasted relative to other uses of that capital. Similarly, high returns on capital indicate opportunities to increase production and/or reduce water tariffs. Conversely, return on capital will vary directly with water tariffs. For any given reticulation system, the higher the water tariff, the higher the return on capital.

One of the factors that influences desired return on capital is perceived risk. The challenge is how best to measure this risk.

Risk is defined as the volatility of returns from an investment. Most investments can be expected to show some volatility purely as a consequence of the actual changes in the economy or unexpected changes in inflation.

The techniques for dealing with uncertainty in capital projects can be classified into three groups:

4.1.1.1 State Preference approaches

This approach attempts to explicitly evaluate all possible series of cash flows resulting from a capital project. In its most literal sense, the State Preference Approach treats separately each possible series of events, which could result from an investment project and calculates the Net Present Value (NPV) of each of these series of events. This approach does not assign probabilities to the possibility of each particular event happening, leaving the future in the custody of the market. The

only agreement that need exist is that about which series of events are possible and the NPV of the asset in each of these possible states.

4.1.1.2 Valuation models

Valuation models, the best known being the Capital Asset Pricing Model (CAPM), are a group of techniques that describe the project in terms of some summary characteristics necessary to determine the value of the proposed assets. These techniques originated as part of portfolio analysis and their purpose is to produce an estimated market valuation for the investment proposal.

4.1.1.3 Risk estimate models

Simple risk estimate models are the so-called non-market methods of dealing with risk. While they are not theoretically correct methods of proceeding, they are often the only pragmatic way of assessing and making allowances for risk.

4.1.2 Under/over investment

Return on capital is heavily influenced by the degree to which an industry is under or over capitalised. While the degree that an industry might be over or under capitalised can be the result of a real change in a market, it can also be influenced by price regulation. For a given market demand and price, the larger the degree of under investment, the larger will be the reported return on capital. The reverse holds true for over investment.

Under investment will be seen most clearly in the form of water leakage in water reticulation systems with price ceilings and private operators. It can be the case that low water tariffs will not make it profitable to reinvest in an old water reticulation system. Under these conditions, it makes financial sense to allow the leaks to continue because this, financially, is a better option than replacing the reticulation system.

4.1.3 Cost efficiency

Cost efficiency can be regarded as an important financial indicator and in this case is best served by cost of delivery per water kilolitre. Care must be taken in this instance that indicators of cost efficiency are taken over time for one specific location. Cost comparisons across locations are very difficult because the cost of providing water in Beaufort West, for example, will be different to Nelspruit, Durban or Cape Town.

4.2 Technical indicators

A number of indicators suggest themselves:

4.2.1 Water leakage

It is clearly not in the national interest to have severe water leakage in a country where water is scarce. Water leakage in the catchment system through evaporation and siltage compromises the efficient use of the capital used in the catchment system. Water leakage in the reticulation compounds this.

There is a clear trade-off between the social goal of clean and affordable water to all and water tariffs. As shown above, reducing water tariffs can result in under investment. Such under investment in the reticulation system will lead to water leakage.

4.2.2 Water pressure

Water pressure and water purity are the key factors on which consumers judge the competence of the water operator.

One of the surest means of reducing water leakage is to reduce water pressure. For the water user this reduces customer satisfaction and general perceptions about the water operator (and usually about the local authority). There is therefore the need to produce an acceptable water pressure while at the same time attempting to minimise water leakage.

4.2.3 Water purity

Water purity must meet certain specific targets. Clearly, there is a trade-off between water purity and water tariffs. Higher tariffs can facilitate improved water quality. Lower tariffs are likely to compromise water quality.

4.3 Social indicators

Unlike most goods, because water is a basic need and access to clean water confers clear positive externalities, there are a number of important social indicators.

4.3.1 Universal access

Access to safe, potable water is a social (and constitutional) requisite. In addition to providing utility to the individual consumer, it reduces the probability of individual and epidemic disease. This lowers public and private medical costs and improves expected economic productivity.

The existence of such externalities provides an argument for water subsidies. If water is to be subsidised, then we must address such issues as who bears the burden of the subsidy and how the subsidy is to be administered.

4.3.2 Affordability

Parallel to universal access is the issue of affordability. We already see the situation where water is available but households cannot afford to buy water. This was one of the major factors that contributed to the cholera outbreak in KwaZulu Natal during September 2000.

The challenge in South Africa is how to provide water to households with little or no income. Allowing a certain amount of free water, or the existence of free standpipes, while morally defensible, is a very blunt instrument as these kinds of instruments subsidise both the poor and the rich.

4.3.3 Customer Service

Customer perceptions about water reliability and purity are important. So too is the level of customer service. Good public relations and nation building demands that not only should water be delivered but that this should be done with courtesy.

The level of customer service can be gauged from such factors as response time for serious leaks, handling and dealing with account and other queries, etc. Perceptions can be assessed through targeted questionnaires and more general surveys.

4.4 The Case for Foreign Investment.

We take three factors into account in promoting the case for foreign investment in the water industry.

- Constraints on increasing government debt. Three issues are important here. First, the service cost of the public debt is very high and consumes nearly twenty percent of the national budget. Second, public debt equals 55% of Gross Domestic Product. While this is not necessarily that high by international standards, fiscal responsibility suggests that this ratio should be lower. Third, there are other areas also demanding increases in government spending. Some, like the provision of health services and education, will be more problematic to finance through foreign investment.
- There is a clear need for substantial investment into water reticulation and water provision. This includes both the upgrading of older systems and the development of new systems. Such infrastructural projects are expensive.
- Balanced against the need for massive investment is the very low level of domestic savings. Substantial domestic borrowing has the potential to crowd out forms of investment.

All three of these factors indicate an overwhelming case for foreign investment in the water industry. In addition, foreign investment has the potential to improve local technical expertise and generate innovative ways of providing water at affordable tariffs.

Should government wish to encourage foreign investment in the water industry, much work is needed to overcome the bad publicity surrounding some foreign investment proposals and the excessive delays that have resulted. The third cellular license, the casino and slot route industry, and the Biwater concession in Nelspruit have all brought South Africa into disrepute with foreign investors. In the Biwater case, in particular, both the fierce resistance to the project from some quarters and the protracted length of time for negotiations will be long remembered by foreign investors in the water industry.

Clear lines of communication, and agreed financial, technical and regulatory structures will encourage foreign investment.

5. Policy options and tools of the South African water industry

5.1 Deregulation

This policy refers to the abandonment of regulatory constraints that restrict entry and therefore competition, or control the quality of the product or service offered.

It only has significance in situations where regulation is a genuine barrier to entry. For this to be the case the following criteria have to be met:

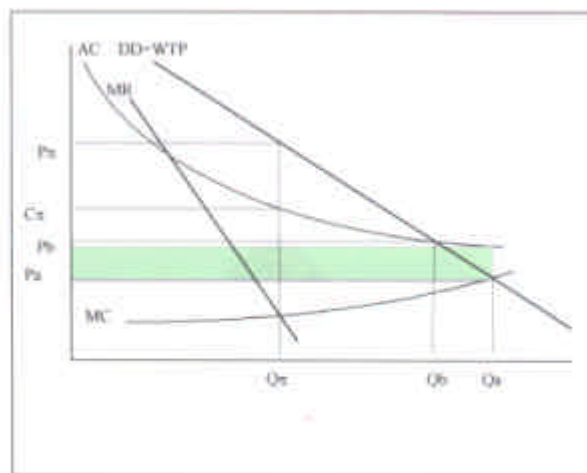
- The industry may not be a natural monopoly; in other words the industry's monopoly must depend on official entry and operating regulations and not on economies of scale and/or scope.
- Members of the public must be unable to provide a similar good or service for themselves at a lower price.

Where water provision is offered as a private sector service, it is frequently observed as a utility. This suggests that there are indeed scale economies present and consequently benefits from horizontal aggregation. These exist at each level of operation, from water capture and storage, to reticulation, and to final sale. What is less clear is whether there are synergies between these operations that would provide economies of scope from vertical integration as well.

In the urban water market there are significant economies of scale especially in purification and reticulation.

These urban economies of scale and the organisational savings available when water distribution is managed at a catchment level, suggest that local water markets be organised as natural monopolies (see Figure 3).

Figure 3: Natural monopoly



The classic problem of the natural monopoly is immediately apparent. The enterprise could opt to maximise its profits by selling only Q_{π} water at a price of P_{π} and cost C_{π} , or to be allocatively efficient, selling Q_a water at a price of P_a per unit, but necessarily making a loss (the shaded area). The final option is to try to break-even by selling Q_b water at price P_b per unit. Note that marginal cost pricing, and hence allocative efficiency, will require a water price subsidy equivalent to the shaded area (see points in section 1.3.2.1).

The extent of the market is a function of the size of the catchment and the intensity of water use within it. Each catchment will provide one natural monopoly, providing the most efficient water service. When considering a large basin such as the Orange, the scope of the natural monopoly expands but it is still efficient to have only one enterprise in control. Inter-basin transfers effectively expand the local market for water to include both affected basins. Where basins are interconnected, efficient pricing of water permits, and hence the efficient allocation of the resource, is most easily achieved if the permit market is coordinated as a single natural monopoly for the catchments involved.

If the abuse of monopoly power is a point of concern, then the constraints on that power have to be recognised. Despite the scale economies present in the commercial water market, it is not a pure monopoly since the water market does have substitutes. Despite the new water act, the public can buy bottled drinking water, sink boreholes, collect rainwater, reuse grey water from showers, baths etc. These are unaffected by the structure of the commercial water market. Other constraints include the market being contestable (as posited Baumol *et al* 1998), and the objective function of water boards that need not be profit maximisers. There seem to be elements of both aspects present; certainly the local water boards in South Africa have typically focused on covering costs rather than on generating profits. Consequently, the appearance of monopoly does not imply the practice of monopoly pricing or even the exercise of monopoly power.

Efficiency and pricing issues aside, a precondition for encouraging deregulation should be that the resulting competition would not impose net social costs. This is particularly important where there is asymmetry of information between the consuming public and the providers of the good or service. For example, raw water can present health hazards. If water is to be sold as potable, it needs to be treated. Does this mean water treatment has to be regulated? In a world of strict liability and

costless litigation the answer would be no, but in reality regulation may be the cheapest way to achieve the socially necessary result.

There is no need to sell water treated to potable standards; the public can treat their own, but there are clear gains to regulations that prevent misrepresentation in a world of asymmetric information. There are two clear efficiency related issues here:

- There may be efficiency gains if water is treated to potable standards before reticulation rather than by individual users.
- The public must have full information as to the quality of the water, whatever it may be.

In the agricultural sector, regulation of water supply has focused on quantity issues. Water is rationed by regulations whether it comes from impoundments that serve a district, or directly from a river flowing through a farm. Internationally (and in South Africa) the allocation method has generally involved regulating the area to be irrigated, or the quantity of water available, and only rarely to use the price system as a rationing device.

In this context, deregulation does not imply anarchic access to water, but the creation of a water market to which all users in a basin (including environmental groups and the state) have access. The theory of such tradable quota markets is well documented. It suggests that the resulting allocation will be efficiency maximising. There are, however, two important provisos. *First*, it presumes that the amount of water made available to the market is optimal. *Second*, there is potential for profound impacts on the distribution of income. The initial allocation of tradable water permits will have distributional effects. If, to obviate this, water is sold through a Dutch auction or by free tender, then the price paid will reduce incomes of users across the board.

5.2 Price caps

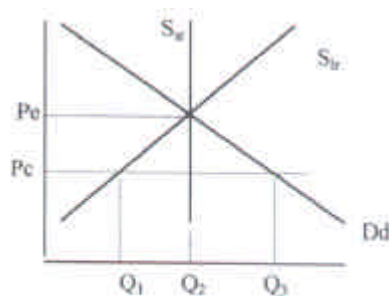
A price cap is no more than a ceiling above which the price of water (normally for a specified use) may not rise. Like all forms of price discrimination, this requires that water allocated to one use cannot be easily converted to another by the purchaser.

Perhaps the most important current price cap is that set on the environmental reserve. Here the state has decided that a price of zero should be set on water identified for the required instream flow. Provided a price cap is set below the clearing price, it is likely to lead to a shortage.

In the market period and in the short run, the supply curve is likely to be vertical and the shortage only Q_3-Q_2 (see Figure 4). If over time the quantity of water supplied decreases as a result of the sustained low price, then the shortage will increase to Q_3-Q_1 in the long run.

Even where water is provided by a regulated public utility, the long run supply may be more price elastic than the short run supply. A number of reasons can be offered: the first is running costs. Dams tend to silt up, reticulation systems to need repair etc. At capped prices the utility may not be able to fund such necessary expenditures, and where maintenance expenditures are not met, water output ultimately falls.

Figure 4: Price caps



A second reason is that the public can augment official water supplies in a number of ways: rain-tanks, re-use of grey water, sinking boreholes etc. At the capped price their incentive to augment official supplies is reduced, and there is a drop in the supply of water within the system as a whole.

Since the use of a price cap means that the allocative function of the market is operating incompletely (assuming that the cap is below the market clearing price of water) some other means of allocating water between competing users has to be found. It follows that there has to be some implicitly optimal distribution at which one can aim. Where there is an incomplete property right (e.g. when a user is unable to bid for water such as where a river is to flow into another state or into a national park) it makes sense that the state act to correct this deficiency. Rationing at a fixed price is one such approach, however, the market mechanism itself provides a number of tools, and these are described in section 5.3.

5.3 Price structure

As mentioned already, the price system can be used as a rationing instrument. At one extreme is the pure free market approach: a limited supply of water is available and since those able to make the most productive use of it are those prepared to pay the highest price, the efficient allocation is achieved by letting it go to the highest bidder.

This approach has merits when allocating water to agriculture or industry in a single basin. Internationally, the conventional approach is to use tradable water permits. Locally this method fell out of official favour in the mid-1990s, but seems to be reasserting itself and DWAF again regards it as a legitimate allocative tool.

The water act of 1998 identified 25 litres per person per day, as a basic need; this amount to be treated as a right. In urban areas, the allocative system has to allow this basic need to be met irrespective of household income. Consequently the water price paid by the poor should be zero for this basic amount. Thereafter the price may rise.

In the UK, many households obtain water by paying a monthly connection fee. This is a fixed cost; consequently increases in the monthly levy provide no incentive to save water. By contrast, once the majority of water users are individually metered, the pricing system has the potential to induce water saving. Urban water connections are generally metered in South Africa, the few exceptions being in low-income areas and informal settlements where standpipes serve a number of households.

Three stylised approaches to metered water pricing will be discussed:

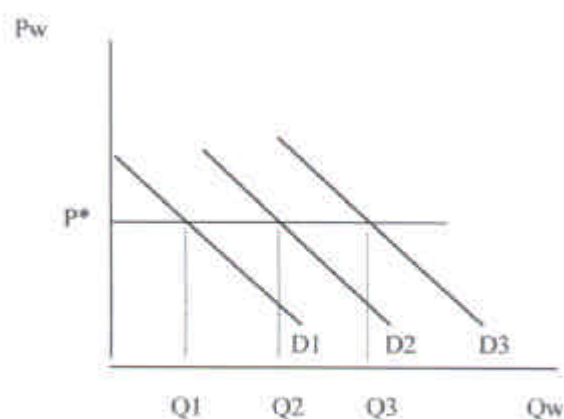
- Flat rate pricing.

- Marginal cost pricing.
- Escalating tariffs.

5.3.1 Flat rate pricing

The price of water is fixed at some price per unit and sold at that price to all users irrespective of their demand. The market allocates more water to those whose demand is greatest. The price may be set in a number of ways, e.g. to ensure that total use does not exceed the supply available or to cover the costs of provision, purification and reticulation. In Figure 5, at a price of P^* consumer one whose demand is least, will only buy Q_1 units of water, consumer two would buy Q_2 units and consumer three, whose demand is greatest, will buy the most, Q_3 units.

Figure 5: Flat rate pricing



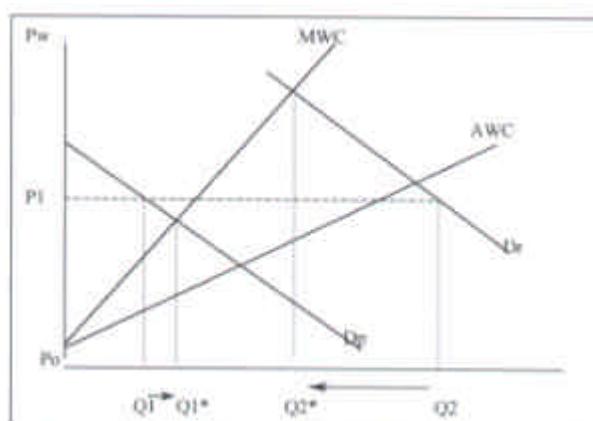
5.3.2 Marginal cost pricing

Marginal cost pricing is achieved by linking the price of water to the cost of the water that comes from the most expensive (the most recently introduced) source used by a city. For example, in the case of Gauteng, this would mean pricing all water to households as if it came from the Lesotho Highlands Scheme. The approach is represented in Figure 6.

Once the demand for water rises above Q_1 , a new source must be added to the supply. When it rises above Q_2 , yet another source must be added and another as it rises above Q_3 . Since the cheapest sources are those developed first, the incremental (or marginal) cost of water is rising. Under marginal cost pricing the price of water will rise from P^* to P^{**} as market demand increases from D^* to D^{**} .

5.3.3 Escalating tariffs

Demand for water generally rises with income. Since water demand may be a proxy for income, there is an egalitarian case for the unit price of water to rise with the metered amount consumed by any one household. The assumption is that heavy users can afford to pay proportionately more and should do so. Such an escalating tariff should reduce the amount of water purchased by all households and induce greater water savings than an equivalent flat rate scheme, even though the average price of water may be the same. This is shown in Figure 7. To make the results comparable assume that it is the median household whose water demand schedule is shown below.

Figure 8: Escalating water tariffs as a progressive tax

5.3 Privatisation and Unbundling

As mentioned earlier, the bulk provision of water is attended by economies of scale scope and/or organisation, which encourage both horizontal and vertical integration within any catchment. If it is felt that there are diseconomies present that potentially outweigh the advantages generated by the central control of the catchment, then there should be benefits to unbundling.

5.3.1 Vertical aggregation and unbundling

There are a number of activities involved in the provision of bulk water, these correspond to the manufacture, wholesaling and retailing activities experienced by conventional goods. The first phase would be water's initial capture and containment, settlement and purification. The second phase would be its reticulation, while the final phase would be its actual sale to final users and the collection of the revenues due.

If there were administrative savings to be made by having one organisation perform all these activities then vertical integration would be economically justifiable. If, over time, it becomes clear that there is a case for each level of water provision to be handled by a separate enterprise, then there may be gains to unbundling. Note that in any single catchment this would take the single monopoly water provider, and break it up into a vertical series of monopoly providers, each of these would also be a monopsony, buying water from the enterprise preceding it in the water provision process.

5.3.2 Horizontal aggregation and unbundling

It is established that scale economies imply natural monopoly. If there are scale economies in each step of the water provision process, but not vertical organisation of the production process, then each step will be a separate monopoly. One enterprise might build and manage dams and one might settle and purify the water. One might reticulate it, and one do the final billing and retail administration. At any one level of activity the monopoly could be required to unbundle further; however, there is little to suggest that this would benefit consumers.

Three issues are central to the debate on the vertical integration of water provision:

- The presence or absence of economies that would make it a lower cost approach to the public provision of water.
- The issue of accountability and security of supply. Where a city or irrigation area has a single water provider, monitoring costs are reduced and the supplier cannot shift the blame for any failure to deliver. Water security should thus be enhanced.

- Externalities: where dams and other water infrastructure impose external costs on society (e.g. reduced environmental quality) simple marginal cost pricing is not socially optimal. Ideally the water provider should supply a lower quantity that would equate the marginal social cost of water and the public's marginal willingness to pay for it. If monopoly involves raising the water price and lowering water supply, then the social optimum may be closer to the monopoly level of provision than to the competitive one.

Conclusion

Economic theory generally supports the view that competitive private enterprises under a system of rules and law will maximise efficiency in delivery of infrastructure and associated services for the community. This argument has two bases: the effectiveness of the profit motive in the private sector, and the variety of factors that hinder the efficiency of the public. These include the lack of clear methods of measuring performance, the assignment of multiple goals which often conflict, lack of incentives to minimise costs, lack of managerial accountability and vulnerability to political interference.

On the other hand, there is evidence that privatised public utilities, under pressure to deliver short term dividends to shareholders, may forgo long-term maintenance of infrastructure. This is the common charge of myopia that has been levelled against privatised railways and water utilities internationally. It argues that since private sector managers have to maximise the present value of a stream of earnings, positive real rates of interest shorten their time horizons relative to those of public sector managers whose concern is with technical efficiency.

The myopia of private managers does not mean that markets necessarily fail to allocate water efficiently, thus where water is a dominant factor of production and a scarce resource, it makes sense to auction it. This is the case in the agricultural sector and could also be the case in industrialised cities facing short-term water crises through drought. In both cases those enterprises most in need and best able to use the water, will be willing and able to pay the highest prices.

Where water is sold to households, or to industrial users in urban areas, economic theory suggests the use of marginal cost pricing, that is, having the public pay a price per litre equal to the cost of the most recent new addition to the water supply (presuming that this is also the most expensive). Most textbook analyses argue that natural monopoly arises where there are persistent economies of scale, as such average cost is expected to exceed marginal cost, and consequently economic efficiency requires a subsidy to the producer.

On the other hand, if the average cost of water provision is rising because each new impoundment is more expensive, then marginal cost must exceed average cost and there need not be a subsidy. In such a case the "natural" element of the monopoly relates to high set-up costs, which form a barrier to entry, rather than to the conventional natural monopoly that Varian (1993) discusses. For example, the provision of dams and reticulation systems involves high set-up costs, which might not be redeemed by a pure private sector provider.

Public enterprises are often assigned multiple goals such as: the efficient delivery of basic services; financial sustainability; capital replacement; job maintenance, and so on. Where these goals conflict (as they often do), reliable measurement of performance becomes virtually impossible. Thus failure to minimise costs can also be attributed to a desire to meet social objectives. Since these use different units of measurement the net result is incommensurable.

In the instance of water supply these measurement difficulties are amplified by clear conflicts between some of the key performance indicators. Some common points of conflict:

- Poverty, affordability and return on capital. For private sector operator, low tariffs mean low returns on capital.

- Return on capital and adequate investment. Low returns on capital mean low levels of private sector investment. Private investors, facing low returns to investment in water supply are more likely to invest elsewhere.
- Adequate investment, water leakages and water shortages: reticulation systems leak, however at any point in time the water loss can be reduced by increasing maintenance expenditures. The return on these expenditures is therefore the market value of the water saved: the lower the price of water, the lower the return on maintenance expenditures. One immediate side effect of low water tariffs is therefore increased water leakage. Over the longer term primary water shortage may also become an issue. If the cost of new dams is to be borne by end users, low water tariffs mean low investment in new storage dams. In a privatised system, capped water prices may thus result in future water shortages.
- Water leakage, water pressure and consumer satisfaction. One way for water operators to reduce water leakage (and therefore costs) is to reduce water pressure. However, the British experience indicates that one of the key factors determining consumer satisfaction with water supply is water pressure.
- Short term viability and long term sustainability. Positive real interest rates will give private sector managers an incentive to use unsustainable technologies with high shutdown and replacement costs rather than sustainable water supply systems with higher short run costs. This under-investment in sustainable supply systems may be accentuated where they have positive ecological externalities.

Three key issues emerge:

- *First*, making water affordable is difficult and problematic. In the absence of subsidies to providers, short-term affordability can lead to long-term shortages due to inadequate maintenance expenditure and low levels of investment. On the other hand, high water tariffs may meet consumer resistance and be at odds with government's stated development priorities.
- *Second*, there may be trade-offs between the technical indicators, e.g. water pressure and leakage losses, water palatability and the extent of water re-use.
- *Third*, these conflicts are complicated by the existence of positive socio-economic externalities from universal access to water and negative ecological externalities associated with impoundments, especially where the latter are absent from more expensive water sources such as recycling and desalination.

These are very real policy and indicator conflicts. While there is no absolute solution to them, one way forward is to use a system that incorporates all technical indicators into a single assessment model. Typically such models recognise the conflict between objectives and allow for discretionary ranking of objectives. This done, they then return an overall weighted performance indicator. Such multi-criteria decision techniques have been used by DWAF for some years in evaluating alternative dam sites, and can quite reasonably be used for policy and efficiency appraisal purposes.

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