REPORT TO THE WATER RESEARCH COMMISSION

WATER AND SANITATION IN URBAN AREAS: FINANCIAL AND INSTITUTIONAL REVIEW

JUNE 1994

REPORT 5

MACRO-ECONOMIC SKETCH

A SKETCH OF THE MACRO-ECONOMIC IMPLICATIONS OF MAJOR INVESTMENT IN THE (DOMESTIC) URBAN WATER AND SANITATION SECTOR

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PREFACE

BACKGROUND

The Water Research Commission (WRC) appointed Palmer Development Group to undertake an institutional and financial review of water supply and sanitation services in the urban areas of South Africa.

OBJECTIVE

The overall objective of this project is:

To present information and analysis that can help relevant community leaders and decision-makers:

- *to guide and promote the extension of services and the reshaping of organisations such as can enable all people living in the (urban) areas of South Africa to have adequate and appropriate water supply and sanitation, and*

- *to facilitate the related processes of financial, institutional, (legislative) and other changes that the adoption and implementation of the above objective will require.*

The specific objectives of the project and working assumptions have been set out in the Draft Project Inception Document.

This report is written in fulfilment of Objective 6, namely: to make a preliminary assessment of the macro-economic implications of major investment to provide water supply and sanitation services to all urban residents, using alternative level of service approaches.

This report was written by Rolfe Eberhard.

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1. INTRODUCTION

1.1 Scope

The main objective of this report is to sketch the linkages between investment in urban water and sanitation services and the macro-economy.

There is general consensus that South Africa should:

- Embark on a large-scale social infrastructure investment programme seeking to redress the imbalances and deprivations of apartheid.

- Restructure the economy so as to achieve rapid and sustained economic growth.

These two objectives are intimately linked. Economic growth depends on social and political stability, which in turn depends on the capacity of the new government to deliver the prospect and reality of a better future to the majority of the population. Sustained economic growth will also not be achieved without drastic improvement in human resource skills and productivity.

Investment in urban water and sanitation services will form a major component of an overall reconstruction and development programme. Understanding the linkages between:

- investment in water and sanitation and economic development

- the economic impact of investment in water and sanitation *vis a vis* investment in other sectors

is thus critical if the overall social infrastructure investment programme is to be designed and implemented in such a way that its contribution towards rapid and sustained economic growth is optimised.

It should be noted that the Development Bank, amongst other organisations, is carrying out extensive macro-economic analysis of the impacts of the proposed reconstruction and development programmes. In these studies, issues such as inter-sector allocation of public resources will be examined in detail.

This report seeks only to sketch some of the issues that will need to be addressed, through providing a water sector perspective.

1.2 Objectives

The specific objectives of this report are:

- To sketch the macro-economic context within which future investments in urban water and sanitation services will take place.

- To outline the linkages between investment in water and sanitation services and economic development.

- To contextualise the investment requirements in the urban water and sanitation sector with those in other sectors (such as housing, electricity, education etc.) and to outline some issues relating to inter-sectoral linkages and the allocation of resources between sectors.

2. THE MACRO-ECONOMIC CONTEXT

2.1 Introduction

It is clear that South Africa's first democratically elected government will have to address the demands of the newly-enfranchised for improved social and private services, such as education, health care, water and sanitation services, housing and social security. The ANC has laid out a comprehensive Reconstruction and Development programme. This programme has yet to be fully economically costed and assessed. The Development Bank has, independently, estimated costs for a reconstruction and development programme, although in a very preliminary way.

At the same time the government has to focus on economic growth so as to reduce unemployment and increase average personal wealth in order for both the economy and households to be able to afford these services.

Thus two key macro-economic decisions face the new government:

- The amount of expenditure to be directed to social infrastructure.

- The inter-sector allocation of expenditure on social infrastructure.

This section of the report briefly sketches the macro-economic context within which these decisions must be made. The discussion follows that presented in the DBSA's macro-economic policy model (DBSA, 1993)

2.2 The DBSA macro-economic policy model

During 1993, the DBSA developed an initial macro-economic policy model which aimed to illustrate what should be involved in a national policy of human development and economic construction.

The key theses of the model were:

- Effective expenditure on human development in South Africa is intimately linked to the process of economic growth, because:

  - Higher expenditure on human development depends on the generation of additional

resources through economic growth.

- Sustained economic growth cannot be achieved without a drastic improvement in the technical, managerial and entrepreneurial skills of the great majority of hitherto disadvantaged people.

- Social and political stability largely depend on the capacity of new government to deliver the prospect and reality of a better future to the majority of the population.

- A policy framework must be designed to give optimal weight **first** to the needs and aspirations of South Africa's people, **second** to expenditure on human development, and **third** to the improvement of the productivity and the size of the capital stock. Moreover, to ensure long term sustainability, this will have to be achieved within the constraints imposed by the maintenance of macro-economic and monetary stability.

- A special fiscal programme of accelerated human development, to be considered on a multi-party basis, outside the normal framework of annual budgetary decisions, should be considered as the most effective way of reconstructing the economy.

The feasibility of a programme of reconstruction and development depends largely upon two sets of circumstances:

- The institutional capacity in the country to manage and implement the development process.

- The economic capacity of the country to accommodate the programme without jeopardising macro-economic stability.

2.3 Economic stagnation

The South African economy is currently in stagnation. The proximate symptoms of the stagnation are clear:

- While resources for capital formation were abundantly available up to the early 1980s, the flow has dried up all but completely since then.

- Up to the early 1980s capital progressively replaced labour in the productive functions.

- The employment of people in the formal economy dropped dramatically since 1974.

- The productivity of capital declined seriously throughout the 1970s, and continued to decline thereafter, but at a slower pace.

On a cumulative basis, real GDP per capita dropped by more than 17% from its peak in 1982 to the 1992 level.

In addition to this there has been a seriously widening gap between the small and constant number of relatively skilled people earning constant or rising incomes, and the large and rapidly growing number of people seeking to earn an income in the informal sector, or having to depend upon family or government support, or crime.

2.4 Productivity constraints

Current productivity constraints relate to:

- Trends towards greater capital intensity of production, of which technological forces are the most important.

- Historic investment, for strategic reasons, in highly capital intensive industries with very low productivity as measured by their output-to-capital ratios.

- The relatively high cost of unskilled labour relative to the cost of capital and of higher skills, and the trend in the change in relative costs, making capital relatively less costly in relation to labour.

- The influence of industrial relations and segmentation of the workforce.

2.5 Constraints on domestic capital formation

The decline in physical capital formation is the result of both demand and supply conditions. Both were, in turn, largely the result of the drastic deterioration in the domestic and international political situation in South Africa.

On the demand side, the domestic decline in confidence and reduced horizons has led to a decline in the desire to invest in increased productive capacity.

On the supply side, three structural constraints severely reduced the scope for such expenditure:

- The drain on available private savings by government deficits.
- The drain on savings by the outflow of capital to the rest of the world.
- The decline in the domestic propensity to save, which has arisen since 1989, and is due partly to lower per capita private incomes and partly to increased tax burdens on households and corporations.

2.6 Economic growth - status quo

The long run economic growth potential of the South African economy in the absence of fundamental restructuring is low. If a figure had to be put to it, something between one and two percent would be appropriate (DBSA, 1993).

2.7 Economic growth - reconstruction scenario

Economic growth of the order of 5% to 6% per annum within a few years could be achieved if: (DBSA, 1993)

- Labour productivity increases at 1% per annum.
- Capital productivity increases to its 1970 - 75 levels.
- Multi-factor productivity increases by about 9% over 5 years.
- The growth in the capital stock increases soon to about 3.5% per annum.

Focus on productivity

The improvement in multi-factor productivity is crucial, and could be achieved by: (DBSA, 1993)

- Discontinuing public sector investment in capital intensive projects whose justification lies in their so-called "strategic" value.

- A shift in the pattern of investment away from capital intensive infrastructure towards less capital intensive industries.

- The maintenance of (realistic) positive real interest rates.

- The maintenance of stability in the real effective rate of exchange of the rand.

- The promotion of competitive market conditions.

- A major renaissance in industrial relations particularly regarding human capital in the generation and the distribution of value added.

Focus on capital formation

An increase in capital formation is dependent on a scenario which envisages a structural reversal of the balance of payments. Both the capital and current accounts need to turn around. Foreign **inflow** is required which will leave some room for structural deficits on the current account. This is normal and expected for a developing country.

The likelihood of such a structural reversal in the balance of payments is partly dependent upon the availability of foreign aid and concessionary loans, but is largely related to foreign private investment confidence in the country. There are political preconditions for this, but the economic preconditions are the maintenance of domestic macro-economic financial discipline plus the prospects of rapid domestic growth in economic output and the productivity of the capital investment.

The domestic propensity to invest will depend on roughly the same criteria.

Hence, all the elements of the investment scenario depend primarily on a policy programme of reconstruction of the domestic economic system as suggested above.

Income distribution

The reconstruction scenario envisages an impressive improvement in the distribution of income among the population.

2.8 Affordability of reconstruction programme (DBSA)

According to the DBSA's macro-economic model, the government could afford to spend the following extra-budgetary amounts on a reconstruction and development programme, assuming general government expenditure remains constant at 34% (1992 figure):

	R billion
1994	2.8
1995	6.4
1996	11.5
1997	17.6
1998	24.8

This amounts to a total of 63.1 billion over 5 years.

2.9 Affordability of reconstruction programme (MERG)

The Macro-economic Research Group (MERG) have provided an alternative framework for Macroeconomic Policy (MERG, 1993) which preceded that of the DBSA's (DBSA, 1993) on which the above context description has been based.

In this policy framework they undertook an initial quantification of a public expenditure strategy and came up with the following estimates of the additional revenue that could be contributed towards a reconstruction and development programme over the next 10 years:

a) Scenario 1

Assumptions:

- 3.75% real growth in annual non-interest government expenditure over the next ten years.

  MERG noted that this figure was not offered in any prescriptive or normative sense, but was an initial estimate used for exploratory purposes. They further noted that the figure represented, more or less, the maximum growth in expenditure that appeared feasible from a macro-economic perspective.

- The economic growth rate increases to 5% per annum over four years.

  MERG was of the view that a carefully constructed national development strategy could achieve this, but cautioned that it would not be achieved if increased public expenditure simply went to higher consumption-orientated social welfare and low productivity in the public sector.

- The real increase in central government expenditure is fully utilised for the removal of backlogs and the provision of additional investment in social infrastructure and human development in basic education and training, primary health care, housing, electrification, urban infrastructure etc.

Based on the above assumptions, the cumulative additional amount that can be spent over the ten year period adds up to R 248 billion.

b) Scenario 2

MERG noted that the above scenario may be too ambitious as it would in effect result in an increase in government investment from 5.9% of total government expenditure to 31.4%, and as a proportion of GDP, from 0.02% to 11.3%. A second scenario was therefore developed as follows:

- Sum of other (non-social investment) expenditure grows at 2.75% per annum in real terms to keep up with the rate of population growth.

In this scenario, an estimated R75 billion will be made available for additional social investment expenditure over the next 10 years (compared to the R248 billion in the first scenario).

c) Scenario 3

A third scenario assumes that it would be possible to substantially rationalise public spending, and therefore assumes:

- 55% of the additional spending of R248 billion will be available for the removal of physical backlogs and other additional social investment planned in a reconstruction and development programme.

MERG was of the view that this scenario was probably the most realistic of the three.

2.10 Summary

This section has sketched the macro-economic context within which new investment in social and physical infrastructure in South Africa will take place. There is consensus on the need for a national programme of reconstruction and development. Various initial attempts have been made to assess the affordability of these investments and the impact that they may have on the economy. The approaches and assessments vary. It is sufficient, for the purposes of this report, to note that much more detailed work is being undertaken and that there is general consensus that the design of a large-scale investment programme must take into account the impacts of this on the macro-economy.

In the following section, the linkages between infrastructure investment and economic development are outlined.

3. INFRASTRUCTURE INVESTMENT AND DEVELOPMENT LINKAGES

3.1 Introduction

This section examines the linkages between investment in infrastructure and economic growth and development. The discussion is taken from Muller (1993).

The key issue to be addressed is whether investment in social infrastructure (for the improvement in quality of life) will necessarily be associated with productivity gains which, it is hoped, will be an output of such investment.

3.2 Theoretical considerations

Muller adopts the following definition of infrastructure (overhead capital) as the most suitable and useful: (Muller, 1993, p3)

> "Briefly, capital may be regarded as overhead capital (1) to the extent that it is a source of external economies ...; [and] (2) to the extent that it has to be provided in large units, ahead of demand."[1]

Investment in infrastructure may have the following affects:

- A generative (or productive) effect

  It can be regarded as part of the production function. It is possible to disaggregate infrastructure provision by sector and region and demonstrate an association with production and income.

- A distributive effect

  This usually forms part of regional economic policy in that choices in the location of infrastructure investment can increase or reduce disparities in welfare and income distribution profiles between regions.

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[1] Youngson, A. J, "Overhead capital. Edinburgh University Press. 1967. in Muller (1992).

- A consumption effect

  Investment in infrastructure may also be a source of household consumption, and therefore be regarded as a consumption good. Electricity and water supply are obvious examples of this.

- A human development effect

  The relatively recent development of a "human development index" by the United Nations is an explicit recognition that there are important linkages between economic growth, wealth distribution, and social indicators such as population health status, education levels and the extent of basic infrastructure provision.

A key issue that needs to be addressed is "the extent to which the provision of infrastructure to achieve human development objectives is separate from or coherent with its provision in support of human development objectives" (Muller, 1993, p6).

3.3 Empirical evidence

There is much empirical evidence that, under the right conditions, increased investment in public infrastructure has a positive effect on economic growth.

For example, recent evidence from the United States economy suggests that increased public investment in core infrastructure (water, sewerage, electricity, highways, mass transit, airports and gas) stimulates private sector output by as much as four to seven times more than the investment (Aschauer, 1989 in WASH, 1992, p7).

Many studies have been undertaken on the newly industrialised economies in east Asia which underline this point (referenced in Muller, 1993).

3.4 The South African context

Muller (ibid) notes that much of the infrastructure development in South Africa historically has been directed towards consumption of one kind or another, and that it is likely that there will be future pressure to continue this allocation, albeit to different beneficiaries, in the name of redressing backlogs. He states that "if this occurs, it is predictable that an increase in public investment is unlikely to be matched by an improvement in the performance of the South African economy" (ibid, p7). This raises the question of how the two (seemingly

disparate goals) can best be met.

Muller is of the opinion that, "given the physical expression of apartheid's distortion of the economy, a better understanding of the spatial issues underlying the contribution of infrastructure to economic development is needed." He also notes that apartheid planning also influenced the structure of production, and therefore it was "also necessary to understand the potential contribution of infrastructure provision to a more efficient structure of production." (ibid)

After examining the spatial elements of growth, Muller concluded: "The implications in a South African context are disturbing. While the spacial patterns of infrastructure provision are both demonstrably inefficient in support of production and ineffective in terms of meeting the consumption requirements of the population, they are a given; as such, they must inevitably serve to determine [to some extent at least] future infrastructure provision."[2] (ibid, p8, own insertion in [ ])

Muller's examination of structural elements is more related to the productive function of infrastructure investment. He notes that there may be "a choice between large conflicting allocations of resource with limited scope for compromise - an analysis which is particularly appealing when the scale of large infrastructure investments is considered." (ibid, p10)

[2] A classic example of this is Botshabelo, created as a de-concentration point a considerable distance away from Bloemfontein, but with no real economic rationale.

4. INVESTMENT IN WATER SUPPLY - ECONOMIC LINKAGES

4.1 Introduction

The discussion in the previous section provided a general discussion on the linkages between investment in infrastructure and economic growth and development. In this section, the relationship between investment in water supply, economic growth and development is discussed in more detail.

4.2 Overview

The potential economic benefits from water supply and sanitation investments are shown in Figure 1 below:

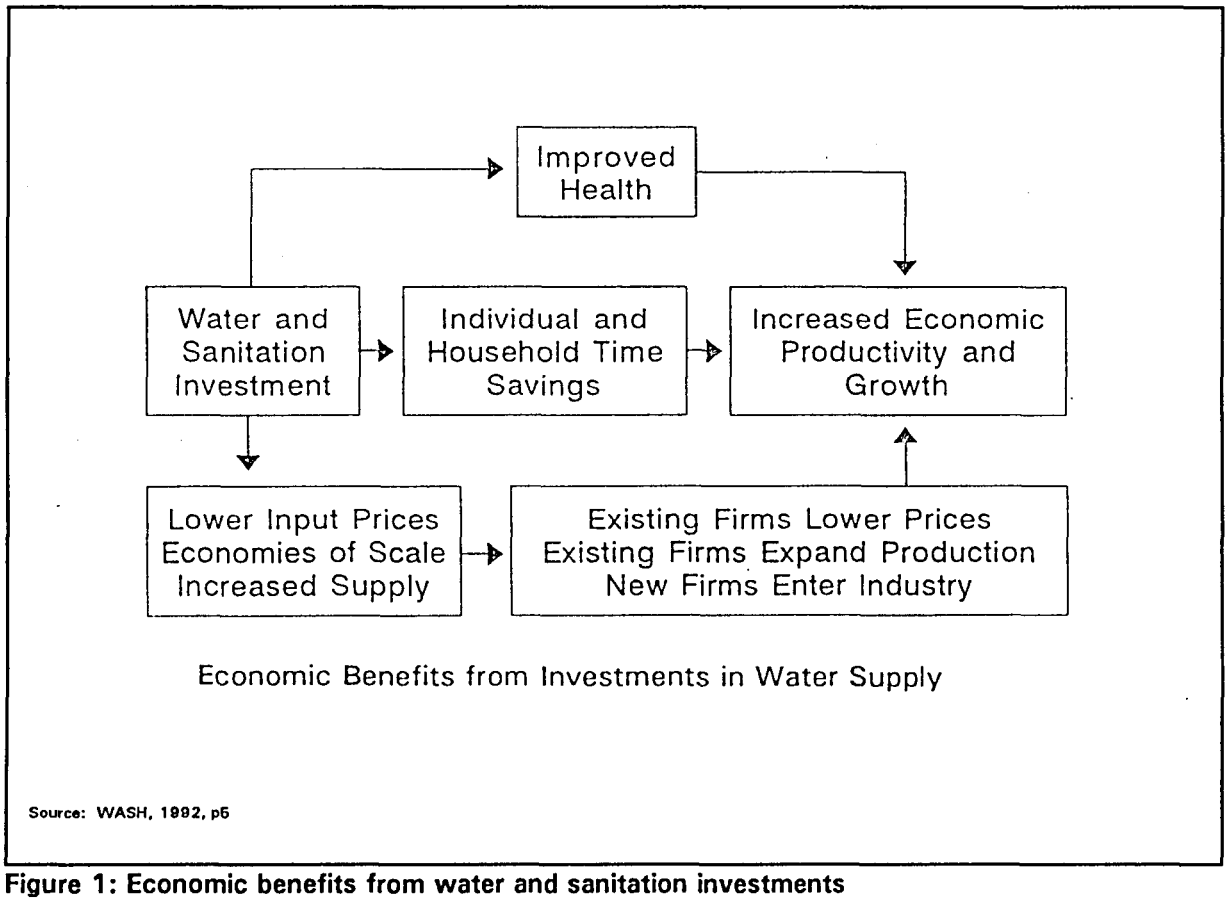

Figure 1: Economic benefits from water and sanitation investments

There are four principle sources of direct economic gains at the firm, market and national levels (WASH, 1992):

- Increased efficiency and production of water supply itself.
- Increased production of all goods and services.
- Increased private investment, triggered in part by public investment in water supply.
- Increased job creation and employment.

Indirect economic benefits may include:

- Improved health conditions[3,4].
- Time saving by individuals and households.

There are a number of linkages between water supply and sanitation investments that need to be explicitly recognised:

- Health improvements are only possible if improved water supply is accompanied by complementary investments in sanitation.
- Increased water supply could necessitate additional investment in the disposal and treatment of wastewater.
- The nature of the water supply and sanitation investments have an impact on the return flows into the water cycle. This is an important consideration in the South African

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[3] "A World Bank position paper on domestic water supply (World Bank, 1976) cautiously limited itself to saying that 'other things being equal, a safe and adequate water supply is generally associated with a healthier population.' ... At low levels of development, investments in improved domestic water supply are often necessary but generally not sufficient to realise the potential health benefits. For middle-level developing countries, where the population is generally better educated, the health benefits of investments in water supply and sanitation are generally substantial. At higher levels of development one typically observes small additional health investments in such facilities." (Rogers, 1992, p15)

[4] For a discussion of the relationship between water supply, sanitation and health in the South African context, see Palmer Development Group (1993a).

context.

It should be borne in mind that investments in water and sanitation can also impact negatively on economic growth. Investments in water supply and sanitation may be sub-optimal, and therefore economically inefficient and wasteful of resources, for a number of reasons, including:

- Premature investments in water supply, regarded as necessary as the result of inefficient and/or wasteful use of water.
- Investments in water supply and sanitation which are not least-cost solutions.
- Investments in sanitation which give no additional health or economic benefit, compared to the existing situation.

4.3 Water supply and national economic growth

Investment in water supply may promote economic growth in several ways (WASH, 1992):

- It may increase the water supply for the commercial and industrial sector, through system expansion or rehabilitation.
- Increased availability of water may encourage the formation of new industrial and commercial enterprises by removing a major constraint on production.
- It may stimulate investment by the commercial and industrial sector.

However, these benefits will only be realised under the following conditions:

- The expanded system must result in greater efficiency and lower prices. [Unless existing and new water input prices are a relatively insignificant production cost, and availability is the constraint, rather than cost.]
- Publicly supplied water for commercial and industrial users must be cheaper than available substitutes.
- Investment in water supply must complement other components of the infrastructure.

4.4 Water supply as a limit to economic growth

Inadequate and/or inefficient water supply may limit economic growth within a country or region in a number of ways:

- Make certain enterprises uneconomic as a result of water that is of poor quality, unreliable or too costly.

- Prevent the expansion of enterprises or establishment of new enterprises because of the lack of availability of adequate water.

4.5 The concept of water scarcity

[After Rogers (1992)]

Water is a renewable resource and therefore cannot be a scarce resource, using a conventional interpretation of the concept of scarcity.

In economic terms, however, water may be referred to as a scarce resource because abundant sources of free and unpolluted water are no longer available (at least in most urban settings around the world today).

Water resources have come under pressure primarily from:

- Increased urban consumption demands.

- Degradation of water quality.

Economists define water scarcity in terms of an "economic demand" for water in which both the quantity and the price must be specified, where the price reflects the economic value of water.

4.6 The market for water

If water was sold in a perfect market, then the economic value of water would be equal to the price of water. However, there are a number of factors inherent in the "water market" which give rise to market failure. The most important of these are: (After Eckstein, 1958 in Rogers, 1992)

- Increasing returns-to-scale on the production side are prevalent in water projects. Water supply therefore often takes place within a context of natural monopoly.

- Externalities due to physical interdependence among production processes are inherent in many water activities. These are experienced both in the spatial sense (for example, upstream and downstream users) and temporal sense (for example, common pool effects of ground water).

- The classical model assumes that income distribution in a given setting is optimal. However, this is rarely the case, and many water projects are, in fact, aimed at changing the maldistribution of income.

- When all producers are not small relative to the market, the principle of marginality[5] fails to achieve the economically efficient solution.

- Resources are not necessarily mobile. Typically [pre-investment] capital resources are relatively mobile, labour resources are much less so, and invested capital resources are immobile.

Rogers (1992, p4) states that there is now general opinion that careful application of neo-classical principles can deal with the market failures most likely to occur in water. Brown and Sibley (1986) discuss various techniques of improving utility pricing which comes close to the economically efficient solution and which, at the same time, are close to the practical methods useable by utilities. Some of the methods are mentioned below:

- Using Ramsey[6] pricing to cater for natural monopoly situations.

- Including externalities into the analysis through "internalising the externalities".

- Shadow pricing to account for the immobility of resources.

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[5] In a perfectly functioning market economy, the most economically efficient allocation of resources occurs where the supplier produces at the point where marginal cost equals marginal revenue.

[6] Ramsey pricing is a variant of price discrimination which offers a simple 'inverse elasticity' rule for reaching efficient price structures in multi-product firms. It has been applied particularly to utility firms in the electricity and telecommunications industries. However, Shepherd (1992) argues that "despite it's proponents great enthusiasm for the idea, there are a number of serious limits and problems" and he concludes that "it is a flawed tool, [with] some of its defects appearing to be crippling if not fatal".

- Constraining the distribution of benefits to cater for maldistribution of income.

4.7 The economic value of water

In the light of the above discussion, a number of approaches have been developed to obtain an estimate of the economic value of water, some of which are outlined below: (after Rogers, 1992)

- "Opportunity cost" and "willingness to pay"

  At the point where the usage of water by one person or party interferes with that of another, water is said to have an "opportunity cost". The loss of opportunity (the reduction in the amount of water available) costs the affected party the amount that s/he values the lost water. At this point, the "value" of the water should reflect the "willingness to pay" of the user who is losing water.

- Third party allocation - social choice theory

  If allocation of water resources were left to an outside party, then that party might ask how society would best benefit from the allocation. One way of answering this question is to apply the logic of social choice theory embodied in modern economics which allocates the water to the use with the highest value.

4.8 Water pricing

The economic starting point (aiming to ensure the efficient allocation of resources) is to set price equal to marginal cost. In the case of water supply, the marginal cost should be the long-run marginal cost (or average incremental cost) because of the "lumpiness" of water investments. Rogers (1992) states that the marginal cost must include the opportunity cost of water.

It should be borne in mind, however, that any tariff policy usually also has financial and political objectives in addition to economic objectives, and that these need to considered when developing water tariff policy[7].

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[7] For a comprehensive discussion of tariff policy principles and a proposed tariff policy for South Africa, see Palmer Development Group (1994a).

5. INVESTMENT IN WATER SUPPLY: SOUTH AFRICA

5.1 Introduction

South Africa is a water scarce country with an average rainfall of about 500 mm per annum compared to the world average of 860 mm per annum. Water resources are, more over, unevenly distributed within South Africa, with the eastern portion of the country receiving a disproportionately high share compared to the much drier western regions of the country.

The largest urban demographic concentration in South Africa and it's economic heart[8], is situated on a watershed in a relatively water poor region. As a consequence, water resources must be developed far afield at great cost.

Large investments in water infrastructure have been implemented in the past to secure adequate water for South Africa's urban areas, especially the PWV region. However, as the demand for water rises, ever larger schemes need to be planned and built. Notable amongst these is the Lesotho Highlands Water Project with an estimated investment cost of R 5.9 billion (1992 costs) for the first phase[9]. Future schemes may include transporting water from the Transkei and possibly even the Zambezi River to the PWV region.

Pricing of bulk and reticulated urban water supplies in South Africa is almost universally based on average historical costs (AHC)[10]. Long-run marginal costs are significantly higher than current AHC for most (if not all) of the major urban centres[11].

Pricing of water for agriculture, which accounted for an estimated 52% of total consumption in 1990[12], is, in many instances, highly subsidised[13].

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8 The Pretoria-Vereeniging-Witwatersrand region (PWV), which accounts for some 40% of the country's GNP.

9 Phase 1A.

10 This principle was departed from partially in the case of the Lesotho Highlands Scheme where a levy was introduced prior to the implementation of the scheme so as to reduce the impact of the inevitable price increase as a result of the scheme.

11 For example, the marginal cost of raw water supply to the PWV from the Lesotho Highlands Water Project (LHWP) is some five times the current average price (based on AHC, but including a levy for the LHWP). See Report 1.

12 DWA (1986) "Management of Water Resources in the Republic of South Africa."

It may be argued, therefore, that water prices in South Africa provide distorted signals which could lead to the sub-optimal allocation of resources when decisions pertaining to investment in water supplies are made. It is possible that sub-optimal decisions relate both to:

- The distribution of investment finance (and hence allocation of water) within the sector (for example, between agriculture and urban water supplies).

- The total amount invested in the water sector, *vis a vis* investment in other sectors (such as industrial development, etc), that is, the inter-sectoral allocation of investment finance.

Any analysis of the macro-economic impact of investments in the water sector needs to bear this context in mind.

5.2 Investment estimates (financial terms)

Estimates of investment needs based on the following three scenarios are summarised in Table 1:

- provide all households with at least a basic service (communal standpipe) in 10 years

- provide all households with at least an intermediate level of service (yard tap) in 10 years

- provide all households with at least a full level of service (house connection) in 10 years.

It should also be noted that the above investment requirements relate to **residential demand** in the low-income sector only.

Cost estimates for water supply are most sensitive to assumptions concerning water consumption, which are summarised in Table 2.

5.3 Financing requirements

It is not possible to accurately estimate total financing requirements on the basis of these capital expenditure estimates without setting out an investment programme and undertaking an analysis of operating expenditure and revenue.

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[13] See, for example, Muller and Hollingworth (1991).

Table 1: Capital investment requirements: Water

(all figures 1993 R million)	Internal	Bulk	Total
Upgrading existing backlog (total)			
to BASIC	406	1 041	1 447
to INTERMEDIATE	874	2 695	3 569
to FULL	1 249	4 470	5 719
Rehabilitation of FULL	310	516	826
Catering for new "low-income[1]" demand (per annum)			
at BASIC	86	212	298
at INTERMEDIATE	137	400	537
at FULL	159	557	716
Total investment requirement over 10 years			
BASIC	1 270	3 160	4 430
INTERMEDIATE	2 250	6 700	8 950
FULL	2 840	10 040	12 880
Rehabilitation of FULL	310	520	830

Notes: 1. "low-income" equated to new black household formation.
2. Investment requirements for proclaimed urban areas (excluding "dense settlements".

Source: Report 2, Palmer Development Group, 1994b

Table 2: Basic cost assumptions for water consumption

Level of service	Assumed average consumption l per capital per day
Basic (standpipe)	50
Intermediate (yard tap)	120
Full (house connection)	250

Source: Report 2 (Palmer Development Group, 1994)

Such an analysis is only meaningful if carried out at the local metropolitan or urban level[14]. Nevertheless, as a first approximation, it is fair to assume the total financing requirement as follows:

- Assume a national capital subsidy programme for housing of R3.5 billion per annum over the next 10 years.

- Assume R3 billion of this available for once off housing subsidies of R12 500 per household qualifying for the subsidy.

- Assume R 1 350 of the R12 500 available for water supply **internal reticulation.**

Therefore, the total capital subsidy available for water supply in urban areas will be about R3.25 billion over 10 years. This subsidy is sufficient to fully finance the internal services component for a full level of service for all low-income households.

However, the bulk and connector services investment requirement is some **three-times** the internal services component (R10 billion compared to R2.8 billion). This capital investment will have to be financed through the tariff.

It should be noted that to provide all low-income households with an intermediate level of service (as apposed to a full level of service) will result in reduced expenditure requirements of about R600 million for the internal services component and R3 300 million for the bulk services component.

It is therefore clear that it is only meaningful to design an appropriate investment strategy at the local level, taking into account the impact of the investment on bulk infrastructure requirements and the consequent burden on tariffs. It is further clear that **tariff policy** is a key component of any investment strategy in water supply.

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[14] An "Investment - Tariff model" for a user-designed capital investment programme in water supply has been developed as part of this Water Research Commission project. The model illustrates the impact of different investment programme and tariff scenarios on the financial viability of a water utilities operating in a discreet urban area with a uniform set of cost factors and tariff policy. A parallel model for sanitation is also under development. See Palmer Development Group (1994c).

5.4 Conclusions

There is general consensus that all residents in South Africa should have adequate access to a safe source of water supply. In the urban areas, the choice in the level of service that will achieve this goal is essentially:

- basic: communal yard tap within 100m
- intermediate: yard tap
- house connection

The differences in these levels of service, from an economic point of view, are:

- capital cost of internal services reticulation
- average water consumption and hence expenditure on bulk infrastructure

The capital cost of internal services can, in all likelihood, be fully covered through a national housing capital subsidy (irrespective of the level of service chosen).

Water consumption will have a significant impact on required capital expenditure on bulk infrastructure. Ultimately, efficient resource allocation can only be ensured with the implementation of a rational tariff policy in which the true economic value of water is reflected[15]. Within this tariff policy framework, individual households must be able to choose the level of water supply and consumption level that matches their willingness to pay, and water supply agencies must ensure that any investment programme that is embarked upon is financially viable and sustainable without the need for ongoing assistance from the state[16].

[15] For further discussion of tariff policy, see Working Paper 11 "Some ideas to inform the Current Tariff Policy Debate for Urban Water and Sanitation services." (Palmer Development Group, 1994a).

[16] See Working Paper 15 "An Investment-Tariff model for water supply in urban areas." (Palmer Development Group, 1994c) for a tool to assist agencies in their strategic planning to achieve this.

6. INVESTMENT IN SANITATION

6.1 Introduction

The nature of the economic impact of investment in sanitation is, in many respects, quite different to investment in water supply.

The term "sanitation" is used to refer only to human excreta and liquid waste disposal. Only residential sanitation is considered in this report. Economic arguments related to the treatment and disposal of wastewater from industry, mining and possibly commerce, are quite different to those raised here.

The discussion makes a distinction between three levels of sanitation service which are defined as follows:

- **basic**: an on-site system (usually a VIP[17] latrine, but a basic on-site aquaprivy linked to a soak-away may also be included in this category).

- **intermediate**: a low-flush septic tank system linked to a small-bore solids free reticulation system.

- **full**: a conventional sewerage system.

6.2 Economic linkages

Some of the main economic related features of investment in sanitation are outlined below:

- The economic benefits from investment in sanitation and wastewater disposal, most often quoted, are:

  - Improved community health, and the economic benefits that arise from this, such as reduced curative health care costs and improved productivity.

  - Improved quality of the environment, in particular the water environment, and the economic benefits that arise from this, such as, reduced water treatment costs, reduced incidence of water transmitted disease and improved recreation opportunities

[17] Ventilated Improved Pit.

on and around water bodies.

- The health benefit derived from a basic level of sanitation service is, all other things being equal, equivalent to that derived from a high level of sanitation service.

- There is no guarantee that a high level of sanitation service impacts less on the environment than a basic level of sanitation service. Environmental impact is dependent on a range of conditions often specific to local conditions, and it may be the case that the environmental impact arising from an on-site system is less than from a piped system[18].

- In terms of residential sanitation systems, once a system has been installed, the "consumption" or usage of the system is largely independent of the cost and price / tariff charged for the operation and maintenance of the system. Thus, unlike water, the monthly charge for provision of the service does not provide an economic signal for how much of "the resource" (the sanitation service) should be consumed. The "entry cost" (development cost and connection fee) is therefore much more significant for sanitation services than for water supply services.

- The type of sanitation system installed (together with the level of water supply provided) has an impact on return flows to the water cycle. Where return flows are significant in terms of the overall supply of water, as is the case in some areas of South Africa, this is an important consideration to be borne in mind when making investment decisions.

6.3 Investment estimates (financial terms)

Estimates of investment needs based on the following three scenarios are summarised in Table 3:

- Provide all households with at least a basic level of service in 10 years.

- Provide all households with at least an intermediate level of service in 10 years.

- Provide all households with at least a full level of service over 10 years.

It should also be noted that the above investment requirements relate to **residential demand** in the low-income sector only.

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[18] See, for example, Palmer Development Group (1993b) "Urban Sanitation Evaluation" Paper B5 "Sanitation and the environment".

Table 3: Capital investment requirements: Sanitation

(all figures 1993 R million)	Internal	Bulk	Total
Upgrading existing backlog (total)			
to BASIC	1 600	-	1 600
to INTERMEDIATE	2 410	1 920	4 330
to FULL	3 250	2 530	5 780
Rehabilitation of FULL	1 600	300	1 900
Catering for new "low-income[1]" demand (per annum)			
at BASIC	195	-	195
at INTERMEDIATE	276	215	491
at FULL	365	283	648
Total investment requirement over 10 years			
BASIC	3 550	-	3 550
INTERMEDIATE	5 170	4 070	9 240
FULL	6 900	5 360	12 260
Rehabilitation of FULL	1 600	300	1 900

Notes: 1. "low-income" equated to new black household formation.
2. Investment requirements of proclaimed urban areas (excluding dense settlements).

Source: Report 2, Palmer Development Group, 1994b

6.4 Financing requirements

It is not possible to accurately estimate total financing requirements on the basis of these capital expenditure estimates without setting out an investment programme and undertaking an analysis of operating expenditure and revenue. Such an analysis is only meaningful if carried out at the local metropolitan or urban level[19]. Nevertheless, as a first approximation, it is fair to assume the total financing requirement as follows:

- Assume a national capital subsidy programme for housing of R3.5 billion per annum over the next 10 years.

- Assume R3 billion of this available for housing subsidies of R12 500 per household.

[19]See footnote 14.

- Assume R 3 450 of the R12 500 available for sanitation **internal services.**

Therefore, the total capital subsidy available for sanitation services in urban areas will be about R8.3 billion over 10 years. This subsidy is sufficient to fully finance the internal services component for a full level of service for all low-income households.

However, the bulk and connector services investment requirement for the intermediate and full levels of service is a further R4 billion and R5.6 billion respectively.

It is likely that this capital investment would have to be financed from local sources.

6.5 Operating and maintenance implications

The average operating and maintenance costs for the various levels of sanitation service are:[20]

- basic R8 per household per month
- intermediate -[21]
- full R22 per household per month

The total operation and maintenance cost implications may be estimated as follows:

- Assume all households without an adequate sanitation service now are provided with a basic and full level of service respectively.

- Assume all new low-income households are provided with a basic and full level of service respectively.

- Number of households currently without a basic level of service: 1.2 million

- Number of new low-income households per annum: 144 000

- Therefore, annual operation and maintenance costs at year 10 of the investment programme are:

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[20] Palmer Development Group (1993c)

[21] No representative cost data available.

Basic: R224 million
Full: R697 million

An investment strategy which seeks to provide all households with a full level of sanitation service will therefore incur an additional annual operation and maintenance expenditure of about R470 million compared to a basic level of service. This additional expenditure accrues little or no additional economic benefit.

6.6 Linkage with water supply

The linkages between investments in sanitation and water supply have already been outlined in Section 4.2. It was stated there that additional investments in water supply may necessitate investments in wastewater disposal. The corollary of this also needs to be noted. Sanitation systems may themselves be consumers of water, and there is a significant difference in the water requirement of a basic system (almost negligible) to that of a full system. The increase in water usage as a result of the installation of waterborne sanitation may be estimated to be between 50 and 120 litres per capita per day[22]. However, it must also be borne in mind that a basic level of sanitation may also result in reduced return flows (compared to a conventional waterborne sanitation system). The importance of this will vary depending on local circumstances.

6.7 Conclusions

From an economic perspective, no additional benefit is derived from providing a high level of sanitation compared to a basic level of sanitation, provided that the environmental costs (in economic terms) are roughly equivalent[23].

The additional expenditure incurred for a high level of service has a low economic return, with little multiplier effect (much of the expenditure is capital intensive and little goes to labour).

There is therefore a strong economic argument that the additional costs of providing a high level of sanitation (compared to a basic level) should, in principle, be borne by the users.

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[22] Palmer Development Group (1993b)

[23] Obviously, other factors must be taken into account when deciding on an appropriate level of sanitation. These are not dealt with here. See "Urban Sanitation Evaluation" (Palmer Development Group, 1993).

7. INTER-SECTORAL LINKAGES AND ALLOCATION

7.1 Introduction

Rogers (1992, p9) notes that "it is a paradox that although water resources have probably received more analytical attention than any other kind of investment, there has been little attention paid to relating the water sector to inter-sectoral or macro-allocation decisions. Other resource sectors such as energy have well developed methodologies to relate sectoral and macro plans. The development of reliable planning methodology to relate water sector plans to the overall macro development of a country is a generic problem that is of major significance to guiding investments. Few attempts to do this [have been found]".

In this section, the investment requirements in the water and sanitation sectors are contextualised by presenting the recent cost estimates for proposed national reconstruction and development programmes, and some issues pertaining to the difficulties of developing a methodology for making cross-sectoral allocations are raised. The section concludes that, as yet, no reliable planning methodology exists which assists in optimising water sector investments *vis a vis* investments in other sectors, other than getting the prices right within the water sector.

7.2 Reconstruction and Development Programme (ANC)

The ANC's Reconstruction and Development Programme (RDP) comprises:

- meeting basic needs
- developing human resources
- building the economy
- democratising the state

The core components of the "meeting basic needs" focus of the RDP are:

- Public Works Programme — "There must be a coordinated national public works programme to provide much needed infrastructure, to repair environmental damage, and to link back into, expand and contribute to the restructuring of the industrial base."

- Land Reform — "The RDP must implement a fundamental demand

	driven programme which aims to supply residential and productive land to the poorest section of the rural population and aspirant farmers."
• Housing and services:	A national housing programme with a target of building a "minimum of 1 million houses over 5 years".
• Water and sanitation:	A national water and sanitation programme to provide every person with adequate facilities for health in the short term ("20 - 30 lcd safe water within 200 meters and an adequate safe sanitation facility").
• Electrification:	A national electrification programme "to provide for an additional 2.5 million households by the year 2000".
• Telecommunications:	"To provide universal affordable access for all as rapidly as possible within a sustainable and viable telecommunications system".
• Transport:	"An effective publicly-owned passenger transport system must be developed, integrating road, rail and air transportation."
• Nutrition:	Removal of VAT from basic foodstuffs, price controls on standard bread, improve social security payments and embark on short-term interventions to support nutrition education, and the stable, low-cost supply of staple foods combined with carefully targeted income transfers and food subsidies.
• Health care:	Inter-alia: free health care for all children under six, focus on maternal and child health care, immunisation, an AIDs programme, shift of budgetary resources from curative medicine to primary health care.
• Social welfare	Goal: "the attainment of basic social welfare rights for all South Africans" where "social welfare includes the right to basic needs such as shelter, food, health care,

work opportunities, income security and all those aspects that promote the physical, social and emotional well-being of all people in our society, with special provision made for those who are unable to provide for themselves because of specific problems."

- Social security — Social assistance in the form of cash or in-kind benefits should be given to those most at risk (such assistance could take the form of work opportunities in public works programmes, the provision of food, clothing and health care to those in need; and cash in the form of disability grants).

A preliminary costing of the following infrastructure elements of the programme is given below:

- housing — **R3.5 billion per annum** over 10 years

  This is based on the national housing programme recently announced National Housing Forum, in which the ANC was a participant. The major component of the housing programme consists of a R12 500 capital subsidy for housing for households earning less than a set income.

- water and sanitation

  Urban areas:

  Water: If an intermediate level of service is provided, then the internal reticulation component of the required investment would be fully covered in the housing programme. However, an additional **R4.7 billion** would have to be spent on bulk and connector services over 5 years which would be financed through the tariff.

  Sanitation: Although the internal reticulation component of a full level of sanitation service could be fully covered in the housing programme, an additional **R3.9 billion** would have to be spent on bulk and connector services over 5 years which would probably have to be financed through local user charges

and/or property taxes.

Rural areas: **Water**: It is estimated that 60% to 70% of households living in rural areas do not have access to adequate water supplies. The DBSA estimates that it would cost **R2.1 billion** to provide rural water to 1.6 million households over the next 5 years.

Sanitation: It is estimated that about 90% of households living in rural areas do not have adequate sanitation facilities. The DBSA estimates that it would cost about **R1 billion** to provide adequate sanitation facilities to 1.9 million households over the next 5 years.

- electrification: Total capital expenditure of about **R7.5 billion**, based on an average cost per connection of R3 000.

Thus capital expenditure over 5 years on housing, water, sanitation and electricity could amount to about **R37 billion** of which about **R21 billion** would be direct state expenditure. The latter figure assumes bulk services for water and sanitation in urban areas, and all electricity connections, are financed within the respective sectors through tariffs and/or other user charges.

The ANC recently announced that it would spend **R39 billion** over the next five years to implement the RDP. Details on how this figure was calculated are not currently available, however, based on the above estimates it is possible that this figure is an underestimate of what is actually required to fully realise the goals of the RDP. If this is the case, then either the goals of the programme would have to be scaled down or the expenditure increased.

7.3 Human Development and Economic Reconstruction (DBSA)

The core components of the DBSA's proposed Human Development and Economic Reconstruction programme are summarised below[24]:

[24] The intention of developing this programme was not to put forward a prescriptive programme, but rather to illustrate the expenditure challenge facing South Africa and to examine the macro-economic constraints and opportunities of financing the order of magnitude of expenditure yielded by such a programme.

• Basic education	Introduction of universal access to basic education of an acceptable quality up to the end of standard 7.
• Adult education	Key initiatives in adult education and training to contribute to productivity and underpin occupational mobility, including upgrading technical colleges, basic skills training, adult literacy programme, in-service training for pubic servants.
• Primary health care	Phased shift in the health budget and a broadening of the scope of primary services and 50 new community health centres per year.
• Housing	Main components are a once off capital subsidy of R15 000 and upgrading of selected informal settlements and public hostels.
• Rural development and land access	A state assisted, market-based land reform programme.
• Electricity, telecommunications and transport	60% of homes electrified by 1998; extending telephone services to 40% of low-income urban dwellings, and convenient access in rural villages; upgrading and maintenance of public transport facilities surrounding metropolitan areas and improved rural road network.
• Water and sanitation	Access to safe water supply for the majority of the rural population and improved rural sanitation. Improved water supply to urban settlements and adequate urban sanitation.
• Small business development	Improved access to finance, business management training and counselling and provision of access to business premises.
• Social security and Welfare	Nutrition support, reform of social grant system and labour intensive employment creation programmes

The DBSA's preliminary estimates of capital expenditure on social and economic infrastructure and services are summarised in Table 4. Total capital expenditure is estimated to be of the order of **R57 billion** over 5 years.

7.4 Reconstruction costs summary

While the nature and cost estimates of the reconstruction programmes presented by the ANC and the DBSA differ somewhat, the investment requirements in water and sanitation account for a significant portion of the total capital investment requirements. A proper understanding of the macro-economic impacts of different policies and approaches to investment in the water and sanitation sectors is therefore critical to ensure that resources are allocated efficiently.

7.5 Cross-sector allocation difficulties

Rogers (1992) notes that there are a number of difficulties associated with making macro-economic allocations between investments in water resources and other economic sectors. One reason is the pervasiveness of water use throughout the economy. Another reason noted by Rogers is the possible existence of vested interests within the water sector. He states: "In most countries it is not of particular concern that the water planning and investments be balanced with other sectoral activities; indeed, the idea of such balancing is threatening to groups with a vested interest in water investments and management." (ibid, p7) South Africa would appear to be no exception to this: massive investments have been undertaken using a supply driven approach with, until recently, very little attention being paid to demand management using the economic value of water as a possible allocation tool.

Pricing is the major tool used by economists to attempt to bring about efficient resource use and allocation. However, unless prices in all sectors are based on sound economic principles, inefficient allocation of resources may still result even if the pricing structures within water supply are correctly set. It is possible to use shadow prices as a correcting mechanism where it is known that prices are artificially set (for political or other reasons) and the real economically based prices can be estimated.

Rogers noted that the energy sector has been particularly successful in developing reliable methodologies which relate sectoral and macro plans, and that this is an urgent need in the water sector.

Table 4: DBSA Reconstruction Costs (Capital, R million)

Sector	Total capital expenditure	% distribution
Education	1 180	2.1
Health care	890	1.6
Housing	22 600	39.8
Water and sanitation	13 300	23.4
Electricity	3 900	6.9
Rural development and land access	9 580	16.7
Transport and telecommunications	4 580	8.0
Small business development	804	1.4
Social security and welfare	-	0.0
TOTAL	56 834	100
Semi-government finance	18 259	32
Central-government finance	38 575	68

Note: Total capital expenditure over 5 years.

Source: DBSA "Macro-economic model" (DBSA, 1993)

8. CONCLUSIONS

8.1 Summary

This report has:

- Provided a sketch of the macro-economic context within which future capital investment in the water and sanitation sectors will take place.

- Outlined the linkages between investments in infrastructure, particularly in water and sanitation infrastructure, and economic development.

- Contextualised investment needs in water and sanitation with those of other sectors and raised some methodological issues to be addressed in seeking to optimise the allocation of investment resources across sectors.

The main conclusions arising from the report are summarised below.

8.2 Macro-economic context

A large capital investment programme will only be affordable if South Africa embarks on strategies to increase labour and capital productivity and investment in capital stock. Investments in water and sanitation should contribute, or at least not detract from, these overall macro-economic objectives.

Estimates of the affordability of a capital reconstruction and development programme vary, but a total expenditure figure by central government of between R40 billion and R60 billion over five years would appear to be reasonable.

8.3 Infrastructure investment - distributional issues

Investment in infrastructure has an important distributional component. South Africa's investment has, unfortunately, been skewed in the past, and this will affect the efficiency and effectiveness of future investments. Investment in water supply and sanitation are long-term investments, and great care needs to be taken in ensuring that the location of investments will facilitate efficient and effective use of the infrastructure both now and in the future.

8.4 Water investment - the importance of price

Water pricing policy is the key to the efficient allocation of resources **within** the water sector and ensuring that adequate, but not excessive, resources are allocated **to** the sector. For more detailed discussion on water tariff policy, see Palmer Development Group (1994a).

8.5 Sanitation investment

There is no guarantee that a higher level of sanitation will result in greater economic benefits than a basic level, and there is therefore a strong economic argument that the additional costs of providing a high level of sanitation as opposed to a basic level of service, are borne by the users.

8.6 Inter-sectoral allocation of resources

As yet, no reliable planning methodology exists which assists in optimising the water sector investments *vis a vis* investments in other sectors, other than getting the prices right within the water sector. This is a particularly important issue in the South Africa context and further research in this area is urgently required.

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